Zephyr Environmental

Heidelberg Materials Langwarrin Work Plan Variation

Air Quality Assessment

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EXECUTIVE SUMMARY

Heidelberg Materials seeks a Work-Plan variation under the Mineral Resources (Sustainable Development) Act 1990 to expand sand extraction area to 60 Valley Road, Langwarrin at a rate of 400 000 tonnes per annum.

This air quality assessment was prepared to provide understanding to the potential dust impacts using atmospheric dispersion modelling to determine the impacts of the proposed Work Plan variation to the surrounding land use and compare it to current permitted activities.

The main scope of work considered key objectives that included:

- Completion of a review to assess compliance with Victoria's Environment Protection Act 2017 General Environmental Duty (GED) and EPA Publication 1961.2 Air-Pollution Assessment Criteria (APAC);
- Demonstrate whether the expansion can support a variation of the 500 m default separation distance applied to quarries handling under EPA Publication 1949;
- Provide evidence base for planning approval under the Development Facilitation program.
- Provide predicted ground level concentration results of the dispersion modelling to support a human health Impact Assessment (HHIA).

Two representative operating cases were modelled:

- Scenario 1 (S1) – Current Operations, which includes rehabilitation of discontinued extraction areas and sand processing from off-site sand
- Scenario 2 (S2) – Work-Plan Variation, including future sand mining in the expanded area to the north of the existing site boundary, rehabilitation, and sand processing in the processing plant.

Existing environmental conditions considered:

- Observed Meteorology collected at Ballam Park (which has occurred since 2021).
- Background particulate matter in the ambient environment collected from EPA Dandenong North data (2021-2023) as 2023 is the last available year of background data available from EPA at the time of writing this assessment. No ambient concentrations of particulate matter have been collected near the quarry.

The regulatory and assessment framework included:

- Level 1 (qualitative) assessment: Applied to Stage 1 top-soil stripping and bund formation, following EPA 1943 nuisance-dust matrix.
- Level 3 (quantitative) assessment: Applied to Stage 2 quarrying, consistent with EPA 1961.2 triggers (greater than 400 kt per annum extraction and receptors located less than 500m).
- Estimation of emissions using the approaches listed in the National Pollutant Inventory Emission Estimation Handbooks and the USEPA equivalent known as AP-42
- Processing of meteorological data from Frankston Ballam Park through AERMET using local terrain and land use data for the years 2021 to 2023. These years were selected as 2021 was the first year that meteorological data was collected by the Bureau of Meteorology at this location, and 2023 is the last year for which background data is available from the EPA background monitoring site at Dandenong, noting that meteorology and background data must always be for the same years.
- Dispersion modelling using the latest version of the regulatory dispersion model AERMOD (version 24142) to account for influences in terrain for roads sources as recommended by USEPA Appendix W 2024.
- Comparative assessment of change in predicted concentrations between the work plan variation (S2) and the current permitted operation (S1) and comparison of significance in

change as per EPA Publication 1961.2, which defines a non-significant change as being below 4% of the relevant standard.

- Cumulative assessment of PM_{10} and $PM_{2.5}$ for Scenario 2 to understand whether the impact from the proposed operation is expected to result in predicted concentrations below the APAC and Environment Reference Standard indicators and objectives.
- Assessment of RCS in accordance with EPA Publication 1961.2, conservatively considering 100 % annual mean PM_{10} as RCS.
- Incremental assessment of predicted metals concentration as a fraction of PM_{10}, since background concentrations of metals in the ambient environment are not routinely measured.
- Consideration of all results:
  - At sensitive receptors located in the vicinity of the site, with nearest dwellings located 125m north, where the averaging period was greater than 1 hour
  - At the most exposed offsite location where the averaging period for the species of concern was 1 hour or less.
- Human-Health Impact Assessment (HHIA) which consisted of an external review of predicted model results for PM_{10}, $PM_{2.5}$, metals and RCS as part of particulate matter, and

The findings of this air quality assessment indicated that:

- Stage 1 earthworks present a short-term but manageable dust risk provided EPA-1943 controls and real-time monitoring are applied.
- For Stage 2 (proposed work plan variation), the proposed wet extraction operations in addition to increased controls deliver:
  - Substantial reductions in contribution to surrounding sensitive receptors (approximately 50% of the criterion) for the maximum 24-hour PM impacts compared to current operations.
  - All cumulative PM_{10} and $PM_{2.5}$ are below the ERS indicators and objectives.
  - Predicted RCS concentrations a maximum of 50 % of the EPA 1961.2 APAC.
  - Metals to be less than 1 % of their respective EPA 1961.2 APACs.
- The HHIA assessment confirms that the impacts to be considered low and acceptable residual health risk to residents and recreational users.

The increased dust control measures considered for Scenario 2 in accordance with the GED are required to achieve the predicted reductions in concentrations of PM_{10}, $PM_{2.5}$, RCS and metals to promote a positive change in air quality contributions to sensitive receptors. It is also recommended that a fence line monitoring program is put in place to assist in the management of air quality impacts during operations.

Based on the outcomes of this Air Quality Impact Assessment (AQIA) and the positive determination of risk at receptors within the Human Health Impact Assessment (HHIA) report, a separation distance variation for the Work Plan is therefore deemed appropriate, allowing for its reduction to between the site boundary and the nearest sensitive receptors.

1 INTRODUCTION

A Work Plan variation was submitted under Mineral Resources (Sustainable Development) Act 1990 to Resources Victoria to expand the extraction area to 60 Valley Road, Langwarrin. A description of the proposed activities under the Work Plan variation is provided in Section 2.

It is intended that the application for planning permission will be submitted to the Minister for Planning under the Development Facilitation program, which seeks to fast-track priority projects that boost jobs and economic activity and improve delivery times for significant developments.

This air quality assessment has been written to provide the decision maker with an understanding of the likely impact to surrounding land uses from residual emissions to the surrounding environment. The assessment uses atmospheric dispersion modelling to determine the impacts of the proposed Work Plan variation to the surrounding land use.

Emissions estimates have been prepared for two Scenarios:

- Scenario 1 (S1): Current Operations.
- Scenario 2 (S2): Work Plan variation (i.e., proposed expansion of the existing extraction area northward.

Potential impacts to air quality because of these emissions will be predicted at sensitive receptor locations using air quality dispersion modelling completed in accordance with United States' Environmental Protection Agency (USEPA) and Victoria Environment Protection Authority's (VIC EPA) guidance (e.g., VIC EPA Publication 1551). Results of the dispersion modelling will be compared to the VIC EPA: "Air Pollution Assessment Criteria" (APACs) to assess potential risks to human health receptors.

The results of the dispersion modelling have also been provided to support a human health Impact Assessment (HHIA). The HHIA has been completed by an external specialist, who has assessed the residual risk of the proposed Work Plan variation to the surrounding land use in comparison to the currently approved activities.

2 PROJECT DESCRIPTION

Heidelberg Materials Construction Materials Pty Ltd (now Heidelberg Materials) commenced sand extraction at 150 Quarry Road, Langwarrin following the purchase of the site from Rocla in 2016. Extraction of the resource within under Works Authority 13 (WA13) is now complete.

Heidelberg Materials is currently rehabilitating the land at 150 Quarry Road through the importation, spreading and compaction of clean fill from various infrastructure projects in Victoria's southeast. These projects include the Southern Program Alliance LCRP, Western Program Alliance LCRP, and the Dandenong LCRP. Day to day operation of the rehabilitation program is being undertaken by Resource Co Pty Ltd under a sub-contract to Heidelberg Materials.

Heidelberg Material submitted a Work Plan Variation under Mineral Resources (Sustainable Development) Act 1990 to Resources Victoria to expand the extraction area to 60 Valley Road, Langwarrin. Figure 2-1 shows the existing and the proposed Work Plan boundaries.

Figure 2-1: Existing and variation Work Plan boundaries and work area

It is intended that the battleaxe handle would remain largely unchanged and would provide for emergency access only, with the house which is adjacent to Quarry Road remaining in place and leased.

The highlighted area in Figure 2-1 is the approximate extent of the extractive resource and operation, with the details of the operation contained in Table.

Table 2-1: Summary of extractive resource and operation (Taken from Table 3-1 of the Planning Permit Application Report)

Item	Description
Sand Reserve	2.1 to 2.4 million tonnes
Estimated maximum depth	35 m
Estimated volume of topsoil	55,000 m^3 (depth of 1 m)
Estimated volume of overburden	10,000 m^3 (depth of 2 m)
Average tonnage (sand)	400,000 tonnes per annum
Area of disturbance	53.8 hectares
Quarry lifespan	5 to 6 years dependant on final depth and market conditions
Operation type	Dry open pit (until water table), wet open pit (below water table) material pushed to pond and dredging used.

There are three stages to the Work Plan variation:

- Stage 1 – pre-quarrying – fence repair/installation as necessary, vegetation removal, overburden placement as bund wall.
- Stage 2 – quarrying / operation – development of the quarry, benching the deep part of the deposit with some rehabilitation occurring as areas of the resource are exhausted.
- Stage 3 – rehabilitation – removal of plant and preparation for end use.

During quarrying/operation, the intent is to remove the resource moving from the southern extent of the work plan variation to the northern boundary. The resource will be excavated to the maximum depth, extending the excavation area in benches to maintain the stability of the extraction area. As the resource is extracted, it will be placed in a stockpile where it will be collected by a bulldozer and pushed down a slope into a pond formed by the inflow of groundwater to the excavated area. A dredge is then used to collect the saturated sand and pump the sand to the wet process plant. As the extraction progresses northwards the pond area formed by the inflow of groundwater will also extend northwards.

The pumped sand is directed to the wet processing plant and is fed into the plant saturated. The plant consists of a number of processes which size and remove impurities from the sand. Each of these processes is wet and therefore dust emissions from the process do not occur. At the end of the process, the excess water is removed, and the material is unloaded onto a dewatering grate. At the point of unloading the sand contains more than 20% moisture, meaning dust generation from the unloading will not occur. The dewatering grate allows water to drain from the sand and the water is moved to the stockpile when the moisture level is greater than 10%. Again, the high moisture content means that the level of dust generation is minimal. The material stays in the stockpile until it is approximately 5% moisture content.

Approximately 2500 m^3 per month (121 tonnes per day) of the washed and sized sand is sent to the drying plant whilst the remainder is sold in bulk with pickup by trucks with loading by front end loader.

The previously quarried area is currently being rehabilitated and during the Work Plan variation and the working areas are expected to be the same as current (see Figure 7-4). During this time an average of 46,500 m^3 of clean fill will be brought onto the site and deposited in the rehab area through rear dumping. The material will then be spread and compacted using a dozer and compactor.

The Work Plan variation was approved on 10 March 2022, and contained five requirements with respect to air quality impacts put forward by EPA:

- Six months prior to commencement of works approved under Work Plan Variation PLN001130, the authority holder must commence the collection of 12 months monitoring data for respirable crystalline silica; and
- Within 3 months of completion of the monitoring program required under Condition 1, the authority holders must provide ERR with a report, including risk treatment plan (as applicable), demonstrating in consultation with the EPA, that respirable crystalline levels are below the relevant standards and that the risks of respirable crystalline silica to sensitive receptors have been eliminated or minimised as far as reasonably practicable.
- Prior to commencement of works approved under Work Plan Variation PLN001130, the work authority holder must re-run the existing AERMOD model with the following amendments and determine if any additional controls may be required to control the risk of harm from offsite dust:
    - Switch on terrain features for a more accurate prediction of concentration at receptor sites. Terrain features should always be switched on as a default.
    - Identify, verify and apply alternative sources of background data where available.
    - Move the dust sources toward the northern edge within the five year extension to account for the impact at receptor sites located to the north of the site.
- Within 3 months of completion of the revised modelling required under Condition 3, the authority holders must provide ERR with a report, including risk treatment plan (as applicable), demonstrating (in consultation with the EPA) that modelled air quality is in line with relevant standards and that the risks have been eliminated or minimised as far as reasonably practicable.

3 REGULATORY REQUIREMENTS

3.1 Legislation

3.1.1 Environment Protection Act

The EP Act came into effect on 1 July 2021. The EP Act includes environmental obligations and protections for all Victorians and changes the focus for environment protection and human health to a prevention-based approach centred on the General Environmental Duty (GED). The GED requires all Victorians and businesses to have a responsibility to reduce risk to human health and the environment. Specifically, Section 25 Sub-section 1 of the EP Act requires:

> "*A person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable*".

The interpretation of this requirement is explained in Section 6 of the EP Act and requires the person to:

- Eliminate risks of harm to human health and the environment so far as reasonably practicable; and
- If it is not reasonably practicable to eliminate risks of harm to human health and the environment, to reduce those risks so far as reasonably practicable.

Further under Section 28 of the EP Act, there is a transitional duty relating to material harm which requires that:

> "*A person must not engage in conduct that results in material harm to human health or the environment from pollution or waste*".

3.1.2 Environment Reference Standard

The Environment Reference Standard (ERS) is made under the EP Act and:

- Identifies environmental values that the Victorian community want to achieve and maintain; and
- Provides a way to assess those environmental values in locations across Victoria[1].
- Table 2.1 of the ERS provides the environmental values of the ambient air environment. This is reproduced in Table 3-1.

[1] EPA Victoria – The Environment Reference Standard. Available at https://www.epa.vic.gov.au/about-epa/laws/epa-tools-and-powers/environment-reference-standard. Last accessed 19 August 2022.

Table 3-1: Environmental values of the ambient air environment from the ERS2

Environmental Value	Description of Environmental Value
Life, health and well-being of humans	Air quality that sustains life, health and well-being of humans
Life, health and well-being of other forms of life, including the protection of ecosystems and biodiversity	Air quality that sustains life, health and well-being of other forms of life, including the protection of ecosystems and biodiversity
Local amenity and aesthetic enjoyment	Air quality that supports lifestyle, recreation and leisure
Visibility	Air quality with low levels of particulate matter and very good visible range
The useful life and aesthetic appearance of buildings, structures, property and materials	Air quality that does not cause physical and structural damage to buildings, structures, property and materials
Climate systems that are consistent with human development, the life, health and well-being of humans, and the protection of ecosystems and biodiversity	Air quality that is not undermined, or at risk, by a warming and drying climate together with increasing population and economic growth

The relevant indicators for the Work Plan variation that the environmental values are being met are contained in Table 2.2 of the ERS (reproduced as Table 3-2).

Table 3-2: Indicators and objectives for the ambient air environment[2]

Indicators	Objectives	Averaging Period
Particles as PM10 (maximum concentration)	50 µg/m^3	1 day
	20 µg/m^3	1 year
Particles as PM2.5 (maximum concentration)	25 µg/m^3	1 day
	8 µg/m^3	1 year

The ERS also describes the environmental value of the land that is to be protected and the land use categories to which those land uses apply (Table 4.1 and Table 4.2 within the ERS). With respect to potential emissions of particulate matter and associated heavy metals or respirable crystalline silica generated from the mine operation, the environmental values that have the potential to be impacted are:

- Human health – Land quality that is suitable for the specific land use and safe for the human use of that land; and
- Aesthetics – Aesthetic issues do not adversely impact the use of land. Aesthetic issues include the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity.

The protection of human health applies to all listed land uses (parks and reserves, agricultural use, sensitive uses, recreation / open space, commercial and industrial).

The protection of aesthetics applies to parks and reserves, sensitive uses, recreation / open space and commercial uses.

The key emissions to atmosphere of potential concern from the mining operation comprise:

- Particulate matter of which three size fractions concern impact to amenity and health:
  - Total suspended particulate matter (TSP) from which the main concern is dust deposition on the surrounding land use
  - Particulate matter of less than 10 µm in aerodynamic diameter (PM_{10}) from which the main concern is health impact through respiration

[2] The Environment Reference Standard. Available at https://www.epa.vic.gov.au/-/media/epa/files/about-epa/laws/consolidated-ers-prepared-by-epa-29-mar-2022.pdf?la=en&hash=D3030F2A5865C6B2394B12B7B53DF540. Last accessed 19 August 2022.

- Particulate matter of less than 2.5 in aerodynamic diameter ($PM_{2.5}$) from which the main concern is health impact through respiration.

- Heavy metals that are variously associated with the emitted particulate matter of which the primary concern is arsenic. Heavy metals associated with PM_{10} may be directly inhaled, whilst heavy metals associated with the TSP have the potential to be washed into rainwater tanks where dust deposition occurs onto roofs that have attached water tanks.
- Respirable Crystalline Silica (RCS) can be a natural constituent part of the rock which is mined or the overlying overburden. RCS has a known health risk which can cause silicosis where $PM_{2.5}$ of which a portion is RCS is inhaled.

3.2 EPA Guidance on Assessing and Controlling Risk

As discussed in Section 3.1.1 the GED requires that risk is eliminated or where this is not possible that risk is reduced as far as reasonably practicable.

3.2.1 EPA Publication 1695.1

EPA Publication 1695.1 provides guidance on how risk should be assessed and controlled to assist with compliance with the GED.

The approach adopts a four-stage approach as shown in Figure 3-1:

- Identify hazards - What hazards are present that might cause harm
- Assess risks - What is the level or severity of risk, based on likelihood and consequence
- Implement controls - What measures are suitable and available to the business to eliminate or reduce a risk
- Check controls - Review controls to ensure they are effective.

Figure 3-1: Steps in assessing and controlling risk (EPA Publication 1695.1)

3.2.2 EPA Publication 1856

As discussed in Section 3.1.1, a key consideration of the Environment Protection Act, 2017 is the GED which requires that risk is eliminated, or where this is not possible reduced so far as reasonably practicable. It is therefore important to consider what is meant by reasonably practicable.

It is important to note that reasonably practicable does not mean the implementation of all and any available controls regardless of the cost to reduce the risk to as low as possible. Such an interpretation would run the risk of making industry untenable in Victoria.

Rather, EPA Publication 1856 provides guidance to businesses on how to define what is reasonably practicable and defines six factors for consideration:

- Eliminate first: Can you eliminate the risk?
- Likelihood: What's the chance that harm will occur?
- Degree (consequence): How severe could the harm be on human health or the environment?
- Your knowledge about the risks: What do you know, or what can you find out, about the risks your activities pose?
- Availability and suitability: What technology, processes or equipment are available to control the risk? What controls are suitable for use in your circumstances?
- Cost: How much does the control cost to put in place compared to how effective it would be in reducing the risk?

3.3 EPA Guidance on Air Quality

3.3.1 EPA Publication 1961.2

EPA Publication 1961.2: Guideline for Assessing and Minimising Air Pollution in Victoria – for air pollution managers and specialists, is the main guidance for the assessment and management of air quality impacts. EPA Publication 1961.2 provides guidance on:

- Risk minimisation under the GED
- Guidance on the required assessments for extraction applications
- Air Pollution assessment criteria that are used to determine whether there may be an unacceptable risk to human health.

3.3.1.1 Risk minimisation under the GED

Section 7 of EPA Publication 1961.2 considers risk minimisation under the GED and considers that risk controls may be preventative (controlling harmful events from happening) or mitigative (controlling the consequence or damage from a harmful event if it were to occur). EPA Publication 1961.2 adopts the risk management hierarchy from EPA Publication 1695.1 as shown in Figure 3-2.

In the context of extractive activities, the process inherently produces dust, and it is not possible to eliminate the hazard, nor is it possible to substitute the hazard as the emissions produced are dust and this cannot be substituted for a different hazard. Consequently, the approaches to the minimisation of risk are related to engineering and administrative controls.

Figure 3-2: Risk hierarchy from EPA Publication 1695 as adopted by EPA Publication 1961.2

The application of the engineering and administrative controls must, however, be considered in the context of what is reasonably practicable using the approach outlined in EPA Publication 1856 (Section 3.2.2).

3.3.1.2 Guidance on levels of assessment

Section 5.1.3 of EPA Publication 1961.2 details the level of assessment required dependant on the level of risk such that:

- Level 1 – Qualitative Assessment - For some emission sources, it may not be necessary or useful to carry out a full quantitative assessment of pollution risks. Instead, a qualitative, or semi-quantitative screening assessment may be sufficient. This may occur when a source is very common and well understood, with risks that are known to be controllable using certain techniques or technologies. In these instances, the resulting risks are usually so low that a qualitative assessment is sufficient. This includes:
  - Concrete batching plants.
  - New asphalt batching plants.
  - New motor vehicle spray painting booths.
  - Natural gas boilers <20 MW.
  - Small gas turbines <5 MW combined heat and power plant.
  - Mass emission rates that are so low they can be considered negligible.
  - Fugitive emissions that are difficult to assess accurately, such as:
    - Waste processing facilities accepting solid inert or construction and demolition wastes.
    - Earth-moving activities.
    - Construction activities.
    - Sites processing organic wastes or green wastes.
- Level 2 - Quantitative assessment. If the Level 1 assessment indicates the need for further quantitative assessment, then a Level 2 assessment should be conducted. This comprises modelling using the regulatory dispersion model AERMOD or an approved alternative, and/or

monitoring pollutant concentrations and comparing these to the relevant Air Pollution Assessment Criteria (APACs) to assess risks.

- Level 3 – detailed risk assessment. In some uncommon instances, comparing ground level concentrations with APACs is not enough to assess risk. This is normally due to the characteristics of the emission source or receiving environment. Examples include sites emitting a complex mixture of highly toxic substances, or emissions that have the potential to deposit into soil or water and bioaccumulate in organisms or biomagnify in the food chain. Specific circumstances when a Level 3 assessment is suitable are when the scenario is complex and the risk posed by the site's emissions or receiving environment cannot be completely understood with a simple comparison of concentrations to the APACs. In this circumstance a combination of methods may be used which for an extractive source are likely to include:
  - Human health Impact Assessment (HHIA) of air toxics.
  - HHIA or criteria pollutants.
  - Ecological Risk Assessment.
  - Nuisance dust risk Assessment.

In addition, for extractive industries, EPA Publication 1961.2 provides additional guidance on the level of assessment to be completed (Table 3-3).

Table 3-3 Level of assessment for mining and extractive industries (EPA Publication 1961.2 Table 1)

	Size of extractive industry			
Location of extractive industry	Large mine or quarry greater than 500,000 t/yr extraction	Medium mine or quarry between 150,000 t/yr and 500,000 t/yr extraction	Small mine or quarry between 50,000 t/yr and 150,000 t/yr extraction	Mine or quarry with yearly extraction below 50,000 t/yr extraction
Urban area	Level 3	Level 3	Level 2	Level 1
Rural area close to residences (less than 500 m from the limit of work described in the work plan)	Level 3	Level 2	Level 1	Level 1
Rural area (residences more than 500 m from the limit of work described in the work plan)	Level 2	Level 1	Level 1	Level 1

3.3.1.3 Multiple lines of evidence

In completing an assessment under EPA Publication 1961.2, the assessment process requires the consideration of multiple lines of evidence:

- Comparison of predicted concentrations to background pollution. In circumstances when background air concentrations exceed relevant APACs, it can be useful to provide an indication of:
  - the total predicted number of exceedances of the relevant APAC.
  - whether exceedances were attributable to background pollution or were associated with the emissions from the proposed/current activity.
- Incremental contribution to ground level concentrations. In some assessments (particularly for PM10 and PM2.5), it is useful to consider whether the incremental contribution of the source is a significant addition to what naturally occurs in the environment. As a general rule, an increment of 4% of the relevant APACs can be applied at the most impacted sensitive location. That's because this increment indicates a contribution so small that it is unlikely to result in measurable impacts in the population. When particulate plumes are likely to impact a large population (greater than 25,000 people), a criteria pollutant health Impact Assessment may be required to evaluate risks from incremental contributions.
- Observational data. The assessment of air pollution risks can sometimes benefit from observations, such as visual cues, odour, or visible signs of impact. On their own, these lines of evidence are seldom enough to draw meaningful conclusions, but alongside other data they can be very useful.
- Reports from the public. Community complaints, complaints databases, dust diaries or other types of community-recorded observations can provide an indication of the nature of observable impacts through time. As with all indicative data, they need to be interpreted with care.

However, in some cases they can be invaluable as they can identify long-term trends of observed impacts in exposed communities.

- Comparison to reference sites. Relying on knowledge from other sites with comparable activities and/or exposed populations can sometimes provide a strong reference point when assessing risks. For example, published air monitoring or epidemiological data may exist for areas near a similar type of facility that might help understand likely impacts.
- Monitoring data from indicative instruments. Sampling carried out with instruments not meeting regulatory quality requirements can, in some cases and with adequate justification, be included in a broader discussion of risks as indicative results. In these instances, care should be always taken to clearly outline the limitations or errors (if known) of the approach in order to avoid inadvertently misrepresenting the accuracy or precision of the results.
- Outputs of other detailed impact assessment methods. Some of the methods described elsewhere in this guideline are not enough on their own to provide clarity on the risks from air pollution. For example, burden of disease and criteria pollutant HHIA (Sections13.1 and 13.3) are seldom enough on their own to inform a risk-based decision on air pollution. However, they can become more useful when accompanied by other types of evidence.

3.3.1.4 Air Pollution Assessment Criteria

EPA Publication 1961.2 (VIC EPA, 2025) provides Air Pollution Assessment Criteria (APACs), which are considered by the guidance as values that:

- Monitoring data can be directly compared to, providing the sampling time corresponds to the averaging time of the individual APACs
- Are not a level to pollute up to
- Help emitters understand the current inherent risks posed by activities to inform the implementation of appropriate controls
- Provide a benchmark against which remaining risks after proposed controls are implemented can be evaluated to determine whether the residual risk is acceptable.

The majority of the APACs are listed for cumulative impacts, which consider emissions from surrounding uses and regional background concentrations. Cumulative effects assessment cannot be undertaken for metals because:

- No baseline measurements of metals in dust collected prior to the Work Plan variation submission.
- No detail is publicly available from the surrounding operators on their emissions to atmosphere.

The nearest EPA monitoring station at Dandenong North is representative of regional background but not may not be representative of the local area given the surrounding land use. Cumulative effects were assessed for PM10 in three years, but only one year (2023) of data are available to assess cumulative effects of PM2.5.

As discussed in Section 3.3.1.3 one of the multiple lines of evidence is the use of 4% of the assessment criteria as indicative as to whether the increment is potentially significant or not. As noted in EPA Publication 1961.2:

> "*The increment of 4% was derived as the percentage of the 24-hour PM2.5 APAC that just meets the resolution requirements of a beta attenuation monitor (that is 1 µg/m3 over 24 hours, AS/NZS 3580.9.11:2008). This is conservatively consistent with approaches adopted overseas (for example APPLE 2007, US EPA 2014)*".

Table 3-4 provides the APACs for particulate and metals that will be emitted from activities during the Work Plan variation. The indicative 4% of the APAC has been provided for both particulates and metals.

The percentage has been derived from the resolution of particulate monitoring, in this instance, the emissions of metals is associated with particulate matter from the rehabilitation phase and, if they were measured, it would be completed using the same method as used for particulates.

Table 3-4: Relevant APACs and 4% of the APAC for cumulative criteria (EPA Pub. 1961.2)

Indicators	Averaging period	APAC (µg/m³)	4% of APAC
PM_{10}	24 hour	50	2
	Annual	20	0.8
$PM_{2.5}$	24 hour	25	1
	Annual	8	0.32
Antimony and antimony compounds	24 hour	1	0.04
	Annual	0.3	0.012
Arsenic and arsenic compounds	1 hour	9.9	0.396
	1 year	0.015	0.0006
	1 year (incremental)	0.007	N/A
Barium and barium compounds	1 hour	5	0.2
Beryllium and beryllium compounds	Annual	0.001	0.00004
Cadmium and cadmium compounds	1 hour	18	0.72
	24 hours	0.03	0.0012
	Annual	0.005	0.0002
Chromium (hexavalent)[1]	1 hour	1.3	0.052
	1 year	0.005	0.0002
Chromium (trivalent)[1]	30 days	0.1	0.004
Copper and copper compounds	1 hour	10	0.4
Lead and lead compounds	1 year	0.5	0.02
Manganese and manganese compounds	1 hour	9.1	0.364
	Annual	0.15	0.006
Mercury and mercury compounds	1 year	1	0.04
Nickel and nickel compounds	1 hour	0.2	0.008
	Annual	0.01	0.0004
Respirable Crystalline Silica	Annual	3	0.12
Silver and silver compounds	1 hour	0.1	0.004
Zinc and zinc compounds	1 hour	20	0.8
	Annual	2	0.08

3.3.2 *EPA Publication 1943*

EPA Publication 1943 provides guidance for assessing nuisance dust and provides a qualitative approach on the assessment of nuisance dust. This guidance is to be used for the assessment of sites where no quantitative data exists to provide a guide on which sources should be mitigated. In keeping with the levels of assessment described in EPA Publication 1961.2 (Section 3.3.1.2), this qualitative assessment method can be used under a level 1 assessment.

As shown in Table 3-5, Table 3-6 and Table 3-7. The qualitative assessment provides scoring on the:

- Size of the dust emitting source
- Activities being undertaken
- Type of dust emission
- Level of control
- Distance to receptors
- Orientation of receptors relative to the prevailing wind direction
- Intervening terrain
- Intervening land use
- Historical context.

Table 3-5: Hazard potential and effectiveness weighting

Score	Size of dust emitting source	Activities being undertaken	Type of dust emission	Level of Control
1	Small: materials usage in the order of hundreds of tonnes/m^3 per year; area sources of tens of m^2	Low potential for dust emissions: Dust not generated by activity per se (car yards, auto recyclers, washing and cleaning leads to sediments. Sites with exposed areas without activity (typically vacant yards, lots etc.).	Coarse: only larger stony materials on site, very coarse sand, blue metal	Full control or containment: Fully sealed areas and/or highly effective, tangible measures in place leading to little or no residual dust. Releases only due to plant failure. Good housekeeping, enclosed operation with extraction and treatment equipment
2	Medium: materials usage in the order of thousands of tonnes/m^3 per year; area sources of hundreds of m^2.	Moderate potential for dust emissions: activities on unsealed sites, i.e., container parks, or other access roads, leading to track-out onto external roads. Cement and building products manufacturing.	Intermediate: crushed rock, beach and builders' sands, or fine stone, aggregates.	Partial Control or containment: Some areas of the site may be controlled or sealed but there are areas not addressed (e.g., haul roads or car parks). Reliance on management and housekeeping (i.e., water carts, keeping tip-faces small, wheel washes etc.).
3	Large: Materials usage in the order of hundreds of thousands of tonnes/m^3 per year; area sources of thousands of m^2	High potential for dust emissions: grinding, blasting, material handling in the open air, crushing, screening, haul roads for heavy vehicles, agricultural activities (ploughing fields)	Fine: Very fine dust that can readily become airborne (i.e., silt clay, coal dust, dried tracked-out mud, gypsum, cement etc.)	No effective control or containment: Large exposed stockpiles or unsealed areas, specifically dry conditions, open-air operation with no containment, management controls not maintained

Table 3-6: Dust exposure pathway and effectiveness weighting

Score	Distance	Orientation of receptors relative to wind direction	Terrain	Intervening land use
1	• Receptors are hundreds of metres or kilometres from the source or • Separation distance has been met easily.	• Winds rarely (<10%) blow from source to receptor or • Source is upwind, winds are of low speed	• Source located in a valley or quarry hole, downslope from receptor or highly undulating terrain between source and receptor	• High vegetation, i.e., densely forested or, • Highly built-up or intervening zone with multiple non-sensitive uses that have no dust emissions of their own
2	• Receptors are tens or hundreds of metres from the source or • Separation distance has not been met or met but only just at the threshold distances	• Even distribution of winds (10-20%) from source to receptor or • source is upwind, winds are of moderate speed • High frequency (>10%) of stable weather conditions with low dispersion.	• Source is at the same altitude as the receiving environment, generally flat land.	• Moderate vegetation and/or • Intervening land use zone contains other non-sensitive industries or smaller businesses
3	• Receptors are adjacent to the source/site or • Distance well below (less than half) separation distances.	• High frequency (>20%) of winds from source to receptor or • source is upwind, winds are of high speed	• Source is upslope of receiving environment and/or located in the same valley	• Open land and cleared of obstacles and/or • Isolated dwellings or structures in the pathway

Table 3-7: Receiving environment sensitivity weighting

Score	Historical context	Land use
2	No previous history No incidents or non-compliance. Only single isolated reports. Generally, the public is unconcerned.	Low general expectation of amenity • exposure can be easily avoided. • Dust doesn't have an impact in any lasting way on appearance, aesthetics or value of property by soiling or, locations where human exposure is transient or, areas of low ecological value • E.g., footpaths, walking or bike trails, farmland (unless sensitive horticultural land,) short-term car parks, roads, no nearby waterways, dry arid areas, or wasteland (abandoned paddocks etc.).
4	Some history Occasional complaints, and history of the industry causing problems elsewhere. Some concern in the immediate area but not widespread.	Moderate general expectation of amenity • people can move on and can potentially avoid exposure. • Dust could impact on appearance, aesthetics or value of property, locations where people are occupationally exposed over a full working day but not in a home setting or, areas of moderate ecological value • E.g., enjoyment of the outdoors, recreational activities, playing sports, offices, warehouses and industrial units, playgrounds, shopping areas, longer-term vehicle storage, peri-urban or outer suburban nature areas, somewhat modified waterways
6	Significant history The community has had regular impacts of dust and is highly sensitised. Regular or repeated non-compliance, past enforcement activity	High general expectation of amenity • exposure cannot be avoided. • Dust is likely to impact on damage to property, clothes, and vehicles, affects food preparation, etc. or, individuals may be exposed for over eight hours or more in a day, areas of high ecological value • E.g., residential properties with backyards and open living areas, rural living zones, hospitals, schools, prisons, accommodation, residential care homes, car parks associated with workplace or residential parking

The qualitative assessment can be used to consider the potential for individual sources to generate nuisance dust or for all sites as a whole.

The sum of the scores from each category formulate the potential risk of fugitive dust to the surrounding land use.

Table 3-8: Overall risk of dust impact (EPA Publication 1943 (VIC EPA, 2022))

Cumulative Score	Descriptor	Comment
32-36	Very high	Dust impacts almost certain
27-31	High	Dust impacts likely to occur
22-26	Medium	Dust impacts likely
17-21	Moderate	Dust impacts only likely to occur on rare occasions
12-16	Low	Dust impacts are not likely

3.3.3 EPA Publication 1894

EPA Publication 1894 provides guidance on 'Managing of Soil Disturbance'. The following potential controls are listed to prevent emissions during soil disturbance:

- Avoid clearing areas that don't need to be disturbed.
- Minimise vegetation disturbance.
- Stage soil work to minimise areas of exposure.
- Plan and schedule soil disturbance activities and consider adverse weather conditions (for example hot, dry or wet periods, high winds, heavy rainfall events and days with poor air quality).
- Conduct regular meteorological monitoring (for example wind conditions and rainfall) and be flexible and adjust your work plan or reschedule as necessary. For example, wherever possible, plan topsoil stripping and grading on days when wind conditions are less likely to carry dust towards sensitive areas. Also, stop works if dust from your site is visible beyond the site boundaries and moving towards sensitive receivers. Resume works only when you can implement effective controls or weather conditions, and air quality improve.
- Divert clean surface water away from disturbed soil where possible.
- Install shade cloths as a windbreak to slow down winds and minimise wind erosion (wind-blown dust).
- Install dust screens around the site as appropriate.
- Wind barriers (for example solid board fences, crate walls, bales of hay, burlap fences and trees) help with preventing erosion by obstructing the wind near the ground and in turn, prevent soil from being blown off site. Wind barriers are most effective when placed perpendicular to the prevailing wind.
- Supress dust by using water carts to wet down areas where works are happening, including outside business hours if windy weather is forecast.
- Stabilise exposed soils for example, revegetating soils (e.g. hydro seeding, hydro mulching) by applying spray suppressants or soil binders, or installing stabilisation matting.
- Suppress dust using misting or fogging systems.
- Stabilise vehicle movement areas to prevent tracking of sediment or generation of dust.

- Avoid driving over stabilised or exposed soil.
- Install a sediment or silt fence to stop silt and sediment runoff from leaving your work area.

To monitor the controls, EPA Publication 1894 recommends:

- Regularly performing maintenance and reinforcement as required of installed controls, for example replanting failed vegetation or applying further application of soil binders.
- Monitoring revegetated or stabilised areas to assess effectiveness of controls.
- Inspecting controls following high rainfall and/or high wind events to confirm if any reinforcing or re-establishment is required.
- Regularly reassessing the need to clear vegetation for activities and staging clearance where required.
- Monitoring air quality for dust by using ambient dust monitoring equipment located on and off site. This will assist with identifying the effectiveness of implemented dust controls. For example, you can monitor dust from your site's activities by using dust deposition monitors or video cameras at the downwind boundary. Portable gauges located downwind such as a DustTrak unit can send real-time data for dust and weather conditions. This includes temperature, rain, wind speed and direction.

3.3.4 EPA Publication 1895

EPA Publication 1895 provides guidance on 'Managing Stockpiles'. The following potential controls are listed to prevent emissions from stockpiles:

- Design and designate an area for stockpiles before site works commence. Locate stockpiles away from the site boundary, waterways and catchments, residential areas, and other sensitive receivers. Use the location to protect stockpiles from the prevailing wind.
- Shape stockpiles, taking into consideration width to height ratio, nature of stockpiled material, location, access and available area for the stockpile. Limit stockpile heights based on their stability, manageability, dust and amenity impacts.
- You may need more gentle slopes for unstable soils. Avoid building steep sided stockpiles that have sharp changes in shape.
- Store fine or powdery material (less than 3 mm in size) inside buildings or enclosures if practicable.
- Divert stormwater away from stockpiles using a catch drain or earth bank.
- Cover small stockpiles with mulch, hessian, tarpaulins or stabilisation matting. Anchor covers will prevent them from blowing away.
- Contour stockpiles within floodplains to minimise erosion during high rainfall events.
- Keep stockpiles for shortest time possible.
- Minimise the time the stockpile will be inactive.
- Stabilise inactive soil stockpiles left for long periods of time by establishing vegetation or grass (for example hydroseeding). Subsoil stockpiles may need an outer layer of topsoil to help establishing grass.
- Surround stockpiles with sediment control fences to minimise run-off of material. Remove sediment when it is halfway up the sediment control fence, return the material to the stockpile and consider implementing additional controls for effective management.
- Erect fences, screens with shade cloth or use other windbreaks such as trees, hedges and earth-banks of similar height and size to the stockpile.

- Enclose stockpiles within bunkers.
- Use machinery to contour or scarify across the slope of the surface of the stockpiles. It will help reduce run-off velocity and erosion.
- Suppress dust from small stockpiles using water or chemical dust suppressants, apply using a water truck or hand-held hose.

To monitor the controls, EPA Publication 1894 recommends:

- Measure and monitor the size and geometry of the stockpiles. Adjust the height and dimensions of stockpiles to control the stability and dust and amenity impacts.
- Monitor stormwater catchment diversion controls.
- Ensure catch drains and earth banks are adequately diverting stormwater.
- Remove accumulated stockpile material adjacent to sediment control fences and reinforce fences as required.
- Regularly clean and maintain wind barriers.
- Where practicable use “real time” downwind dust measurement or boundary video to assess effectiveness of dust management activities.
- Where necessary be prepared to increase level of dust mitigation if measures are not effective.

3.3.5 EPA Publication 1897

EPA Publication 1897 provides guidance on ‘Managing Truck and Other Vehicle Movement’. The following potential controls are listed to prevent emissions and impact from truck and vehicle movements:

- Manage site access
- Identify the planned movement and traffic routes of vehicles on your site and develop a traffic management plan.
- Minimise site access to limit the impact from vehicles on roads.
- Identify entry and exit points, and high traffic areas on your site.
- Stabilise site entry and exit points with a sealed road, aggregate or road base.
- Divert surface water run-off away from site access points so it does not wash or track sediment offsite.
- Manage road use
- Minimise the number of access roads vehicles use.
- Seal roads with asphalt or a spray seal, or stabilise with aggregate, gravel or road base. You may need to replace aggregate or gravel periodically.
- Maintain, clean and grade haul routes on a regular basis.
- Locate unsealed roads to avoid erodible areas of the site, such as sloping terrain or unstable soils.
- If roads are not stabilised or sealed, minimise dust using water or chemical dust suppressants.
- Provide sealed or stabilised car parks for site workers to park their vehicles to prevent track-out of soil and mud onto public roads.
- Minimise haul route distances and locate haul routes away from sensitive receivers.
- Restrict vehicles to defined roads and site entry and exit points. Fence the site to prevent vehicles bypassing designated site access points.

- Set appropriate and site-specific speed limits to minimise generating dust. Ensure you signpost roads and that site workers are aware of designated speed limits.
- Machinery hygiene
- Avoid and minimise mud, soil and dust entering on site from incoming trucks and vehicles.
- Identify and assess invasive plants that may be present and control the spread so far as reasonably practicable.
- Avoid driving in areas that may contain invasive plants and maintain clean machinery on site.
- Manage dirt and mud on access roads/routes
- Cover trucks transporting loose materials with fitted canopies. Ensure you cover all loads before trucks leave site.
- Limit load size to avoid spillages.
- Remove soil from the rim of trucks before they leave site. Place scraped material in a location where it won't be washed offsite. This control may only be suitable where there is a small number of vehicles leaving site.
- Install rumble grids at site exit points to shake soil off trucks. Take care not to position them in or over a drainage line. Ensure the road between rumble grids and the site exit is stabilised and with adequate distance and wheel rotations (recommended minimum three-wheel rotation).
- Submerge rumble grids in water so tyres are washed as the truck crosses the rumble grid. Prefabricated rumble grid/wheel baths are available for purchase or hire. Drain and replace the water in the wheel bath periodically. Water from wheel baths should be treated as 'waste' and managed in line with the waste hierarchy.
- Minimise use of a wheel wash or hand-held hose to wash vehicle tyres due to the large volume of wastewater generated. If a wheel wash or hand-held hose is used, treat the water as 'waste' and manage in line with the waste hierarchy, preferably capturing and reusing this wastewater for wetting exposed areas.
- Clean sediment off roads as soon as possible. Do this by using a broom and shovel, water or street sweeper. Treat the water as 'waste' and manage in line with the waste hierarchy, preferably capturing and treating the water.
- Use a water-assisted dust sweeper on access and local roads to remove material tracked off site. Avoid dry sweeping of large areas.
- Install hard surfaced haul routes, and regularly damp down with fixed or mobile sprinkler systems or mobile bowsers. Regularly clean the haul routes and if necessary clean local roads.

3.4 Separation distances

The EPA Separation distance guidelines (Publication 1949; August 2024) lists recommended safe distances between dust and odour sources and receptors. The guidance help facilitate planning decisions about land use around activities with potential offsite impacts. The EPA SDG states that:

> *"Separation distances are intended to accommodate both routine or day-to-day emissions and unintended offsite emissions. Where there is routine or day to day emissions from a premises, there may still be unintended offsite emissions experienced at or beyond the boundary of the source premises. Unlike routine emissions, unintended emissions are in addition to routine emissions and are often intermittent or episodic. They may occur due to:*
>
> - the nature of the operation
> - minor changes in weather conditions
> - minor accidents
> - minor equipment failure.

Unintended offsite emissions may still happen even when an industry/activity is operating in accordance with all relevant statutory obligations, including minimising the risk of harm to human health or the environment from pollution and waste so far as reasonably practicable.

Separation distances are intended to allow unintended emissions to disperse, and in doing so, minimise human health and amenity risks for any nearby sensitive land uses".

Table 3-9 shows two relevant separation distances. The separation distance for "rock" quarries is 500 m in all cases. The project mines sand not rock, so a 250 m buffer applicable to mines for other materials, might be appropriate. However, the sand being quarried is known to contain RCS, which means even though sand is being produced, a 500 m separation distance may be most appropriate.

Table 3-9 Separation distances for extractive industries under EPA Publication 1949

Type of Industry/activity	Activity/definition	Scale and Description	Publication 1949
Quarry	Quarrying, crushing, screening, stockpiling and conveying of rock	Without blasting	500 m
		With blasting	500 m
		With respirable crystalline silica	500 m
Mine for other minerals	Crushing, screening, stockpiling and conveying of other minerals	-	250 m

Where these separation distances cannot be met EPA Publication 1949 provides guidance on how to seek a variation to the separation distance. The guidance states, in order to seek a variation the proponent should "*complete a risk Assessment in support of their application*". The guidance stands the proponent should:

- *provide the decision maker with a risk Assessment based on the source, pathway, receptor model, considering cumulative impacts where relevant*
- *based on the findings of the risk Assessment, propose an alternative separation distance*
- *demonstrate that the proposed separation distance poses a low risk of dust impact.*

The guidance goes on to state:

Evidence that the proposed separation distance poses a low risk of harm from dust may include an assessment of the size of the dust source, the type of dust emission, the frequency, intensity and duration of the dust emission and the level of dust control implemented.

Ultimate the decision to vary a recommended separation distance and the conditions relevant to a development proposal are the responsibility of the "decision maker".

4 EXISTING CONDITIONS

4.1 Climate

The Project site is located in a temperate environment. Climatic averages and extremes have been recorded by the BoM at Frankston Beach (086371) meteorological station between the years 1992 to 2018 (Table 4-1).

Overall, the local area is characterised by:

- Average maximum temperature of 24.9°C in February
- Average minimum temperature of 8.0 °C in July
- Average maximum 9 am relative humidity of 22% in June and July
- Average minimum 3 pm relative humidity of 59% in December and January

A summary of the major climate statistics recorded at this site is provided below in Table 4-1.

Table 4-1: Mean climatic conditions for nearest Bureau of Meteorology observation station at Frankston Beach (086371)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	From	To
Mean maximum temperature (°C)	24.8	24.9	22.7	19.3	16	13.6	12.8	13.6	15.6	17.9	20.5	22.6	18.7	27	1992	2018
Mean minimum temperature (°C)	15.6	16	14.6	12.3	10.6	8.6	8.0	8.3	9.4	10.6	12.3	13.9	11.7	26	1992	2018
Mean rainfall (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Decile 5 (median) rainfall (mm)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean number of days of rain ≥ 1 mm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean number of clear days	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean number of cloudy days	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean 9am temperature (°C)	18.2	18.4	16.7	14.4	12.4	10.3	9.5	10.2	11.6	13.2	14.8	16.5	13.9	19	1992	2010
Mean 9am relative humidity (%)	70	73	74	77	81	82	82	79	76	72	72	70	76	17	1994	2010
Mean 9am wind speed (km/h)	15.4	12.9	13.1	14.7	15.9	17	17.7	19.2	20.4	18.3	16.7	17.4	16.6	18	1992	2010
Mean 3pm temperature (°C)	21.6	21.9	20.2	17.4	14.9	12.7	11.8	12.4	13.8	15.6	17.8	19.6	16.6	19	1992	2010
Mean 3pm relative humidity (%)	59	60	60	63	70	73	74	71	67	61	60	59	65	17	1994	2010
Mean 3pm wind speed (km/h)	21.2	19.5	19.2	18.4	17.9	18.7	18.8	19.8	21.5	21	21	21	19.8	18	1992	2010

(Australian Government Bureau ofMeteorology, 2024)

4.1.1 Observed wind conditions

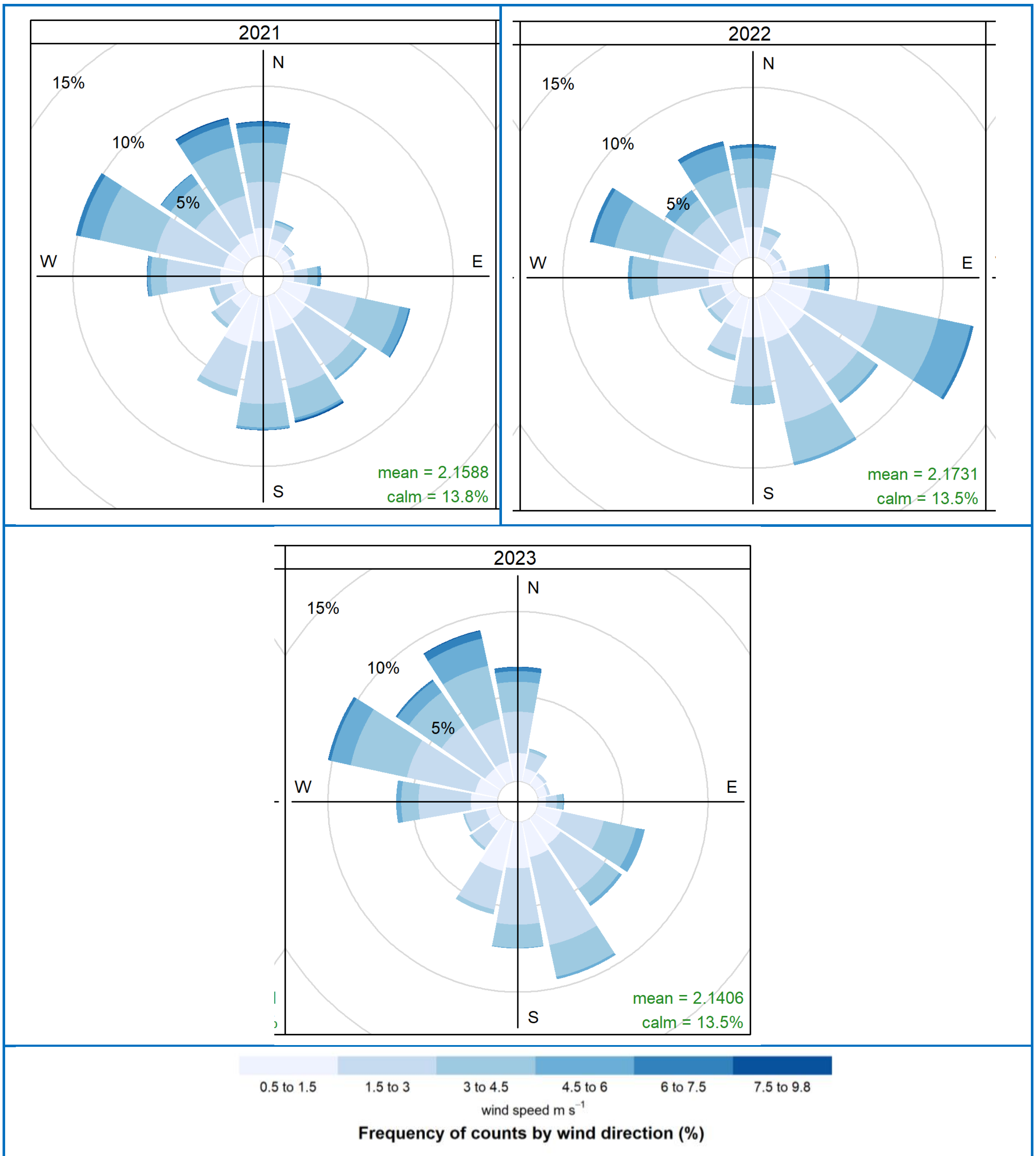
An annual wind roses were created using the meteorological data collected from Ballam Park (086388) and Frankston (086371) BoM stations as presented in Figure 4-1 and Figure 4-3. Seasonal wind roses for both stations are presented in Figure 4-2 and Figure 4-4.

Yearly wind data shown in Figure 4-1 presents wind roses for the years 2021, 2022, and 2023 at the BoM station at Ballam Park. Overall, prevailing wind direction in all three years indicate wind blowing from the northwestern quadrant, with a moderate frequency of wind blowing from south-eastern quadrant. Very few north-easterly winds occurred.

Seasonal wind roses are presented in Figure 4-2 from Ballam Park. In spring, the predominant wind direction is from south-eastern quadrant and moderate frequency of wind blowing from the northwestern quadrant with a seasonal mean wind speed of 2.2 m/s and calm winds corresponding to 12% of the time. The predominant wind direction during summer is from the southeastern quadrant with a mean wind speed of 3.0 m/s and calm winds 8.1% of the time. Autumn presents predominant wind blowing from both the southeastern and northwestern quadrant with a mean wind speed of 1.9 m/s and calm winds 17% of the time. In winter, wind is predominantly blowing from north-north-west with a mean wind speed of 2.2 m/s and calm winds 17% of the time. There is a clear predominance of north-westerly winds during winter and low frequency of winds blowing from other directions.

Meteorological data collected from Frankston Beach (086371) from years 2019 to 2023 are presented in Figure 4-3. The predominant wind direction varies across the five years, however, all years present winds of higher wind speed blowing directly from north. In 2019 wind was blowing predominantly from the western quadrant. In 2020, the predominant wind direction is from east-south-east and moderate frequency from the western quadrant. In 2021, predominant wind direction blowing from both the eastern and western quadrants. In 2022, wind direction has a predominant eastern vector, with moderate frequency from the north. Annual wind rose for 2023 indicated a higher predominance of wind direction and wind speed blowing from the northern vector and moderate frequency of winds blowing from the south-western quadrant.

Seasonal meteorological data from Frankston Beach (Figure 4-4) shows spring with predominant wind direction from the western quadrant with a mean wind speed of 4.9 m/s and calm winds 1.5% of the time. In summer, wind direction of wind is more frequent from the south, southwest and southeastern quadrants with a mean wind speed of 4.5 m/s and calm winds 1.1% of the time. Autumn presents predominant wind direction from the north with a mean wind speed of 4.6 m/s and calm winds 1.7% of the time. Winter presents a predominant northern vector component of wind in both frequency and wind speed, with a mean wind speed of 5.1m/s and calm winds 2.7% of the time.

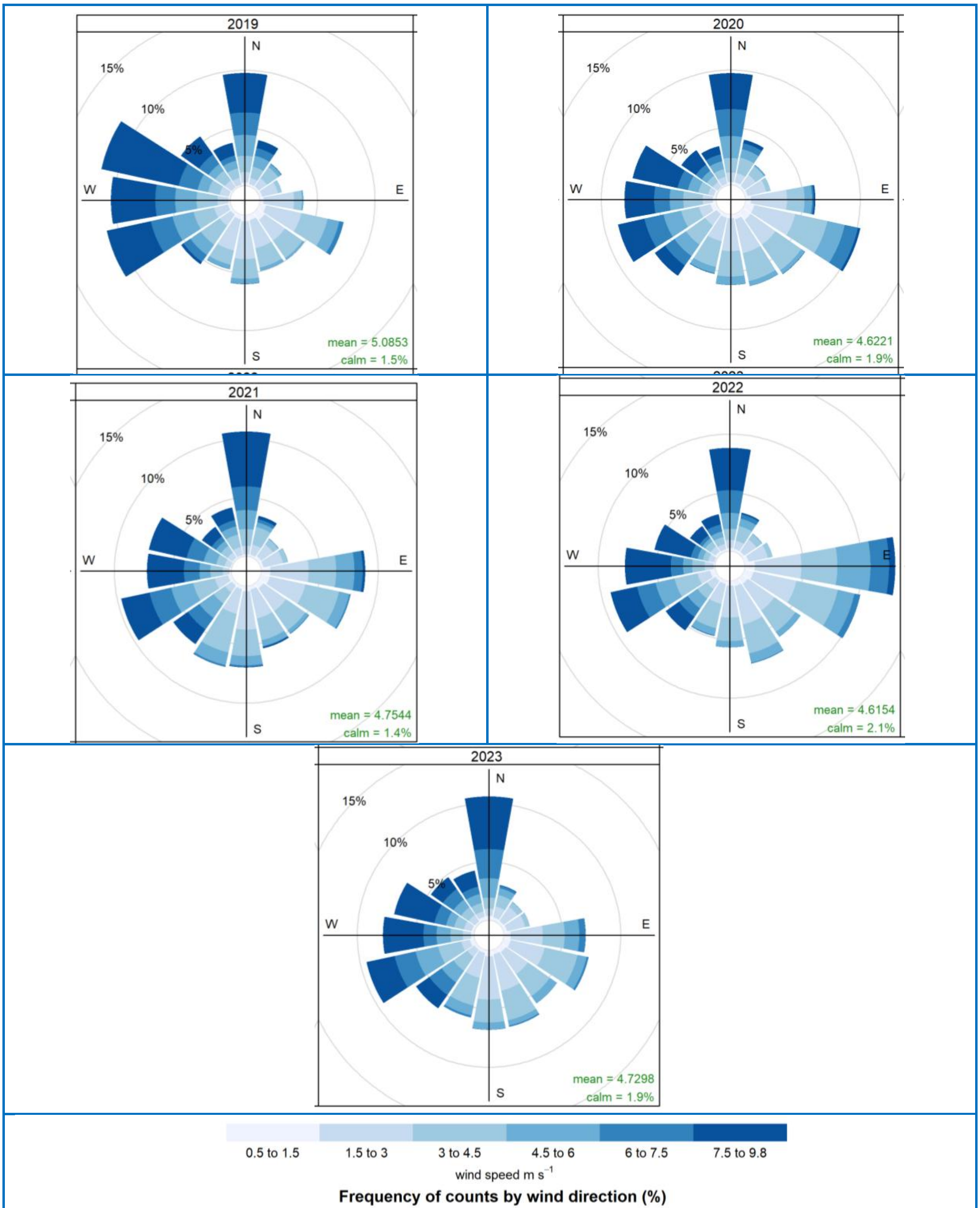


Site	Year	Average wind speed	Calm winds (<0.5 m/s)
Frankston (Ballam Park), Victoria BoM station (086388)	2021	2.2 m/s	14%
Data Type	2022	2.2 m/s	14%
Observation	2023	2.1 m/s	14%

Figure 4-1: Annual wind roses at Ballam Park

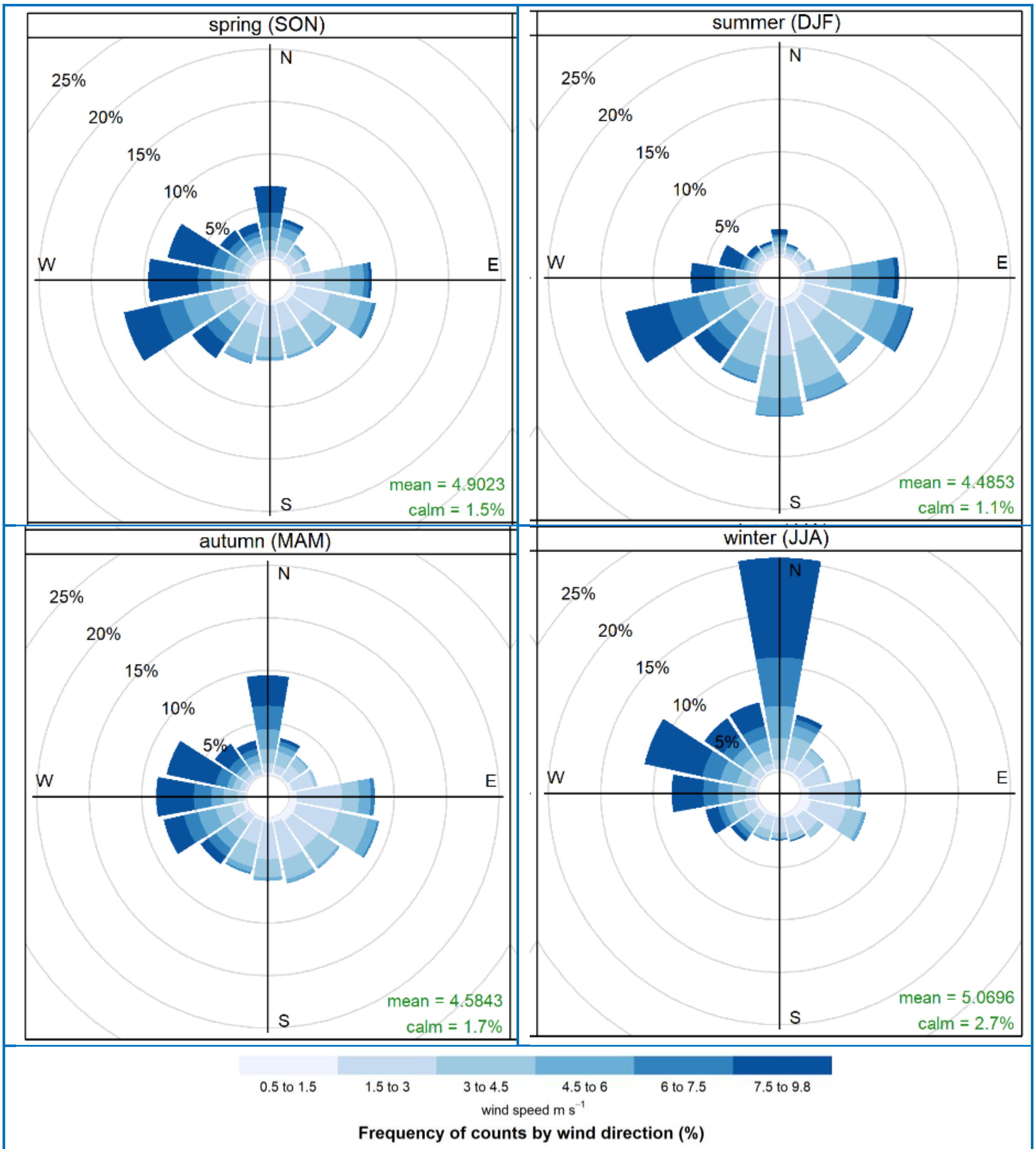
Site	Season	Average wind speed	Calm winds (<0.5 m/s)
Frankston (Ballam Park), Victoria BoM station (086388)	Spring	2.2 m/s	12%
	Summer	2.3 m/s	8.1%
Data Type	Autumn	1.9 m/s	17%
Observation	Winter	2.2 m/s	19%

Figure 4-2:: Seasonal wind roses at Ballam Park



Site	Year	Average wind speed	Calm winds (<0.5 m/s)
Frankston Beach Victoria BoM station (086371)	2019	5.1 m/s	1.5%
	2020	4.6 m/s	1.9%
	2021	4.8 m/s	1.4%
Data Type	2022	4.6 m/s	2.1%
Observation	2023	4.7 m/s	1.9%

Figure 4-3:Annual wind roses at Frankston



Site	Season	Average wind speed	Calm winds (<0.5 m/s)
Frankston Victoria BoM station (086371)	Sprin	4.9 m/s	1.5%
	Summer	4.5 m/s	1.1%
Data Type	Autumn	4.6 m/s	1.7%
Observation	Winter	5.1 m/s	2.7%

Figure 4-4: Seasonal wind roses at Frankston

4.1.2 Atmospheric stability

The stability class of meteorological data is used to define the atmospheric turbulence and its impact on atmospheric dispersion capabilities. The stability class is determined by various meteorological conditions such as wind speed, solar radiation, cloud cover, static stability, convective or thermal turbulence and mechanical turbulence. There are mainly six atmospheric stabilities designated:

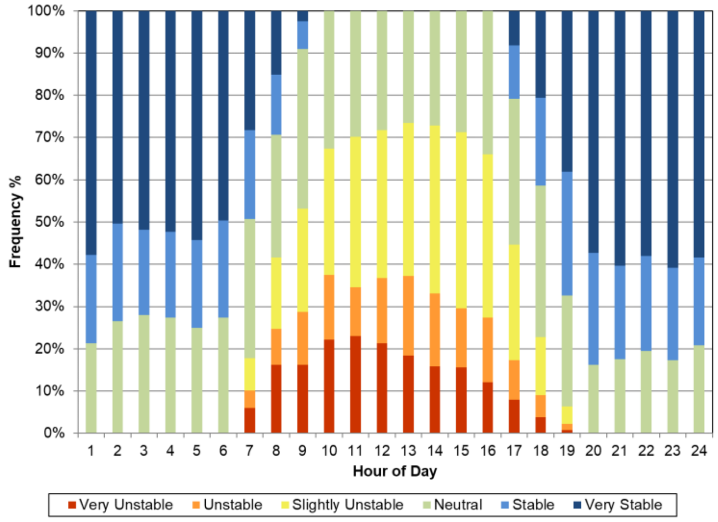
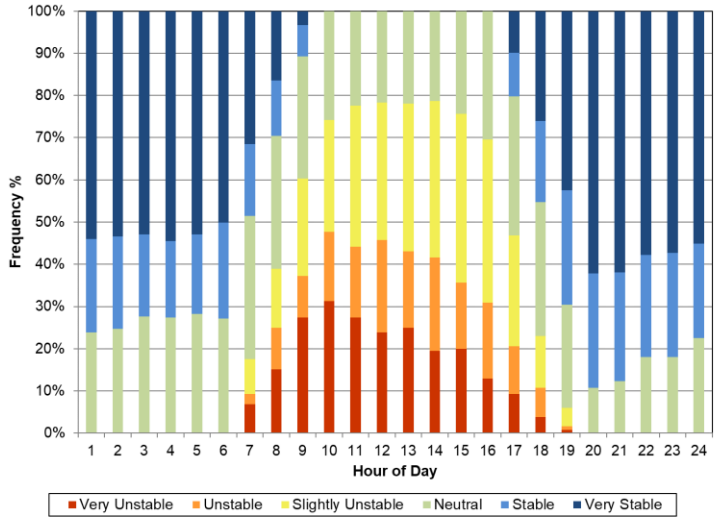
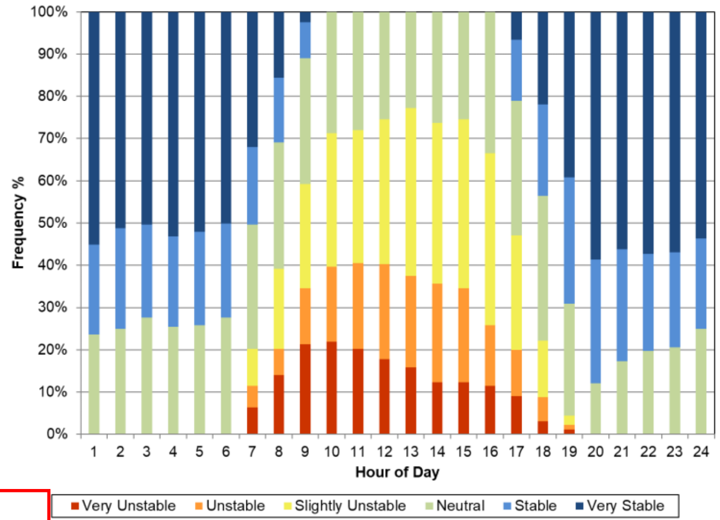
- A – very unstable
- B – unstable
- C – slightly unstable
- D – neutral
- E – slightly stable
- F – stable (and G – very stable conditions. In most dispersion models, stability classes F and G are combined into one class, F)

The stability class is crucial in understanding and predicting the behaviour of pollutants in the atmosphere. Gaussian plume dispersion models use stability categories as indicators of atmospheric turbulence and the dispersive properties of the atmosphere (NSW EPA, 2022).

Atmospheric stability was obtained using prognostic meteorological modelling (AERMET, see Section 7.3) and presented in Table 4-2. The graphs show that the early hours (1 am to 7 am) and late hours (20-24) are mostly stable (blue), which represent low wind nighttime stable conditions when turbulence is suppressed.

Conversely, atmospheric conditions that are more unstable (A, B and C), when atmospheric accelerations of the vertical motion of an air parcel increases, are more frequent during the hours of 7 am to 6 pm. This corresponds to the period of the day when temperature is more elevated due to solar radiation.

Table 4-2: Stability Classes

Year	Stability class determined according to (Golder, 1972)
2021	
2022	
2023	

4.2 Ambient air quality

The closest air quality monitoring station with publicly available PM_{10} and $PM_{2.5}$ data to the Site is the EPA monitoring station at Dandenong North. The Dandenong station is located approximately 15 km north of the site and considered representative of regional air quality.

Table 4-3 summarises PM_{10} and $PM_{2.5}$ statistics for the Dandenong North location. $PM_{2.5}$ was not measured at his location in 2021 and 2022, and therefore no assessment of cumulative effects for these years can be completed for the assessment. There are background measurements of metals in dust and therefore it is not possible to assess potential cumulative effects of metals.

The summary of maximum observed 24-hr concentrations at Dandenong show one exceedance of respective 24-hr APAC in 2022 for PM_{10} and no exceedance of the maximum 24 hour $PM_{2.5}$ was observed in 2023. The mean of the 24-hr values are equivalent to the annual average APACs. For the available data there were no exceedances of the annual average APACs.

Table 4-3: Summary of background air quality

Year	24-hr PM_{10} ($\mu g/m^3$)			
	Mean	Median	Max	# Exceedances
2021	16.1	15.4	45.7	0
2022	15.7	14.7	52.3	1
2023	16.0	15.2	38.0	0
APAC	**20**	**-**	**50**	-
Year	**24-hr $PM_{2.5}$ ($\mu g/m^3$)**			
	Mean	**Median**	**Max**	**# Exceedances**
2021				
2022				
2023	5.1	4.7	17.1	0
APAC	**8.0**	**-**	**25**	-

The Heidelberg Materials site is located amidst other activities that have the potential to generated dust and contribute to cumulative PM impacts locally. The activities around the Heidelberg Materials site include production of quarry products to the south and east of the site, sand extraction and landfilling to the northwest of the site, and production of mineral sands to the northeast. These adjacent activities are illustrated in Figure 4-5.

Although it is only located 15 km north of the project, the observed PM_{10} concentrations at Dandenong North may not be representative of background conditions in the local area. This is because the regional background value from Dandenong North will not include potential cumulative impacts from local dust sources near the existing project.

One way to address this is to include activities at the quarries within the dispersion modelling. However, none of the surrounding quarries report to the National Pollutant Inventory. There are no other publicly available sources of information with which to create reasonable emissions estimates from these local sources.

Consequently, background PM_{10} concentrations in this assessment should be considered a minimum estimate of background PM_{10} concentration locally; i.e., use of the Dandenong North data alone could lead to under-estimation of local cumulative effects of PM_{10} in the assessment.

Figure 4-5: Surrounding activities with potential to dust generation

4.3 Sensitive receptors

The Heidelberg Materials site is surrounded by residential areas, vacant land, and other quarry operations. The individuals and animals likely to be affected by airborne nuisance dust from the Heidelberg Materials site's activities include local residents, visitors, drivers, grazing animals, and workers. The receptors in proximity of the site are:

- North: Residential homes are situated at least 125 metres away from the proposed extraction area, with Valley Road running along the site's northern boundary.
- East: The eastern side is surrounded by residences, vacant land or pasture. There are three residences to the northeast which are more than 200 metres away from the proposed extraction area. A livestock dugout and shed/shelters are located within 200 metres east of the proposed extraction area.
- West: Most of the land to the west is occupied by other quarries or is vacant. The Frankston Centenary Tennis Club and Golf Course are located further west and more than 500 metres downwind.

Workers can be found at the Heidelberg Materials site during operational hours and in the surrounding quarries and industrial areas during business hours.

For a detailed description of the receptors and an illustration of their locations please refer to Section 7.3.8.2 and Figure 7-6.

5 ASSESSMENT APPROACH

Having considered the available guidance from EPA on the requirements for an air quality assessment (Section 3.3) and the availability of background data or data on surrounding activities and the potential to complete a cumulative assessment (Section 4.2), it was considered that:

- A Level 1 assessment was required for Stage 1 of the quarry development as it comprises earth moving and construction activities which will occur over a short period of time over a rapidly changing location. As described in EPA Publication 1961.2, fugitive emissions which are difficult to quantify should be assessed using a level 1 assessment.
- A Level 3 assessment was required for Stage 2 of the quarry development as:
  - The level of extraction is expected to be 400,000 tonnes per year and there is an urban residential zone within 500 m of the proposed extraction area. Therefore Level 3 assessment is required.
  - There is no available background metals data and only one year of PM2.5 data. Therefore, a direct comparison with the APACs (with the exception of those that are listed for incremental impact) cannot be made. Consequently, a human health Impact Assessment is recommended.

The Level 3 assessment for Stage 2 of the quarry development comprised:

- Consideration on whether the proposed Work Plan variation meets the required separation distance and whether there are grounds for a variation to the prescribed separation distance.
- Consideration of assessing and controlling risk in accordance with the guidance discussed in Section 3.2.
- Atmospheric dispersion modelling of the current approved operation of the site and the proposed Work Plan variation using the regulatory dispersion model (see Section 7.3 for the description of the model setup).
- Detailing of the results (see Section 7.4) of the dispersion modelling through:
  - Comparison of dispersion model results for the proposed use with the current approved use to understand the change in predicted contribution to sensitive receptors
  - A comparison of the results to their relevant cumulative or incremental APAC / ERS objective to determine the potential impact of the proposed operation.
  - Passing the modelling results to an HHIA specialist to complete an Impact Assessment (see Section 7.5 for a summary of the findings and Appendix D for the full report) as a second line of evidence.

6 QUARRY DEVELOPMENT STAGE 1

6.1 Semi-quantitative Risk Assessment

Stage 1 of the quarry development comprises the removal of the topsoil and overburden. As discussed in Section 3.3.1.2 for fugitive emissions that are difficult to quantify EPA Publication 1961.2 recommends the use of a level 1 assessment. The appropriate qualitative assessment for the short term activity in removing the top soil and overburden and the formation of a bund wall is considered to be through the use of EPA Publication 1943.

Table 6-2 provides the semi-quantitative risk assessment for the activities of removal of the topsoil and overburden and placement of the material in an earthen bund using the approach provided in EPA Publication 1943 (described in Section 3.3.2). The reasons for the selections of the scoring in Table 6-2 are provided in Table 6-1.

Table 6-1: Scoring rational for Table 6-2

Category	Reason for scoring
Size of dust emitting source	Topsoil and overburden removal will be 65,000 m3 which based on the density of the topsoil and the overburden equates to 168,550 tonnes. This is in the hundreds of thousands of tonnes of material moved which classifies the activity as 'Large' in Table 3-5.
Activities being undertaken	The activities being undertaken have a 'high potential for dust'; as material is handled in the open air and there will be a haul road from the excavation area to the bund placement area.
Type of dust	The type of dust is classified as 'intermediate' as it is normal soil and is not considered to be especially fine material.
Level of Control	There will be 'partial control' as there will be a reliance on management and housekeeping such as the use of water carts, keeping areas of excavation relatively small at any one time. This is industry standard for extraction operations.
Distance	Receptors are tens or hundreds of meters from the edge of the Work Plan variation area, however the distance to those sensitive receptors is less than half the separation distance.
Orientation of receptors relative to the prevailing wind direction	Consideration of Figure 4-1 indicates that there is an even distribution of winds from the source to the receptor occurring approximately 10% to 20% of the time.
Terrain	Whilst the source is forming a quarry hole, at the commencement of extraction and for the formation of the bund the source is at the same altitude as the receiving environment. The topsoil and overburden extend to a depth of 3 m, which is not considered sufficient to result in reduction of dispersing dust.
Intervening land use	The intervening land use is cleared land with isolated dwellings.
Historical context	Objections have been made to the approval of proposed Work Plan variation. Those objections have indicated historical issues with dust.
Land use	The land use of the area adjacent to the proposed Work Plan variation has a 'high general expectation of amenity' as it is used for residential use.

The semi-quantitative Risk assessment shown in Table 6-2 indicates a high risk of dust impacts meaning that dust impacts are likely to occur. This is an expected outcome of this assessment given the proximity of the removal of the top soil and overburden to sensitive sources.

Table 6-2: Qualitative assessment using EPA Publication 1943 for the excavation of topsoil and overburden and the placement of soil and shaping of the earthen bunds

Source	Hazard Potential				Pathway effectiveness				Receiving environment sensitivity		Summary
	Size of dust emitting source	Activities being undertaken	Type of dust	Level of Control	Distance	Orientation of receptors relative to the prevailing wind direction	Terrain	Intervening land use	Historical context	Land use	
Excavation of topsoil and overburden	3	3	2	2	3	2	2	3	4	6	30
Placing and shaping of earthen bund	3	3	2	2	3	2	2	3	4	6	30

6.2 Reduction of risk to the extent practicable

Whilst the semi-quantitative Risk assessment indicates a potentially high risk of impact for the removal of the topsoil and overburden, the Risk assessment methodology assumes that such an activity will occur every year for the foreseeable future. Rather the removal of the topsoil and overburden plus the formation of the bunds will be completed within a 2 to 3 months. It is considered that will appropriate mitigation and management techniques the work can be completed without causing an impact to surrounding sensitive receptors.

6.2.1 Air quality management plan

Prior to the commencement of Stage 1 an air quality management plan will be required which considers the recommendations in EPA Publication 1894 (Section 3.3.3), EPA Publication 1895 (Section 3.3.4) and EPA Publication 1897 (Section 3.3.5) and determines whether the recommended management techniques are practicable for implementation and where they are not practicable details why those management measures are not practicable.

It is noted that the majority of the sensitive receptors are located to the north of the proposed Work Plan variation area, and that the seasonal wind roses for Frankston Ballam Park (Figure 4-2) indicate that during the winter there is a low occurrence of winds blowing from the south and south-east to the north and north-west where the receptors are located. Where topsoil and overburden removal and formation of the bunds can be completed in this season, this will lower the risk of impact to the surrounding sensitive receptors.

Given the proximity of the sensitive receptors, it is recommended that continuous real-time monitoring of PM be employed to monitor local air quality. Monitoring should include measurements at multiple locations (e.g., northern and southern boundary) rather than near the processing plant and haul roads. PM monitoring should employ indicative and/or near reference methods consistent with current best practices for medium-sized dust-generating emitters such as quarries and landfills.

6.2.2 Reactive monitoring to minimise residual risk

It is recommended that an indicative instrument is selected from the current list of MCERTS Certified Products: Indicative Ambient Particulate Monitors[3] for the monitoring of PM_{10} and $PM_{2.5}$. MCERTS is a product certification process which operates in the United Kingdom and products must go through a rigorous testing procedure to enable inclusion within the list of certified products.

The recommended MCERTS compliant equipment uses the light scattering method to measure the concentration of particulate matter in the atmosphere. These instruments can shine different wavelengths of light through the sample in the chamber to determine the concentration of different size fractions at the same time. These instruments have limitations which include, but are not limited to the:

- Size of the pump may not adequately overcome the settling velocity of larger particles resulting in a potential under sampling of PM_{10} or greater.
- Heater has to be sufficiently small to be powered by solar / battery and as such at very high humidity or in the case of super saturation of the atmosphere, the monitor may indicate high concentrations of particulate matter where this is not the case.
- Method of analysis is different from regulatory grade or equivalent grade instruments and a change in method will result in a slightly different measurement even where everything else is equal.

3 https://www.csagroup.org/en-gb/services/mcerts/mcerts-product-certification/mcerts-certified-products/mcerts-certified-products-indicative-ambient-particulate-monitors/

It is therefore important that one indicative instrument of the type uses elsewhere in the project is co-located with the reference grade instruments. Over a period of a minimum of three months the measurements should be plotted against one-another to calculate the k-factor which should be able to be programmed into the instrument of data collection system. It should be noted that measured concentrations of the indicative instrument should be plotted against the reference or equivalent method for each 24-hour period and that the k-factor may need to be different for various bounds of concentrations, i.e. low concentrations may require one k-factor and higher concentrations may require a different k-factor.

It is noted that the conditions of approval for the Work Plan variation are the measurement of crystalline silica for a period of 12 months which must commence 6 months prior to commencement of activities approved under the Work Plan. Measurement of crystalline silica in ambient air is typically completed using a high volumetric sampler to measure $PM_{2.5}$ and the measurement content of the sample is analysed for respirable crystalline silica. Thus, measurement for respirable crystalline silica also provides a measurement for $PM_{2.5}$. A high volumetric sampler is an Australian Standard method, and the measurement technique is typically used to measure concentrations one day in six. The head of the instrument can be changed to measure both PM_{10} and $PM_{2.5}$. Thus, it would be possible to use this instrument, with a co-located MCERTS equivalent instrument co-located to derive the relevant k-factor for both PM_{10} and $PM_{2.5}$ by changing the heads.

Once the k-factor has been developed, the measurements of the MCERTS instruments can be used during all stages of quarry operations to manage the risk of dust impact to nearby sensitive receptors using the trigger thresholds. EPA Publication 1961.2 suggests that the trigger levels for active management for PM_{10} should be:

- 80 µg/m^3 (1-hour average)
- 120 µg/m^3 (30-minute average)
- 150 µg/m^3 (15-minute average)
- 165 µg/m^3 (10-minute average).

It should be noted that continued exceedance of these levels over multiple hours indicates that the 24-hour standard will not be met. Consequently, it is recommended that the monitors be set to send SMS alerts and emails to the relevant Site based personnel with responsibility for environmental management and compliance where these trigger levels are exceeded.

Continuous monitoring of PM enables the development of an adaptive dust management plan ADMP. The ADMP will typically use threshold "trigger" concentrations of PM_{10} at various averaging periods (15-minute, 1-hr). Exceedances of the "triggers" are then assessed according to a response plan such as the example flowchart shown in Figure 6-1.

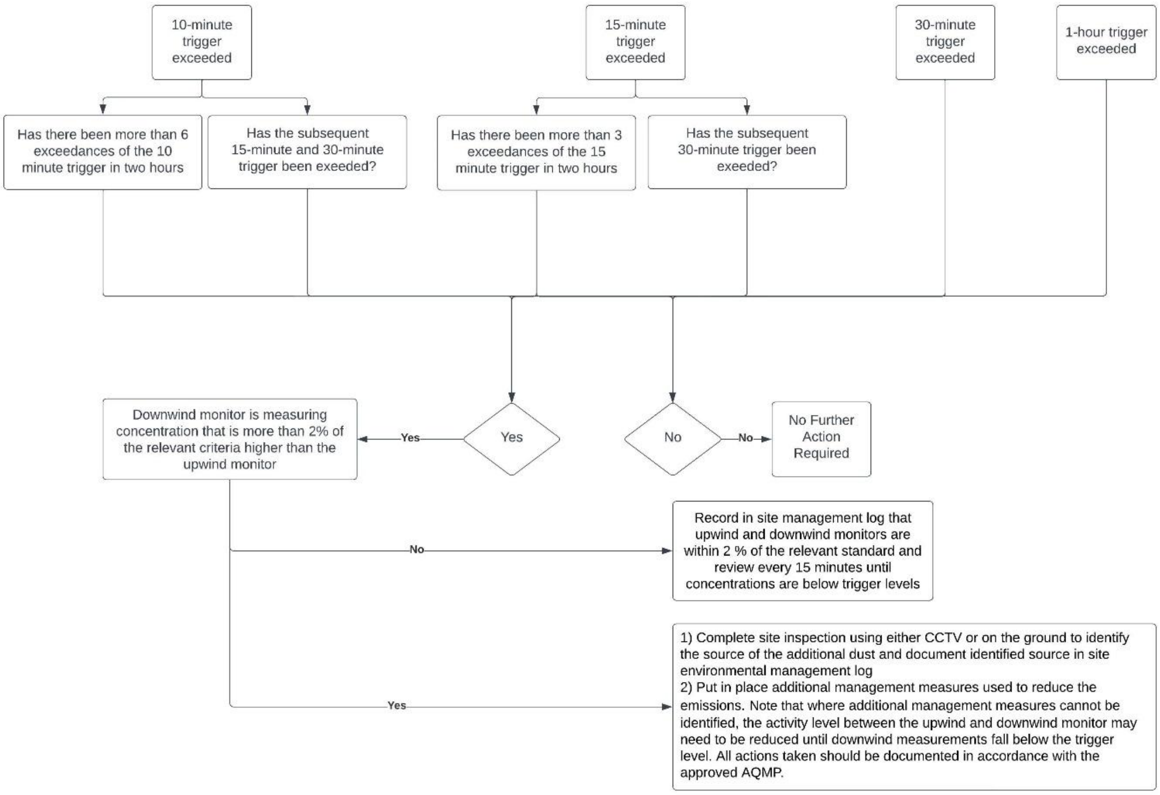


Figure 6-1: Proposed trigger action response

7 QUARRY DEVELOPMENT STAGE 2

Stage 2 of the quarry development comprises the extraction of the sand resource from the Work Plan variation area. As described in Section 5, this assessment comprises:

- Assessment of the required separation distance.
- A consideration of controlling the risk for compliance with the GED.
- Atmospheric dispersion modelling.
- HHIA assessment based on the atmospheric dispersion model results.

7.1 Separation distance assessment

The work plan variation area, the haul road network and the processing area all handle or are on sand which contains respirable crystalline silica. In accordance with Table 3-9 the relevant separation distance from these uses is 500 m.

Figure 7-1 shows the 500 m separation distance from the work plan variation, the haul road that will be used to access the rehabilitation area during the operation of the extension area and the processing plant area and the nearest identified sensitive receptors from the air quality assessment.

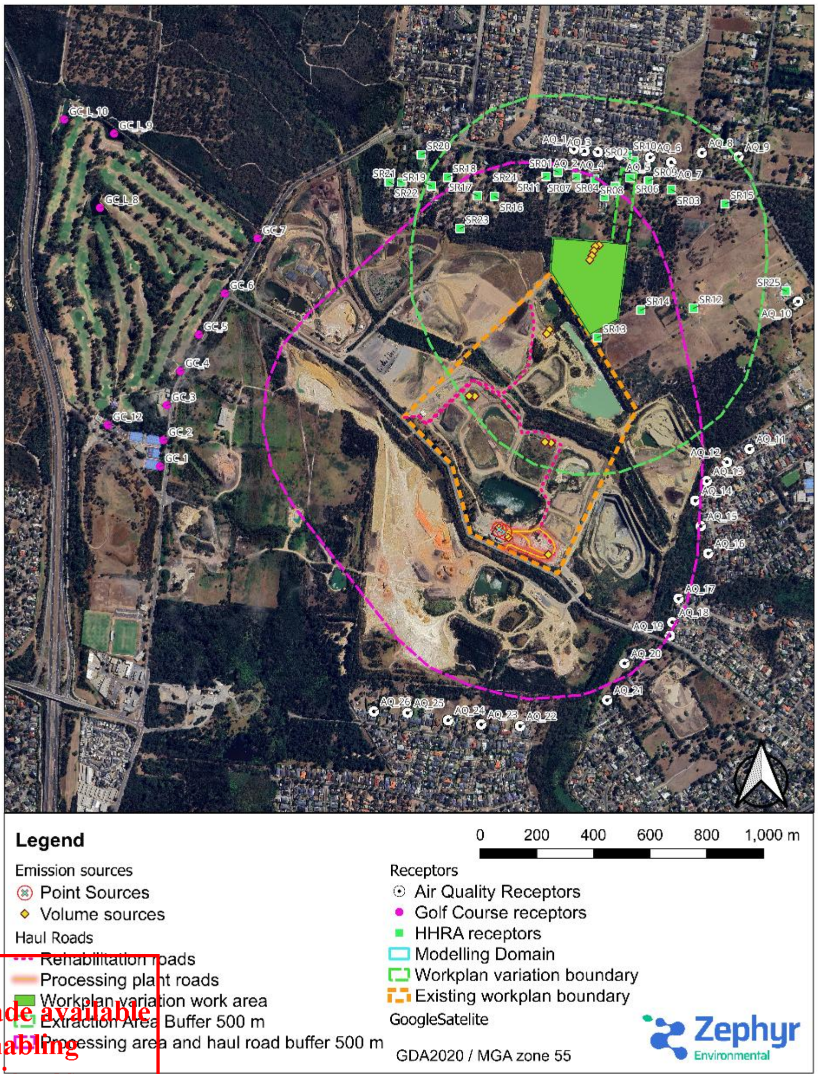


Figure 7-1: Separation distances around the proposed expansion area, the sand processing area and the haul road to the rehabilitation area

Sensitive receptors are within both the 500 m separation distance for the work plan variation and the separation distance for the sand processing plant and haul road to the rehabilitation area. Consequently, a variation from the separation distance is required considering the results of the air quality assessment and the HHIA.

7.2 Controlling risk in accordance with the GED

As discussed in Section 3.1.1 the GED requires that the risk is eliminated or, where this is not possible, reduced as far as reasonably practicable. Section 3.3.1.1 provides the approach outlined in EPA Publication 1961.2 and considers that in an extractive industry, the process of removing the resource and processing that resource inherently produces dust and that it is not possible to eliminate or substitute the hazard. Consequently, the use of engineering and administrative controls are used to minimise the emissions as far as reasonably practicable. As detailed in EPA Publication 1856 (Section 3.2.2) the engineering and administrative controls must be reasonably practicable and this means considering whether controls are:

- Available (i.e. commonly used at other sites).
- Can be physically adopted due to the constraints of the site, the availability of the control mechanism (e.g. is there sufficient water available).
- Whether the cost is proportional to the reduced risk.

Table 7-1 considers the activities for the proposed Work Plan variation, the available controls for mitigation, whether it is proposed that those mitigation measures are adopted during the Work Plan variation and the reasons why any specific mitigation measures are not practicable. The selected mitigation measures were incorporated to the dispersion modelling and are considered standard management techniques adopted in the extractive industry.

Whilst not able to be included in the dispersion modelling, it would further be recommended, that in addition to using ambient monitoring during Stage 1 of the quarry development, the same monitoring should be continued during Stage 2 and that the trigger levels and actions shown in Figure 6-1 be adopted.

Table 7-1: Considered engineering and administrative controls to reduce risk

Activity	Options Available	Potential Control	Comment	Control Applied (Y/N)
Extraction				
Sand extraction using excavator	Application of water to the face to reduce dust generation	50%	Not considered practicable due to the stability of the face being potentially impacted	N
	Pit retention	5% PM_{10}, 0% $PM_{2.5}$	This is a natural reduction which occurs when working within a pit compared to the surrounding land elevation	Y
Loading stockpile	Application of water to the stockpile	50%	Not practicable as extraction area is not accessible to wheeled vehicles such as a water cart.	N
Transferring sand to processing plant	Transfer via haul road network requiring use of level 2 watering	75%	Eliminated risk of using haul roads by using pumping	N
	Transfer via pumping	100%	Adopted	Y
Transfer sand to pumping pond by dozer	Watering of haul roads using level 2 watering	75%	Not practicable due to decline of road from the extraction point to the pond means it cannot be accessed by a water cart	N
Processing				
Wet processing	Saturated sands during processing	100%	Adopted	Y
Transfer wet processed material to drying plant	Application of water to the stockpile to reduce dust emissions during pickup	50%	Not practicable as the sand is dried to 5% moisture after wet processing to the feed specification of the drying facility. The application of water would put it outside of the range for the drying facility.	N
	Application of Level 2 watering to route used by FEL	75%	Adopted	Y
	Use conveyor rather than Front End loader	93%	Pickup and drop off using FEL would still occur to conveyor hopper. Distance between wet plant and drying building and height of entrance means conveyor would cross access road too low preventing use of road.	N
Outload wet processed material	Application of water to the stockpile	50%	Not practicable, this sand is taken from the same stockpile as the sand for the drying facility. The sand is dried to 5% moisture after wet processing to the feed specification of the drying facility. The application of water would put it outside of the range for the drying facility.	N
	Truck loading station with enclosure	75%	Insufficient space in front of wash plant	N
Sand drying	Use of venturi scrubber with bag house	99.9%	Currently in use	Y

Activity	Options Available	Potential Control	Comment	Control Applied (Y/N)
Sand sorting	Use of venturi scrubber with bag house	99.9%	On order for installation	Y
Out loading of dried sand	Partial enclosure and variable height stacker	75%	Loading of sand constitutes 0.6% of total emissions. The cost of implementing this technology is not proportionate to the risk	N
Rehabilitation				
Delivery of clean fill via haul road network	Level 2 watering of haul roads	75%	Clean fill can only be delivered to site by truck. The material needs to be deposited in the location of the rehabilitation which can only be achieved through the use of the haul road. The use of water trucks to minimise emissions is considered standard practice.	Y
Unloading of material	Water sprays	50%	This is a flat area and water sprays are a practicable method of mitigating emissions	Y
Spreading and compacting	Water sprays	50%	This is a flat area and water sprays are a practicable method of mitigating emissions	Y

7.3 Model setup

Atmospheric dispersion modelling requires a four-stage process:

- Generation of meteorological files.
- Emission estimation.
- Dispersion model setup.
- Post processing.

In the context of this dispersion modelling process, EPA put forward four conditions of the Work Plan approval of which one, with sub-requirements, related to remodelling of the proposed Work Plan variation.

7.3.1 EPA conditions on Work Plan variation

As discussed in Section 2, EPA requested conditions be added to the approval that prior to the Work Plan variation being implemented that the proposed activities be remodelled. These requirements for remodelling are:

- Prior to commencement of works approved under Work Plan Variation PLN001130, the work authority holder must re-run the existing AERMOD model with the following amendments and determine if any additional controls may be required to control the risk of harm from offsite dust:
- Switch on terrain features for a more accurate prediction of concentration at receptor sites. Terrain features should always be switched on as a default.
- Identify, verify and apply alternative sources of background data where available.
- Move the dust sources toward the northern edge within the five-year extension to account for the impact at receptor sites located to the north of the site.

The applicability of these requirements is discussed in the following sub-sections

7.3.1.1 Terrain features

Haul roads are known to be the largest contributors to dust emissions on an extractive site, and it is therefore important that they are modelled using the most appropriate method. The haul roads which carry the clean fill to the rehabilitation area and the roads in the process area have been modelled using a source type known as 'RLine'.

RLine sources are the recommended method for the modelling of roads within the Guideline on Air Quality Models; Enhancements to the AERMOD Dispersion Modelling System in the United States which is known as Appendix W. As the USEPA is the model author it has been elected to follow the USEPA guidance on the use of the model. An updated guideline from EPA on the use of AERMOD has not been published and the draft guideline on the use of AERMOD (EPA Publication 1551) was published more than 11 years ago. This EPA Publication pre-dates the inclusion of RLine sources within AERMOD, and EPA Publication 1551 has never been finalised.

The 2024 Appendix W Final Rule (US EPA, 2024) informs that RLine sources have been included by USEPA as a new regulatory source type in AERMOD for mobile modelling. It is important to note, however, that the inclusion of terrain in the recent versions of the model with Rline sources does not supersede the USEPA's PM Hot-Spot guidance where FLAT terrain is recommended for modelling applications (US EPA, 2024b; US EPA, 2021).

It is agreed that the use of terrain would make the model more accurate, and as recommended by VIC EPA, the model has been updated to include terrain with Rline sources. Appendix W also states that the *RLINE source type has undergone significant evaluation by the EPA and FHWA as part of the*

Interagency Agreement between the EPA and FHWA and, as noted in the preamble to the proposed rule, has shown improved performance since its introduction into AERMOD in 2019.

7.3.1.2 Background data

The nearest EPA monitor is located in Dandenong to the north of the Dandenong south industrial estate. Continuous hourly PM10 data are available for years 2021 through 2023. Continuous hourly PM2.5 data are only available for 2023.

Gaps in the hourly data were filled based on prevailing meteorology and average PM concentrations during those meteorology conditions. Continuous 1-hr data is then averaged over each day (24-hr period) and annual and added to model predictions to assess cumulative effects. Cumulative PM10 (years 2021 to 2022) and PM2.5 (years 2023 only) concentrations are then compared to their corresponding (cumulative) APACs.

Cumulative effects for metals and RCS could not be undertaken as there are no background data available. Please see Section 4.2 for additional details.

7.3.1.3 Move sources to the northern boundary

As discussed in Section 7.3.6.2, the sources have been configured in the dispersion modelling to be located on the northern boundary directly south of the closest receptor to provide a conservative assessment.

7.3.2 Generation of meteorological files

Meteorological data is required for atmospheric dispersion modelling in a specific format that the dispersion model can read.

Draft EPA Publication 1551 - Guidance notes for using the regulatory air pollution model AERMOD in Victoria (EPA Victoria, 2013), states that atmospheric dispersion modelling with the regulatory dispersion model requires a five-year meteorological dataset. Draft EPA Publication 1550: Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD)(EPA Victoria, 2013) considers that in order of preference, meteorological data is to be obtained from onsite measurement, from a nearby Bureau of Meteorology station within 5 km of the site, or using prognostic modelling using The Air Pollution Model (TAPM) or MM5.

7.3.2.1 Observation and year selection

There is no on-site meteorological data, however there is a Bureau of Meteorological site at Frankston Ballam Park which is located approximately 2 km south-west of the proposed Work Plan variation area. The next nearest Bureau of Meteorology observation station, that provides 1-minute observations is at Moorabbin Airport located approximately 18 km north-west of the proposed Work Plan variation area.

Measurements at Frankston Ballam Park commenced in mid-2020 and full calendar year data is therefore available for 2021 to 2023. Whilst this does not meet the five-year requirement within Draft EPA Publication 1951, the years 2021 to 2023 cover two La Niña years and one year which started La Niña, passed through neutral conditions and ended as El Niño.

As shown in Figure 4-3 (Section 4.1.1) the wind patterns for all three years are fairly similar. It was therefore considered that the extension of the dataset through the use of prognostic data to five years was not warranted as the accuracy of prognostic data is typically less than nearby observational data. The three years of available data showed fairly consistent wind patterns indicating that other years would be similar.

The 1-minute observations at Frankston Ballam Park were converted to 1-hour averages using the arithmetic average for all parameters except for rainfall and wind direction. Rainfall was calculated using the 1-hour total, whilst wind direction was calculated using a vector average. This is a typical approach when using Bureau of Meteorological data for atmospheric dispersion modelling.

7.3.2.2 AERMET processing

AERMET is the meteorological pre-processor for the AERMOD dispersion model and uses known meteorological observations together with surrounding land use and terrain information to generate a meteorological file compatible with AERMOD.

The 1 hour averaged observations from the Bureau of Meteorology site at Ballam Park were considered representative of the Site. Draft EPA Publication 1550 requires that the land use surrounding the Site is considered such that:

- The surface roughness (z0) should be determined based on land cover data within a 1 km radius from the meteorological site. If the value of z0 varies significantly by direction, sector dependency should be used (sector width >= 30 0).
- The Albedo and Bowen Ratio should be determined based on land cover data within a 10 km by 10 km domain cantered on the meteorological station. A simple un-weighted arithmetic mean should be used. There is no need to consider sector dependency.

It was determined that there are three sectors within 1 km of the proposed Work Plan variation that have different land use, and therefore a varying surface roughness, these are described in Table 7-2.

The values for surface roughness, albedo and Bowen ratio were therefore calculated for each season using the tables for land use types contained in Draft EPA Publication 1550, and those used are provided in Table 7-2.

Table 7-2: Indicators and objectives for the ambient air environment

Environmental Value	Sector	Spring	Summer	Autumn	Winter
Surface roughness	0˚ to 160˚	0.05	0.1	0.1	0.01
	160˚ to 330˚	0.3	0.3	0.3	0.3
	330˚ to 360˚	0.18	0.25	0.25	0.151
Albedo	All sectors	0.158	0.158	0.158	0.176
Bowen Ratio	All sectors	0.65	0.73	0.91	0.91

The nearest upper air station that is available in Victoria is at Melbourne Airport, and it was considered that the upper air measurements at Melbourne Airport would not be representative of the project site. Consequently, the upper air estimator in AERMET was used to derive the upper air file. The upper air estimator uses ground-based observations to estimate how the upper air meteorology will behave. It was considered that the accuracy required for the upper air file is less important than for the surface meteorology, as the majority of the sources are ground-based, or have very low buoyancy, and as such the upper air meteorology will not significantly influence dispersion. sources and upper air meteorology will not impact dispersion.

7.3.3 Emissions Mitigation

Two emissions Scenarios ae proposed and these have differing emissions mitigation approaches.

7.3.3.1 Scenario 1

Dust emissions from haul roads represent the most significant source of air pollution in quarry activities. Level 1 watering is currently applied on site as mitigation measures for dust for truck movement.

Additional measures such as change in haulage route during dry and hot days as well as avoidance of rehabilitation activities closer to the eastern site boundary are being applied.

Table 7-3: Control measures assumed for activities in Scenario 1

Activity	Control	Type of control	Reference
Transport of sand via FEL to drying plant	50%	Haul Roads (Level 1 watering)	AP-42 13.2.2
Truck bringing processed sand to site	50%	Haul Roads (Level 1 watering)	AP-42 13.2.2
Truck movement delivering soil for rehabilitation	50%	Haul Roads (Level 1 watering)	AP-42 13.2.2

For the sand drying activities there is currently a venturi scrubber which is associated the drying process, however the sorting process vents directly to atmosphere. A venturi scrubber for the sorting process is currently on order. The emission factor from AP42 11.19.1 for drying using a venturi scrubber has been adopted, whilst the typical 99.9% removal efficiency of a venturi scrubber has been removed from the emission factor for sorting as no emission factor is published without a venturi scrubber.

7.3.3.2 Scenario 2

In this emissions scenario, sand extraction activities expand to the northern boundary, and rehabilitation activities are expected to continue occurring in the same area as Scenario 1.

The mine void is expected to continue to be filled in domains A, B and D as shown in Figure 7-2 for the duration of the proposed 5-year sand extraction in the Work Plan variation. Additional sand extraction and handling, represent a growing need for enhanced dust control measures, which is in line with the General Environmental Duty for extractive industries.

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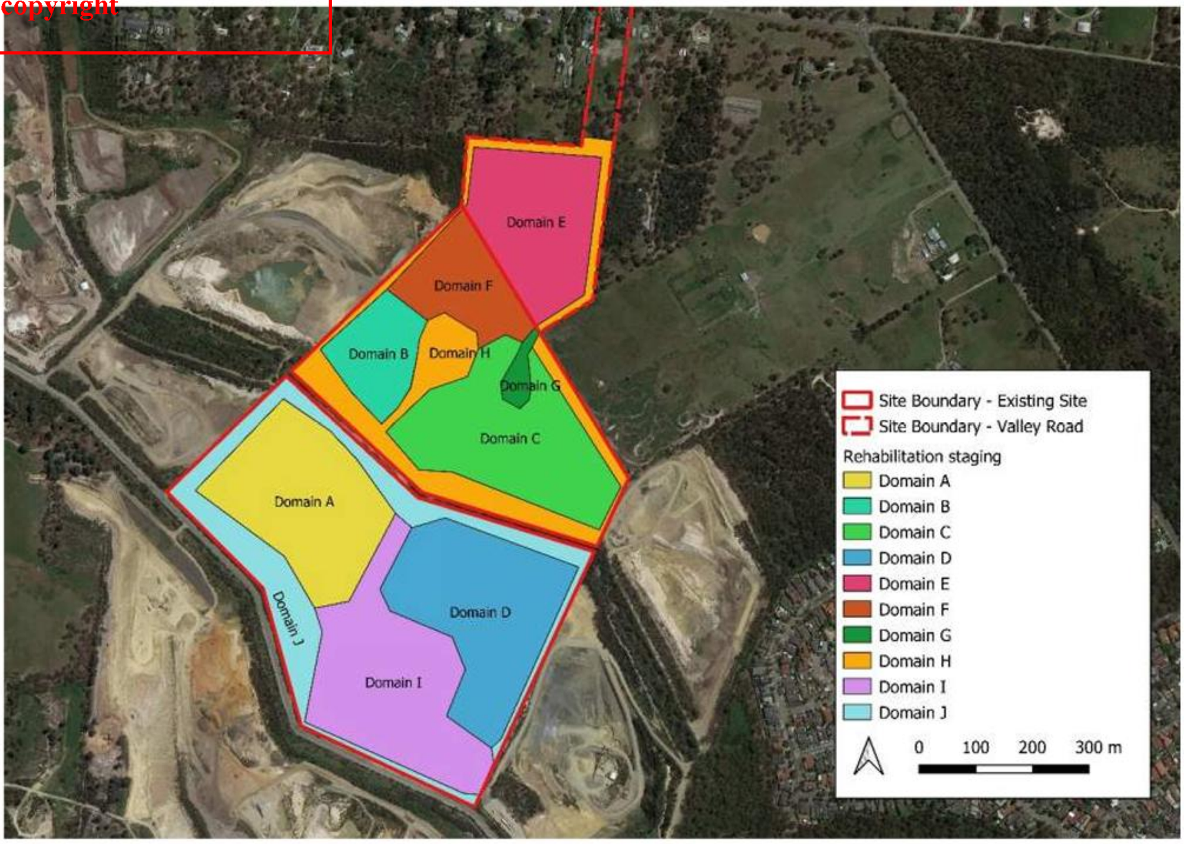

Figure 4-2 Rehabilitation domains

Figure 7-2: Rehabilitation areas detailed in the rehabilitation plan (Ricardo, 2021)

In the model, additional Scenario 2 mitigation measures include Level 2 watering of the haul roads in the processing area and in the rehabilitation area. Scenario 2 also includes the use of a venturi scrubber (99.9% removal efficiency), emissions reduction for pit retention, and the assumed use of water sprays for material handling. These list of new or additional controls for Scenario 2 are presented in Table 7-4.

Table 7-4: Control measures assumed for activities in Scenario 2

Activity	Control	Type of control	Reference
Sand extraction	50% TSP 10% PM10 0% PM2.5	Pit retention	AP-42 13.2.4 and NPI Table 2
Bulldozer pushing material down a slope	50% TSP 10% PM10 0% PM2.5	Pit retention	AP-42 13.2.4 and NPI Table 2
Soil material handling in rehabilitation areas	50%	Water sprays (non-coal)	AP-42 13.2.4 and NPI Table 2 and NPI Appendix A Section 1.1.5
Haul Roads	75%	Haul Roads (Level 2 watering)	AP-42 13.2.2

It should be noted that the use of water sprays on the sand extraction area or the pushing route for the dozer from the sand extraction area to the pond is not practicable as the use of water would make the sand within the extraction area unstable and water on the route would make it not possible for the machinery to pass due to the slope of the route.

7.3.4 Emission estimation

Emission estimation was completed using USEPA in the emission factor compendium known as AP-42. Many of these equations are also found within the National Pollutant Inventory Emission Estimation Technique manuals, however the references in those manuals have often been superseded by subsequent versions of AP-42.

EPA publication 1961.2 considers that part of consideration of the General Environmental Duty is the State of Knowledge which describes what the person knows, or ought reasonably to know about the harm or risks of harm and any ways of eliminating or reducing those risks. As AP-42 represents the latest version of equations for sources on the Site, these equations were used to define the emission estimates (Table 7-5).

Table 7-5: Emission Equations from AP-42

Inventory Activity	Units	TSP Emission Factor	PM_{10} Emission Factor	$PM_{2.5}$ Emission Factor	Source
Rehab activities					
Loading/unloading clean fill rear dumping NB: dozers use equation below	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP42 13.2.4 NPI Table 2
Bulldozers/front end loaders on rehab material i.e. dozers FEL pushing material around	kg/hr	$2.6 \times \frac{s^{1.2}}{M^{1.3}}$	$0.3375 \times \frac{s^{1.5}}{M^{1.4}}$	0.105 * TSP	AP42 11.9 Table 11.9-2 NPI Table 2
Resource Activities					
Extraction of resource by Front end loader or shovel	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP42 13.2.4 and NPI Table 2
Bulldozers pushing material around	kg/hr	$2.6 \times \frac{s^{1.2}}{M^{1.3}}$	$0.3375 \times \frac{s^{1.5}}{M^{1.4}}$	0.105 * TSP	AP42 11.9 Table 11.9-2 and NPI Table 2
Pickup of resource after washing plant by front end loader for delivery to drying plant or truck	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP42 13.2.4 and NPI Table 2
Unloading of resource from front end loader to either truck or drier hopper	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP42 13.2.4 and NPI Table 2
Baghouse emissions from drying	kg/t	0.0053	0.0053	0.0053	AP42 11.19.1

Inventory Activity	Units	TSP Emission Factor	PM_{10} Emission Factor	$PM_{2.5}$ Emission Factor	Source
Baghouse emissions from sorting without venturi system (current)	kg/t	0.42	0.42	0.42	AP42 11.19.1 Removal of 99.9% efficiency of venturi system
Baghouse emissions from sorting with venturi system (to be installed shortly)	kg/t	0.0042	0.0042	0.0042	AP42 11.19.1
Hauling					
Hauling on unsealed roads	kg/VKT	$\left(\frac{0.4536}{1.6093}\right) \times 4.9 * \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 1.5 * \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 0.15 * \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	AP42 13.2.2 and NPI Table 2
Wind erosion					
Wind erosion of exposed areas including stockpiles	kg/ha/h	$u^* = 0.053u_{10}^{+}$ and $P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$	0.5 * TSP	0.075 * TSP	AP42 13.2.5

7.3.4.1 Site specific factors

The equations shown in Table 7-5 use site specific information which includes:

- Moisture content.
- Silt content.
- Vehicle mass.
- Kilometres travelled in a year, which is based on the carrying capacity and the volume of material to be moved.

Table shows the moisture content and the silt content that were used for the materials handled together with the source of that information. Table shows the vehicle masses used for each source and for haul roads the carrying capacity of the trucks and volume of material moved.

Table 7-6: Silt content and moisture content of materials handled on site

Material	Silt content (%)	Moisture content (%)	Source of data
Rehabilitation soil	10	7	No test data available Silt content based on typical upper level of silt content in soils Moisture content based on a slightly higher moisture content than found in the underlying sands for the general area.
Sand in-situ	1	5	Silt content based on document provided by Heidelberg Materials – 'SPECIALTY DRIED SANDS 2023.pdf' Moisture content provided by Heidelberg Materials in email
Sand delivered to site for processing (currently)	1	5	Silt content based on document provided by Heidelberg Materials – 'SPECIALTY DRIED SANDS 2023.pdf' Moisture content provided by Heidelberg Materials in email
Sand after wet processing for delivery to drying plant	1	5	Silt content based on document provided by Heidelberg Materials – 'SPECIALTY DRIED SANDS 2023.pdf' Moisture content provided by Heidelberg Materials in email
Sand after wet processing taken from site	1	5	Silt content based on document provided by Heidelberg Materials – 'SPECIALTY DRIED SANDS 2023.pdf' Moisture content provided by Heidelberg Materials in email
Sand after drying plant	1	2	Silt content based on document provided by Heidelberg Materials – 'SPECIALTY DRIED SANDS 2023.pdf' Moisture content provided by Heidelberg Materials in email
Haul roads	4	5	No direct measurement, based on experience at other facilities of typical values.

Table 7-7: Basis for calculation of km vehicle travelled to derive kg/yr from kg/VKT on hauling

Source	Gross vehicle mass (t)	Vehicle capacity (t)	Material moved (t/yr)	Length of haul road (km)
Truck delivering sand to site for drying (current)	26.8	26.6	33,145	0.17
Transport of sand from wet process plant to drier plant	13.1	6.1	33,145	0.17

Table 7-8: Activity data used for Scenario 1 and Scenario 2

Source	Amount	Units	Data source	Notes
Rehabilitation soil coming delivered on site	46,500	m^3/month (average)	RE: Proposed alteration to Work Plan [NRF-APAC.1036828.4051138.FID3089657] 21/02/2024	Rehabilitation soil coming delivered on site
Soil Density	2.63	(t/m3)	Victorian Background Soil Dataset - Greater Melbourne, Frankston (Density, sub-surface 2.63 g/cm3)	Density of sub-surface soil
Sand (for further drying and sorting)	2,500	m^3/month	Email 22/2/24 - > RE: Proposed alteration to Work Plan [NRF-APAC.1036828.4051138.FID3089657]	-
Sands density	1.5	(t/m3)	RE: Proposed alteration to Work Plan [NRF-APAC.1036828.4051138.FID3089657]	-
Dozer pushing soil in rehabilitation area	11	Hours/day	Endorsed Work Plan Appendix 8 Geotechnical Report (and Appendices) located at Tabs 2Ba(i)4 and 2Ba(i)5 of your Dropbox brief.	-

Table 7-9: Tonnes per year handled to convert kg/tonne to kg/year used for Scenario 1 and 2

Source	Amount	Units	Data source	Notes
Rehabilitation soil delivered on site	1,487,923	tonnes/year	RE: Proposed alteration to Work Plan [NRF-APAC.1036828.4051138.FID3089657] 21/02/2024	calculated based on volume of material delivered on site
Processing Sand	33,145	tonnes/year	Email 22/2/24 - > RE: Proposed alteration to Work Plan [NRF-APAC.1036828.4051138.FID3089657]	Calculated based on handled amount

Metal composition for the rehab soils being delivered to the are not available. An estimate of the likely metal content has therefore been taken from the Victorian Soil Information database (https://soilexplorer.org.au/) which for the Frankston area of Melbourne provides measured metal content of the surface and sub-surface soils.

The soils being brought onto the site are clean fill from major projects within the local geographic area. It is therefore considered that the use of the Victorian Soil Information database, restricted to the Frankston area provides a reasonable estimate of likely metal soil content. In reality the actual metal content will be a blend of both surface and subsoils, however, the exact blend is not known so both have been used independently to understand the potential metal content of dust generated by the handling of these soils.

For the sands handling and the haul roads, information provided by Heidelberg Materials on the metal oxide content of the soils has been used. The same information has been used for the haul roads, as it was noted during a site visit that the haul roads are on the sand layer of the geology.

7.3.4.2 Wind erosion

AP-42 Chapter 13.2.5 provides an approach which uses the particle size distribution within the friable materials to define the emission rate for each hour from wind blown sources based on wind speed.

Table 13.2.5-1 of AP-42 (US EPA, 2006c) is replicated in respectively Table 7-10. Based on the description of the largest catch for each soil type, the wind speed threshold (u_t) is provided. Evaluation of the size distribution of the sands using information provided by Heidelberg Materials indicates that the midpoint of the sieve size opening that had the largest catch in the analysis was 1.5 meaning that a wind speed of 0.76 m/sec is the minimum wind speed velocity that is required before wind erosion of sands starts to occur on disturbed areas.

For the rehabilitation of soils, no sieve data was available and a midpoint sieve size of 0.75 was used resulting in a minimum wind speed velocity of 0.58 m/sec for wind erosion to start to occur on disturbed areas.

As the wind speed increases beyond the wind speed threshold the emission rate becomes greater. It is not appropriate, however, to use the wind speed from the meteorological data files used in the dispersion model as these wind speeds are those that occur at a height of 10 m above the surface of the earth. The wind erosion face of the worked soil or stockpile is much nearer to the surface of the earth. As the height decreases, wind also decreases as the friction between the wind and the earth increases.

Thus the friction velocity of the wind can be calculated using Equation 7-1

Equation 7-1: Friction Velocity

$$u^* = 0.053u_{10}^+$$

where:

u^* is the friction velocity of the wind in m/sec

u_{10}^+ is the fastest windspeed at the reference anemometer for the period between disturbances.

The meteorological data for the AERMOD inputs is an hour average. Typically, the peak gust in an hour is approximately 1.35 times the average wind speed, and u_{10}^+ can therefore be calculated by multiplying the 1 hour average by 1.35.

An estimate of emissions of TSP can be calculated using Equation 7-2 which is taken from AP-42 Section 13.2.5 (US EPA, 2006C).

Equation 7-2: Erosion potential for exposed surface

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)^2$$

Where:

P is the emission rate in g/m^2

In accordance with the NPI for Mining (NPI, 2012) and with the Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques report (SKM, 2005), PM_{10} and $PM_{2.5}$ were taken to be 50% and 20% respectively. Table 7-10: Wind speed threshold based on catch of Tyler sieve (Table 13.2.5-1 of AP-42)

Tyler Sieve No.	Opening	Midpoint	$u_t^{t*}\ m/s$
5	4	n/a	n/a
9	2	3	1.00
16	1	1.5	0.76
32	0.5	0.75	0.58
60	0.25	0.375	0.43

7.3.5 Scenario development

The following two scenarios have been examined, which description are presented in the sections below:

- Scenario 1: Current Operations.
- Scenario 2: Work Plan variation.
    - In this scenario, the quarry expands to the north of the existing site boundary.

7.3.5.1 Scenario 1

This scenario encompasses emissions sources and activities currently conducted on-site, which comprises the rehabilitation of discontinued extraction areas and sand processing from off-site sand.

The activities considered in Scenario 1 (S1) are detailed below, which also includes current rehabilitation activities undertaken in three areas:

- Rehabilitation occurring in domains A, B and D as shown in Figure 7-2 spread across the Site with soil being brought from off-site and delivered to these three areas through two main routes with trucks entering from the western gate as presented in (Figure 7-3).
- Minimal watering of haul roads which was observed during the site visit.
- No watering of rehabilitation areas when unloading or spreading the solid with a dozer and a compactor.
- Sand material is being brought onto the site for processing through the sand drying facility.
- Movement of the sand from the receipt area to the drying facility.
- Venturi scrubbers for the sand drying and cooling, constituting in vertical stack emission sources.
- No filter for the dry sand sorting (as observed on-site), which was assumed as a horizontal emission source.
- Loading of trucks and truck movements associated with dry sand collection.
- Wind erosions from all areas being revolved, however, excluding open areas as this approach is considered an over estimate.

7.3.5.2 Scenario 2

At the commencement of the Work Plan variation, the first two months of operations involve stripping topsoil and overburden. The short duration of these activities and the rapid movement of the source locations means that the accurate modelling of this activity is complex and there is difficulty in providing certainty that any results would be either an underestimate or conservative.

Nevertheless, despite the modelling difficulties, this report provides recommendations for best management practices related to the stripping of soil and overburden activities (See Section 6). These recommendations align with the General Environmental Duty, aiming to proactively prevent and minimize risks of harm to the environment and human health from pollution. Therefore, only ongoing activities were considered in the prediction of dust concentrations and deposition resulting from the Work Plan variation.

The modelling for Scenario 2 (S2) considers activities that will occur during the Work Plan variation including future sand mining in the expanded area to the north of the existing site boundary, rehabilitation occurring in three areas, and sand processing in the processing plant, as follows:

- Rehabilitation continue to occur in domains A, B and D as shown Figure 7-2, directly north of the wet processing plant with soil being brought from off-site to these areas to be spread with a dozer and a compactor.
- Level 2 watering of the haul road to the rehabilitation area following industry standard operations for mining and quarrying operations and as part of the GED.
- Watering with water sprays of spreading areas to minimise dust.
- Sand is being extracted from the farthest northern boundary of the expanded area as a conservative approach to impact on closest receptors. This material is then pushed down the slope towards the adjacent pond area. No mitigation measures were considered for these sources. This is because introducing water near the extraction face could present risks for the activity. Additionally, the steepness of the slope on which the dozer operates makes it impossible to use a watercart.
- Movement of the sand from the wet-process stockpile area to the drying facility.
- Venturi scrubbers for the sand drying and cooling.
- Added Venturi scrubber for the dry sand sorting (as advised this will be installed).
- Loading of trucks and truck movements associated with dry sand collection.
- Loading of trucks and truck movements associated with non-dried sand collection.
- Wind erosions from all areas being worked, but not from all open areas as this approach is considered an overestimate.

It should be noted that the modelled scenario is representative of the worst-case emissions that will occur during the period when sand is extracted above the water table (expected to be encountered between 22 m and 24 mAHD). Once extraction occurs below the water table the resource will be very moist with emissions near the northern extent negligible.

7.3.6 Source configuration

7.3.6.1 Scenario 1

In Scenario 1, sources were assigned to areas where activities are currently taking place, as observed during a site visit. The activities can be categorized into three main areas (refer to Figure 7-3).

- Sand Delivery and Processing: These activities are located in the southern part of the site, close to the processing plant.
- Truck Movements: The main site access allows all truck movements for the delivery of sand and soil.
- Rehabilitation Activities: These activities are distributed across three different areas of the site, including soil handling at the material unloading zones

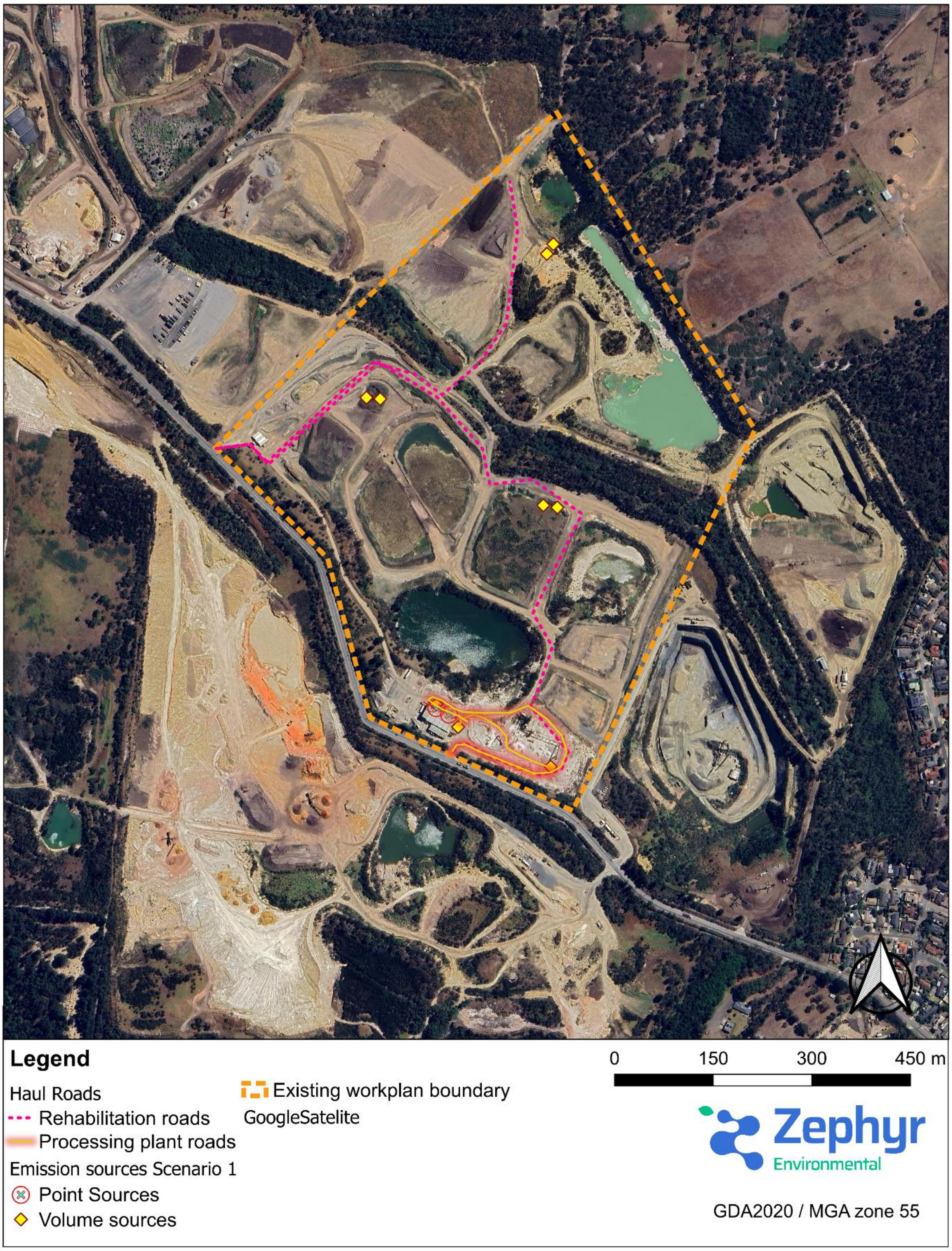

Figure 7-3: Source locations for Scenario 1

Table 7-11: Modelled point sources description and parameters for Scenario 1

Activity	Source ID	Type of Source modelled	Coordinates X (m)	Coordinates Y (m)	Description	Base Elevation (m)	Release height (m)	Stack Diameter	Exit Velocity	Exit Temperature (K)
Controlled Point source emission from processing plant	DS_BH1	POINT (Vertical release)	341495.39	5777504.28	Baghouse emissions from drying emissions	47.44	10	0.5	10	293.15
Uncontrolled Point source emission from processing plant	DS_BH2	POINT (horizontal release)	341476.17	5777514.11	No baghouse, just horizontal release	47.66	5	0.5	10	293.15

Table 7-12: Modelled volume sources description and parameters for Scenario 1

Activity	Source ID	Type of Source modelled	Coordinates X (m)	Coordinates Y (m)	Description	Base Elevation (m)	Release height (m)	Sigma Y (m)	Sigma Z (m)
Loading of non-coal material	CON_1	VOLUME	341649.97	5777425.06	Pickup of sand for transport to drier, truck delivering sand for pro	54	1.5	1.163	2
Unloading of non-coal material	CON_2	VOLUME	341509.22	5777485.49	Unloading of sand to the hopper	48	1.5	1.163	2
Loading of non-coal material	DS1	VOLUME	341475.81	5777519.97	Loading sand from driers to trucks	47.47	1.5	1.163	2
Bulldozer non-coal	DC1	VOLUME	341644.24	5778205.11	Dozer and Compactor in rehab Area 2	49.33	0.5	1.163	2
Bulldozer non-coal	DC2	VOLUME	341369.94	5777986.51	Dozer and Compactor in Rehab Area 1	34.55	0.5	1.163	2
Bulldozer non-coal	DC3	VOLUME	341638.78	5777822.63	Dozer and compactor in rehab Area 3	34.97	0.5	1.163	2
Truck Unloading Non-coal material	T_REH_U1	VOLUME	341654.10	5778220.02	Truck unloading soil for rehabilitation on site	48.51	1.5	1.163	2
Truck Unloading Non-coal material	T_REH_U2	VOLUME	341390.67	5777984.39	Truck unloading soil for rehabilitation on site Area 1	34.48	1.5	1.163	2
Truck Unloading Non-coal material	T_REH_U3	VOLUME	341660.11	5777819.43	Truck unloading soil for rehabilitation on site Area 3	34.96	1.5	1.163	2

Table 7-13: Modelled line sources description and parameters for Scenario 1

Activity	Source ID	Type of Source modelled	Description	Release height (m)	Sigma Z (m)	Length X (m)	Road Length (m)
Truck movement on unsealed road	T_CON	RLINE	Transport of sand via FEL to drying plant	0	2	5	173
Truck movement on unsealed road	T_PROD	RLINE	Truck bringing processed sand to site	0	2	5	165
Truck movement on unsealed road	T_DPROD	RLINE	Truck out loading dry sand	0	5	5	565
Truck movement on unsealed road	T_REH_1	RLINE	Truck movement delivering soil for rehabilitation to Area 2	0	0.5	10	797
Truck movement on unsealed road	T_REH_2	RLINE	Truck movement delivering soil for rehabilitation to Area 1	0	0.5	10	1363

7.3.6.2 Scenario 2

In Scenario 2, sources were assigned to areas where activities are currently taking place, as well as the future activities related to the expansion of sand extraction. The activities can be categorized into three main areas (refer to Figure 2).

- Sand extraction: sand extraction will be undertaken within the expanded area north of the site. Sand will be extracted using an excavator and carried down a slope with a dozer, to further be slurred to the processing plant.
- Sand Processing: These activities are located in the southern part of the site, close to the processing plant.
- Truck Movements: The main site access allows all truck movements for sand the and rehabilitation soil entering from the western gate.
- Rehabilitation Activities: These activities are occurring in three areas of the site, including soil handling at the material unloading zones

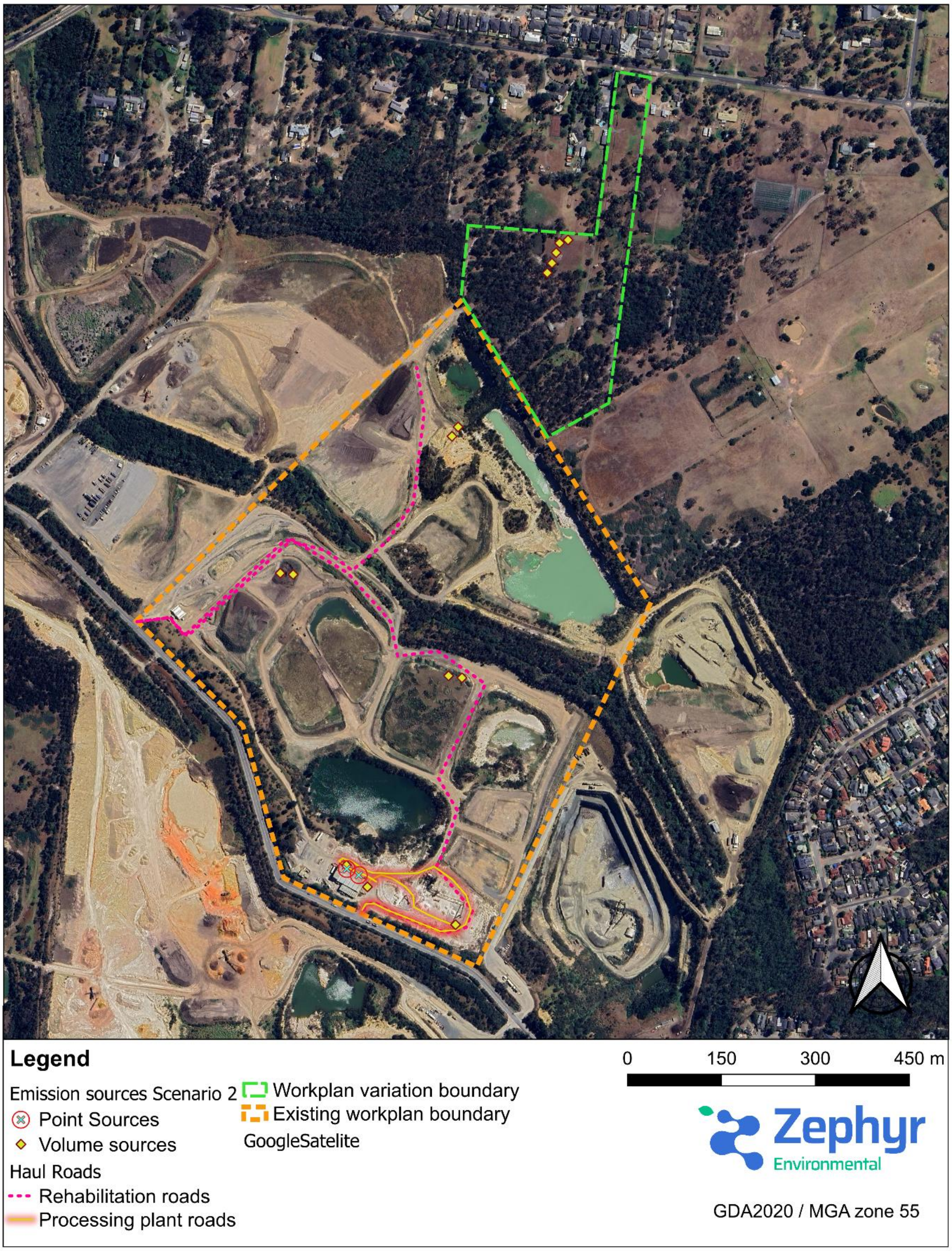

Figure 7-4: Source locations for Scenario 2

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Table 7-14: Modelled point sources description and parameters for Scenario 2

Activity	Source ID	Type of Source modelled	Coordinates X (m)	Coordinates Y (m)	Description	Base Elevation (m)	Release height (m)	Stack Diameter	Exit Velocity	Exit Temperature (K)
Controlled Point source emission from processing plant	DS_BH1	POINT (Vertical release)	341495.39	5777504.28	Baghouse emissions from drying emissions	47.44	10	0.5	10	293.15
Controlled Point source emission from processing plant	DS_BH2	POINT (Vertical release)	341476.17	5777514.11	No baghouse, just horizontal release	47.66	10	0.5	10	293.15

Table 7-15: Modelled volume sources description and parameters for Scenario 2

Activity	Source ID	Type of Source modelled	Coordinates X (m)	Coordinates Y (m)	Description	Base Elevation (m)	Release height (m)	Sigma Y (m)	Sigma Z (m)
Loading of non-coal material	CON_1	VOLUME	341649.97	5777425.06	Pickup of sand for transport to drier and out loading	54.05	1.5	1.163	2
					Loading of truck with washed non-dried sand	54.05	1.5	1.163	2
Unloading of non-coal material	CON_2	VOLUME	341509.22	5777485.49	Unloading of sand to the hopper	48.2	1.5	1.163	2
Loading of non-coal material	DS1	VOLUME	341475.81	5777519.97	Loading sand from driers to trucks	47.47	1.5	1.163	2
FEL Loading and unloading non-coal	S1	VOLUME	341829.62	5778518.67	Sand Extraction and handling	49.61	1	1.163	2
Bulldozer non-coal	D2_S1	VOLUME	341816.03	5778513.86	Dozer pushing material down slope	49.24	0.2	1.163	2
Bulldozer non-coal	D2_S2	VOLUME	341810.60	5778498.39	Dozer pushing material down slope	49.31	0.2	1.163	2
Bulldozer non-coal	D2_S3	VOLUME	341803.91	5778481.66	Dozer pushing material down slope	49.54	0.2	1.163	2
Bulldozer non-coal	D2_S4	VOLUME	341796.38	5778466.19	Dozer pushing material down slope	50.25	0.2	1.163	2
Bulldozer non-coal	DC1	VOLUME	341644.24	5778205.11	Dozer and Compactor in rehab Area 2	49.33	0.5	1.163	2

Activity	Source ID	Type of Source modelled	Coordinates		Description	Base Elevation (m)	Release height (m)	Sigma Y (m)	Sigma Z (m)
			X (m)	Y (m)					
Bulldozer non-coal	DC2	VOLUME	341369.94	5777986.51	Dozer and Compactor in Rehab Area 1	34.55	0.5	1.163	2
Bulldozer non-coal	DC3	VOLUME	341638.78	5777822.63	Dozer and compactor in rehab Area 3	34.97	0.5	1.163	2
Truck Unloading Non-coal material	T_REH_U1	VOLUME	341654.10	5778220.02	Truck unloading soil for rehabilitation on site	48.51	1.5	1.163	2
Truck Unloading Non-coal material	T_REH_U2	VOLUME	341390.67	5777984.39	Truck unloading soil for rehabilitation on site Area 1	34.48	1.5	1.163	2
Truck Unloading Non-coal material	T_REH_U3	VOLUME	341660.11	5777819.43	Truck unloading soil for rehabilitation on site Area 3	34.96	1.5	1.163	2

Table 7-16: Modelled line sources description and parameters for Scenario 2

Activity	Source ID	Type of Source modelled	Description	Release height (m)	Sigma Z (m)	Length X (m)	Road Length (m)
Truck movement on unsealed road	T_CON	RLINE	Transport of sand via FEL to drying plant	0	2	5	173
Truck movement on unsealed road	T_PROD	RLINE	Truck bringing processed sand to site	0	2	5	165
Truck movement on unsealed road	T_DPROD	RLINE	Truck out loading dry sand	0	5	5	565
Truck movement on unsealed road	T_REH_1	RLINE	Truck movement delivering soil for rehabilitation to Area 2	0	0.5	10	797
Truck movement on unsealed road	T_REH_2	RLINE	Truck movement delivering soil for rehabilitation to Area 1	0	0.5	10	1363

7.3.7 Estimates of emissions

Emission rates were established following the guidance of AP-42 (Table 7-5) for the sources specified in Section 7.3.6. Variable emission files were generated for each volume and point sources, with hourly variations accounted for each meteorological year modelled from 2021 to 2023.

Emissions originating from truck activity on unsealed roads were incorporated into the AERMOD as a constant emission rate for the hours of operation as presented in Table 7-17. The haul roads were modelled as a RLINE sources in AERMOD for PM_{10} and $PM_{2.5}$, requiring an emission rate specified in g/second/m2. Deposition is not able to be modelled by AERMOD using RLINE sources and consequently the RLINE sources were converted to sequence volume sources which require an emission rate specified in g/second.

7.3.7.1 Scenario 1

Using the equations contained in Table 7-5 together with the data in Table 7-6 to Table 7-9 the emission rates shown in Table 7-17 and Table 7-18 were estimated.

Table 7-17: Emission rates for truck movement on unsealed road in Scenario 1

Activity -	Source ID	Emission Rate		
		TSP (g/s)	PM_{10} (g/s.m^2)	$PM_{2.5}$ (g/s.m^2)
Transport of sand via FEL to drying plant	T_CON	0.0389	1.1×10^{-5}	1.1×10^{-6}
Truck bringing processed sand to site	T_PROD	0.0127	3.9×10^{-6}	3.9×10^{-7}
Truck out loading dry sand	T_DPROD	0.0740	6.4×10^{-6}	6.4×10^{-7}
Truck movement delivering soil for rehabilitation to Area 2	T_REH_1	2.73	8.4×10^{-5}	8.4×10^{-6}
Truck movement delivering soil for rehabilitation to Area 1	T_REH_2	2.34	4.2×10^{-5}	4.2×10^{-6}

Table 7-18: Emission rates for non-haul road activities in Scenario 1

Activity -	Source ID	Emission Rate		
		TSP (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)
Truck unloading soil	T_REH_U1 T_REH_U3 T_REH_U3	0.010	0.0047	0.0007
Dozer pushing soil in rehabilitation area	DC1 DC2 DC3	0.304	0.065	0.032
Compactor in rehabilitation area	DC1 DC2 DC3	0.304	0.065	0.032
Truck delivering sand to be dried	CON_1	0.0010	0.0005	0.00007
Pickup of sand for transfer to drier	CON_1	0.0005	0.0002	0.00003
Unloading of sand to the drier hopper	CON_2	0.0005	0.0002	0.00003
Loading dried sand to trucks	DS1	0.0038	0.0018	0.0003
Venturi scrubber emissions drier	DS_BH1	0.0074	0.0074	0.0074
Sorting emissions (no mitigation)	DS_BH2	0.588	0.588	0.588

7.3.7.2 Scenario 2

Using the equations contained in Table 7-5 together with the data in Table 7-6 to Table 7-9, the emission rates contained in Table 7-19 to Table 7-20 were derived.

Table 7-19: Emission rates for truck movement on unsealed road in Scenario 2

Activity -	Source ID	Emission Rate ($g/s.m^2$)		
		TSP(g/s)	PM_{10} ($g/s.m^2$)	$PM_{2.5}$ ($g/s.m^2$)
Transport of sand via FED to drying plant	T_CON	0.0195	5.5×10^{-6}	5.5×10^{-7}
Truck out loading of non-dried product	T_PROD	0.0599	1.8×10^{-5}	1.8×10^{-6}
Truck out loading dry sand	T_DPROD	0.0185	1.6×10^{-6}	1.6×10^{-7}
Truck movement bringing soil for rehabilitation	T_REH_1	1.37	4.2×10^{-5}	4.2×10^{-6}
Truck movement bringing soil for rehabilitation	T_REH_2	1.17	2.1×10^{-5}	2.1×10^{-6}

Table 7-20: Emission rates for non-haul road activities in Scenario 2

Activity -	Source ID	Emission Rate		
		TSP (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)
Sand extraction	S1	0.0084	0.0076	0.0012
Dropping of sand onto stockpile	S1	0.0084	0.0076	0.0012
Bulldozer pushing sand down slope	D2_S1 D2_S2 D2_S3 D2_S4	0.011	0.0024	0.0023
Truck unloading soil	T_REH_U1 T_REH_U3 T_REH_U3	0.0050	0.0024	0.00036
Dozer pushing soil in rehabilitation area	DC1 DC2 DC3	0.1520	0.0327	0.0160
Compactor in rehabilitation area	DC1 DC2 DC3	0.1520	0.0327	0.0160
Pickup of sand for transfer to drier	CON_1	0.0005	0.0002	0.00004
Pickup of non-dried sand for out loading	CON_1	0.0118	0.0056	0.00085
Loading of truck with non-dried sand	CON_1	0.0118	0.0056	0.00085
Unloading of sand to the drier hopper	CON_2	0.0005	0.0002	0.00004
Loading dried sand to trucks	DS1	0.0039	0.0018	0.00028
Venturi scrubber emissions drier	DS_BH1	0.0074	0.0074	0.0074
Venturi scrubber sorting emissions	DS_BH2	0.0059	0.0059	0.0059

Heavy metals concentration was assessed as PM_{10} annual average concentration and as annual deposition at modelled receptors have . The metals composition in both sand and rehabilitation soil materials are detailed below.

7.3.7.3 Heavy metals content of sources

Heavy metals concentration are assessed as part of the post-processing step. This involves modelling the PM10 contribution at each receptor for each source, and the application of source-specific metals content for the modelled PM_{10} from each source. Metals results are then summed for all sources and averaged over the appropriate periods prior to comparison to the relevant APACS.

Information regarding composition of specialty sands provided by Heidelberg Materials determined the metal oxide content of the resource as shown in Table 7-21.

Table 7-21: Metal oxide content of resource

Metal oxide	Percentage
Silicon Dioxide (SiO_2):	99.30%
Iron Oxide (Fe_2O_3):	0.10%
Aluminium Oxide (Al_2O_3):	0.25%
Titanium Dioxide (TiO_2):	0.10%
Chromium Oxide (Cr_2O_3):	<10ppm
Sodium Oxide (Na_2O):	0.01%
Potassium Oxide (K_2O):	0.01%
Calcium Oxide (CaO):	<0.01%
Magnesium Oxide (MgO):	<0.01%
Loss On Ignition:	0.15%

The metal content of the rehabilitation soils has not been tested, however it is known that the rehab soils are clean fill from nearby major infrastructure projects. The Victorian Background Soil database is a publicly available resource based on research completed by RMIT in collaboration with the Hazardous Waste Fund and the Australian Contaminated Land Consultants Association[4]. The average data for testing within soils around Frankston is shown in Table 7-22.

Table 7-22: Metal content of rehab soils from the Victoria Background Soil Database

Metal	Surface soils (%)	Sub-surface (%)
Mercury	5×10^{-8}	5×10^{-8}
Manganese	3.88×10^{-5}	7.2×10^{-6}
Chromium (III+VI)	5.2×10^{-6}	1.82×10^{-5}
Antimony	2.5×10^{-6}	2.5×10^{-6}
Thallium	2.5×10^{-6}	2.5×10^{-6}
Zinc	2.14×10^{-5}	0.000003
Silver	0.000001	0.000001
Strontium	8.4×10^{-6}	0.000005
Calcium	0.000876	0.000322
Phosphorus	0.000206	0.000025
Selenium	2.5×10^{-6}	2.5×10^{-6}
Barium	0.000022	0.000019
Boron	0.000025	0.000025

[4] Available at https://soilexplorer.org.au. Last accessed 8 March 2024/

Metal	Surface soils (%)	Sub-surface (%)
Potassium	0.000224	0.000258
Arsenic	0.000003	3.2×10^{-6}
Molybdenum	1.4×10^{-6}	0.000001
Copper	4.9×10^{-6}	2.5×10^{-6}
Magnesium	0.000272	0.00047
Lead	1.57×10^{-5}	5.7×10^{-6}
Vanadium	0.000009	3.22×10^{-5}
Beryllium	5×10^{-7}	8×10^{-7}
Cadmium	5×10^{-7}	5×10^{-7}
Cobalt	1.4×10^{-6}	1.8×10^{-6}
Iron	0.00266	0.016709
Aluminium	0.001956	0.012209
Nickel	0.000002	4.4×10^{-6}
Titanium	0.000044	0.00004
Tin	2.5×10^{-6}	2.5×10^{-6}

7.3.8 Receptors

Dispersion modelling was completed over a modelled grid and at discrete receptors.

7.3.8.1 Grid receptors

A nested grid was generated to obtain concentration plots across the grid domain. The configuration of the grid id detailed in Table 7-23 and the aerial representation is presented in Figure 7-5. A grid spacing resolution chosen follows the Guidance notes for using the regulatory air pollution model AERMOD in Victoria.

Table 7-23: Modelling Gird parameters

Parameter	Value
X (m)	339.800
Y (m)	57.765.500
Size width (m)	4000
Height width (m)	4000
Receptor spacing (m)	50
Distance from Bounding Box (m)	1000 3000
Receptor spacing	100 250
Total number of receptors	9657

7.3.8.2 Specific receptors

A range of receptors were included in the model, as presented in Figure 7-6 and detailed in Table 7-24:

- Sensitive receptors, grouped as HHIA (HHIA) receptors in Table 7-24. These include residential areas, Rural Conservation Zones, General Residential Zone in Frankston, and other places where people have residence, work, or spend significant amounts of time. These locations were requested by the specialists completing the human health Impact Assessment.

- Air quality receptors grouped as AQ indicate additional receptors to the HHIA receptors mentioned above, which include residential areas to the east and south of the site boundary. These receptors are located on the edge of densely populated urban areas and provide a representation of the most exposed sensitive receptors in these directions.
- Golf course receptors: receptors along the edge of the golf course are located to the west of the site. This location was requested by the HHIA specialists.
- Boundary receptors were placed around the facility's boundary at a 100 m spacing to capture all high concentrations along the fence line. Boundary receptors were determined for both the existing and expansion site boundary. However, no direct comparison of results at the boundary receptors are made to the indicators and objectives in the ERS. No comparison is completed at these locations because it is not reasonable to expect that individuals will be present for the 24-hr or annual averaging periods (EPA Publication 1961.2).

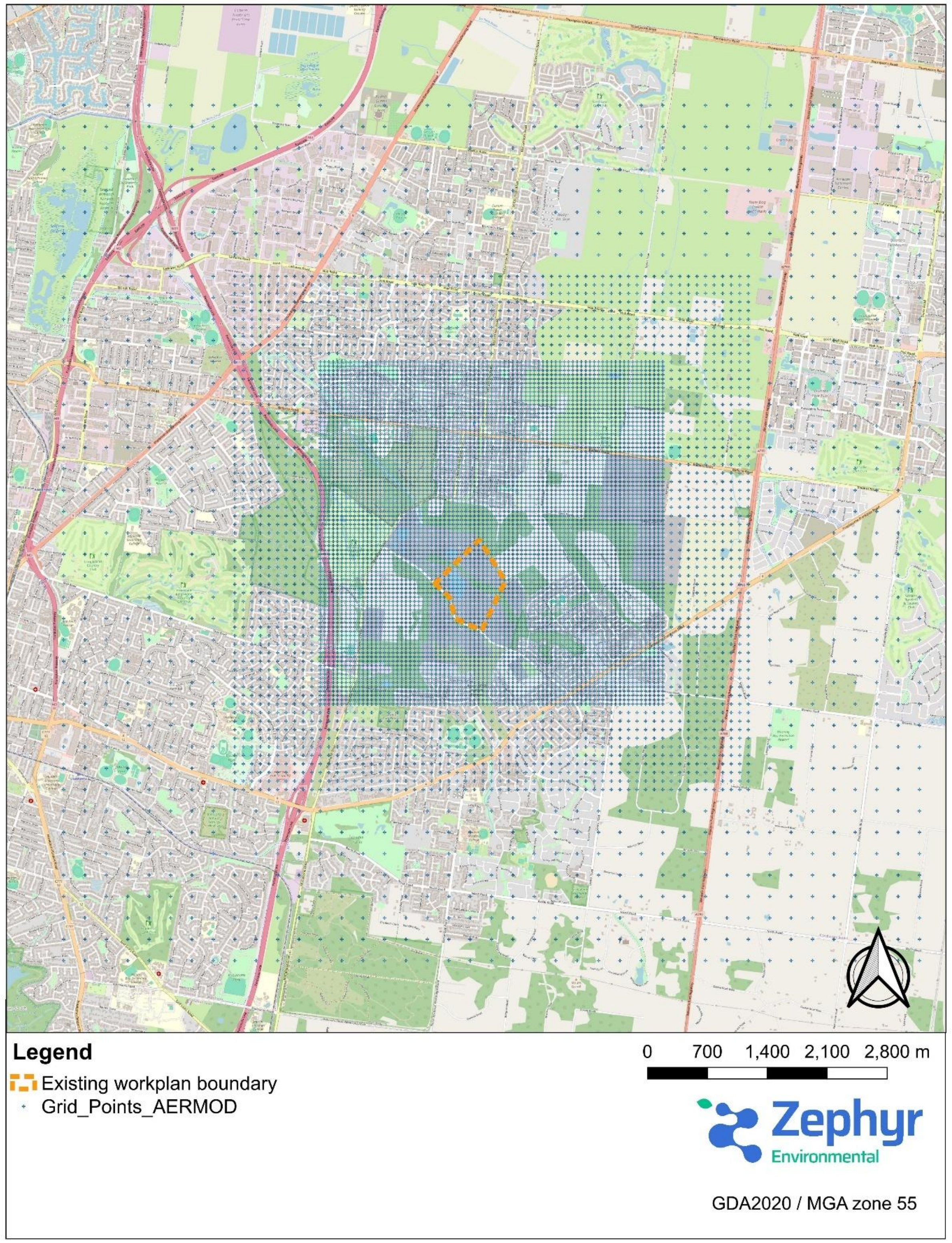

Figure 7-5: Modelled grid receptors

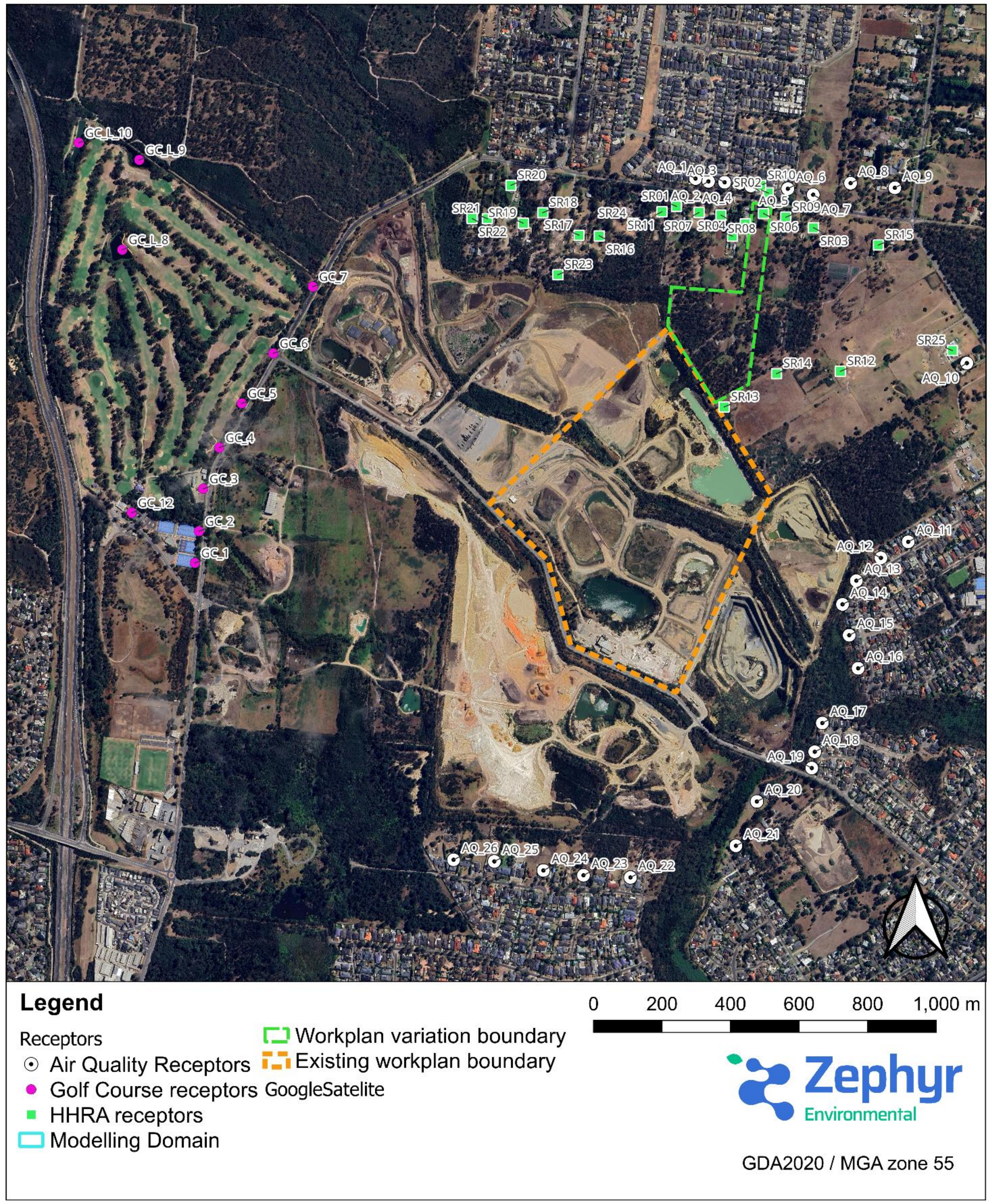

Figure 7-6: Other modelled receptors

Table 7-24: List of all receptors modelled

X (m)	Y (m)	GROUP	ID
341740.34	5778858.42	AQ	AQ_1
341778.04	5778850.34	AQ	AQ_2
341825.16	5778847.65	AQ	AQ_3
341869.58	5778844.96	AQ	AQ_4
341901.9	5778836.88	AQ	AQ_5
342009.6	5778828.8	AQ	AQ_6
342083.65	5778811.3	AQ	AQ_7
342192.7	5778844.96	AQ	AQ_8
342321.94	5778831.49	AQ	AQ_9
342531.97	5778319.9	AQ	AQ_10
342360.88	5777798.53	AQ	AQ_11
342281.3	5777751.56	AQ	AQ_12
342209.54	5777685.01	AQ	AQ_13
342169.09	5777615.86	AQ	AQ_14
342188.66	5777525.84	AQ	AQ_15
342214.75	5777429.29	AQ	AQ_16
342110.2	5777269.66	AQ	AQ_17
342088.2	5777185.72	AQ	AQ_18
342079.51	5777138.25	AQ	AQ_19
341919.28	5777040.74	AQ	AQ_20
341858.08	5776911.48	AQ	AQ_21
341550.23	5776818.99	AQ	AQ_22
341413.3	5776825.33	AQ	AQ_23
341296.39	5776839.47	AQ	AQ_24
341153.07	5776865.87	AQ	AQ_25
341034.27	5776870.58	AQ	AQ_26
341684.68	5778777.23	HHIA	HHRA SR01
341952.79	5778816.31	HHIA	HHRA SR02
342084.51	5778715.12	HHIA	HHRA SR03
341848.14	5778690.39	HHIA	HHRA SR04
341885.68	5778726.29	HHIA	HHRA SR05
341938.66	5778756.63	HHIA	HHRA SR06
341750.47	5778759.28	HHIA	HHRA SR07
341814.58	5778751.6	HHIA	HHRA SR08
342003.82	5778745.66	HHIA	HHRA SR09
341930.8	5778838.77	HHIA	HHRA SR10
341642.46	5778761.82	HHIA	HHRA SR11
342162.73	5778295.89	HHIA	HHRA SR12
341823.63	5778192.18	HHIA	HHRA SR13
341976.62	5778289.22	HHIA	HHRA SR14
342274.05	5778664.55	HHIA	HHRA SR15
341459.58	5778691.27	HHIA	HHRA SR16
341400.46	5778693.22	HHIA	HHRA SR17
341294.45	5778758.88	HHIA	HHRA SR18
341237.82	5778728.26	HHIA	HHRA SR19
341201.54	5778838.88	HHIA	HHRA SR20
341132.69	5778741.36	HHIA	HHRA SR21
341088.09	5778741.89	HHIA	HHRA SR22
341338.59	5778577.75	HHIA	HHRA SR23
341557.91	5778727.93	HHIA	HHRA SR24
342489.62	5778356.6	HHIA	HHRA SR25
340279.22	5777737.02	Golf Course	GC_1
340291.18	5777829.43	Golf Course	GC_2

X (m)	Y (m)	GROUP	ID
340303.56	5777953.11	Golf Course	GC_3
340350.61	5778073.41	Golf Course	GC_4
340416.11	5778202.65	Golf Course	GC_5
340508.23	5778348.48	Golf Course	GC_6
340623.34	5778543.03	Golf Course	GC_7
340067.42	5778650.95	Golf Course	GC_L_8
340117	5778912.98	Golf Course	GC_L_9
339940.58	5778962.93	Golf Course	GC_L_10
339453.83	5779458.54	Golf Course	GC_11
340095.11	5777883.49	Golf Course	GC_12

7.3.9 Post processing

The models have been run for three meteorological years. To derive one set of results, the model output was post processed as concentration plots and predicted concentration at receptors as detailed in Table 7-24.

7.3.9.1 PM_{10} and $PM_{2.5}$

For PM_{10} and $PM_{2.5}$, the maximum modelled 24-hour result and the annual average result at each modelled grid point and each sensitive receptor were considered, and the maximum value from the three modelled years selected to provide the most conservative outcome.

7.3.9.2 Results processing

Within the modelling, sources associated with sand extraction, sand handling or sand drying were put into one source group. The haul roads were placed into a second source group and the sources associated with rehabilitation (minus the roads) were put into a third source group.

As the majority of the haul roads were observed during the site visit to be on the resource, the maximum result for the three modelled years for annual mean PM_{10} and deposition from the sand and road source groups were summed and multiplied by the values in Table 7-21. To derive metals concentration and deposition from rehabilitation activities, the maximum result for the three modelled years annual mean concentration of PM_{10} and deposition were multiplied by the values in Table 7-22.

As the maximum 1-hour concentration at a receptor could be on a different hour for each source group, the timeseries for one hour for each source group and each specific receptor was extracted from the model. The results from the relevant source groups were multiplied by the values in Table 7-21 and Table 7-22 respectively.

7.3.9.3 RCS

Testing has not been completed to determine the level of RCS either within the sand resource or within the rehab soils. When measured in the ambient environment sampling from $PM_{2.5}$ monitors are used to determine the fraction that is RCS. To provide a conservative assessment, the annual mean $PM_{2.5}$ concentration was considered to be 100% respirable crystalline silica. This is likely to be a significant overestimate of likely concentrations.

7.4 Dispersion model results

Sensitive Receptors were divided into three assessment groups (Table 7-24). The receptor groups are for the HHIA, for Air Quality (AQ; which include residential locations from HHIA), and receptors near the Golf Course (GC).

In accordance with EPA Publication 1961.2, the criteria are applied where it is reasonable to expect the population to be present for the averaging period of the criterion. Thus:

- PM_{10} and $PM_{2.5}$ are assessed at AQ and HHIA receptors
- RCS is assessed at AQ and HHIA receptors
- Metals with an averaging period of 1 hour or less are assessed at AQ, HHIA and GC receptors
- Metals with an averaging period of more than 1 hour are assessed at AQ and HHIA receptors.

Full results for all modelled receptors and averaging periods are provided in Appendix A and B.

The intent of modelling Scenario 1 (existing operations) and Scenario 2 (proposed) was to understand the predicted change in concentration of the proposed operation in comparison to the currently approved operation. Initially, therefore the change in predicted contributions (Scenario 2 minus Scenario 1) is considered in comparison to the significance level stated in EPA Publication 1961.2 of 4 % of the criterion. Background concentrations have then been added to the results from Scenario 2 to understand the cumulative impact to the surrounding land use as a result of the proposed operation in comparison to the APAC in EPA Publication 1961.2 and the objectives listed in the Environment Reference Standard.

7.4.1 Change in predicted contribution

7.4.1.1 Change in particulate matter concentration

Table 7-25 presents the maximum 24-hr average PM_{10} and $PM_{2.5}$ predictions for air quality receptors for Scenario 1 and Scenario 2 alongside the change in predicted Project contribution as a percentage of the relevant air quality standard.

Table 7-26 presents the change in maximum annual average project contribution for PM_{10} and $PM_{2.5}$ as a percentage of the relevant air quality criteria. Appendix A presents the predicted concentrations at AQ, HHIA and GC receptors.

Table 7-25: Summary of maximum 24-hr PM predictions at AQ receptors for Project contribution only

ID	Maximum 24-hr PM_{10} (µg/m3)		PM_{10} % Change (S2/S1)	Maximum 24-hr PM_{25}(µg/m3)		PM_{25} % Change (S2/S1)
	Scenario 1	Scenario 2		Scenario 1	Scenario 2	
AQ_1	42.63	17.85	-50%	11.94	2.47	-38%
AQ_2	43.73	18.29	-51%	12.51	2.61	-40%
AQ_3	42.73	17.80	-50%	12.68	2.65	-40%
AQ_4	39.97	16.40	-47%	12.64	2.55	-40%
AQ_5	37.29	14.94	-45%	12.73	2.43	-41%
AQ_6	28.17	11.78	-33%	9.79	1.78	-32%
AQ_7	25.00	10.73	-29%	7.20	1.67	-22%
AQ_8	21.01	9.20	-24%	7.23	1.32	-24%
AQ_9	18.33	7.78	-21%	6.05	1.10	-20%
AQ_10	12.37	4.75	-15%	5.29	0.69	-18%
AQ_11	16.76	7.26	-19%	7.05	0.99	-24%
AQ_12	20.23	8.56	-23%	9.50	1.46	-32%
AQ_13	23.43	9.67	-28%	12.07	2.10	-40%
AQ_14	24.76	10.48	-29%	13.09	1.81	-45%
AQ_15	24.29	9.74	-29%	13.58	1.39	-49%
AQ_16	26.60	8.83	-36%	16.12	1.26	-59%

AQ_17	40.33	14.25	-52%	16.89	2.09	-59%
AQ_18	40.84	13.20	-55%	19.91	2.02	-72%
AQ_19	39.71	12.38	-55%	20.37	1.92	-74%
AQ_20	33.36	12.07	-43%	19.68	1.69	-72%
AQ_21	35.05	11.67	-47%	16.21	1.63	-58%
AQ_22	46.26	11.59	-69%	27.69	1.83	-103%
AQ_23	33.00	9.49	-47%	19.51	1.69	-71%
AQ_24	30.98	7.84	-46%	19.14	1.45	-71%
AQ_25	22.71	6.71	-32%	11.86	1.10	-43%
AQ_26	22.41	6.61	-32%	12.75	1.15	-46%

Table 7-26: Summary of Annual Average PM predictions AQ receptors for Project contribution only

ID	Annual Average PM_{10} (µg/m3)		PM_{10} % Change (S2/S1)	Annual Average PM_{25}(µg/m3)		% Change PM_{25} (S2/S1)
	Scenario 1	Scenario 2		Scenario 1	Scenario 2	
AQ_1	3.87	1.59	-11%	1.16	0.21	-12%
AQ_2	3.77	1.55	-11%	1.15	0.21	-12%
AQ_3	3.56	1.45	-11%	1.12	0.20	-12%
AQ_4	3.31	1.33	-10%	1.08	0.18	-11%
AQ_5	3.12	1.23	-9%	1.06	0.17	-11%
AQ_6	2.58	1.00	-8%	0.91	0.14	-10%
AQ_7	2.20	0.85	-7%	0.77	0.12	-8%
AQ_8	1.75	0.64	-6%	0.68	0.09	-7%
AQ_9	1.35	0.48	-4%	0.56	0.07	-6%
AQ_10	0.89	0.33	-3%	0.35	0.05	-4%
AQ_11	1.75	0.69	-5%	0.61	0.10	-6%
AQ_12	2.26	0.86	-7%	0.83	0.13	-9%
AQ_13	2.89	1.05	-9%	1.15	0.16	-12%
AQ_14	3.35	1.16	-11%	1.46	0.18	-16%
AQ_15	3.29	1.07	-11%	1.57	0.17	-17%
AQ_16	3.11	0.98	-11%	1.56	0.15	-18%
AQ_17	3.31	1.00	-12%	1.74	0.15	-20%
AQ_18	2.93	0.88	-10%	1.55	0.13	-18%
AQ_19	2.75	0.83	-10%	1.46	0.13	-17%
AQ_20	3.23	1.01	-11%	1.63	0.15	-18%
AQ_21	3.09	0.98	-11%	1.54	0.14	-17%
AQ_22	3.35	0.88	-12%	1.98	0.14	-23%
AQ_23	2.57	0.66	-10%	1.51	0.10	-18%
AQ_24	1.67	0.48	-6%	0.90	0.07	-10%
AQ_25	1.24	0.38	-4%	0.64	0.05	-7%
AQ_26	1.20	0.35	-4%	0.63	0.05	-7%

The predicted changes shown in Table 7-25 and Table 7-26 are all negative values of more than 4 % of the criterion. This indicates that adoption of the project will result in a measurable reduction in project contribution to ambient air quality, which represents a significant positive outcome corresponding to improved overall environmental quality.

This improvement is driven by the adoption of additional dust controls measures, which reduce emissions and therefore allow for the extraction within the extended area but also will result in improved air quality for a number of the local receptors.

This result is further evidenced in Figure 7-7 and Figure 7-8, which respectively provide the maximum predicted contribution to 24-hr average PM_{10} and $PM_{2.5}$ concentration contours. Results for S1 are shown on the left-hand figure, and results for S2 on the right-hand image in each case. These concentration contour plots do not include background air quality. The results show that:

- Contribution of PM_{10} to the surrounding land use is driven by the rehabilitation and production activities which are currently permitted
- The proposed additional activity when combined with mitigation for currently permitted activities results in a lower impact to the surrounding land use than current operations.
- Change in contribution from Scenario 2 compared to Scenario 1 to the surrounding land use show a reduction in predicted concentration compared to the relevant APAC

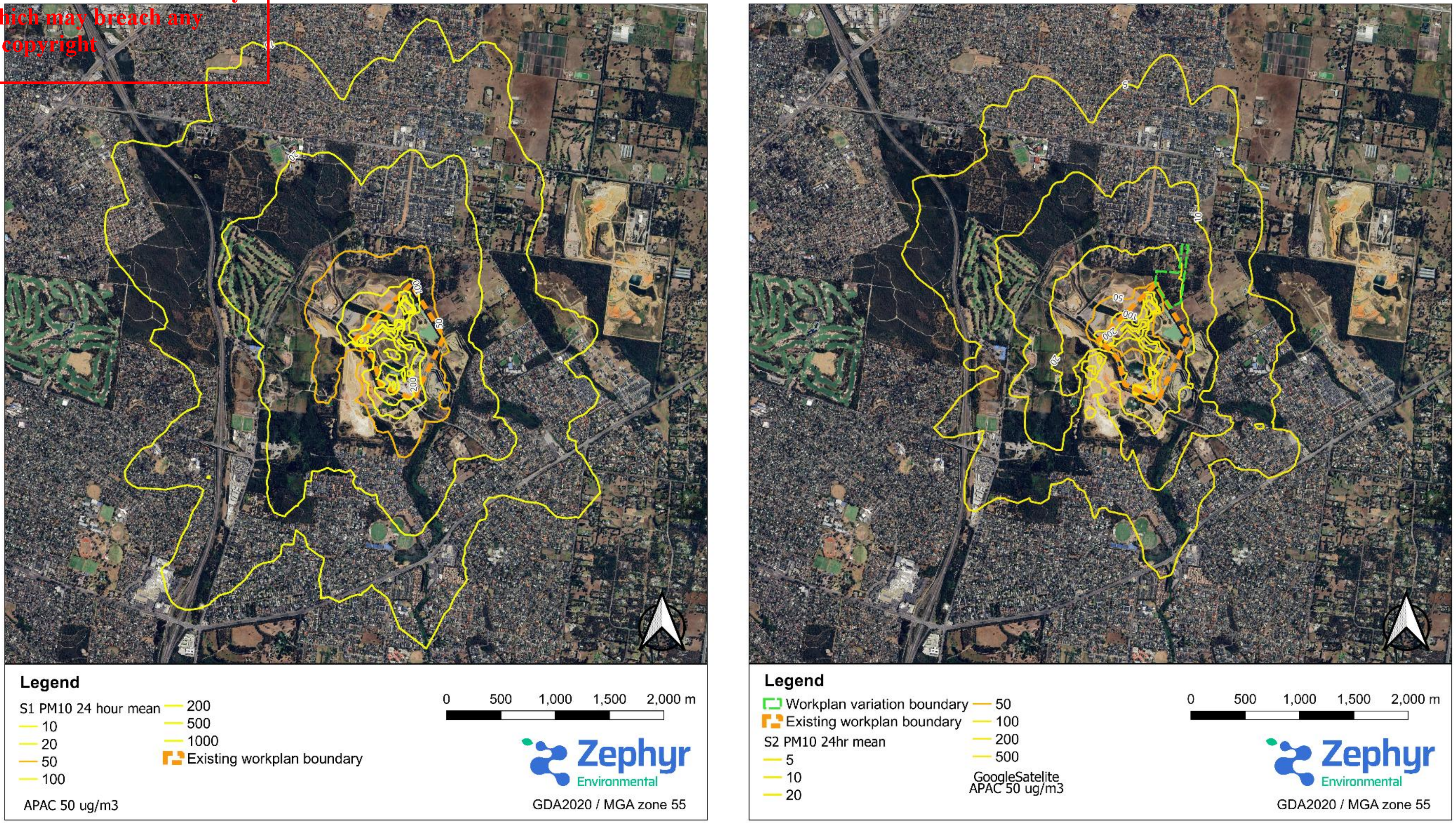

Figure 7-7: Maximum modelled contribution of 24-hour average PM_{10} concentrations to the surrounding land use for S1 (left) and S2 (right)

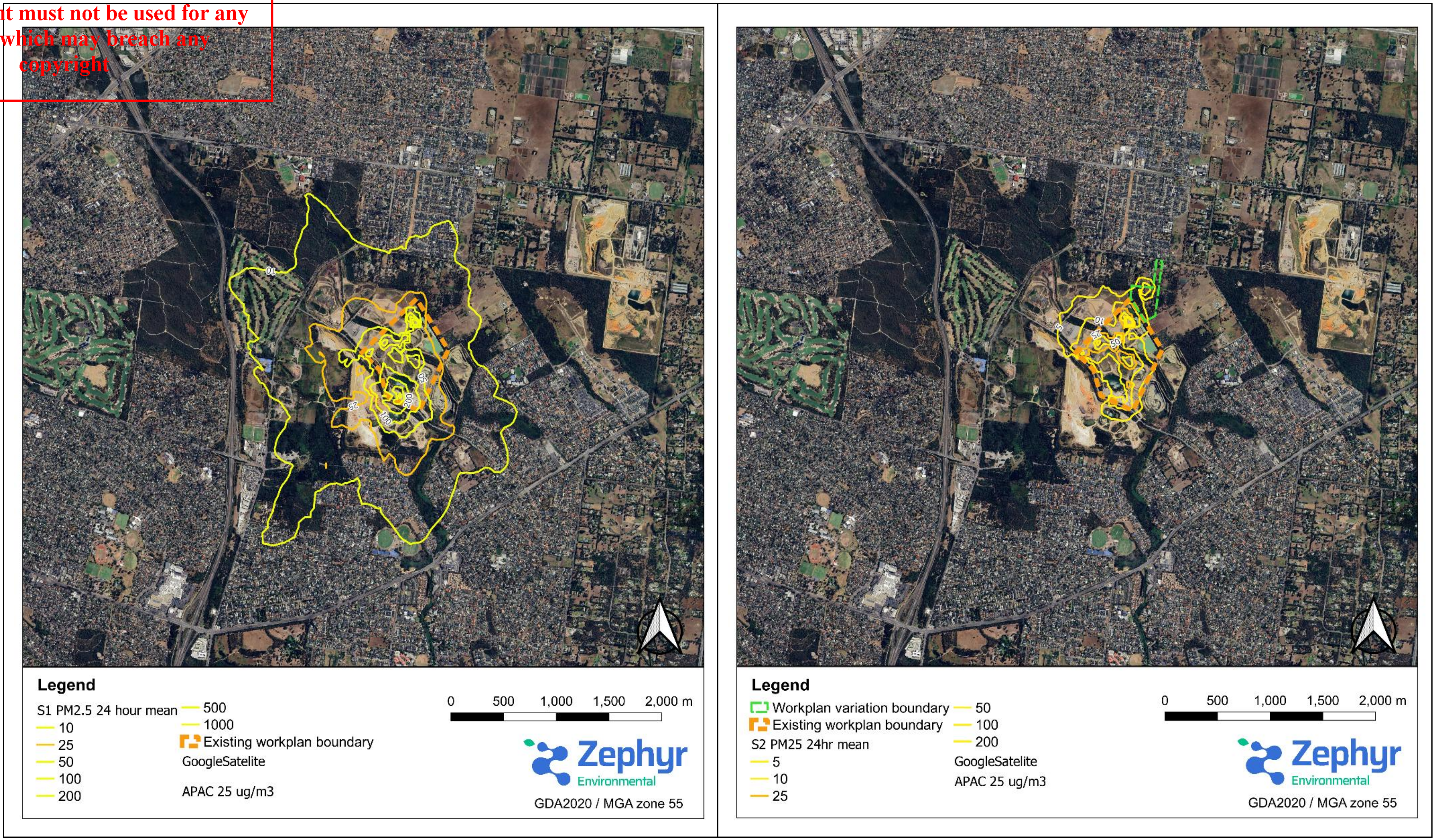

Figure 7-8: Maximum modelled contribution of 24-hour average $PM_{2.5}$ concentrations to the surrounding land use for S1 (left) and S2 (right)

7.4.1.2 Change in metals results

All predicted change in contribution to metals and metals compounds predictions were less than 1% of their relevant APAC as presented in Table 7-27. In accordance with EPA Publication 1961.2 where the change in air quality is less than 4 % of the relevant APAC, the change can be considered not to be significant. These results therefore represent a very low to negligible change in risks to air quality due to metals in dust comparing Scenario 1 to Scenario 2.

Table 7-27: Summary in change of metal predicted concentrations

Indicators	Averaging period	APAC (µg/m³)	Max at AQ receptors (µg/m³)		% change	Max all (µg/m³)[1]		% of APAC
			Scenario 1	Scenario 2		Scenario 1	Scenario 2	
Antimony and antimony compounds	24 hour	1	1.1E-05	5.6E-06	<0.1%	3.3E-05	1.1E-05	<0.1%
	Annual	0.3	6.2E-07	2.9E-07	<0.1%	3.2E-06	1.5E-06	<0.1%
Arsenic and arsenic compounds	1 hour	9.9	8.2E-05	4.2E-05	<0.1%	1.0E-03	4.6E-04	<0.1%
	1 year	0.015	8.0E-07	3.7E-07	<0.1%	4.1E-06	1.9E-06	<0.1%
	1 year (incremental)	0.007	8.0E-07	3.7E-07	<0.1%	4.1E-06	1.9E-06	<0.1%
Barium and barium compounds	1 hour	5	5.7E-04	2.9E-04	<0.1%	7.1E-03	3.1E-03	<0.1%
Beryllium and beryllium compounds	Annual	0.001	2.0E-07	9.4E-08	<0.1%	1.0E-06	4.7E-07	<0.1%
Cadmium and cadmium compounds	1 hour	18	1.3E-05	6.5E-06	<0.1%	1.6E-04	7.1E-05	<0.1%
	24 hours	0.03	2.1E-06	1.1E-06	<0.1%	6.5E-06	2.1E-06	<0.1%
	Annual	0.005	1.2E-07	5.9E-08	<0.1%	6.3E-07	2.9E-07	<0.1%
Chromium (hexavalent)[1]	1 hour	1.3	9.3E-04	3.7E-04	<0.1%	1.3E-02	6.2E-03	<0.1%
	1 year	0.005	2.1E-05	8.7E-06	<0.1%	6.0E-05	2.6E-05	<0.1%
Chromium (trivalent)[1]	30 days	0.1	4.9E-04	1.9E-04	<0.1%	4.9E-04	1.9E-04	<0.1%
Copper and copper compounds	1 hour	10	1.3E-04	6.4E-05	<0.1%	1.6E-03	7.0E-04	<0.1%
Lead and lead compounds	1 year	0.5	3.9E-06	1.8E-06	<0.1%	2.0E-05	9.1E-06	<0.1%
Manganese and manganese compounds	1 hour	9.1	1.0E-03	5.0E-04	<0.1%	1.3E-02	5.5E-03	<0.1%
	Annual	0.15	9.6E-06	4.5E-06	<0.1%	4.9E-05	2.3E-05	<0.1%
Mercury and mercury compounds	1 year	1	1.2E-08	5.9E-09	<0.1%	6.3E-08	2.9E-08	<0.1%
Nickel and nickel compounds	1 hour	0.2	1.1E-04	5.7E-05	<0.1%	1.4E-03	6.3E-04	<0.1%
	Annual	0.01	1.1E-06	5.1E-07	<0.1%	5.6E-06	2.6E-06	<0.1%
Silver and silver compounds	1 hour	0.1	2.6E-05	1.3E-05	<0.1%	3.2E-04	1.4E-04	<0.1%
Zinc and zinc compounds	1 hour	20	5.5E-04	2.8E-04	<0.1%	6.9E-03	3.0E-03	<0.1%
	Annual	2	5.3E-06	2.5E-06	<0.1%	2.7E-05	1.2E-05	<0.1%

1 For criterion greater than 1-hour, maximum concentration was extracted from all receptors including air quality receptors and HHIA receptors (Table 7-24). For criterion less or equal to 1-hour, maximum predicted concentration was extracted at or beyond the Project boundary.

7.4.1.3 Change in RCS

Exposure to RCS is an inhalation risk for livestock and human health receptors. Prior to the most recent version of EPA Publication 1961 (1961.2), RCS assessment related to air quality impacts often relied on $PM_{2.5}$ annual concentrations. This was largely because $PM_{2.5}$ represents the fine particulate matter fraction, which is most readily inhaled deep into the lungs where RCS can cause significant health issues (like silicosis).

In the recently updated EPA Publication 1961.2, "*EPA recommends assessment of RCS in the PM_{10} fraction as a precautionary approach to ensure protection of ambient air and to reflect the weight of evidence on health effects associated with respirable particles in occupational health and safety assessments*". This change in assessment reflects that PM_{10} captures a broader range of respirable particles. Since RCS can exist in various particle sizes within the respirable range, using PM_{10} as the size fraction for RCS assessment provides a more precautionary and highly conservative approach to protect public health.

In this air quality assessment the predicted concentrations of RCS are considered to be an overestimate as:

- RCS concentrations were assumed as 100% of PM_{10}
- The use of PM_{10} as the size fraction of RCS in accordance with EPA Publication 1961. is a conservative and precautionary approach, which is likely to overstate the risk to human health as it is typically in the $PM_{2.5}$ fraction that the RCS can penetrate deep into the lung.

Table 7-32 summarises RCS prediction results at air quality receptors. Further assessment of risk of RCS was investigated in the HHIA report in Appendix D.

Table 7-32 also compares the change in risk of Scenario 1 versus Scenario 2 using a percent difference approach. This metric broadly represents the relative improvement in RCS exposure between the existing case (Scenario 1) versus the proposed expansion (Scenario 2).

Table 7-28: Summary of RCS predictions for key receptors

Receptor	RCS (µg/m³) annual average – Scenario 1	RCS (µg/m³) annual average – Scenario 2	% Change (S2/S1)
AQ_1	3.87	1.59	-76%
AQ_2	3.77	1.55	-74%
AQ_3	3.56	1.45	-70%
AQ_4	3.31	1.33	-66%
AQ_5	3.12	1.23	-63%
AQ_6	2.58	1.00	-53%
AQ_7	2.20	0.85	-45%
AQ_8	1.75	0.64	-37%
AQ_9	1.35	0.48	-29%
AQ_10	0.89	0.33	-19%
AQ_11	1.75	0.69	-36%
AQ_12	2.26	0.86	-47%
AQ_13	2.89	1.05	-61%
AQ_14	3.35	1.16	-73%
AQ_15	3.29	1.07	-74%
AQ_16	3.11	0.98	-71%
AQ_17	3.31	1.00	-77%
AQ_18	2.93	0.88	-68%

Receptor	RCS (µg/m³) annual average – Scenario 1	RCS (µg/m³) annual average – Scenario 2	% Change (S2/S1)
AQ_19	2.75	0.83	-64%
AQ_20	3.23	1.01	-74%
AQ_21	3.09	0.98	-71%
AQ_22	3.35	0.88	-82%
AQ_23	2.57	0.66	-63%
AQ_24	1.67	0.48	-40%
AQ_25	1.24	0.38	-29%
AQ_26	1.20	0.35	-28%
APAC		**3.0**	

7.4.2 Scenario 2 - PM results summary

The results for Scenario 2 were combined with the background concentration which occurred on the day of the maximum predicted concentration to determine the cumulative impact on the surrounding sensitive receptors of the proposed development.

The highest maximum predicted 24-hr PM_{10} concentrations for Scenario 2 is observed at AQ_2 receptor location with Project contribution of 18 µg/m³ and cumulative concentration of 39 µg/m³(Table 7-29). This cumulative impact is below the 24-hr PM_{10} APAC (50 µg/m³).

The highest maximum predicted 24-hr average for $PM_{2.5}$ concentration is predicted at AQ_3, with project contribution of 2.65 µg/m³, whereas the highest cumulative concentration of 11.91 µg/m³ is observed at receptor AQ_17, therefore not exceeding the APAC of 25 µg/m³.

As presented in Table 7-30, annual average cumulative concentration for both PM_{10} and $PM_{2.5}$ are also not predicted to exceed their respective APAC, 20 µg/m³ and 8 µg/m³ at the air quality receptors. Appendix A presents the predicted concentrations at other receptors and show that the criteria are also not predicted to be exceeded. Further risk was assessed in the HHIA assessment (Appendix D).

Table 7-29: Cumulative 24-hr PM_{10} and $PM_{2.5}$ predicted concentration

ID	24-hr Average PM_{10} (µg/m3)		24-hr Average PM_{25}(µg/m3)	
	Maximum predicted	Cumulative concentration	Maximum predicted	Cumulative concentration
AQ_1	17.85	39.02	2.47	5.37
AQ_2	18.29	39.45	2.61	5.51
AQ_3	17.80	38.96	2.65	5.55
AQ_4	16.40	37.57	2.55	5.45
AQ_5	14.94	36.11	2.43	5.33
AQ_6	12.36	27.55	1.78	6.01
AQ_7	11.23	26.42	1.67	5.90
AQ_8	9.20	24.20	1.32	5.55
AQ_9	7.78	22.78	1.10	5.33
AQ_10	4.75	21.64	0.69	2.95
AQ_11	7.26	20.09	0.99	5.97
AQ_12	8.56	21.39	1.46	6.44
AQ_13	9.67	18.15	2.10	7.08
AQ_14	10.48	20.67	1.81	7.51
AQ_15	9.74	19.93	1.39	6.18
AQ_16	8.83	19.02	1.26	4.31
AQ_17	14.25	28.74	2.09	11.91
AQ_18	13.20	27.69	2.02	11.84
AQ_19	12.38	26.87	1.92	7.68
AQ_20	12.07	20.31	1.69	11.50
AQ_21	11.67	19.92	1.63	3.26

ID	24-hr Average PM_{10} (µg/m3)		24-hr Average PM_{25}(µg/m3)	
	Maximum predicted	Cumulative concentration	Maximum predicted	Cumulative concentration
AQ_22	11.59	26.74	1.83	7.40
AQ_23	10.01	26.36	1.69	5.23
AQ_24	8.42	24.77	1.45	4.99
AQ_25	7.33	23.69	1.10	4.64
AQ_26	7.18	23.54	1.15	5.60

Table 7-30: Cumulative annual PM_{10} and $PM_{2.5}$ predicted concentration

ID	Annual Average PM_{10} (µg/m3)		Annual Average PM_{25}(µg/m3)	
	Model predicted	Cumulative concentration	Model predicted	Cumulative concentration
AQ_1	1.59	17.53	0.21	5.31
AQ_2	1.55	17.48	0.21	5.31
AQ_3	1.45	17.38	0.20	5.30
AQ_4	1.33	17.27	0.18	5.28
AQ_5	1.23	17.17	0.17	5.27
AQ_6	1.00	16.93	0.14	5.24
AQ_7	0.85	16.79	0.12	5.22
AQ_8	0.64	16.57	0.09	5.19
AQ_9	0.48	16.41	0.07	5.17
AQ_10	0.33	16.27	0.05	5.15
AQ_11	0.69	16.62	0.10	5.20
AQ_12	0.86	16.79	0.13	5.23
AQ_13	1.05	16.99	0.16	5.26
AQ_14	1.16	17.09	0.18	5.28
AQ_15	1.07	17.01	0.17	5.27
AQ_16	0.98	16.92	0.15	5.25
AQ_17	1.00	16.93	0.15	5.25
AQ_18	0.88	16.81	0.13	5.23
AQ_19	0.83	16.76	0.13	5.23
AQ_20	1.01	16.94	0.15	5.25
AQ_21	0.98	16.91	0.14	5.24
AQ_22	0.88	16.81	0.14	5.24
AQ_23	0.66	16.60	0.10	5.20
AQ_24	0.48	16.41	0.07	5.17
AQ_25	0.38	16.31	0.05	5.15
AQ_26	0.35	16.28	0.05	5.15

7.4.3 Metals results - Scenario 2

Whilst the APACs for metals and metal compounds are, for the most part cumulative, in reality background concentrations of metals in the ambient environment are not routinely measured. Consequently, in practice, the predicted concentrations are assessed incrementally rather than cumulatively as in most cases the background concentrations of these compounds can be assumed to be zero. All metals prediction results for each receptor group are found in Appendix B.

All predicted metals and metals compounds predictions were less than 1% of their relevant APAC as presented in Table 7-27. In accordance with EPA Publication 1961.2 where the change in air quality is less than 4 % of the relevant APAC, the change can be considered not to be significant. These results therefore represent a very low to negligible risks to air quality due to metals in dust for proposed activities developed in Scenario 2.

Table 7-31: Summary of metal predicted concentrations at receptors – Scenario 2

Indicators	Averaging period	APAC (µg/m³)	Max at AQ receptors (µg/m³)	% of APAC	Max all receptors (µg/m³)[1]	% of APAC
Antimony and antimony compounds	24 hour	1	5.6E-06	<0.1%	1.1E-05	<0.1%
	Annual	0.3	2.9E-07	<0.1%	1.5E-06	<0.1%
Arsenic and arsenic compounds	1 hour	9.9	4.2E-05	<0.1%	4.6E-04	<0.1%
	1 year	0.015	3.7E-07	<0.1%	1.9E-06	<0.1%
	1 year (incremental)	0.007	3.7E-07	<0.1%	1.9E-06	<0.1%
Barium and barium compounds	1 hour	5	2.9E-04	<0.1%	3.1E-03	<0.1%
Beryllium and beryllium compounds	Annual	0.001	9.4E-08	<0.1%	4.7E-07	<0.1%
Cadmium and cadmium compounds	1 hour	18	6.5E-06	<0.1%	7.1E-05	<0.1%
	24 hours	0.03	1.1E-06	<0.1%	2.1E-06	<0.1%
	Annual	0.005	5.9E-08	<0.1%	2.9E-07	<0.1%
Chromium (hexavalent)[1]	1 hour	1.3	3.7E-04	<0.1%	6.2E-03	0.5%
	1 year	0.005	8.7E-06	0.2%	2.6E-05	0.5%
Chromium (trivalent)[1]	30 days	0.1	1.9E-04	0.2%	1.9E-04	0.2%
Copper and copper compounds	1 hour	10	6.4E-05	<0.1%	7.0E-04	<0.1%
Lead and lead compounds	1 year	0.5	1.8E-06	<0.1%	9.1E-06	<0.1%
Manganese and manganese compounds	1 hour	9.1	5.0E-04	<0.1%	5.5E-03	<0.1%
	Annual	0.15	4.5E-06	<0.1%	2.3E-05	<0.1%
Mercury and mercury compounds	1 year	1	5.9E-09	<0.1%	2.9E-08	<0.1%
Nickel and nickel compounds	1 hour	0.2	5.7E-05	<0.1%	6.3E-04	0.3%
	Annual	0.01	5.1E-07	<0.1%	2.6E-06	<0.1%
Silver and silver compounds	1 hour	0.1	1.3E-05	<0.1%	1.4E-04	0.1%
Zinc and zinc compounds	1 hour	20	2.8E-04	<0.1%	3.0E-03	<0.1%
	Annual	2	2.5E-06	<0.1%	1.2E-05	<0.1%

11 For criterion greater than 1-hour, maximum concentration was extracted from all receptors including air quality receptors and HHIA receptors (Table 7-24). For criterion less or equal to 1-hour, maximum predicted concentration was extracted at or beyond the Project boundary.

7.4.4 RCS summary – Scenario 2

APACs for Respirable Crystalline Silica is incremental rather than cumulative because in most cases the background RCS concentrations can be assumed to be zero. RCS predictions for each receptor group are found in Appendix B.

Table 7-32 summarises RCS predicted results at air quality receptors assessed as 100% PM_{10} annual average for Scenario 2 operations. Further risk associated with RCS was assesses as part of the HHIA assessment (Appendix D).

Table 7-32: Summary of RCS) predictions for key receptors

Receptor	RCS (µg/m³) annual average – Scenario 2	% of APAC
AQ_1	1.59	53%

Receptor	RCS (µg/m³) annual average – Scenario 2	% of APAC
AQ_2	1.55	52%
AQ_3	1.45	48%
AQ_4	1.33	44%
AQ_5	1.23	41%
AQ_6	1.00	33%
AQ_7	0.85	28%
AQ_8	0.64	21%
AQ_9	0.48	16%
AQ_10	0.33	11%
AQ_11	0.69	23%
AQ_12	0.86	29%
AQ_13	1.05	35%
AQ_14	1.16	39%
AQ_15	1.07	36%
AQ_16	0.98	33%
AQ_17	1.00	33%
AQ_18	0.88	29%
AQ_19	0.83	28%
AQ_20	1.01	34%
AQ_21	0.98	33%
AQ_22	0.88	29%
AQ_23	0.66	22%
AQ_24	0.48	16%
AQ_25	0.38	13%
AQ_26	0.35	12%
	APAC	3.0

7.5 Summary of HHIA findings

A Human Health Impact Assessment (HHIA) was carried out to evaluate potential health risks to the community near Langwarrin Quarry. This assessment covered both current operations and future plans for the quarry. The HHIA followed the guidelines set by the Environmental Health Standing Committee (enHealth), specifically their environmental health Impact Assessment and health impact assessment guidelines, as well as the Victorian Environment Protection Authority (EPA) Guidance 1961 for assessing and minimising air pollution. The assessment determined that the potential health risks linked to the project are low and acceptable.

The HHIA's findings were based on predicted ground-level air concentrations and deposition rates obtained from this Air Quality Impact Assessment (AQIA), which considered both existing and proposed quarry operations. The main potential health concerns were related to air and particulate emissions from quarrying activities.

The exposure pathways included the primary inhalation of air pollutants and potential deposition onto soils, leading to secondary exposure, which focused on the potential risks to residents, commercial workers, and recreational receptors in the surrounding areas. Secondary exposure pathways included risks associated with direct skin contact, the consumption of fruit and vegetables grown in local gardens, and the consumption of eggs from backyard chickens. An assessment of a conservative residential scenario, where 100% of fruit and vegetable intake was from a home garden, also indicated low and acceptable risks.

The scope of the HHIA was subject to specific boundaries and limitations that include:

- The assessment was focused on potential chronic (long-term) health impacts. Potential impacts from acute (short-term) exposures or non-standard events, such as process upset conditions, were not assessed.
- The assessment considered potential health risks to off-site human receptors only, including nearby residents and workers, and recreational users of adjacent facilities. Risks to Heidelberg Materials workers within the project boundary were excluded from the scope of the HHIA.
- A quantitative cumulative impact assessment, incorporating emissions from neighbouring industrial facilities, was not conducted due to a lack of available data. However, a qualitative evaluation was undertaken, which concluded that a significant margin of safety exists to account for potential cumulative impacts.
- The assessment acknowledged certain data gaps, such as limited local background monitoring data for specific metals and respirable crystalline silica (RCS) and the chemical characterisation of rehabilitation soils.

In summary, the HHIA has concluded that the potential health risks to human health as a result of the Project are low and acceptable for all surrounding receptors for both baseline and proposed future operations. The existing community health indicators were either consistent with or below the Victorian average for the criteria reviewed. A qualitative assessment indicated a significant margin of safety to account for potential cumulative impacts from surrounding quarry operations.

8 RECOMMENDATIONS AND CONCLUSIONS

The intent of the study was to:

- Compare the contributions from Scenario 1 (current operations) with Scenario 2 (Proposed Operations) to determine whether the change in concentration was greater than 4 % of the relevant standard, which is the level of change, specified in EPA Publication 1961.2, below which any change is considered non-significant.
- Compare impacts including background from Scenario 2 to the air pollution assessment criteria (APAC) contained in EPA Publication 1961.2 and the Environment Reference Standard Objectives for relevant residual emissions.

8.1 Expected change in contribution to sensitive receptors

The observed reductions in predicted concentrations of particulates and metals, including PM_{10}, $PM_{2.5}$, and RCS under Scenario 2 operations indicate a clear and positive change in air quality contributions to sensitive receptors. Crucially, these reductions were directly attributable to the implementation of additional dust control measures integrated to the Scenario 2 operations.

The primary objective of this assessment of quantifying this change relative to current operations (Scenario 1) was to determine its significance as per EPA Publication 1961.2, which defines a non-significant change as being below 4% of the relevant standard. Given the predicted reductions in ground level concentrations, it is anticipated that the change in predicted contribution from the proposed operations (Scenario 2) will likely fall below this 4% threshold for many receptors, signifying a non-significant, but environmentally beneficial, alteration to baseline air quality.

8.2 Scenario 2

Results of the PM_{10} and RCS modelling for Scenario 2 indicate the following:

1. Although the proposed quarrying area for the expansion would occur closer to receptors; potential exposure to inhalation risks from PM_{10} and RSC decrease. In many cases the median improvement in receptors exposure to PM_{10} and RCS in S2 compared to S1is >75%.
2. In Scenario 2 there are no predicted exceedances of the 24-hr APAC for PM_{10} or $PM_{2.5}$. This includes the cumulative effects of Scenario 2 emissions and background PM_{10} (and $PM_{2.5}$ in 2023).
3. Lower exposure to PM and RCS at sensitive receptors occurs in Scenario 2 because Heidelberg has committed to the following as part of the proposed expansion:
   a. Using a low-dust quarrying method; i.e., dredging and piping of a slurry;
   b. Installing a venturi scrubber on the drying equipment (i.e., 99.9% removal efficiency);
   c. Implementing additional controls for dust; e.g., Level 2 watering where rainfall is < 2 mm or soil evaporation is greater than 2 mm and continuous road watering during hot, dry, and/or windy conditions.
4. The Scenario 2 prediction are uncertain for the following reasons:
   a. Its representativeness depends on the effective implementation of the proposed controls (see previous conclusion);
   b. There are no local air quality measurements with which to assess background PM_{10} or RSC concentrations; or, potential cumulative effects from other local sources of PM_{10} and RSC.
   c. No attempt has been made to account for the cumulative effects of emissions from surrounding land uses; i.e., other rock and sand quarries.

Based on the results of the air quality assessment it is concluded that air quality impacts from the proposed Work Plan variation meet the relevant APAC criteria and residual impacts are likely: *very low to negligible*. Therefore, a separation distance variation for the Work Plan variation may be appropriate.

Since adequate mitigation of PM and RCS risks depend on the efficacy of the Heidelberg's proposed dust mitigation measures, Zephyr recommends the following:

- Air quality monitoring for PM_{10} and RCS should be undertaken (e.g., using a small network of low-cost sensors) along with on-site meteorology measurements to:
  - Measure air quality under existing conditions at the property boundary;
  - Help to improve the management of on-site dust sources;
  - Help to determine the magnitude of cumulative impacts associated with PM and RCS emissions from the neighbouring land uses (e.g., livestock operations and other sand and rock quarries); and
  - To help validate the Scenario 2 air quality model predictions.
- Heidelberg develop and implement a robust trigger-action-response plan for air quality (dust and RSC). When integrated with a dust monitoring network, this will enable Heidelberg to remain proactive about dust prevention, but also appropriately reactive when either visible dust, or dust at concentrations that could lead to APAC exceedances have been observed.

8.3 Separation Distance Variation

Based on the results of the air quality assessment it is concluded that:

- A variation for the separation distance for the existing operations is not warranted as air quality impacts indicate the potential for exceedance of the 24-hr APACs for PM_{10} and $PM_{2.5}$.
- Air quality impacts from the proposed Work Plan variation meet the relevant APAC criteria and therefore residual impacts are likely: *very low to negligible*.

The air quality impact assessment showed that Scenario 2 impacts, even when cumulatively assessed with background concentrations, remain below their respective Air Pollution Assessment Criteria (APACs). While the magnitude of this change, observed as a reduction in concentrations, may exceed the 4% threshold for non-significance relative to the relevant standard, it represents a measurable and beneficial improvement in air quality. This positive outcome, with all cumulative impacts also confirmed to be below APAC, ultimately translates to a reduced exposure risk and an improved air quality environment for sensitive receptors.

Based on the outcomes of this Air Quality Impact Assessment (AQIA) and the positive determination of risk at receptors within the Human Health Impact Assessment (HHIA) report, a separation distance variation for the Work Plan is therefore deemed appropriate, allowing for its reduction to between the site boundary and the nearest sensitive receptors.

9 APPENDIX A

PM_{10} and $PM_{2.5}$ PREDICTED CONCENTRATIONS * AT RECEPTORS

Table 9-1: Scenario 1 and Scenario 2 operations (Project contribution only)– maximum predicted 24 hour average PM_{10} and $PM_{2.5}$ contributions to specific model receptors -

ID	X	Y	PM_{10} (µg/m³)		$PM_{2.5}$ (µg/m³)	
			Scenario 1	Scenario 2	Scenario 1	Scenario 2
AQ_1	341740	5778858	42.63	17.85	11.94	2.47
AQ_2	341778	5778850	43.73	18.29	12.51	2.61
AQ_3	341825	5778848	42.73	17.80	12.68	2.65
AQ_4	341870	5778845	39.97	16.40	12.64	2.55
AQ_5	341902	5778837	37.29	14.94	12.73	2.43
AQ_6	342010	5778829	28.17	11.78	9.79	1.78
AQ_7	342084	5778811	25.00	10.73	7.20	1.67
AQ_8	342193	5778845	21.01	9.20	7.23	1.32
AQ_9	342322	5778831	18.33	7.78	6.05	1.10
AQ_10	342532	5778320	12.37	4.75	5.29	0.69
AQ_11	342361	5777799	16.76	7.26	7.05	0.99
AQ_12	342281	5777752	20.23	8.56	9.50	1.46
AQ_13	342210	5777685	23.43	9.67	12.07	2.10
AQ_14	342169	5777616	24.76	10.48	13.09	1.81
AQ_15	342189	5777526	24.29	9.74	13.58	1.39
AQ_16	342215	5777429	26.60	8.83	16.12	1.26
AQ_17	342110	5777270	40.33	14.25	16.89	2.09
AQ_18	342088	5777186	40.84	13.20	19.91	2.02
AQ_19	342080	5777138	39.71	12.38	20.37	1.92
AQ_20	341919	5777041	33.36	12.07	19.68	1.69
AQ_21	341858	5776911	35.05	11.67	16.21	1.63
AQ_22	341550	5776819	46.26	11.59	27.69	1.83
AQ_23	341413	5776825	33.00	9.49	19.51	1.69
AQ_24	341296	5776839	30.98	7.84	19.14	1.45
AQ_25	341153	5776866	22.71	6.71	11.86	1.10
AQ_26	341034	5776871	22.41	6.61	12.75	1.15
HHRA01	341685	5778777	44.09	17.94	14.53	2.44
HHRA02	341953	5778816	32.21	12.62	11.64	2.05
HHRA03	342085	5778715	26.33	11.21	9.53	1.66
HHRA04	341848	5778690	45.95	19.91	14.17	3.49
HHRA05	341886	5778726	40.10	16.91	12.97	2.91
HHRA06	341939	5778757	33.29	14.04	11.80	2.21
HHRA07	341750	5778759	49.74	20.49	14.68	2.94

ID	X	Y	PM10 (µg/m³)		PM2.5 (µg/m³)	
			Scenario 1	Scenario 2	Scenario 1	Scenario 2
HHRA08	341815	5778752	47.92	19.94	14.62	3.09
HHRA09	342004	5778746	30.49	12.68	10.60	2.05
HHRA10	341931	5778839	34.45	13.51	12.41	2.23
HHRA11	341642	5778762	48.27	19.00	15.47	2.36
HHRA12	342163	5778296	25.27	10.16	10.35	1.48
HHRA13	341824	5778192	57.28	25.76	17.44	4.40
HHRA14	341977	5778289	36.84	16.26	11.39	2.48
HHRA15	342274	5778665	20.26	8.11	7.20	1.16
HHRA16	341460	5778691	47.82	18.95	15.46	2.54
HHRA17	341400	5778693	47.55	19.68	13.68	3.01
HHRA18	341294	5778759	43.61	19.18	10.86	2.87
HHRA19	341238	5778728	47.19	20.56	11.84	2.95
HHRA20	341202	5778839	39.90	17.36	10.11	2.43
HHRA21	341133	5778741	45.92	19.71	12.32	2.73
HHRA22	341088	5778742	46.25	19.05	13.41	2.71
HHRA23	341339	5778578	55.83	25.29	15.85	3.90
HHRA24	341558	5778728	50.99	20.07	16.33	2.60
HHRA25	342490	5778357	13.19	4.89	5.92	0.75
GC_1	340279	5777737	18.42	7.36	10.00	1.03
GC_2	340291	5777829	18.55	7.19	11.39	1.00
GC_3	340304	5777953	20.66	8.11	10.99	0.95
GC_4	340351	5778073	24.19	9.61	11.55	1.21
GC_5	340416	5778203	31.07	12.07	16.92	1.51
GC_6	340508	5778348	35.42	14.08	15.91	1.97
GC_7	340623	5778543	37.72	16.16	11.96	2.29
GC_L_8	340067	5778651	20.27	7.58	9.39	1.08
GC_L_9	340117	5778913	20.59	8.32	6.65	1.19
GC_L_10	339941	5778963	17.52	6.65	6.34	0.94
GC_11	339454	5779459	11.04	4.26	3.91	0.63
GC_12	340095	5777883	16.63	5.41	9.47	0.68

Table 9-2: Scenario 1 and Scenario 2 operations (Project contribution only)– Annual average PM_{10} and $PM_{2.5}$ contributions to specific model receptors -

ID	X	Y	PM_{10} (µg/m³)		$PM_{2.5}$ (µg/m³)	
			Scenario 1	Scenario 2	Scenario 1	Scenario 2
AQ_1	341740	5778858	3.87	1.59	1.16	0.21
AQ_2	341778	5778850	3.77	1.55	1.15	0.21
AQ_3	341825	5778848	3.56	1.45	1.12	0.20
AQ_4	341870	5778845	3.31	1.33	1.08	0.18
AQ_5	341902	5778837	3.12	1.23	1.06	0.17
AQ_6	342010	5778829	2.58	1.00	0.91	0.14
AQ_7	342084	5778811	2.20	0.85	0.77	0.12
AQ_8	342193	5778845	1.75	0.64	0.68	0.09
AQ_9	342322	5778831	1.35	0.48	0.56	0.07
AQ_10	342532	5778320	0.89	0.33	0.35	0.05
AQ_11	342361	5777799	1.75	0.69	0.61	0.10
AQ_12	342281	5777752	2.26	0.86	0.83	0.13
AQ_13	342210	5777685	2.89	1.05	1.15	0.16
AQ_14	342169	5777616	3.35	1.16	1.46	0.18
AQ_15	342189	5777526	3.29	1.07	1.57	0.17
AQ_16	342215	5777429	3.11	0.98	1.56	0.15
AQ_17	342110	5777270	3.31	1.00	1.74	0.15
AQ_18	342088	5777186	2.93	0.88	1.55	0.13
AQ_19	342080	5777138	2.75	0.83	1.46	0.13
AQ_20	341919	5777041	3.23	1.01	1.63	0.15
AQ_21	341858	5776911	3.09	0.98	1.54	0.14
AQ_22	341550	5776819	3.35	0.88	1.98	0.14
AQ_23	341413	5776825	2.57	0.66	1.51	0.10
AQ_24	341296	5776839	1.67	0.48	0.90	0.07
AQ_25	341153	5776866	1.24	0.38	0.64	0.05
AQ_26	341034	5776871	1.20	0.35	0.63	0.05
HHRA01	341685	5778777	4.36	1.79	1.34	0.24
HHRA02	341953	5778816	2.90	1.14	1.01	0.16
HHRA03	342085	5778715	2.26	0.83	0.89	0.12
HHRA04	341848	5778690	4.17	1.79	1.30	0.27
HHRA05	341886	5778726	3.67	1.52	1.18	0.22
HHRA06	341939	5778757	3.16	1.26	1.07	0.18
HHRA07	341759	5778759	4.36	1.81	1.34	0.25

ID	X	Y	PM10 (µg/m³)		PM2.5 (µg/m³)	
			Scenario 1	Scenario 2	Scenario 1	Scenario 2
HHRA08	341815	5778752	4.07	1.69	1.28	0.24
HHRA09	342004	5778746	2.71	1.04	0.99	0.15
HHRA10	341931	5778839	2.94	1.14	1.03	0.16
HHRA11	341642	5778762	4.61	1.90	1.40	0.26
HHRA12	342163	5778296	2.28	0.86	0.91	0.14
HHRA13	341824	5778192	8.96	3.81	2.79	0.65
HHRA14	341977	5778289	4.03	1.62	1.45	0.26
HHRA15	342274	5778665	1.50	0.52	0.64	0.08
HHRA16	341460	5778691	5.79	2.42	1.62	0.31
HHRA17	341400	5778693	6.46	2.77	1.66	0.35
HHRA18	341294	5778759	5.68	2.46	1.44	0.32
HHRA19	341238	5778728	6.15	2.64	1.58	0.33
HHRA20	341202	5778839	4.82	2.05	1.29	0.26
HHRA21	341133	5778741	5.89	2.48	1.60	0.31
HHRA22	341088	5778742	5.86	2.44	1.63	0.31
HHRA23	341339	5778578	8.33	3.63	2.04	0.46
HHRA24	341558	5778728	5.22	2.17	1.52	0.28
HHRA25	342490	5778357	0.91	0.34	0.38	0.05
GC_1	340279	5777737	1.81	0.40	1.19	0.07
GC_2	340291	5777829	2.20	0.50	1.43	0.08
GC_3	340304	5777953	2.70	0.68	1.62	0.10
GC_4	340351	5778073	3.48	1.00	1.84	0.14
GC_5	340416	5778203	4.49	1.50	1.95	0.20
GC_6	340508	5778348	5.41	2.01	1.93	0.25
GC_7	340623	5778543	5.31	2.04	1.76	0.25
GC_L_8	340067	5778651	2.75	1.00	1.03	0.13
GC_L_9	340117	5778913	2.48	0.92	0.90	0.12
GC_L_10	339941	5778963	2.06	0.75	0.77	0.10
GC_11	339454	5779459	1.19	0.42	0.46	0.05
GC_12	340095	5777883	1.76	0.41	1.13	0.07

Table 9-3: Scenario 2 operations – Cumulative Maximum predicted 24 hour PM_{10} and $PM_{2.5}$ concentration at specific model receptors

ID	X	Y	PM_{10} (µg/m³) Background	PM_{10} (µg/m³) Model (Max)	PM_{10} (µg/m³) Total	$PM_{2.5}$ (µg/m³) Background	$PM_{2.5}$ (µg/m³) Model (Max)	$PM_{2.5}$ (µg/m³) Total
AQ_1	341740	5778858	21	18	39	2.9	2.5	5.4
AQ_2	341778	5778850	21	18	39	2.9	2.6	5.5
AQ_3	341825	5778848	21	18	39	2.9	2.6	5.5
AQ_4	341870	5778845	21	16	38	2.9	2.6	5.5
AQ_5	341902	5778837	21	15	36	2.9	2.4	5.3
AQ_6	342010	5778829	15	12	28	4.2	1.8	6.0
AQ_7	342084	5778811	15	11	26	4.2	1.7	5.9
AQ_8	342193	5778845	15	9	24	4.2	1.3	5.5
AQ_9	342322	5778831	15	8	23	4.2	1.1	5.3
AQ_10	342532	5778320	17	5	22	2.3	0.7	3.0
AQ_11	342361	5777799	13	7	20	5.0	1.0	6.0
AQ_12	342281	5777752	13	9	21	5.0	1.5	6.4
AQ_13	342210	5777685	8	10	18	5.0	2.1	7.1
AQ_14	342169	5777616	10	10	21	5.7	1.8	7.5
AQ_15	342189	5777526	10	10	20	4.8	1.4	6.2
AQ_16	342215	5777429	10	9	19	3.1	1.3	4.3
AQ_17	342110	5777270	14	14	29	9.8	2.1	12
AQ_18	342088	5777186	14	13	28	9.8	2.0	12
AQ_19	342080	5777138	14	12	27	5.8	1.9	7.7
AQ_20	341919	5777041	8	12	20	9.8	1.7	12
AQ_21	341858	5776911	8	12	20	1.6	1.6	3.3
AQ_22	341550	5776819	15	12	27	5.6	1.8	7.4
AQ_23	341413	5776825	16	10	26	3.5	1.7	5.2
AQ_24	341296	5776839	16	8	25	3.5	1.4	5.0
AQ_25	341153	5776866	16	7	24	3.5	1.1	4.6
AQ_26	341034	5776871	16	7	24	4.4	1.2	5.6
HHRA01	341685	5778777	21	18	39	6.4	2.4	8.9
HHRA02	341953	5778816	15	13	28	4.2	2.1	6.3
HHRA03	342085	5778715	15	11	26	4.2	1.7	5.9
HHRA04	341848	5778690	21	20	41	2.9	3.5	6.4
HHRA05	341886	5778726	21	17	38	4.2	2.9	7.1

ID	X	Y	PM$_{10}$ (µg/m^3)			PM$_{2.5}$ (µg/m^3)		
			Background	Model (Max)	Total	Background	Model (Max)	Total
HHRA06	341939	5778757	15	15	30	4.2	2.2	6.4
HHRA07	341750	5778759	21	20	42	2.9	2.9	5.8
HHRA08	341815	5778752	21	20	41	2.9	3.1	6.0
HHRA09	342004	5778746	15	13	28	4.2	2.0	6.3
HHRA10	341931	5778839	21	14	35	2.9	2.2	5.1
HHRA11	341642	5778762	16	19	35	6.4	2.4	8.8
HHRA12	342163	5778296	15	10	26	2.3	1.5	3.7
HHRA13	341824	5778192	17	26	43	6.8	4.4	11
HHRA14	341977	5778289	15	16	32	2.3	2.5	4.7
HHRA15	342274	5778665	15	8	23	4.2	1.2	5.4
HHRA16	341460	5778691	20	19	39	7.2	2.5	9.8
HHRA17	341400	5778693	20	20	40	10	3.0	13
HHRA18	341294	5778759	11	19	30	10	2.9	13
HHRA19	341238	5778728	11	21	31	10	3.0	13
HHRA20	341202	5778839	11	17	28	10	2.4	12
HHRA21	341133	5778741	11	20	30	10	2.7	13
HHRA22	341088	5778742	23	19	42	10	2.7	13
HHRA23	341339	5778578	18	25	43	7	3.9	11
HHRA24	341558	5778728	16	20	36	6.4	2.6	9.0
HHRA25	342490	5778357	15	5	20	2.3	0.8	3.0
GC_1	340279	5777737	22	7	29	7.3	1.0	8.3
GC_2	340291	5777829	22	7	29	7.3	1.0	8.3
GC_3	340304	5777953	18	8	26	7.3	1.0	8.3
GC_4	340351	5778073	18	10	28	7.3	1.2	8.5
GC_5	340416	5778203	19	12	32	7	1.5	8.8
GC_6	340508	5778348	18	14	32	7.3	2.0	9.3
GC_7	340623	5778543	19	16	35	12.3	2.3	15
GC_L_8	340067	5778651	22	8	29	12	1.1	13
GC_L_9	340117	5778913	19	8	27	12.3	1.2	13
GC_L_10	339941	5778963	19	7	25	12.3	0.9	13
GC_11	339454	5779459	19	4	23	12.3	0.6	13
GC_12	340095	5777883	18	5	24	7.3	0.7	8.0

Table 9-4: Scenario 2 operations – Cumulative Annual average PM_{10} and $PM_{2.5}$ concentration at specific model receptors

ID	X	Y	PM_{10} (µg/m³) Maximum predicted	PM_{10} (µg/m³) Cumulative concentration	$PM_{2.5}$ (µg/m³) Maximum predicted	$PM_{2.5}$ (µg/m³) Cumulative concentration
AQ_1	341740	5778858	1.59	17.53	0.21	5.31
AQ_2	341778	5778850	1.55	17.48	0.21	5.31
AQ_3	341825	5778848	1.45	17.38	0.20	5.30
AQ_4	341870	5778845	1.33	17.27	0.18	5.28
AQ_5	341902	5778837	1.23	17.17	0.17	5.27
AQ_6	342010	5778829	1.00	16.93	0.14	5.24
AQ_7	342084	5778811	0.85	16.79	0.12	5.22
AQ_8	342193	5778845	0.64	16.57	0.09	5.19
AQ_9	342322	5778831	0.48	16.41	0.07	5.17
AQ_10	342532	5778320	0.33	16.27	0.05	5.15
AQ_11	342361	5777799	0.69	16.62	0.10	5.20
AQ_12	342281	5777752	0.86	16.79	0.13	5.23
AQ_13	342210	5777685	1.05	16.99	0.16	5.26
AQ_14	342169	5777616	1.16	17.09	0.18	5.28
AQ_15	342189	5777526	1.07	17.01	0.17	5.27
AQ_16	342215	5777429	0.98	16.92	0.15	5.25
AQ_17	342110	5777270	1.00	16.93	0.15	5.25
AQ_18	342088	5777186	0.88	16.81	0.13	5.23
AQ_19	342080	5777138	0.83	16.76	0.13	5.23
AQ_20	341919	5777041	1.01	16.94	0.15	5.25
AQ_21	341858	5776911	0.98	16.91	0.14	5.24
AQ_22	341550	5776819	0.88	16.81	0.14	5.24
AQ_23	341413	5776825	0.66	16.60	0.10	5.20
AQ_24	341296	5776839	0.48	16.41	0.07	5.17
AQ_25	341153	5776866	0.38	16.31	0.05	5.15
AQ_26	341034	5776871	0.35	16.28	0.05	5.15
HHRA01	341685	5778777	1.79	17.73	0.24	5.34
HHRA02	341953	5778816	1.14	17.07	0.16	5.26
HHRA03	342085	5778715	0.83	16.77	0.12	5.22
HHRA04	341848	5778690	1.79	17.73	0.27	5.37
HHRA05	341886	5778726	1.52	17.46	0.22	5.32
HHRA06	341939	5778757	1.26	17.19	0.18	5.28
HHRA07	341750	5778759	1.81	17.74	0.25	5.35
HHRA08	341815	5778752	1.69	17.63	0.24	5.34

ID	X	Y	PM10 (µg/m³) Maximum predicted	PM10 (µg/m³) Cumulative concentration	PM2.5 (µg/m³) Maximum predicted	PM2.5 (µg/m³) Cumulative concentration
HHRA09	342004	5778746	1.04	16.98	0.15	5.25
HHRA10	341931	5778839	1.14	17.08	0.16	5.26
HHRA11	341642	5778762	1.90	17.84	0.26	5.36
HHRA12	342163	5778296	0.86	16.79	0.14	5.24
HHRA13	341824	5778192	3.81	19.74	0.65	5.75
HHRA14	341977	5778289	1.62	17.55	0.26	5.36
HHRA15	342274	5778665	0.52	16.46	0.08	5.18
HHRA16	341460	5778691	2.42	18.35	0.31	5.41
HHRA17	341400	5778693	2.77	18.70	0.35	5.45
HHRA18	341294	5778759	2.46	18.39	0.32	5.42
HHRA19	341238	5778728	2.64	18.58	0.33	5.43
HHRA20	341202	5778839	2.05	17.98	0.26	5.36
HHRA21	341133	5778741	2.48	18.42	0.31	5.41
HHRA22	341088	5778742	2.44	18.38	0.31	5.41
HHRA23	341339	5778578	3.63	19.57	0.46	5.56
HHRA24	341558	5778728	2.17	18.10	0.28	5.38
HHRA25	342490	5778357	0.34	16.27	0.05	5.15
GC_1	340279	5777737	0.40	16.33	0.07	5.17
GC_2	340291	5777829	0.50	16.43	0.08	5.18
GC_3	340304	5777953	0.68	16.61	0.10	5.20
GC_4	340351	5778073	1.00	16.93	0.14	5.24
GC_5	340416	5778203	1.50	17.43	0.20	5.30
GC_6	340508	5778348	2.01	17.95	0.25	5.35
GC_7	340623	5778543	2.04	17.97	0.25	5.35
GC_L_8	340067	5778651	1.00	16.93	0.13	5.23
GC_L_9	340117	5778913	0.92	16.85	0.12	5.22
GC_L_10	339941	5778963	0.75	16.69	0.10	5.20
GC_11	339454	5779459	0.42	16.36	0.05	5.15
GC_12	340095	5777883	0.41	16.34	0.07	5.17

10 APPENDIX B

HEAVY METALS PREDICTED CONCENTRATION AT RECEPTORS

Table 10-1: Scenario 1 operations – maximum predicted metals and RCS concentration at specific model receptors

ID	Antimony (Sb)		Arsenic (As)			Barium (Ba)	Beryllium (Be)	Cadmium (Cd)			Chromium – Cr(VI)		Chromium – Cr(III)	Copper (Cu)	Lead (Pb)	Manganese (Mn)		Mercury (Hg)	Nickel (Ni)		Silver (Ag)	Zinc (Zn)	
	24-hr	Annual	1-hr	Annual	Annual (incr)	1-hr	Annual	1-hr	24-hr	Annual	1-hr	Annual	30 days	1-hr	Annual	1-hr	Annual	Annual	1-hr	Annual	1-hr	1-hr	Annual
AQ_1	6.3E-06	3.6E-07	6.5E-05	4.6E-07	4.6E-07	4.5E-04	1.2E-07	1.0E-05	1.3E-06	7.2E-08	7.6E-04	2.1E-05	4.7E-05	9.9E-05	2.3E-06	7.9E-04	5.6E-06	7.2E-09	8.9E-05	6.4E-07	2.0E-05	4.3E-04	3.1E-06
AQ_2	6.8E-06	3.6E-07	6.5E-05	4.6E-07	4.6E-07	4.5E-04	1.2E-07	1.0E-05	1.4E-06	7.2E-08	7.2E-04	2.1E-05	4.6E-05	1.0E-04	2.3E-06	7.9E-04	5.6E-06	7.2E-09	9.0E-05	6.4E-07	2.0E-05	4.4E-04	3.1E-06
AQ_3	7.0E-06	3.5E-07	6.5E-05	4.4E-07	4.4E-07	4.5E-04	1.1E-07	1.0E-05	1.4E-06	6.9E-08	7.4E-04	2.0E-05	4.3E-05	9.9E-05	2.2E-06	7.9E-04	5.4E-06	6.9E-09	8.9E-05	6.1E-07	2.0E-05	4.3E-04	3.0E-06
AQ_4	6.6E-06	3.3E-07	6.0E-05	4.2E-07	4.2E-07	4.1E-04	1.0E-07	9.4E-06	1.3E-06	6.5E-08	6.8E-04	1.8E-05	4.0E-05	9.2E-05	2.0E-06	7.3E-04	5.1E-06	6.5E-09	8.3E-05	5.7E-07	1.9E-05	4.0E-04	2.8E-06
AQ_5	6.2E-06	3.1E-07	6.2E-05	4.0E-07	4.0E-07	4.3E-04	9.9E-08	9.8E-06	1.2E-06	6.2E-08	7.1E-04	1.7E-05	3.7E-05	9.6E-05	1.9E-06	7.6E-04	4.8E-06	6.2E-09	8.6E-05	5.4E-07	2.0E-05	4.2E-04	2.6E-06
AQ_6	5.0E-06	2.5E-07	4.7E-05	3.2E-07	3.2E-07	3.2E-04	8.1E-08	7.3E-06	1.0E-06	5.1E-08	5.5E-04	1.4E-05	2.9E-05	7.2E-05	1.6E-06	5.7E-04	3.9E-06	5.1E-09	6.5E-05	4.4E-07	1.5E-05	3.1E-04	2.2E-06
AQ_7	4.8E-06	2.3E-07	5.0E-05	2.9E-07	2.9E-07	3.5E-04	7.3E-08	7.9E-06	9.5E-07	4.6E-08	5.9E-04	1.2E-05	2.7E-05	7.7E-05	1.4E-06	6.1E-04	3.6E-06	4.6E-09	6.9E-05	4.0E-07	1.6E-05	3.4E-04	2.0E-06
AQ_8	5.6E-06	1.8E-07	4.6E-05	2.3E-07	2.3E-07	3.2E-04	5.8E-08	7.2E-06	1.1E-06	3.6E-08	5.4E-04	9.7E-06	2.3E-05	7.1E-05	1.1E-06	5.6E-04	2.8E-06	3.6E-09	6.4E-05	3.2E-07	1.4E-05	3.1E-04	1.5E-06
AQ_9	4.0E-06	1.4E-07	3.8E-05	1.8E-07	1.8E-07	2.6E-04	4.5E-08	5.9E-06	8.0E-07	2.8E-08	4.1E-04	7.5E-06	1.8E-05	5.8E-05	8.9E-07	4.6E-04	2.2E-06	2.8E-09	5.2E-05	2.5E-07	1.2E-05	2.5E-04	1.2E-06
AQ_10	2.8E-06	1.6E-07	3.9E-05	2.1E-07	2.1E-07	2.7E-04	5.1E-08	6.1E-06	5.6E-07	3.2E-08	3.9E-04	5.0E-06	1.1E-05	6.0E-05	1.0E-06	4.7E-04	2.5E-06	3.2E-09	5.3E-05	2.8E-07	1.2E-05	2.6E-04	1.4E-06
AQ_11	6.2E-06	3.8E-07	4.2E-05	4.8E-07	4.8E-07	2.9E-04	1.2E-07	6.5E-06	1.2E-06	7.5E-08	4.0E-04	1.1E-05	6.4E-05	6.4E-05	2.4E-06	5.1E-04	5.8E-06	7.5E-09	5.8E-05	6.6E-07	1.3E-05	2.8E-04	3.2E-06
AQ_12	8.7E-06	5.0E-07	5.2E-05	6.4E-07	6.4E-07	3.6E-04	1.6E-07	8.1E-06	1.7E-06	1.0E-07	4.9E-04	1.4E-05	1.2E-04	7.9E-05	3.1E-06	6.3E-04	7.8E-06	1.0E-08	7.1E-05	8.8E-07	1.6E-05	3.5E-04	4.3E-06
AQ_13	1.1E-05	6.0E-07	6.6E-05	7.6E-07	7.6E-07	4.5E-04	1.9E-07	1.0E-05	2.1E-06	1.2E-07	6.3E-04	1.7E-05	2.1E-04	1.0E-04	3.7E-06	7.9E-04	9.3E-06	1.2E-08	9.0E-05	1.1E-06	2.0E-05	4.4E-04	5.1E-06
AQ_14	9.9E-06	6.2E-07	7.5E-05	8.0E-07	8.0E-07	5.2E-04	2.0E-07	1.2E-05	2.0E-06	1.2E-07	7.8E-04	2.0E-05	2.9E-04	1.1E-04	3.9E-06	9.1E-04	9.6E-06	1.2E-08	1.0E-04	1.1E-06	2.3E-05	5.0E-04	5.3E-06
AQ_15	8.7E-06	5.2E-07	8.2E-05	6.7E-07	6.7E-07	5.7E-04	1.7E-07	1.3E-05	1.7E-06	1.0E-07	8.3E-04	1.9E-05	3.3E-04	1.3E-04	3.3E-06	1.0E-03	8.1E-06	1.0E-08	1.1E-04	9.2E-07	2.6E-05	5.5E-04	4.5E-06
AQ_16	6.9E-06	4.3E-07	7.3E-05	5.5E-07	5.5E-07	5.0E-04	1.4E-07	1.1E-05	1.4E-06	8.6E-08	7.2E-04	1.8E-05	3.5E-04	1.1E-04	2.7E-06	8.8E-04	6.7E-06	8.6E-09	1.0E-04	7.6E-07	2.3E-05	4.9E-04	3.7E-06
AQ_17	5.0E-06	3.4E-07	4.5E-05	4.4E-07	4.4E-07	3.1E-04	1.1E-07	7.0E-06	1.0E-06	6.9E-08	6.3E-04	1.8E-05	4.9E-04	6.9E-05	2.2E-06	5.4E-04	5.3E-06	6.9E-09	6.2E-05	6.0E-07	1.4E-05	3.0E-04	2.9E-06
AQ_18	4.1E-06	3.0E-07	4.1E-05	3.8E-07	3.8E-07	2.8E-04	9.6E-08	6.4E-06	8.2E-07	6.0E-08	5.9E-04	1.6E-05	4.9E-04	6.3E-05	1.9E-06	5.0E-04	4.6E-06	6.0E-09	5.6E-05	5.3E-07	1.3E-05	2.7E-04	2.6E-06
AQ_19	3.6E-06	2.8E-07	4.0E-05	3.6E-07	3.6E-07	2.7E-04	9.1E-08	6.2E-06	7.1E-07	5.7E-08	5.5E-04	1.5E-05	4.8E-04	6.1E-05	1.8E-06	4.8E-04	4.4E-06	5.7E-09	5.5E-05	5.0E-07	1.2E-05	2.7E-04	2.4E-06
AQ_20	5.2E-06	3.6E-07	4.5E-05	4.6E-07	4.6E-07	3.1E-04	1.1E-07	7.1E-06	1.0E-06	7.1E-08	6.2E-04	1.8E-05	4.2E-04	6.9E-05	2.2E-06	5.5E-04	5.5E-06	7.1E-09	6.2E-05	6.3E-07	1.4E-05	3.0E-04	3.1E-06
AQ_21	5.0E-06	3.4E-07	4.9E-05	4.3E-07	4.3E-07	3.3E-04	1.1E-07	7.6E-06	9.9E-07	6.7E-08	7.0E-04	1.7E-05	3.2E-04	7.4E-05	2.1E-06	5.9E-04	5.2E-06	6.7E-09	6.7E-05	5.9E-07	1.5E-05	3.2E-04	2.9E-06
AQ_22	5.4E-06	2.9E-07	6.1E-05	3.7E-07	3.7E-07	4.2E-04	9.2E-08	9.5E-06	1.1E-06	5.7E-08	9.3E-04	1.8E-05	6.4E-05	9.3E-05	1.8E-06	7.3E-04	4.4E-06	5.7E-09	8.3E-05	5.0E-07	1.9E-05	4.1E-04	2.4E-06
AQ_23	7.0E-06	2.1E-07	4.8E-05	2.7E-07	2.7E-07	3.3E-04	6.7E-08	7.5E-06	1.4E-06	4.2E-08	7.9E-04	1.4E-05	4.7E-05	7.4E-05	1.3E-06	5.8E-04	3.3E-06	4.2E-09	6.6E-05	3.7E-07	1.5E-05	3.2E-04	1.8E-06
AQ_24	3.8E-06	1.5E-07	3.6E-05	2.0E-07	2.0E-07	2.5E-04	4.9E-08	5.6E-06	7.6E-07	3.1E-08	6.0E-04	9.1E-06	3.2E-05	5.5E-05	9.7E-07	4.3E-04	2.4E-06	3.1E-09	4.9E-05	2.7E-07	1.1E-05	2.4E-04	1.3E-06
AQ_25	3.2E-06	1.1E-07	3.2E-05	1.4E-07	1.4E-07	2.2E-04	3.5E-08	5.1E-06	6.4E-07	2.2E-08	5.0E-04	6.8E-06	3.9E-05	5.0E-05	6.9E-07	3.9E-04	1.7E-06	2.2E-09	4.4E-05	1.9E-07	1.0E-05	2.2E-04	9.4E-07
AQ_26	3.4E-06	1.0E-07	3.4E-05	1.3E-07	1.3E-07	2.3E-04	3.3E-08	5.2E-06	6.7E-07	2.1E-08	5.2E-04	6.5E-06	5.7E-05	5.1E-05	6.5E-07	4.1E-04	1.6E-06	2.1E-09	4.6E-05	1.8E-07	1.0E-05	2.2E-04	8.9E-07
APAC	**1.0**	**0.30**	**9.9**	**0.015**	**0.015**	**5.0**	**0.001**	**18**	**0.03**	**0.005**	**1.3**	**0.005**	**0.1**	**10**	**0.50**	**9.1**	**0.15**	**1.00**	**0.20**	**0.01**	**0.1**	**20**	**2**
Max	**1.1E-05**	**6.2E-07**	**8.2E-05**	**8.0E-07**	**8.0E-07**	**5.7E-04**	**2.0E-07**	**1.3E-05**	**2.1E-06**	**1.2E-07**	**9.3E-04**	**2.1E-05**	**4.9E-04**	**1.3E-04**	**3.9E-06**	**1.0E-03**	**9.6E-06**	**1.2E-08**	**1.1E-04**	**1.1E-06**	**2.6E-05**	**5.5E-04**	**5.3E-06**
Median	**5.5E-06**	**3.2E-07**	**4.8E-05**	**4.1E-07**	**4.1E-07**	**3.3E-04**	**1.0E-07**	**7.5E-06**	**1.1E-06**	**6.4E-08**	**6.2E-04**	**1.7E-05**	**5.2E-05**	**7.4E-05**	**2.0E-06**	**5.9E-04**	**4.9E-06**	**6.4E-09**	**6.6E-05**	**5.6E-07**	**1.5E-05**	**3.2E-04**	**2.7E-06**
% of APAC	**0.00%**	**0.00%**	**0.00%**	**0.01%**	**0.01%**	**0.01%**	**0.02%**	**0.00%**	**0.01%**	**0.00%**	**0.07%**	**0.42%**	**0.49%**	**0.00%**	**0.00%**	**0.01%**	**0.01%**	**0.00%**	**0.06%**	**0.01%**	**0.03%**	**0.00%**	**0.00%**
HHRA-01	7.6E-06	4.3E-07	8.9E-05	5.5E-07	5.5E-07	6.1E-04	1.4E-07	1.4E-05	1.5E-06	8.7E-08	9.7E-04	2.4E-05	5.3E-05	1.4E-04	2.7E-06	1.1E-03	6.7E-06	8.7E-09	1.2E-04	7.6E-07	2.8E-05	6.0E-04	3.7E-06
HHRA SR02	5.2E-06	2.9E-07	5.6E-05	3.7E-07	3.7E-07	3.9E-04	9.2E-08	8.8E-06	1.0E-06	5.7E-08	6.1E-04	1.6E-05	3.3E-05	8.6E-05	1.8E-06	6.8E-04	4.4E-06	5.7E-09	7.7E-05	5.0E-07	1.8E-05	3.8E-04	2.5E-06
HHRA-03	7.3E-06	2.5E-07	6.0E-05	3.2E-07	3.2E-07	4.1E-04	8.1E-08	9.3E-06	1.5E-06	5.1E-08	6.5E-04	1.3E-05	2.9E-05	9.1E-05	1.6E-06	7.2E-04	3.9E-06	5.1E-09	8.2E-05	4.5E-07	1.9E-05	4.0E-04	2.2E-06
HHRA-04	8.2E-06	4.7E-07	7.9E-05	6.0E-07	6.0E-07	5.4E-04	1.5E-07	1.2E-05	1.6E-06	9.3E-08	8.6E-04	2.3E-05	4.8E-05	1.2E-04	2.9E-06	9.6E-04	7.3E-06	9.3E-09	1.1E-04	8.2E-07	2.5E-05	5.3E-04	4.0E-06
HHRA-05	6.9E-06	4.0E-07	7.4E-05	5.1E-07	5.1E-07	5.1E-04	1.3E-07	1.1E-05	1.4E-06	7.9E-08	7.5E-04	2.0E-05	4.1E-05	1.1E-04	2.5E-06	8.9E-04	6.2E-06	7.9E-09	1.0E-04	7.0E-07	2.3E-05	4.9E-04	3.4E-06
HHRA-06	5.9E-06	3.3E-07	5.8E-05	4.2E-07	4.2E-07	4.0E-04	1.1E-07	9.1E-06	1.2E-06	6.6E-08	6.4E-04	1.8E-05	3.5E-05	8.9E-05	2.1E-06	7.1E-04	5.1E-06	6.6E-09	8.0E-05	5.8E-07	1.8E-05	3.9E-04	2.8E-06
HHRA-07	8.2E-06	4.5E-07	8.2E-05	5.8E-07	5.8E-07	5.6E-04	1.4E-07	1.3E-05	1.6E-06	9.1E-08	9.0E-04	2.4E-05	5.4E-05	1.3E-04	2.8E-06	1.0E-03	7.0E-06	9.1E-09	1.1E-04	8.0E-07	2.6E-05	5.5E-04	3.9E-06
HHRA-08	8.1E-06	4.3E-07	7.5E-05	5.5E-07	5.5E-07	5.1E-04	1.4E-07	1.2E-05	1.6E-06	8.6E-08	8.3E-04	2.3E-05	4.9E-05	1.1E-04	2.7E-06	9.0E-04	6.6E-06	8.6E-09	1.0E-04	7.5E-07	2.3E-05	5.0E-04	3.7E-06
HHRA-09	5.8E-06	2.9E-07	5.8E-05	3.7E-07	3.7E-07	4.0E-04	9.2E-08	9.0E-06	1.2E-06	5.7E-08	6.4E-04	1.5E-05	3.2E-05	8.9E-05	1.8E-06	7.0E-04	4.5E-06	5.7E-09	7.9E-05	5.1E-07	1.8E-05	3.9E-04	2.5E-06
HHRA-10	5.6E-06	2.9E-07	6.5E-05	3.7E-07	3.7E-07	4.4E-04	9.2E-08	1.0E-05	1.1E-06	5.8E-08	6.7E-04	1.6E-05	3.4E-05	9.9E-05	1.8E-06	7.8E-04	4.5E-06	5.8E-09	8.9E-05	5.1E-07	2.0E-05	4.3E-04	2.5E-06
HHRA-11	7.8E-06	4.6E-07	8.6E-05	5.9E-07	5.9E-07	5.9E-04	1.5E-07	1.3E-05	1.6E-06	9.2E-08	9.5E-04	2.5E-05	5.4E-05	1.3E-04	2.9E-06	1.0E-03	7.2E-06	9.2E-09	1.2E-04	8.1E-07	2.7E-05	5.8E-04	4.0E-06

HHRA-12	5.4E-06	4.0E-07	6.1E-05	5.1E-07	5.1E-07	4.2E-04	1.3E-07	9.6E-06	1.1E-06	7.9E-08	6.7E-04	1.3E-05	2.7E-05	9.4E-05	2.5E-06	7.4E-04	6.2E-06	7.9E-09	8.4E-05	7.0E-07	1.9E-05	4.1E-04	3.4E-06
HHRA-13	**3.3E-05**	**3.2E-06**	**2.1E-04**	**4.1E-06**	**4.1E-06**	**1.5E-03**	**1.0E-06**	**3.3E-05**	**6.5E-06**	**6.3E-07**	**1.8E-03**	**6.0E-05**	**1.0E-04**	**3.3E-04**	**2.0E-05**	**2.6E-03**	**4.9E-05**	**6.3E-08**	**2.9E-04**	**5.6E-06**	**6.7E-05**	**1.4E-03**	**2.7E-05**
HHRA-14	1.0E-05	7.6E-07	9.2E-05	9.7E-07	9.7E-07	6.3E-04	2.4E-07	1.4E-05	2.1E-06	1.5E-07	9.6E-04	2.4E-05	4.2E-05	1.4E-04	4.8E-06	1.1E-03	1.2E-05	1.5E-08	1.3E-04	1.3E-06	2.9E-05	6.1E-04	6.5E-06
HHRA-15	3.6E-06	1.6E-07	4.0E-05	2.1E-07	2.1E-07	2.8E-04	5.3E-08	6.3E-06	7.2E-07	3.3E-08	4.6E-04	8.4E-06	2.0E-05	6.2E-05	1.0E-06	4.9E-04	2.6E-06	3.3E-09	5.5E-05	2.9E-07	1.3E-05	2.7E-04	1.4E-06
HHRA-16	1.2E-05	7.5E-07	9.1E-05	9.6E-07	9.6E-07	6.2E-04	2.4E-07	1.4E-05	2.3E-06	1.5E-07	9.5E-04	3.2E-05	6.5E-05	1.4E-04	4.7E-06	1.1E-03	1.2E-05	1.5E-08	1.2E-04	1.3E-06	2.8E-05	6.1E-04	6.4E-06
HHRA-17	1.3E-05	8.2E-07	8.3E-05	1.1E-06	1.1E-06	5.7E-04	2.6E-07	1.3E-05	2.5E-06	1.6E-07	9.5E-04	3.6E-05	7.4E-05	1.3E-04	5.2E-06	1.0E-03	1.3E-05	1.6E-08	1.1E-04	1.4E-06	2.6E-05	5.6E-04	7.0E-06
HHRA-18	1.2E-05	6.8E-07	8.0E-05	8.7E-07	8.7E-07	5.5E-04	2.2E-07	1.2E-05	2.3E-06	1.4E-07	8.5E-04	3.2E-05	6.6E-05	1.2E-04	4.3E-06	9.7E-04	1.1E-05	1.4E-08	1.1E-04	1.2E-06	2.5E-05	5.3E-04	5.8E-06
HHRA-19	1.1E-05	7.0E-07	8.4E-05	9.0E-07	9.0E-07	5.7E-04	2.2E-07	1.3E-05	2.3E-06	1.4E-07	8.6E-04	3.4E-05	6.9E-05	1.3E-04	4.4E-06	1.0E-03	1.1E-05	1.4E-08	1.1E-04	1.2E-06	2.6E-05	5.6E-04	6.0E-06
HHRA-20	9.9E-06	5.3E-07	6.9E-05	6.8E-07	6.8E-07	4.7E-04	1.7E-07	1.1E-05	2.0E-06	1.1E-07	6.9E-04	2.7E-05	5.5E-05	1.1E-04	3.3E-06	8.4E-04	8.2E-06	1.1E-08	9.5E-05	9.4E-07	2.2E-05	4.6E-04	4.5E-06
HHRA-21	1.0E-05	6.4E-07	7.5E-05	8.2E-07	8.2E-07	5.1E-04	2.0E-07	1.2E-05	2.1E-06	1.3E-07	8.6E-04	3.3E-05	6.4E-05	1.1E-04	4.0E-06	9.1E-04	9.9E-06	1.3E-08	1.0E-04	1.1E-06	2.3E-05	5.0E-04	5.5E-06
HHRA-22	1.0E-05	6.3E-07	7.8E-05	8.0E-07	8.0E-07	5.4E-04	2.0E-07	1.2E-05	2.0E-06	1.3E-07	8.8E-04	3.3E-05	6.3E-05	1.2E-04	3.9E-06	9.4E-04	9.8E-06	1.3E-08	1.1E-04	1.1E-06	2.4E-05	5.2E-04	5.4E-06
HHRA-23	1.4E-05	1.1E-06	1.0E-04	1.4E-06	1.4E-06	7.1E-04	3.4E-07	1.6E-05	2.7E-06	2.1E-07	1.0E-03	4.7E-05	9.4E-05	1.6E-04	6.7E-06	1.3E-03	1.7E-05	2.1E-08	1.4E-04	1.9E-06	3.2E-05	6.9E-04	9.1E-06
HHRA-24	8.9E-06	5.8E-07	8.4E-05	7.5E-07	7.5E-07	5.8E-04	1.9E-07	1.3E-05	1.8E-06	1.2E-07	9.6E-04	2.9E-05	5.7E-05	1.3E-04	3.7E-06	1.0E-03	9.1E-06	1.2E-08	1.2E-04	1.0E-06	2.6E-05	5.6E-04	5.0E-06
HHRA-25	2.9E-06	1.6E-07	4.1E-05	2.1E-07	2.1E-07	2.8E-04	5.2E-08	6.4E-06	5.9E-07	3.3E-08	4.0E-04	5.1E-06	1.1E-05	6.3E-05	1.0E-06	5.0E-04	2.5E-06	3.3E-09	5.7E-05	2.9E-07	1.3E-05	2.8E-04	1.4E-06
APAC	**1.0**	**0.3**	**9.9**	**0.015**	**0.015**	**5.0**	**0.001**	**18**	**0.03**	**0.005**	**1.3**	**0.005**	**0.1**	**10**	**0.50**	**9.1**	**0.15**	**1.00**	**0.20**	**0.01**	**0.1**	**20**	**2**
Max	**3.3E-05**	**3.2E-06**	**2.1E-04**	**4.1E-06**	**4.1E-06**	**1.5E-03**	**1.0E-06**	**3.3E-05**	**6.5E-06**	**6.3E-07**	**1.8E-03**	**6.0E-05**	**1.0E-04**	**3.3E-04**	**2.0E-05**	**2.6E-03**	**4.9E-05**	**6.3E-08**	**2.9E-04**	**5.6E-06**	**6.7E-05**	**1.4E-03**	**2.7E-05**
Median	**8.2E-06**	**4.6E-07**	**7.8E-05**	**5.9E-07**	**5.9E-07**	**5.4E-04**	**1.5E-07**	**1.2E-05**	**1.6E-06**	**9.2E-08**	**8.6E-04**	**2.4E-05**	**5.3E-05**	**1.2E-04**	**2.9E-06**	**9.4E-04**	**7.2E-06**	**9.2E-09**	**1.1E-04**	**8.1E-07**	**2.4E-05**	**5.2E-04**	**4.0E-06**
% of APAC	**0.00%**	**0.00%**	**0.00%**	**0.03%**	**0.03%**	**0.03%**	**0.10%**	**0.00%**	**0.02%**	**0.01%**	**0.14%**	**1.21%**	**0.10%**	**0.00%**	**0.00%**	**0.03%**	**0.03%**	**0.00%**	**0.15%**	**0.06%**	**0.07%**	**0.01%**	**0.00%**
GC_1	4.4E-06	8.3E-08	1.8E-05	1.1E-07	1.1E-07	1.2E-04	2.6E-08	2.8E-06	8.9E-07	1.7E-08	4.3E-04	9.5E-06	4.7E-05	2.7E-05	5.2E-07	2.1E-04	1.3E-06	1.7E-09	2.4E-05	1.5E-07	5.5E-06	1.2E-04	7.1E-07
GC_2	4.5E-06	9.8E-08	2.3E-05	1.3E-07	1.3E-07	1.6E-04	3.1E-08	3.6E-06	8.9E-07	2.0E-08	4.3E-04	1.1E-05	6.2E-05	3.5E-05	6.1E-07	2.8E-04	1.5E-06	2.0E-09	3.1E-05	1.7E-07	7.2E-06	1.5E-04	8.4E-07
GC_3	3.5E-06	1.3E-07	3.2E-05	1.7E-07	1.7E-07	2.2E-04	4.3E-08	5.1E-06	6.9E-07	2.7E-08	4.5E-04	1.4E-05	1.1E-04	5.0E-05	8.5E-07	3.9E-04	2.1E-06	2.7E-09	4.5E-05	2.4E-07	1.0E-05	2.2E-04	1.2E-06
GC_4	4.1E-06	1.8E-07	3.9E-05	2.3E-07	2.3E-07	2.7E-04	5.8E-08	6.0E-06	8.3E-07	3.6E-08	5.5E-04	1.8E-05	1.9E-04	5.9E-05	1.1E-06	4.7E-04	2.8E-06	3.6E-09	5.3E-05	3.2E-07	1.2E-05	2.6E-04	1.6E-06
GC_5	5.8E-06	2.7E-07	4.8E-05	3.4E-07	3.4E-07	3.3E-04	8.5E-08	7.4E-06	1.2E-06	5.3E-08	6.5E-04	2.4E-05	2.4E-04	7.3E-05	1.7E-06	5.8E-04	4.1E-06	5.3E-09	6.5E-05	4.7E-07	1.5E-05	3.2E-04	2.3E-06
GC_6	7.7E-06	3.7E-07	6.5E-05	4.7E-07	4.7E-07	4.5E-04	1.2E-07	1.0E-05	1.5E-06	7.3E-08	7.4E-04	2.9E-05	3.1E-04	1.0E-04	2.3E-06	7.9E-04	5.7E-06	7.3E-09	9.0E-05	6.4E-07	2.0E-05	4.4E-04	3.1E-06
GC_7	6.5E-06	4.7E-07	7.4E-05	6.0E-07	6.0E-07	5.1E-04	1.5E-07	1.2E-05	1.3E-06	9.4E-08	7.7E-04	2.9E-05	1.9E-04	1.1E-04	2.9E-06	9.0E-04	7.3E-06	9.4E-09	1.0E-04	8.2E-07	2.3E-05	4.9E-04	4.0E-06
GC_L_8	4.5E-06	2.0E-07	3.7E-05	2.6E-07	2.6E-07	2.5E-04	6.5E-08	5.7E-06	9.0E-07	4.1E-08	4.1E-04	1.5E-05	2.0E-04	5.6E-05	1.3E-06	4.5E-04	3.2E-06	4.1E-09	5.0E-05	3.6E-07	1.1E-05	2.5E-04	1.7E-06
GC_L_9	3.4E-06	2.1E-07	4.1E-05	2.7E-07	2.7E-07	2.8E-04	6.8E-08	6.3E-06	6.7E-07	4.2E-08	4.3E-04	1.4E-05	1.0E-04	6.2E-05	1.3E-06	4.9E-04	3.3E-06	4.2E-09	5.6E-05	3.7E-07	1.3E-05	2.7E-04	1.8E-06
GC_L_10	3.0E-06	1.7E-07	2.9E-05	2.2E-07	2.2E-07	2.0E-04	5.5E-08	4.6E-06	6.0E-07	3.4E-08	3.7E-04	1.1E-05	1.1E-04	4.5E-05	1.1E-06	3.6E-04	2.7E-06	3.4E-09	4.0E-05	3.0E-07	9.2E-06	2.0E-04	1.5E-06
GC_11	1.9E-06	1.0E-07	2.2E-05	1.3E-07	1.3E-07	1.5E-04	3.3E-08	3.4E-06	3.8E-07	2.1E-08	2.4E-04	6.5E-06	4.3E-05	3.4E-05	6.5E-07	2.7E-04	1.6E-06	2.1E-09	3.0E-05	1.8E-07	6.9E-06	1.5E-04	8.9E-07
GC_12	3.5E-06	7.9E-08	2.1E-05	1.0E-07	1.0E-07	1.5E-04	2.5E-08	3.3E-06	7.1E-07	1.6E-08	3.6E-04	9.2E-06	5.2E-05	3.2E-05	5.0E-07	2.6E-04	1.2E-06	1.6E-09	2.9E-05	1.4E-07	6.6E-06	1.4E-04	6.8E-07
APAC	**1.0**	**0.30**	**9.9**	**0.015**	**0.015**	**5.0**	**0.001**	**18**	**0.03**	**0.005**	**1.3**	**0.005**	**0.1**	**10**	**0.50**	**9.1**	**0.15**	**1.00**	**0.20**	**0.01**	**0.1**	**20**	**2**
Max	**7.7E-06**	**4.7E-07**	**7.4E-05**	**6.0E-07**	**6.0E-07**	**5.1E-04**	**1.5E-07**	**1.2E-05**	**1.5E-06**	**9.4E-08**	**7.7E-04**	**2.9E-05**	**3.1E-04**	**1.1E-04**	**2.9E-06**	**9.0E-04**	**7.3E-06**	**9.4E-09**	**1.0E-04**	**8.2E-07**	**2.3E-05**	**4.9E-04**	**4.0E-06**
Median	**4.3E-06**	**1.8E-07**	**3.5E-05**	**2.3E-07**	**2.3E-07**	**2.4E-04**	**5.7E-08**	**5.4E-06**	**8.6E-07**	**3.5E-08**	**4.3E-04**	**1.4E-05**	**1.1E-04**	**5.3E-05**	**1.1E-06**	**4.2E-04**	**2.7E-06**	**3.5E-09**	**4.8E-05**	**3.1E-07**	**1.1E-05**	**2.3E-04**	**1.5E-06**
% of APAC	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.01%**	**0.01%**	**0.00%**	**0.01%**	**0.00%**	**0.06%**	**0.58%**	**0.31%**	**0.00%**	**0.00%**	**0.01%**	**0.00%**	**0.00%**	**0.05%**	**0.01%**	**0.02%**	**0.00%**	**0.00%**

Table 10-2: Scenario 2 operations – maximum predicted metals and RCS concentration at specific model receptors

ID	Antimony (Sb)		Arsenic (As)			Barium (Ba)	Beryllium (Be)	Cadmium (Cd)			Chromium – Cr(VI)		Chromium – Cr(III)	Copper (Cu)	Lead (Pb)	Manganese (Mn)		Mercury (Hg)	Nickel (Ni)		Silver (Ag)	Zinc (Zn)	
	24-hr	Annual	1-hr	Annual	Annual (incr)	1-hr	Annual	1-hr	24-hr	Annual	1-hr	Annual	30 days	1-hr	Annual	1-hr	Annual	Annual	1-hr	Annual	1-hr	1-hr	Annual
AQ_1	2.5E-06	1.4E-07	3.2E-05	1.8E-07	1.8E-07	2.2E-04	4.5E-08	5.0E-06	5.1E-07	2.8E-08	3.3E-04	8.7E-06	1.9E-05	4.9E-05	8.9E-07	3.9E-04	2.2E-06	2.8E-09	4.4E-05	2.5E-07	1.0E-05	2.1E-04	1.2E-06
AQ_2	2.7E-06	1.4E-07	3.2E-05	1.8E-07	1.8E-07	2.2E-04	4.4E-08	5.1E-06	5.5E-07	2.8E-08	3.0E-04	8.5E-06	1.8E-05	4.9E-05	8.7E-07	3.9E-04	2.2E-06	2.8E-09	4.4E-05	2.4E-07	1.0E-05	2.2E-04	1.2E-06
AQ_3	2.8E-06	1.3E-07	2.5E-05	1.7E-07	1.7E-07	1.7E-04	4.2E-08	4.0E-06	5.5E-07	2.6E-08	2.6E-04	8.0E-06	1.7E-05	3.9E-05	8.3E-07	3.1E-04	2.1E-06	2.6E-09	3.5E-05	2.3E-07	7.9E-06	1.7E-04	1.1E-06
AQ_4	2.6E-06	1.2E-07	2.5E-05	1.6E-07	1.6E-07	1.7E-04	4.0E-08	3.9E-06	5.2E-07	2.5E-08	2.5E-04	7.3E-06	1.5E-05	3.8E-05	7.8E-07	3.0E-04	1.9E-06	2.5E-09	3.4E-05	2.2E-07	7.8E-06	1.7E-04	1.1E-06
AQ_5	2.6E-06	1.2E-07	2.6E-05	1.5E-07	1.5E-07	1.8E-04	3.8E-08	4.1E-06	5.1E-07	2.4E-08	2.5E-04	6.8E-06	1.4E-05	4.0E-05	7.5E-07	3.2E-04	1.9E-06	2.4E-09	3.6E-05	2.1E-07	8.2E-06	1.8E-04	1.0E-06
AQ_6	2.7E-06	1.0E-07	2.2E-05	1.3E-07	1.3E-07	1.5E-04	3.3E-08	3.4E-06	5.4E-07	2.1E-08	2.3E-04	5.5E-06	1.2E-05	3.4E-05	6.5E-07	2.7E-04	1.6E-06	2.1E-09	3.0E-05	1.8E-07	6.9E-06	1.5E-04	8.9E-07
AQ_7	2.5E-06	9.3E-08	2.2E-05	1.2E-07	1.2E-07	1.5E-04	3.0E-08	3.4E-06	5.1E-07	1.9E-08	2.0E-04	4.8E-06	1.1E-05	3.3E-05	5.9E-07	2.7E-04	1.4E-06	1.9E-09	3.0E-05	1.6E-07	6.8E-06	1.5E-04	8.0E-07
AQ_8	2.2E-06	7.2E-08	1.4E-05	9.2E-08	9.2E-08	9.9E-05	2.3E-08	2.2E-06	4.3E-07	1.4E-08	1.5E-04	3.6E-06	9.0E-06	2.2E-05	4.5E-07	1.7E-04	1.1E-06	1.4E-09	2.0E-05	1.3E-07	4.5E-06	9.6E-05	6.2E-07
AQ_9	1.6E-06	5.7E-08	1.0E-05	7.3E-08	7.3E-08	7.2E-05	1.8E-08	1.6E-06	3.2E-07	1.1E-08	1.4E-04	2.7E-06	7.1E-06	1.6E-05	3.6E-07	1.3E-04	8.9E-07	1.1E-09	1.4E-05	1.0E-07	3.3E-06	7.0E-05	4.9E-07
AQ_10	1.3E-06	7.6E-08	2.1E-05	9.7E-08	9.7E-08	1.5E-04	2.4E-08	3.3E-06	2.6E-07	1.5E-08	2.0E-04	2.0E-06	4.4E-06	3.3E-05	4.8E-07	2.6E-04	1.2E-06	1.5E-09	2.9E-05	1.3E-07	6.7E-06	1.4E-04	6.5E-07
AQ_11	2.2E-06	1.7E-07	2.2E-05	2.1E-07	2.1E-07	1.5E-04	5.3E-08	3.4E-06	4.4E-07	3.3E-08	1.8E-04	4.3E-06	3.0E-05	3.3E-05	1.0E-06	2.6E-04	2.6E-06	3.3E-09	3.0E-05	2.9E-07	6.7E-06	1.4E-04	1.4E-06
AQ_12	3.6E-06	2.2E-07	2.4E-05	2.8E-07	2.8E-07	1.6E-04	7.0E-08	3.7E-06	7.2E-07	4.4E-08	2.3E-04	5.4E-06	5.5E-05	3.6E-05	1.4E-06	2.9E-04	3.4E-06	4.4E-09	3.2E-05	3.8E-07	7.4E-06	1.6E-04	1.9E-06
AQ_13	5.6E-06	2.8E-07	3.4E-05	3.5E-07	3.5E-07	2.4E-04	8.8E-08	5.4E-06	1.1E-06	5.5E-08	2.8E-04	6.6E-06	9.7E-05	5.3E-05	1.7E-06	4.2E-04	4.3E-06	5.5E-09	4.7E-05	4.8E-07	1.1E-05	2.3E-04	2.4E-06
AQ_14	4.8E-06	2.9E-07	3.5E-05	3.7E-07	3.7E-07	2.4E-04	9.4E-08	5.5E-06	9.7E-07	5.9E-08	3.2E-04	7.3E-06	1.4E-04	5.3E-05	1.8E-06	4.2E-04	4.5E-06	5.9E-09	4.8E-05	5.1E-07	1.1E-05	2.3E-04	2.5E-06
AQ_15	4.8E-06	2.4E-07	4.2E-05	3.1E-07	3.1E-07	2.9E-04	7.6E-08	6.5E-06	9.5E-07	4.8E-08	3.7E-04	6.6E-06	1.5E-04	6.4E-05	1.5E-06	5.0E-04	3.7E-06	4.8E-09	5.7E-05	4.2E-07	1.3E-05	2.8E-04	2.0E-06
AQ_16	3.8E-06	1.9E-07	3.6E-05	2.4E-07	2.4E-07	2.5E-04	6.1E-08	5.7E-06	7.6E-07	3.8E-08	2.9E-04	5.9E-06	1.5E-04	5.5E-05	1.2E-06	4.4E-04	2.9E-06	3.8E-09	5.0E-05	3.3E-07	1.1E-05	2.4E-04	1.6E-06
AQ_17	2.3E-06	1.4E-07	2.1E-05	1.8E-07	1.8E-07	1.4E-04	4.6E-08	3.3E-06	4.7E-07	2.9E-08	2.5E-04	5.7E-06	1.9E-04	3.2E-05	9.0E-07	2.6E-04	2.2E-06	2.9E-09	2.9E-05	2.5E-07	6.6E-06	1.4E-04	1.2E-06
AQ_18	2.2E-06	1.2E-07	2.0E-05	1.6E-07	1.6E-07	1.4E-04	4.0E-08	3.1E-06	4.3E-07	2.5E-08	2.1E-04	5.1E-06	1.8E-04	3.0E-05	7.8E-07	2.4E-04	1.9E-06	2.5E-09	2.7E-05	2.2E-07	6.2E-06	1.3E-04	1.1E-06
AQ_19	2.0E-06	1.2E-07	1.8E-05	1.5E-07	1.5E-07	1.2E-04	3.7E-08	2.7E-06	3.9E-07	2.3E-08	2.0E-04	4.7E-06	1.7E-04	2.7E-05	7.3E-07	2.1E-04	1.8E-06	2.3E-09	2.4E-05	2.1E-07	5.5E-06	1.2E-04	1.0E-06
AQ_20	2.2E-06	1.5E-07	2.2E-05	2.0E-07	2.0E-07	1.5E-04	4.9E-08	3.4E-06	4.3E-07	3.1E-08	2.5E-04	5.8E-06	1.3E-04	3.3E-05	9.7E-07	2.6E-04	2.4E-06	3.1E-09	3.0E-05	2.7E-07	6.8E-06	1.5E-04	1.3E-06
AQ_21	2.2E-06	1.5E-07	2.4E-05	1.9E-07	1.9E-07	1.7E-04	4.7E-08	3.8E-06	4.4E-07	2.9E-08	2.6E-04	5.6E-06	8.7E-05	3.7E-05	9.1E-07	2.9E-04	2.3E-06	2.9E-09	3.3E-05	2.6E-07	7.6E-06	1.6E-04	1.2E-06
AQ_22	2.1E-06	1.1E-07	2.1E-05	1.4E-07	1.4E-07	1.5E-04	3.6E-08	3.4E-06	4.2E-07	2.2E-08	2.6E-04	5.0E-06	1.8E-05	3.3E-05	7.0E-07	2.6E-04	1.7E-06	2.2E-09	3.0E-05	2.0E-07	6.7E-06	1.4E-04	9.6E-07
AQ_23	2.3E-06	8.6E-08	2.3E-05	1.1E-07	1.1E-07	1.6E-04	2.7E-08	3.6E-06	4.6E-07	1.7E-08	2.5E-04	3.8E-06	1.3E-05	3.5E-05	5.4E-07	2.8E-04	1.3E-06	1.7E-09	3.2E-05	1.5E-07	7.2E-06	1.5E-04	7.3E-07
AQ_24	1.8E-06	6.7E-08	1.8E-05	8.5E-08	8.5E-08	1.3E-04	2.1E-08	2.9E-06	3.6E-07	1.3E-08	1.9E-04	2.7E-06	9.8E-06	2.8E-05	4.2E-07	2.2E-04	1.0E-06	1.3E-09	2.5E-05	1.2E-07	5.8E-06	1.2E-04	5.7E-07
AQ_25	1.8E-06	4.7E-08	1.6E-05	6.1E-08	6.1E-08	1.1E-04	1.5E-08	2.4E-06	3.5E-07	9.5E-09	1.6E-04	2.1E-06	1.0E-05	2.4E-05	3.0E-07	1.9E-04	7.3E-07	9.5E-10	2.1E-05	8.3E-08	4.9E-06	1.0E-04	4.0E-07
AQ_26	1.9E-06	4.2E-08	1.4E-05	5.4E-08	5.4E-08	9.5E-05	1.4E-08	2.2E-06	3.7E-07	8.4E-09	1.4E-04	2.0E-06	1.0E-05	2.1E-05	2.7E-07	1.7E-04	6.6E-07	8.4E-10	1.9E-05	7.4E-08	4.3E-06	9.3E-05	3.6E-07
APAC	**1.0**	**0.30**	**9.9**	**0.015**	**0.015**	**5.0**	**0.001**	**18**	**0.03**	**0.005**	**1.3**	**0.005**	**0.1**	**10**	**0.50**	**9.1**	**0.15**	**1.00**	**0.20**	**0.01**	**0.1**	**20**	**2**
Max	**5.6E-06**	**2.9E-07**	**4.2E-05**	**3.7E-07**	**3.7E-07**	**2.9E-04**	**9.4E-08**	**6.5E-06**	**1.1E-06**	**5.9E-08**	**3.7E-04**	**8.7E-06**	**1.9E-04**	**6.4E-05**	**1.8E-06**	**5.0E-04**	**4.5E-06**	**5.9E-09**	**5.7E-05**	**5.1E-07**	**1.3E-05**	**2.8E-04**	**2.5E-06**
Median	**2.3E-06**	**1.2E-07**	**2.2E-05**	**1.6E-07**	**1.6E-07**	**1.5E-04**	**4.0E-08**	**3.4E-06**	**4.7E-07**	**2.5E-08**	**2.5E-04**	**5.5E-06**	**1.8E-05**	**3.4E-05**	**7.8E-07**	**2.7E-04**	**1.9E-06**	**2.5E-09**	**3.0E-05**	**2.2E-07**	**6.9E-06**	**1.5E-04**	**1.1E-06**
% of APAC	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.01%**	**0.01%**	**0.00%**	**0.00%**	**0.00%**	**0.03%**	**0.17%**	**0.19%**	**0.00%**	**0.00%**	**0.01%**	**0.00%**	**0.00%**	**0.03%**	**0.01%**	**0.01%**	**0.00%**	**0.00%**
HHRA-01	2.9E-06	1.8E-07	3.6E-05	2.2E-07	2.2E-07	2.5E-04	5.6E-08	5.6E-06	5.8E-07	3.5E-08	3.5E-04	9.9E-06	2.0E-05	5.5E-05	1.1E-06	4.3E-04	2.7E-06	3.5E-09	4.9E-05	3.1E-07	1.1E-05	2.4E-04	1.5E-06
HHRA SR02	2.8E-06	1.2E-07	2.5E-05	1.5E-07	1.5E-07	1.7E-04	3.7E-08	3.9E-06	5.5E-07	2.3E-08	2.4E-04	6.3E-06	1.3E-05	3.8E-05	7.3E-07	3.0E-04	1.8E-06	2.3E-09	3.4E-05	2.0E-07	7.8E-06	1.7E-04	9.9E-07
HHRA-03	2.6E-06	1.0E-07	2.0E-05	1.3E-07	1.3E-07	1.4E-04	3.3E-08	3.1E-06	5.2E-07	2.0E-08	1.8E-04	4.7E-06	1.1E-05	3.0E-05	6.4E-07	2.4E-04	1.6E-06	2.0E-09	2.7E-05	1.8E-07	6.1E-06	1.3E-04	8.7E-07
HHRA-04	3.5E-06	1.8E-07	3.2E-05	2.4E-07	2.4E-07	2.2E-04	5.9E-08	5.1E-06	7.1E-07	3.7E-08	3.5E-04	9.9E-06	1.9E-05	5.0E-05	1.2E-06	3.9E-04	2.9E-06	3.7E-09	4.5E-05	3.2E-07	1.0E-05	2.2E-04	1.6E-06
HHRA-05	3.3E-06	1.6E-07	3.0E-05	2.0E-07	2.0E-07	2.1E-04	5.0E-08	4.8E-06	6.6E-07	3.2E-08	3.2E-04	8.4E-06	1.7E-05	4.7E-05	9.9E-07	3.7E-04	2.4E-06	3.2E-09	4.2E-05	2.8E-07	9.5E-06	2.0E-04	1.3E-06
HHRA-06	3.1E-06	1.3E-07	2.7E-05	1.7E-07	1.7E-07	1.9E-04	4.3E-08	4.2E-06	6.2E-07	2.7E-08	2.7E-04	7.0E-06	1.5E-05	4.1E-05	8.4E-07	3.3E-04	2.1E-06	2.7E-09	3.7E-05	2.4E-07	8.5E-06	1.8E-04	1.1E-06
HHRA-07	3.4E-06	1.8E-07	4.1E-05	2.3E-07	2.3E-07	2.8E-04	5.6E-08	6.4E-06	6.8E-07	3.5E-08	3.8E-04	1.0E-05	2.1E-05	6.3E-05	1.1E-06	5.0E-04	2.7E-06	3.5E-09	5.7E-05	3.1E-07	1.3E-05	2.8E-04	1.5E-06
HHRA-08	3.2E-06	1.7E-07	3.0E-05	2.1E-07	2.1E-07	2.1E-04	5.3E-08	4.7E-06	6.4E-07	3.3E-08	3.0E-04	9.3E-06	1.9E-05	4.6E-05	1.0E-06	3.7E-04	2.6E-06	3.3E-09	4.2E-05	2.9E-07	9.4E-06	2.0E-04	1.4E-06
HHRA-09	3.0E-06	1.2E-07	2.4E-05	1.5E-07	1.5E-07	1.7E-04	3.8E-08	3.8E-06	5.9E-07	2.4E-08	2.4E-04	5.8E-06	1.3E-05	3.7E-05	7.4E-07	2.9E-04	1.8E-06	2.4E-09	3.3E-05	2.1E-07	7.6E-06	1.6E-04	1.0E-06
HHRA-10	2.7E-06	1.1E-07	2.5E-05	1.5E-07	1.5E-07	1.7E-04	3.7E-08	3.9E-06	5.4E-07	2.3E-08	2.5E-04	6.3E-06	1.2E-05	3.8E-05	7.2E-07	3.0E-04	1.8E-06	2.3E-09	3.4E-05	2.0E-07	7.8E-06	1.7E-04	9.8E-07
HHRA-11	3.2E-06	1.9E-07	4.0E-05	2.4E-07	2.4E-07	2.7E-04	6.1E-08	6.2E-06	6.3E-07	3.8E-08	3.9E-04	1.1E-05	2.1E-05	6.1E-05	1.2E-06	4.8E-04	2.9E-06	3.8E-09	5.5E-05	3.3E-07	1.2E-05	2.7E-04	1.6E-06

HHRA-12	2.7E-06	1.8E-07	3.3E-05	2.4E-07	2.4E-07	2.3E-04	5.9E-08	5.1E-06	5.4E-07	3.7E-08	3.0E-04	5.1E-06	9.9E-06	5.0E-05	1.2E-06	4.0E-04	2.9E-06	3.7E-09	4.5E-05	3.2E-07	1.0E-05	2.2E-04	1.6E-06
HHRA-13	1.1E-05	1.5E-06	1.0E-04	1.9E-06	1.9E-06	6.9E-04	4.7E-07	1.6E-05	2.1E-06	2.9E-07	9.2E-04	2.6E-05	4.8E-05	1.5E-04	9.1E-06	1.2E-03	2.3E-05	2.9E-08	1.4E-04	2.6E-06	3.2E-05	6.7E-04	1.2E-05
HHRA-14	4.7E-06	3.6E-07	5.0E-05	4.6E-07	4.6E-07	3.4E-04	1.1E-07	7.8E-06	9.3E-07	7.1E-08	4.3E-04	9.7E-06	1.7E-05	7.6E-05	2.2E-06	6.0E-04	5.5E-06	7.1E-09	6.9E-05	6.3E-07	1.6E-05	3.3E-04	3.1E-06
HHRA-15	2.0E-06	7.5E-08	1.5E-05	9.6E-08	9.6E-08	1.0E-04	2.4E-08	2.3E-06	3.9E-07	1.5E-08	1.7E-04	3.0E-06	7.5E-06	2.2E-05	4.7E-07	1.8E-04	1.2E-06	1.5E-09	2.0E-05	1.3E-07	4.6E-06	9.8E-05	6.4E-07
HHRA-16	5.1E-06	3.2E-07	4.4E-05	4.1E-07	4.1E-07	3.0E-04	1.0E-07	6.9E-06	1.0E-06	6.4E-08	4.0E-04	1.3E-05	2.6E-05	6.8E-05	2.0E-06	5.4E-04	5.0E-06	6.4E-09	6.1E-05	5.6E-07	1.4E-05	3.0E-04	2.7E-06
HHRA-17	5.8E-06	3.5E-07	4.3E-05	4.5E-07	4.5E-07	3.0E-04	1.1E-07	6.8E-06	1.2E-06	7.0E-08	4.3E-04	1.5E-05	3.1E-05	6.6E-05	2.2E-06	5.3E-04	5.4E-06	7.0E-09	6.0E-05	6.1E-07	1.4E-05	2.9E-04	3.0E-06
HHRA-18	5.2E-06	2.8E-07	4.0E-05	3.6E-07	3.6E-07	2.7E-04	9.1E-08	6.2E-06	1.0E-06	5.7E-08	4.0E-04	1.4E-05	2.8E-05	6.1E-05	1.8E-06	4.8E-04	4.4E-06	5.7E-09	5.5E-05	5.0E-07	1.2E-05	2.7E-04	2.4E-06
HHRA-19	5.0E-06	2.9E-07	4.3E-05	3.7E-07	3.7E-07	3.0E-04	9.2E-08	6.7E-06	9.9E-07	5.8E-08	3.9E-04	1.5E-05	2.9E-05	6.6E-05	1.8E-06	5.2E-04	4.5E-06	5.8E-09	5.9E-05	5.1E-07	1.3E-05	2.9E-04	2.5E-06
HHRA-20	4.3E-06	2.2E-07	3.6E-05	2.9E-07	2.9E-07	2.5E-04	7.1E-08	5.6E-06	8.5E-07	4.5E-08	3.2E-04	1.1E-05	2.3E-05	5.5E-05	1.4E-06	4.3E-04	3.5E-06	4.5E-09	4.9E-05	3.9E-07	1.1E-05	2.4E-04	1.9E-06
HHRA-21	4.4E-06	2.5E-07	3.6E-05	3.3E-07	3.3E-07	2.5E-04	8.1E-08	5.7E-06	8.7E-07	5.1E-08	3.6E-04	1.4E-05	2.6E-05	5.6E-05	1.6E-06	4.4E-04	4.0E-06	5.1E-09	5.0E-05	4.5E-07	1.1E-05	2.4E-04	2.2E-06
HHRA-22	4.3E-06	2.5E-07	3.8E-05	3.2E-07	3.2E-07	2.6E-04	7.9E-08	5.9E-06	8.6E-07	5.0E-08	3.7E-04	1.4E-05	2.5E-05	5.8E-05	1.6E-06	4.6E-04	3.9E-06	5.0E-09	5.2E-05	4.4E-07	1.2E-05	2.5E-04	2.1E-06
HHRA-23	6.4E-06	4.4E-07	5.3E-05	5.6E-07	5.6E-07	3.6E-04	1.4E-07	8.2E-06	1.3E-06	8.7E-08	5.0E-04	2.0E-05	4.0E-05	8.1E-05	2.7E-06	6.4E-04	6.8E-06	8.7E-09	7.2E-05	7.7E-07	1.6E-05	3.5E-04	3.7E-06
HHRA-24	3.3E-06	2.4E-07	3.9E-05	3.1E-07	3.1E-07	2.7E-04	7.7E-08	6.0E-06	6.7E-07	4.8E-08	4.1E-04	1.2E-05	2.4E-05	5.9E-05	1.5E-06	4.7E-04	3.7E-06	4.8E-09	5.3E-05	4.3E-07	1.2E-05	2.6E-04	2.1E-06
HHRA-25	1.4E-06	7.9E-08	2.3E-05	1.0E-07	1.0E-07	1.6E-04	2.5E-08	3.5E-06	2.8E-07	1.6E-08	2.0E-04	2.0E-06	4.4E-06	3.5E-05	5.0E-07	2.8E-04	1.2E-06	1.6E-09	3.1E-05	1.4E-07	7.1E-06	1.5E-04	6.8E-07
APAC	**1.0**	**0.3**	**9.9**	**0.015**	**0.015**	**5.0**	**0.001**	**18**	**0.03**	**0.005**	**1.3**	**0.005**	**0.1**	**10**	**0.50**	**9.1**	**0.15**	**1.00**	**0.20**	**0.01**	**0.1**	**20**	**2**
Max	**1.1E-05**	**1.5E-06**	**1.0E-04**	**1.9E-06**	**1.9E-06**	**6.9E-04**	**4.7E-07**	**1.6E-05**	**2.1E-06**	**2.9E-07**	**9.2E-04**	**2.6E-05**	**4.8E-05**	**1.5E-04**	**9.1E-06**	**1.2E-03**	**2.3E-05**	**2.9E-08**	**1.4E-04**	**2.6E-06**	**3.2E-05**	**6.7E-04**	**1.2E-05**
Median	**3.3E-06**	**1.8E-07**	**3.6E-05**	**2.4E-07**	**2.4E-07**	**2.5E-04**	**5.9E-08**	**5.6E-06**	**6.7E-07**	**3.7E-08**	**3.5E-04**	**9.9E-06**	**2.0E-05**	**5.5E-05**	**1.2E-06**	**4.3E-04**	**2.9E-06**	**3.7E-09**	**4.9E-05**	**3.2E-07**	**1.1E-05**	**2.4E-04**	**1.6E-06**
% of APAC	**0.00%**	**0.00%**	**0.00%**	**0.01%**	**0.01%**	**0.01%**	**0.05%**	**0.00%**	**0.01%**	**0.01%**	**0.07%**	**0.53%**	**0.05%**	**0.00%**	**0.00%**	**0.01%**	**0.02%**	**0.00%**	**0.07%**	**0.03%**	**0.03%**	**0.00%**	**0.00%**
GC_1	1.7E-06	3.3E-08	4.6E-06	4.2E-08	4.2E-08	3.2E-05	1.0E-08	7.3E-07	3.5E-07	6.5E-09	1.6E-04	2.2E-06	6.7E-06	7.1E-06	2.1E-07	5.6E-05	5.1E-07	6.5E-10	6.4E-06	5.8E-08	1.5E-06	3.1E-05	2.8E-07
GC_2	1.6E-06	3.8E-08	8.8E-06	4.8E-08	4.8E-08	6.1E-05	1.2E-08	1.4E-06	3.1E-07	7.6E-09	1.7E-04	2.7E-06	8.9E-06	1.3E-05	2.4E-07	1.1E-04	5.9E-07	7.6E-10	1.2E-05	6.7E-08	2.8E-06	5.9E-05	3.2E-07
GC_3	1.4E-06	5.0E-08	1.0E-05	6.5E-08	6.5E-08	6.9E-05	1.6E-08	1.6E-06	2.8E-07	1.0E-08	1.7E-04	3.6E-06	1.5E-05	1.5E-05	3.2E-07	1.2E-04	7.8E-07	1.0E-09	1.4E-05	8.9E-08	3.2E-06	6.7E-05	4.3E-07
GC_4	2.1E-06	6.7E-08	1.2E-05	8.6E-08	8.6E-08	8.1E-05	2.2E-08	1.8E-06	4.3E-07	1.3E-08	2.0E-04	5.3E-06	2.6E-05	1.8E-05	4.2E-07	1.4E-04	1.0E-06	1.3E-09	1.6E-05	1.2E-07	3.7E-06	7.9E-05	5.8E-07
GC_5	3.2E-06	9.7E-08	1.9E-05	1.2E-07	1.2E-07	1.3E-04	3.1E-08	3.0E-06	6.4E-07	1.9E-08	2.2E-04	8.0E-06	5.5E-05	2.9E-05	6.1E-07	2.3E-04	1.5E-06	1.9E-09	2.6E-05	1.7E-07	5.9E-06	1.3E-04	8.3E-07
GC_6	3.3E-06	1.3E-07	2.8E-05	1.7E-07	1.7E-07	1.9E-04	4.3E-08	4.4E-06	6.7E-07	2.7E-08	2.8E-04	1.1E-05	1.3E-04	4.3E-05	8.4E-07	3.4E-04	2.1E-06	2.7E-09	3.9E-05	2.3E-07	8.8E-06	1.9E-04	1.1E-06
GC_7	3.1E-06	1.6E-07	2.9E-05	2.1E-07	2.1E-07	2.0E-04	5.1E-08	4.6E-06	6.1E-07	3.2E-08	2.8E-04	1.1E-05	9.4E-05	4.5E-05	1.0E-06	3.5E-04	2.5E-06	3.2E-09	4.0E-05	2.8E-07	9.1E-06	2.0E-04	1.4E-06
GC_L_8	1.9E-06	7.2E-08	1.8E-05	9.2E-08	9.2E-08	1.2E-04	2.3E-08	2.8E-06	3.7E-07	1.4E-08	1.8E-04	5.4E-06	8.1E-05	2.7E-05	4.5E-07	2.2E-04	1.1E-06	1.4E-09	2.5E-05	1.3E-07	5.6E-06	1.2E-04	6.1E-07
GC_L_9	1.5E-06	7.1E-08	1.6E-05	9.1E-08	9.1E-08	1.1E-04	2.3E-08	2.6E-06	3.1E-07	1.4E-08	1.5E-04	5.0E-06	4.8E-05	2.5E-05	4.5E-07	2.0E-04	1.1E-06	1.4E-09	2.2E-05	1.3E-07	5.1E-06	1.1E-04	6.1E-07
GC_L_10	1.2E-06	5.8E-08	1.5E-05	7.4E-08	7.4E-08	1.0E-04	1.8E-08	2.3E-06	2.4E-07	1.2E-08	1.4E-04	4.1E-06	4.8E-05	2.3E-05	3.6E-07	1.8E-04	8.9E-07	1.2E-09	2.0E-05	1.0E-07	4.6E-06	9.9E-05	4.9E-07
GC_11	8.1E-07	3.3E-08	8.4E-06	4.3E-08	4.3E-08	5.8E-05	1.1E-08	1.3E-06	1.6E-07	6.7E-09	8.3E-05	2.3E-06	1.9E-05	1.3E-05	2.1E-07	1.0E-04	5.2E-07	6.7E-10	1.2E-05	5.9E-08	2.6E-06	5.6E-05	2.9E-07
GC_12	1.1E-06	3.1E-08	5.7E-06	3.9E-08	3.9E-08	3.9E-05	9.8E-09	9.0E-07	2.2E-07	6.1E-09	1.4E-04	2.2E-06	8.9E-06	8.8E-06	1.9E-07	7.0E-05	4.7E-07	6.1E-10	7.9E-06	5.4E-08	1.8E-06	3.8E-05	2.6E-07
APAC	**1.0**	**0.30**	**9.9**	**0.015**	**0.015**	**5.0**	**0.001**	**18**	**0.03**	**0.005**	**1.3**	**0.005**	**0.1**	**10**	**0.50**	**9.1**	**0.15**	**1.00**	**0.20**	**0.01**	**0.1**	**20**	**2**
Max	**3.3E-06**	**1.6E-07**	**2.9E-05**	**2.1E-07**	**2.1E-07**	**2.0E-04**	**5.1E-08**	**4.6E-06**	**6.7E-07**	**3.2E-08**	**2.8E-04**	**1.1E-05**	**1.3E-04**	**4.5E-05**	**1.0E-06**	**3.5E-04**	**2.5E-06**	**3.2E-09**	**4.0E-05**	**2.8E-07**	**9.1E-06**	**2.0E-04**	**1.4E-06**
Median	**1.6E-06**	**6.2E-08**	**1.3E-05**	**8.0E-08**	**8.0E-08**	**9.1E-05**	**2.0E-08**	**2.1E-06**	**3.3E-07**	**1.2E-08**	**1.7E-04**	**4.5E-06**	**3.7E-05**	**2.0E-05**	**3.9E-07**	**1.6E-04**	**9.7E-07**	**1.2E-09**	**1.8E-05**	**1.1E-07**	**4.2E-06**	**8.9E-05**	**5.3E-07**
% of APAC	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.01%**	**0.00%**	**0.00%**	**0.00%**	**0.02%**	**0.22%**	**0.13%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.02%**	**0.00%**	**0.01%**	**0.00%**	**0.00%**

11 APPENDIX C

HEAVY METALS PREDICTED DEPOSITION AT RECEPTOR

Table 11-1: Scenario 1 operations – maximum predicted metals deposition (g/m²/period)

ID	Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Chromium – Cr(III+VI)		Copper (Cu)		Lead (Pb)		Manganese (Mn)		Mercury (Hg)		Nickel (Ni)		Silver (Ag)		Zinc (Zn)	
	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total
AQ_1	2.12E-07	1.62E-06	2.72E-07	2.07E-06	1.87E-06	1.43E-05	6.80E-08	5.19E-07	4.25E-08	3.24E-07	4.44E-06	3.46E-05	4.44E-06	3.46E-05	4.16E-07	3.18E-06	1.33E-06	1.02E-05	3.30E-06	2.52E-05	4.25E-09	3.24E-08	3.74E-07	2.85E-06	8.50E-08	6.48E-07
AQ_2	2.22E-07	1.56E-06	2.84E-07	2.00E-06	1.95E-06	1.37E-05	7.09E-08	5.00E-07	4.43E-08	3.12E-07	4.39E-06	3.33E-05	4.39E-06	3.33E-05	4.34E-07	3.06E-06	1.39E-06	9.81E-06	3.44E-06	2.42E-05	4.43E-09	3.12E-08	3.90E-07	2.75E-06	8.87E-08	6.25E-07
AQ_3	2.20E-07	1.45E-06	2.81E-07	1.85E-06	1.93E-06	1.27E-05	7.03E-08	4.63E-07	4.39E-08	2.89E-07	4.22E-06	3.08E-05	4.22E-06	3.08E-05	4.30E-07	2.83E-06	1.38E-06	9.08E-06	3.41E-06	2.24E-05	4.39E-09	2.89E-08	3.87E-07	2.55E-06	8.78E-08	5.78E-07
AQ_4	2.10E-07	1.34E-06	2.68E-07	1.71E-06	1.84E-06	1.18E-05	6.71E-08	4.28E-07	4.19E-08	2.68E-07	4.00E-06	2.86E-05	4.00E-06	2.86E-05	4.11E-07	2.62E-06	1.32E-06	8.40E-06	3.25E-06	2.08E-05	4.19E-09	2.68E-08	3.69E-07	2.35E-06	8.38E-08	5.35E-07
AQ_5	2.01E-07	1.28E-06	2.58E-07	1.63E-06	1.77E-06	1.12E-05	6.44E-08	4.08E-07	4.02E-08	2.55E-07	3.85E-06	2.74E-05	3.85E-06	2.74E-05	3.94E-07	2.50E-06	1.26E-06	8.01E-06	3.12E-06	1.98E-05	4.02E-09	2.55E-08	3.54E-07	2.25E-06	8.05E-08	5.10E-07
AQ_6	1.42E-07	9.76E-07	1.82E-07	1.25E-06	1.25E-06	8.59E-06	4.55E-08	3.12E-07	2.84E-08	1.95E-07	2.90E-06	2.11E-05	2.90E-06	2.11E-05	2.78E-07	1.91E-06	8.92E-07	6.13E-06	2.20E-06	1.52E-05	2.84E-09	1.95E-08	2.50E-07	1.72E-06	5.68E-08	3.91E-07
AQ_7	1.20E-07	8.24E-07	1.54E-07	1.06E-06	1.06E-06	7.26E-06	3.85E-08	2.64E-07	2.40E-08	1.65E-07	2.61E-06	1.77E-05	2.61E-06	1.77E-05	2.36E-07	1.62E-06	7.55E-07	5.18E-06	1.87E-06	1.28E-05	2.40E-09	1.65E-08	2.12E-07	1.45E-06	4.81E-08	3.30E-07
AQ_8	1.02E-07	6.25E-07	1.30E-07	8.00E-07	8.96E-07	5.50E-06	3.26E-08	2.00E-07	2.04E-08	1.25E-07	2.18E-06	1.37E-05	2.18E-06	1.37E-05	2.00E-07	1.23E-06	6.40E-07	3.93E-06	1.58E-06	9.70E-06	2.04E-09	1.25E-08	1.79E-07	1.10E-06	4.07E-08	2.50E-07
AQ_9	8.02E-08	4.81E-07	1.03E-07	6.16E-07	7.05E-07	4.23E-06	2.57E-08	1.54E-07	1.60E-08	9.62E-08	1.78E-06	1.05E-05	1.78E-06	1.05E-05	1.57E-07	9.43E-07	5.03E-07	3.02E-06	1.24E-06	7.47E-06	1.60E-09	9.62E-09	1.41E-07	8.47E-07	3.21E-08	1.92E-07
AQ_10	1.22E-07	6.80E-07	1.57E-07	8.70E-07	1.08E-06	5.98E-06	3.92E-08	2.17E-07	2.45E-08	1.36E-07	2.00E-06	1.20E-05	2.00E-06	1.20E-05	2.40E-07	1.33E-06	7.69E-07	4.27E-06	1.90E-06	1.05E-05	2.45E-09	1.36E-08	2.16E-07	1.20E-06	4.90E-08	2.72E-07
AQ_11	3.89E-07	2.43E-06	4.98E-07	3.11E-06	3.43E-06	2.14E-05	1.25E-07	7.79E-07	7.79E-08	4.87E-07	7.02E-06	4.19E-05	7.02E-06	4.19E-05	7.63E-07	4.77E-06	2.44E-06	1.53E-05	6.04E-06	3.78E-05	7.79E-09	4.87E-08	6.85E-07	4.28E-06	1.56E-07	9.73E-07
AQ_12	5.23E-07	3.06E-06	6.70E-07	3.92E-06	4.61E-06	2.70E-05	1.68E-07	9.80E-07	1.05E-07	6.13E-07	8.67E-06	5.20E-05	8.67E-06	5.20E-05	1.03E-06	6.00E-06	3.29E-06	1.92E-05	8.12E-06	4.75E-05	1.05E-08	6.13E-08	9.21E-07	5.39E-06	2.09E-07	1.23E-06
AQ_13	6.36E-07	3.76E-06	8.14E-07	4.81E-06	5.60E-06	3.30E-05	2.04E-07	1.20E-06	1.27E-07	7.51E-07	9.96E-06	6.27E-05	9.96E-06	6.27E-05	1.25E-06	7.36E-06	3.99E-06	2.36E-05	9.87E-06	5.83E-05	1.27E-08	7.51E-08	1.12E-06	6.61E-06	2.54E-07	1.50E-06
AQ_14	5.90E-07	3.93E-06	7.55E-07	5.02E-06	5.19E-06	3.45E-05	1.89E-07	1.26E-06	1.18E-07	7.85E-07	9.84E-06	6.72E-05	9.84E-06	6.72E-05	1.16E-06	7.69E-06	3.70E-06	2.47E-05	9.15E-06	6.09E-05	1.18E-08	7.85E-08	1.04E-06	6.91E-06	2.36E-07	1.57E-06
AQ_15	5.91E-07	3.20E-06	7.57E-07	4.09E-06	5.20E-06	2.81E-05	1.89E-07	1.02E-06	1.18E-07	6.39E-07	9.49E-06	5.97E-05	9.49E-06	5.97E-05	1.16E-06	6.26E-06	3.71E-06	2.01E-05	9.17E-06	4.96E-05	1.18E-08	6.39E-08	1.04E-06	5.62E-06	2.36E-07	1.28E-06
AQ_16	5.20E-07	2.48E-06	6.65E-07	3.17E-06	4.57E-06	2.18E-05	1.66E-07	7.92E-07	1.04E-07	4.95E-07	8.44E-06	5.14E-05	8.44E-06	5.14E-05	1.02E-06	4.85E-06	3.26E-06	1.55E-05	8.07E-06	3.84E-05	1.04E-08	4.95E-08	9.15E-07	4.36E-06	2.08E-07	9.90E-07
AQ_17	4.88E-07	1.93E-06	6.25E-07	2.47E-06	4.30E-06	1.70E-05	1.56E-07	6.19E-07	9.76E-08	3.87E-07	9.40E-06	5.01E-05	9.40E-06	5.01E-05	9.57E-07	3.79E-06	3.07E-06	1.21E-05	7.58E-06	3.00E-05	9.76E-09	3.87E-08	8.59E-07	3.40E-06	1.95E-07	7.73E-07
AQ_18	4.48E-07	1.70E-06	5.74E-07	2.17E-06	3.95E-06	1.49E-05	1.43E-07	5.43E-07	8.97E-08	3.39E-07	9.29E-06	4.52E-05	9.29E-06	4.52E-05	8.79E-07	3.32E-06	2.82E-06	1.07E-05	6.96E-06	2.63E-05	8.97E-09	3.39E-08	7.89E-07	2.98E-06	1.79E-07	6.78E-07
AQ_19	4.15E-07	1.58E-06	5.31E-07	2.03E-06	3.65E-06	1.39E-05	1.33E-07	5.06E-07	8.30E-08	3.17E-07	8.94E-06	4.19E-05	8.94E-06	4.19E-05	8.14E-07	3.10E-06	2.61E-06	9.94E-06	6.44E-06	2.46E-05	8.30E-09	3.17E-08	7.31E-07	2.79E-06	1.66E-07	6.33E-07
AQ_20	4.92E-07	1.87E-06	6.29E-07	2.39E-06	4.33E-06	1.65E-05	1.57E-07	5.98E-07	9.83E-08	3.74E-07	1.09E-05	4.78E-05	1.09E-05	4.78E-05	9.64E-07	3.66E-06	3.09E-06	1.17E-05	7.63E-06	2.90E-05	9.83E-09	3.74E-08	8.65E-07	3.29E-06	1.97E-07	7.48E-07
AQ_21	5.04E-07	1.63E-06	6.45E-07	2.08E-06	4.44E-06	1.43E-05	1.61E-07	5.21E-07	1.01E-07	3.26E-07	1.16E-05	4.24E-05	1.16E-05	4.24E-05	9.88E-07	3.19E-06	3.17E-06	1.02E-05	7.82E-06	2.53E-05	1.01E-08	3.26E-08	8.87E-07	2.86E-06	2.02E-07	6.51E-07
AQ_22	3.56E-07	1.12E-06	4.56E-07	1.44E-06	3.13E-06	9.88E-06	1.14E-07	3.59E-07	7.12E-08	2.25E-07	1.06E-05	3.40E-05	1.06E-05	3.40E-05	6.98E-07	2.20E-06	2.24E-06	7.05E-06	5.53E-06	1.74E-05	7.12E-09	2.25E-08	6.27E-07	1.98E-06	1.42E-07	4.49E-07
AQ_23	2.24E-07	7.99E-07	2.87E-07	1.02E-06	1.97E-06	7.04E-06	7.16E-08	2.56E-07	4.48E-08	1.60E-07	7.05E-06	2.49E-05	7.05E-06	2.49E-05	4.39E-07	1.57E-06	1.41E-06	5.02E-06	3.47E-06	1.24E-05	4.48E-09	1.60E-08	3.94E-07	1.41E-06	8.96E-08	3.20E-07
AQ_24	1.29E-07	5.65E-07	1.65E-07	7.23E-07	1.13E-06	4.97E-06	4.12E-08	1.81E-07	2.57E-08	1.13E-07	4.15E-06	1.69E-05	4.15E-06	1.69E-05	2.52E-07	1.11E-06	8.08E-07	3.55E-06	2.00E-06	8.77E-06	2.57E-09	1.13E-08	2.27E-07	9.95E-07	5.15E-08	2.26E-07
AQ_25	8.08E-08	3.59E-07	1.03E-07	4.59E-07	7.11E-07	3.16E-06	2.58E-08	1.15E-07	1.62E-08	7.18E-08	2.41E-06	1.12E-05	2.41E-06	1.12E-05	1.58E-07	7.03E-07	5.07E-07	2.25E-06	1.25E-06	5.57E-06	1.62E-09	7.18E-09	1.42E-07	6.31E-07	3.23E-08	1.44E-07
AQ_26	5.96E-08	2.84E-07	7.63E-08	3.64E-07	5.25E-07	2.50E-06	1.91E-08	9.10E-08	1.19E-08	5.68E-08	1.87E-06	8.93E-06	1.87E-06	8.93E-06	1.17E-07	5.57E-07	3.75E-07	1.78E-06	9.26E-07	4.41E-06	1.19E-09	5.68E-09	1.05E-07	5.00E-07	2.39E-08	1.14E-07
HHRA-01	3.06E-07	2.24E-06	3.92E-07	2.87E-06	2.70E-06	1.97E-05	9.80E-08	7.17E-07	6.13E-08	4.48E-07	6.28E-06	4.65E-05	6.28E-06	4.65E-05	6.00E-07	4.39E-06	1.92E-06	1.41E-05	4.75E-06	3.48E-05	6.13E-09	4.48E-08	5.39E-07	3.94E-06	1.23E-07	8.96E-07
HHRA SR02	1.77E-07	1.16E-06	2.27E-07	1.48E-06	1.56E-06	1.02E-05	5.68E-08	3.71E-07	3.55E-08	2.32E-07	3.40E-06	2.48E-05	3.40E-06	2.48E-05	3.48E-07	2.27E-06	1.11E-06	7.29E-06	2.75E-06	1.80E-05	3.55E-09	2.32E-08	3.12E-07	2.04E-06	7.10E-08	4.64E-07
HHRA-03	1.52E-07	9.65E-07	1.95E-07	1.24E-06	1.34E-06	8.49E-06	4.87E-08	3.09E-07	3.05E-08	1.93E-07	3.20E-06	2.00E-05	3.20E-06	2.00E-05	2.98E-07	1.89E-06	9.56E-07	6.06E-06	2.36E-06	1.50E-05	3.05E-09	1.93E-08	2.68E-07	1.70E-06	6.09E-08	3.86E-07
HHRA-04	2.99E-07	1.96E-06	3.83E-07	2.51E-06	2.63E-06	1.72E-05	9.57E-08	6.26E-07	5.98E-08	3.92E-07	5.20E-06	3.85E-05	5.20E-06	3.85E-05	5.86E-07	3.84E-06	1.88E-06	1.23E-05	4.64E-06	3.04E-05	5.98E-09	3.92E-08	5.27E-07	3.45E-06	1.20E-07	7.83E-07
HHRA-05	2.48E-07	1.63E-06	3.18E-07	2.08E-06	2.18E-06	1.43E-05	7.94E-08	5.20E-07	4.96E-08	3.25E-07	4.43E-06	3.28E-05	4.43E-06	3.28E-05	4.86E-07	3.19E-06	1.56E-06	1.02E-05	3.85E-06	2.52E-05	4.96E-09	3.25E-08	4.37E-07	2.86E-06	9.93E-08	6.50E-07
HHRA-06	1.98E-07	1.33E-06	2.53E-07	1.70E-06	1.74E-06	1.17E-05	6.33E-08	4.24E-07	3.96E-08	2.65E-07	3.67E-06	2.75E-05	3.67E-06	2.75E-05	3.88E-07	2.60E-06	1.24E-06	8.32E-06	3.07E-06	2.06E-05	3.96E-09	2.65E-08	3.48E-07	2.33E-06	7.92E-08	5.30E-07
HHRA-07	2.89E-07	2.11E-06	3.70E-07	2.70E-06	2.54E-06	1.85E-05	9.25E-08	6.74E-07	5.78E-08	4.22E-07	5.65E-06	4.34E-05	5.65E-06	4.34E-05	5.66E-07	4.13E-06	1.81E-06	1.32E-05	4.48E-06	3.27E-05	5.78E-09	4.22E-08	5.09E-07	3.71E-06	1.16E-07	8.43E-07
HHRA-08	2.82E-07	1.86E-06	3.61E-07	2.38E-06	2.48E-06	1.63E-05	9.02E-08	5.94E-07	5.64E-08	3.71E-07	5.21E-06	3.81E-05	5.21E-06	3.81E-05	5.53E-07	3.64E-06	1.77E-06	1.17E-05	4.38E-06	2.88E-05	5.64E-09	3.71E-08	4.96E-07	3.27E-06	1.13E-07	7.43E-07
HHRA-09	1.55E-07	1.13E-06	1.99E-07	1.45E-06	1.37E-06	9.95E-06	4.97E-08	3.62E-07	3.11E-08	2.26E-07	3.47E-06	2.37E-05	3.47E-06	2.37E-05	3.04E-07	2.22E-06	9.76E-07	7.10E-06	2.41E-06	1.75E-05	3.11E-09	2.26E-08	2.73E-07	1.99E-06	6.21E-08	4.52E-07
HHRA-10	1.87E-07	1.19E-06	2.40E-07	1.52E-06	1.65E-06	1.05E-05	5.99E-08	3.81E-07	3.74E-08	2.38E-07	3.60E-06	2.58E-05	3.60E-06	2.58E-05	3.67E-07	2.34E-06	1.18E-06	7.48E-06	2.91E-06	1.85E-05	3.74E-09	2.38E-08	3.29E-07	2.10E-06	7.49E-08	4.77E-07
HHRA-11	3.50E-07	2.45E-06	4.48E-07	3.13E-06	3.08E-06	2.15E-05	1.12E-07	7.84E-07	7.01E-08	4.90E-07	7.19E-06	5.05E-05	7.19E-06	5.05E-05	6.87E-07	4.80E-06	2.20E-06	1.54E-05	5.44E-06	3.80E-05	7.01E-09	4.90E-08	6.17E-07	4.31E-06	1.40E-07	9.79E-07
HHRA-12	2.66E-07	1.66E-06	3.40E-07	2.12E-06	2.34E-06	1.46E-05	8.51E-08	5.31E-07	5.32E-08	3.32E-07	3.99E-06	2.79E-05	3.99E-06	2.79E-05	5.21E-07	3.25E-06	1.67E-06	1.04E-05	4.13E-06	2.57E-05	5.32E-09	3.32E-08	4.68E-07	2.92E-06	1.06E-07	6.64E-07
HHRA-13	2.59E-06	1.72E-05	3.32E-06	2.21E-05	2.28E-05	1.52E-04	8.29E-07	5.51E-06	5.18E-07	3.45E-06	2.78E-05	2.03E-04	2.78E-05	2.03E-04	5.08E-06	3.38E-05	1.63E-05	1.08E-04	4.02E-05	2.67E-04	5.18E-08	3.45E-07	4.56E-06	3.03E-05	1.04E-06	6.89E-06
HHRA-14	4.74E-07	3.41E-06	6.06E-07	4.36E-06	4.17E-06	3.00E-05	1.52E-07	1.09E-06	9.47E-08	6.81E-07	6.96E-06	5.36E-05	6.96E-06	5.36E-05	9.28E-07	6.68E-06	2.97E-06	2.14E-05	7.35E-06	5.29E-05	9.47E-09	6.81E-08	8.33E-07	6.00E-06	1.89E-07	1.36E-06

ID	Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Chromium – Cr(III+VI)		Copper (Cu)		Lead (Pb)		Manganese (Mn)		Mercury (Hg)		Nickel (Ni)		Silver (Ag)		Zinc (Zn)	
	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total
HHRA-15	9.54E-08	6.36E-07	1.22E-07	8.14E-07	8.40E-07	5.59E-06	3.05E-08	2.03E-07	1.91E-08	1.27E-07	2.20E-06	1.31E-05	2.20E-06	1.31E-05	1.87E-07	1.25E-06	5.99E-07	3.99E-06	1.48E-06	9.87E-06	1.91E-09	1.27E-08	1.68E-07	1.12E-06	3.82E-08	2.54E-07
HHRA-16	4.78E-07	3.03E-06	6.12E-07	3.88E-06	4.21E-06	2.67E-05	1.53E-07	9.70E-07	9.56E-08	6.06E-07	1.04E-05	6.46E-05	1.04E-05	6.46E-05	9.37E-07	5.94E-06	3.00E-06	1.90E-05	7.42E-06	4.70E-05	9.56E-09	6.06E-08	8.41E-07	5.33E-06	1.91E-07	1.21E-06
HHRA-17	4.16E-07	2.71E-06	5.33E-07	3.47E-06	3.66E-06	2.38E-05	1.33E-07	8.66E-07	8.32E-08	5.42E-07	9.67E-06	6.14E-05	9.67E-06	6.14E-05	8.16E-07	5.31E-06	2.61E-06	1.70E-05	6.46E-06	4.20E-05	8.32E-09	5.42E-08	7.33E-07	4.77E-06	1.66E-07	1.08E-06
HHRA-18	2.96E-07	1.95E-06	3.78E-07	2.49E-06	2.60E-06	1.71E-05	9.46E-08	6.23E-07	5.91E-08	3.90E-07	7.24E-06	4.62E-05	7.24E-06	4.62E-05	5.79E-07	3.82E-06	1.86E-06	1.22E-05	4.59E-06	3.02E-05	5.91E-09	3.90E-08	5.20E-07	3.43E-06	1.18E-07	7.79E-07
HHRA-19	2.89E-07	1.93E-06	3.70E-07	2.47E-06	2.55E-06	1.70E-05	9.26E-08	6.17E-07	5.78E-08	3.85E-07	7.41E-06	4.85E-05	7.41E-06	4.85E-05	5.67E-07	3.78E-06	1.82E-06	1.21E-05	4.49E-06	2.99E-05	5.78E-09	3.85E-08	5.09E-07	3.39E-06	1.16E-07	7.71E-07
HHRA-20	2.18E-07	1.46E-06	2.79E-07	1.88E-06	1.92E-06	1.29E-05	6.98E-08	4.69E-07	4.36E-08	2.93E-07	5.50E-06	3.61E-05	5.50E-06	3.61E-05	4.27E-07	2.87E-06	1.37E-06	9.20E-06	3.38E-06	2.27E-05	4.36E-09	2.93E-08	3.84E-07	2.58E-06	8.72E-08	5.86E-07
HHRA-21	2.33E-07	1.60E-06	2.99E-07	2.05E-06	2.05E-06	1.41E-05	7.47E-08	5.14E-07	4.67E-08	3.21E-07	6.43E-06	4.28E-05	6.43E-06	4.28E-05	4.58E-07	3.15E-06	1.47E-06	1.01E-05	3.62E-06	2.49E-05	4.67E-09	3.21E-08	4.11E-07	2.82E-06	9.34E-08	6.42E-07
HHRA-22	2.22E-07	1.50E-06	2.84E-07	1.92E-06	1.95E-06	1.32E-05	7.11E-08	4.79E-07	4.44E-08	2.99E-07	6.29E-06	4.12E-05	6.29E-06	4.12E-05	4.35E-07	2.93E-06	1.39E-06	9.40E-06	3.45E-06	2.32E-05	4.44E-09	2.99E-08	3.91E-07	2.63E-06	8.88E-08	5.99E-07
HHRA-23	5.08E-07	3.36E-06	6.51E-07	4.30E-06	4.47E-06	2.95E-05	1.63E-07	1.07E-06	1.02E-07	6.71E-07	1.28E-05	8.23E-05	1.28E-05	8.23E-05	9.96E-07	6.58E-06	3.19E-06	2.11E-05	7.89E-06	5.21E-05	1.02E-08	6.71E-08	8.95E-07	5.91E-06	2.03E-07	1.34E-06
HHRA-24	4.50E-07	2.75E-06	5.76E-07	3.52E-06	3.96E-06	2.42E-05	1.44E-07	8.81E-07	9.01E-08	5.50E-07	9.08E-06	5.74E-05	9.08E-06	5.74E-05	8.83E-07	5.39E-06	2.83E-06	1.73E-05	6.99E-06	4.27E-05	9.01E-09	5.50E-08	7.92E-07	4.84E-06	1.80E-07	1.10E-06
HHRA-25	1.22E-07	6.93E-07	1.57E-07	8.86E-07	1.08E-06	6.09E-06	3.92E-08	2.22E-07	2.45E-08	1.39E-07	1.94E-06	1.20E-05	1.94E-06	1.20E-05	2.40E-07	1.36E-06	7.69E-07	4.35E-06	1.90E-06	1.07E-05	2.45E-09	1.39E-08	2.15E-07	1.22E-06	4.90E-08	2.77E-07
GC_1	3.05E-08	1.96E-07	3.91E-08	2.51E-07	2.69E-07	1.72E-06	9.76E-09	6.27E-08	6.10E-09	3.92E-08	9.80E-07	8.14E-06	9.80E-07	8.14E-06	5.98E-08	3.84E-07	1.92E-07	1.23E-06	4.74E-07	3.04E-06	6.10E-10	3.92E-09	5.37E-08	3.45E-07	1.22E-08	7.83E-08
GC_2	3.41E-08	2.36E-07	4.36E-08	3.02E-07	3.00E-07	2.08E-06	1.09E-08	7.55E-08	6.81E-09	4.72E-08	1.24E-06	1.01E-05	1.24E-06	1.01E-05	6.68E-08	4.62E-07	2.14E-07	1.48E-06	5.29E-07	3.66E-06	6.81E-10	4.72E-09	6.00E-08	4.15E-07	1.36E-08	9.44E-08
GC_3	3.86E-08	3.16E-07	4.94E-08	4.05E-07	3.40E-07	2.78E-06	1.23E-08	1.01E-07	7.72E-09	6.32E-08	1.75E-06	1.40E-05	1.75E-06	1.40E-05	7.56E-08	6.20E-07	2.42E-07	1.99E-06	5.99E-07	4.91E-06	7.72E-10	6.32E-09	6.79E-08	5.57E-07	1.54E-08	1.26E-07
GC_4	5.96E-08	4.47E-07	7.62E-08	5.73E-07	5.24E-07	3.94E-06	1.91E-08	1.43E-07	1.19E-08	8.95E-08	2.57E-06	1.94E-05	2.57E-06	1.94E-05	1.17E-07	8.77E-07	3.74E-07	2.81E-06	9.24E-07	6.94E-06	1.19E-09	8.95E-09	1.05E-07	7.88E-07	2.38E-08	1.79E-07
GC_5	8.20E-08	6.36E-07	1.05E-07	8.15E-07	7.22E-07	5.60E-06	2.62E-08	2.04E-07	1.64E-08	1.27E-07	3.83E-06	2.68E-05	3.83E-06	2.68E-05	1.61E-07	1.25E-06	5.15E-07	4.00E-06	1.27E-06	9.88E-06	1.64E-09	1.27E-08	1.44E-07	1.12E-06	3.28E-08	2.55E-07
GC_6	1.03E-07	8.03E-07	1.31E-07	1.03E-06	9.04E-07	7.07E-06	3.29E-08	2.57E-07	2.05E-08	1.61E-07	4.55E-06	3.30E-05	4.55E-06	3.30E-05	2.01E-07	1.57E-06	6.45E-07	5.05E-06	1.59E-06	1.25E-05	2.05E-09	1.61E-08	1.81E-07	1.41E-06	4.11E-08	3.21E-07
GC_7	9.98E-08	8.85E-07	1.28E-07	1.13E-06	8.78E-07	7.79E-06	3.19E-08	2.83E-07	2.00E-08	1.77E-07	3.93E-06	3.26E-05	3.93E-06	3.26E-05	1.96E-07	1.73E-06	6.27E-07	5.56E-06	1.55E-06	1.37E-05	2.00E-09	1.77E-08	1.76E-07	1.56E-06	3.99E-08	3.54E-07
GC_L_8	4.45E-08	3.80E-07	5.70E-08	4.87E-07	3.92E-07	3.35E-06	1.43E-08	1.22E-07	8.91E-09	7.60E-08	2.15E-06	1.59E-05	2.15E-06	1.59E-05	8.73E-08	7.45E-07	2.80E-07	2.39E-06	6.91E-07	5.90E-06	8.91E-10	7.60E-09	7.84E-08	6.69E-07	1.78E-08	1.52E-07
GC_L_9	4.15E-08	3.30E-07	5.31E-08	4.22E-07	3.65E-07	2.90E-06	1.33E-08	1.06E-07	8.30E-09	6.59E-08	1.52E-06	1.29E-05	1.52E-06	1.29E-05	8.14E-08	6.46E-07	2.61E-07	2.07E-06	6.44E-07	5.12E-06	8.30E-10	6.59E-09	7.31E-08	5.80E-07	1.66E-08	1.32E-07
GC_L_10	3.43E-08	2.80E-07	4.39E-08	3.58E-07	3.02E-07	2.46E-06	1.10E-08	8.96E-08	6.85E-09	5.60E-08	1.33E-06	1.11E-05	1.33E-06	1.11E-05	6.72E-08	5.49E-07	2.15E-07	1.76E-06	5.32E-07	4.34E-06	6.85E-10	5.60E-09	6.03E-08	4.93E-07	1.37E-08	1.12E-07
GC_11	1.97E-08	1.41E-07	2.53E-08	1.80E-07	1.74E-07	1.24E-06	6.31E-09	4.51E-08	3.95E-09	2.82E-08	6.28E-07	5.61E-06	6.28E-07	5.61E-06	3.87E-08	2.76E-07	1.24E-07	8.84E-07	3.06E-07	2.19E-06	3.95E-10	2.82E-09	3.47E-08	2.48E-07	7.89E-09	5.63E-08
GC_12	2.53E-08	1.95E-07	3.24E-08	2.49E-07	2.22E-07	1.71E-06	8.09E-09	6.23E-08	5.06E-09	3.89E-08	1.04E-06	8.09E-06	1.04E-06	8.09E-06	4.95E-08	3.82E-07	1.59E-07	1.22E-06	3.92E-07	3.02E-06	5.06E-10	3.89E-09	4.45E-08	3.43E-07	1.01E-08	7.79E-08

Table 11-2: Scenario 2 operations – maximum predicted metals deposition (g/m²/period)

ID	Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Chromium – Cr(III+VI)		Copper (Cu)		Lead (Pb)		Manganese (Mn)		Mercury (Hg)		Nickel (Ni)		Silver (Ag)		Zinc (Zn)	
	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total
AQ_1	1.06E-07	7.99E-07	1.36E-07	1.02E-06	9.33E-07	7.03E-06	3.39E-08	2.56E-07	2.12E-08	1.60E-07	2.28E-06	1.75E-05	2.28E-06	1.75E-05	2.08E-07	1.57E-06	6.66E-07	5.02E-06	1.64E-06	1.24E-05	2.12E-09	1.60E-08	1.87E-07	1.41E-06	4.24E-08	3.20E-07
AQ_2	1.08E-07	7.63E-07	1.38E-07	9.77E-07	9.47E-07	6.72E-06	3.44E-08	2.44E-07	2.15E-08	1.53E-07	2.17E-06	1.69E-05	2.17E-06	1.69E-05	2.11E-07	1.50E-06	6.76E-07	4.79E-06	1.67E-06	1.18E-05	2.15E-09	1.53E-08	1.89E-07	1.34E-06	4.30E-08	3.05E-07
AQ_3	1.07E-07	7.03E-07	1.37E-07	8.99E-07	9.39E-07	6.18E-06	3.42E-08	2.25E-07	2.14E-08	1.41E-07	2.10E-06	1.57E-05	2.10E-06	1.57E-05	2.09E-07	1.38E-06	6.70E-07	4.41E-06	1.66E-06	1.09E-05	2.14E-09	1.41E-08	1.88E-07	1.24E-06	4.27E-08	2.81E-07
AQ_4	1.01E-07	6.49E-07	1.30E-07	8.31E-07	8.91E-07	5.71E-06	3.24E-08	2.08E-07	2.03E-08	1.30E-07	2.00E-06	1.45E-05	2.00E-06	1.45E-05	1.98E-07	1.27E-06	6.36E-07	4.08E-06	1.57E-06	1.01E-05	2.03E-09	1.30E-08	1.78E-07	1.14E-06	4.05E-08	2.60E-07
AQ_5	9.61E-08	6.20E-07	1.23E-07	7.93E-07	8.46E-07	5.45E-06	3.08E-08	1.98E-07	1.92E-08	1.24E-07	1.93E-06	1.39E-05	1.93E-06	1.39E-05	1.88E-07	1.21E-06	6.04E-07	3.89E-06	1.49E-06	9.61E-06	1.92E-09	1.24E-08	1.69E-07	1.09E-06	3.84E-08	2.48E-07
AQ_6	6.79E-08	4.84E-07	8.70E-08	6.19E-07	5.98E-07	4.26E-06	2.17E-08	1.55E-07	1.36E-08	9.68E-08	1.48E-06	1.06E-05	1.48E-06	1.06E-05	1.33E-07	9.48E-07	4.27E-07	3.04E-06	1.05E-06	7.51E-06	1.36E-09	9.68E-09	1.20E-07	8.52E-07	2.72E-08	1.94E-07
AQ_7	5.89E-08	4.12E-07	7.54E-08	5.27E-07	5.18E-07	3.62E-06	1.88E-08	1.32E-07	1.18E-08	8.24E-08	1.32E-06	8.84E-06	1.32E-06	8.84E-06	1.15E-07	8.07E-07	3.70E-07	2.59E-06	9.14E-07	6.39E-06	1.18E-09	8.24E-09	1.04E-07	7.25E-07	2.35E-08	1.65E-07
AQ_8	5.02E-08	3.14E-07	6.42E-08	4.02E-07	4.41E-07	2.76E-06	1.60E-08	1.00E-07	1.00E-08	6.27E-08	1.09E-06	6.75E-06	1.09E-06	6.75E-06	9.83E-08	6.15E-07	3.15E-07	1.97E-06	7.78E-07	4.87E-06	1.00E-09	6.27E-09	8.83E-08	5.52E-07	2.01E-08	1.25E-07
AQ_9	4.07E-08	2.44E-07	5.21E-08	3.12E-07	3.58E-07	2.14E-06	1.30E-08	7.80E-08	8.14E-09	4.87E-08	8.81E-07	5.16E-06	8.81E-07	5.16E-06	7.97E-08	4.78E-07	2.55E-07	1.53E-06	6.31E-07	3.78E-06	8.14E-10	4.87E-09	7.16E-08	4.29E-07	1.63E-08	9.75E-08
AQ_10	6.45E-08	3.48E-07	8.26E-08	4.46E-07	5.68E-07	3.06E-06	2.06E-08	1.11E-07	1.29E-08	6.96E-08	1.06E-06	6.16E-06	1.06E-06	6.16E-06	1.26E-07	6.82E-07	4.05E-07	2.19E-06	1.00E-06	5.40E-06	1.29E-09	6.96E-09	1.14E-07	6.13E-07	2.58E-08	1.39E-07
AQ_11	1.85E-07	1.19E-06	2.37E-07	1.53E-06	1.63E-06	1.05E-05	5.93E-08	3.82E-07	3.70E-08	2.39E-07	3.38E-06	2.05E-05	3.38E-06	2.05E-05	3.63E-07	2.34E-06	1.16E-06	7.50E-06	2.87E-06	1.85E-05	3.70E-09	2.39E-08	3.26E-07	2.10E-06	7.41E-08	4.78E-07
AQ_12	2.49E-07	1.50E-06	3.19E-07	1.92E-06	2.19E-06	1.32E-05	7.97E-08	4.79E-07	4.98E-08	2.99E-07	4.17E-06	2.54E-05	4.17E-06	2.54E-05	4.88E-07	2.93E-06	1.56E-06	9.40E-06	3.87E-06	2.32E-05	4.98E-09	2.99E-08	4.38E-07	2.63E-06	9.96E-08	5.99E-07
AQ_13	3.12E-07	1.88E-06	4.00E-07	2.40E-06	2.75E-06	1.65E-05	1.00E-07	6.00E-07	6.25E-08	3.75E-07	4.83E-06	3.07E-05	4.83E-06	3.07E-05	6.12E-07	3.68E-06	1.96E-06	1.18E-05	4.85E-06	2.91E-05	6.25E-09	3.75E-08	5.50E-07	3.30E-06	1.25E-07	7.50E-07
AQ_14	3.09E-07	2.00E-06	3.96E-07	2.56E-06	2.72E-06	1.76E-05	9.90E-08	6.40E-07	6.19E-08	4.00E-07	4.96E-06	3.30E-05	4.96E-06	3.30E-05	6.06E-07	3.92E-06	1.94E-06	1.26E-05	4.80E-06	3.10E-05	6.19E-09	4.00E-08	5.45E-07	3.52E-06	1.24E-07	8.00E-07
AQ_15	3.09E-07	1.62E-06	3.95E-07	2.07E-06	2.72E-06	1.42E-05	9.88E-08	5.17E-07	6.17E-08	3.23E-07	4.66E-06	2.88E-05	4.66E-06	2.88E-05	6.05E-07	3.17E-06	1.94E-06	1.01E-05	4.79E-06	2.51E-05	6.17E-09	3.23E-08	5.43E-07	2.84E-06	1.23E-07	6.46E-07
AQ_16	2.64E-07	1.23E-06	3.38E-07	1.57E-06	2.32E-06	1.08E-05	8.45E-08	3.93E-07	5.28E-08	2.46E-07	4.08E-06	2.43E-05	4.08E-06	2.43E-05	5.18E-07	2.41E-06	1.66E-06	7.71E-06	4.10E-06	1.91E-05	5.28E-09	2.46E-08	4.65E-07	2.16E-06	1.06E-07	4.91E-07
AQ_17	2.39E-07	9.42E-07	3.06E-07	1.21E-06	2.10E-06	8.29E-06	7.65E-08	3.01E-07	4.78E-08	1.88E-07	4.46E-06	2.30E-05	4.46E-06	2.30E-05	4.69E-07	1.85E-06	1.50E-06	5.91E-06	3.71E-06	1.46E-05	4.78E-09	1.88E-08	4.21E-07	1.66E-06	9.57E-08	3.77E-07
AQ_18	2.21E-07	8.31E-07	2.83E-07	1.06E-06	1.95E-06	7.31E-06	7.07E-08	2.66E-07	4.42E-08	1.66E-07	4.38E-06	2.07E-05	4.38E-06	2.07E-05	4.33E-07	1.63E-06	1.39E-06	5.22E-06	3.43E-06	1.29E-05	4.42E-09	1.66E-08	3.89E-07	1.46E-06	8.84E-08	3.32E-07
AQ_19	2.07E-07	7.79E-07	2.65E-07	9.97E-07	1.82E-06	6.86E-06	6.61E-08	2.49E-07	4.13E-08	1.56E-07	4.21E-06	1.92E-05	4.21E-06	1.92E-05	4.05E-07	1.53E-06	1.30E-06	4.89E-06	3.21E-06	1.21E-05	4.13E-09	1.56E-08	3.64E-07	1.37E-06	8.27E-08	3.12E-07
AQ_20	2.39E-07	9.27E-07	3.06E-07	1.19E-06	2.10E-06	8.15E-06	7.64E-08	2.97E-07	4.78E-08	1.85E-07	5.16E-06	2.21E-05	5.16E-06	2.21E-05	4.68E-07	1.82E-06	1.50E-06	5.82E-06	3.71E-06	1.44E-05	4.78E-09	1.85E-08	4.20E-07	1.63E-06	9.55E-08	3.71E-07
AQ_21	2.38E-07	7.96E-07	3.04E-07	1.02E-06	2.09E-06	7.01E-06	7.60E-08	2.55E-07	4.75E-08	1.59E-07	5.43E-06	1.96E-05	5.43E-06	1.96E-05	4.66E-07	1.56E-06	1.49E-06	5.00E-06	3.69E-06	1.24E-05	4.75E-09	1.59E-08	4.18E-07	1.40E-06	9.51E-08	3.19E-07
AQ_22	1.66E-07	5.37E-07	2.13E-07	6.87E-07	1.46E-06	4.73E-06	5.32E-08	1.72E-07	3.33E-08	1.07E-07	4.44E-06	1.46E-05	4.44E-06	1.46E-05	3.26E-07	1.05E-06	1.04E-06	3.37E-06	2.58E-06	8.33E-06	3.33E-09	1.07E-08	2.93E-07	9.45E-07	6.66E-08	2.15E-07
AQ_23	1.08E-07	3.85E-07	1.38E-07	4.92E-07	9.48E-07	3.38E-06	3.45E-08	1.23E-07	2.15E-08	7.69E-08	3.00E-06	1.07E-05	3.00E-06	1.07E-05	2.11E-07	7.54E-07	6.76E-07	2.42E-06	1.67E-06	5.97E-06	2.15E-09	7.69E-09	1.90E-07	6.77E-07	4.31E-08	1.54E-07
AQ_24	6.36E-08	2.77E-07	8.14E-08	3.55E-07	5.60E-07	2.44E-06	2.04E-08	8.87E-08	1.27E-08	5.54E-08	1.89E-06	7.52E-06	1.89E-06	7.52E-06	1.25E-07	5.43E-07	3.99E-07	1.74E-06	9.87E-07	4.30E-06	1.27E-09	5.54E-09	1.12E-07	4.88E-07	2.54E-08	1.11E-07
AQ_25	4.06E-08	1.78E-07	5.19E-08	2.28E-07	3.57E-07	1.57E-06	1.30E-08	5.70E-08	8.12E-09	3.56E-08	1.09E-06	5.14E-06	1.09E-06	5.14E-06	7.95E-08	3.49E-07	2.55E-07	1.12E-06	6.30E-07	2.76E-06	8.12E-10	3.56E-09	7.14E-08	3.14E-07	1.62E-08	7.13E-08
AQ_26	3.04E-08	1.37E-07	3.89E-08	1.75E-07	2.68E-07	1.21E-06	9.74E-09	4.39E-08	6.09E-09	2.74E-08	8.68E-07	4.07E-06	8.68E-07	4.07E-06	5.96E-08	2.69E-07	1.91E-07	8.61E-07	4.72E-07	2.13E-06	6.09E-10	2.74E-09	5.36E-08	2.41E-07	1.22E-08	5.48E-08
HHRA-01	1.61E-07	1.12E-06	2.06E-07	1.43E-06	1.42E-06	9.84E-06	5.15E-08	3.58E-07	3.22E-08	2.24E-07	3.23E-06	2.36E-05	3.23E-06	2.36E-05	3.15E-07	2.19E-06	1.01E-06	7.02E-06	2.50E-06	1.74E-05	3.22E-09	2.24E-08	2.83E-07	1.97E-06	6.44E-08	4.47E-07
HHRA SR02	8.46E-08	5.70E-07	1.08E-07	7.29E-07	7.44E-07	5.01E-06	2.71E-08	1.82E-07	1.69E-08	1.14E-07	1.70E-06	1.26E-05	1.70E-06	1.26E-05	1.66E-07	1.12E-06	5.31E-07	3.58E-06	1.31E-06	8.84E-06	1.69E-09	1.14E-08	1.49E-07	1.00E-06	3.38E-08	2.28E-07
HHRA-03	7.46E-08	4.79E-07	9.55E-08	6.13E-07	6.56E-07	4.21E-06	2.39E-08	1.53E-07	1.49E-08	9.58E-08	1.62E-06	1.00E-05	1.62E-06	1.00E-05	1.46E-07	9.39E-07	4.68E-07	3.01E-06	1.16E-06	7.43E-06	1.49E-09	9.58E-09	1.31E-07	8.43E-07	2.98E-08	1.92E-07
HHRA-04	1.46E-07	9.61E-07	1.86E-07	1.23E-06	1.28E-06	8.46E-06	4.66E-08	3.07E-07	2.91E-08	1.92E-07	2.80E-06	2.14E-05	2.80E-06	2.14E-05	2.85E-07	1.88E-06	9.14E-07	6.03E-06	2.26E-06	1.49E-05	2.91E-09	1.92E-08	2.56E-07	1.69E-06	5.82E-08	3.84E-07
HHRA-05	1.20E-07	7.98E-07	1.54E-07	1.02E-06	1.06E-06	7.02E-06	3.84E-08	2.55E-07	2.40E-08	1.60E-07	2.33E-06	1.74E-05	2.33E-06	1.74E-05	2.35E-07	1.56E-06	7.55E-07	5.01E-06	1.86E-06	1.24E-05	2.40E-09	1.60E-08	2.11E-07	1.40E-06	4.81E-08	3.19E-07
HHRA-06	9.50E-08	6.54E-07	1.22E-07	8.37E-07	8.36E-07	5.75E-06	3.04E-08	2.09E-07	1.90E-08	1.31E-07	1.89E-06	1.42E-05	1.89E-06	1.42E-05	1.86E-07	1.28E-06	5.96E-07	4.10E-06	1.47E-06	1.01E-05	1.90E-09	1.31E-08	1.67E-07	1.15E-06	3.80E-08	2.61E-07
HHRA-07	1.39E-07	1.03E-06	1.78E-07	1.32E-06	1.22E-06	9.07E-06	4.44E-08	3.30E-07	2.78E-08	2.06E-07	2.84E-06	2.25E-05	2.84E-06	2.25E-05	2.72E-07	2.02E-06	8.72E-07	6.48E-06	2.15E-06	1.60E-05	2.78E-09	2.06E-08	2.44E-07	1.81E-06	5.55E-08	4.12E-07
HHRA-08	1.37E-07	9.05E-07	1.75E-07	1.16E-06	1.20E-06	7.97E-06	4.38E-08	2.90E-07	2.74E-08	1.81E-07	2.65E-06	2.01E-05	2.65E-06	2.01E-05	2.68E-07	1.77E-06	8.60E-07	5.68E-06	2.12E-06	1.40E-05	2.74E-09	1.81E-08	2.41E-07	1.59E-06	5.48E-08	3.62E-07
HHRA-09	7.53E-08	5.61E-07	9.63E-08	7.18E-07	6.62E-07	4.94E-06	2.41E-08	1.80E-07	1.51E-08	1.12E-07	1.79E-06	1.20E-05	1.79E-06	1.20E-05	1.48E-07	1.10E-06	4.73E-07	3.52E-06	1.17E-06	8.71E-06	1.51E-09	1.12E-08	1.32E-07	9.88E-07	3.01E-08	2.24E-07
HHRA-10	8.86E-08	5.80E-07	1.13E-07	7.43E-07	7.80E-07	5.11E-06	2.84E-08	1.86E-07	1.77E-08	1.16E-07	1.80E-06	1.30E-05	1.80E-06	1.30E-05	1.74E-07	1.14E-06	5.57E-07	3.65E-06	1.38E-06	9.01E-06	1.77E-09	1.16E-08	1.56E-07	1.02E-06	3.55E-08	2.32E-07
HHRA-11	1.85E-07	1.23E-06	2.37E-07	1.58E-06	1.63E-06	1.09E-05	5.92E-08	3.95E-07	3.70E-08	2.47E-07	3.65E-06	2.54E-05	3.65E-06	2.54E-05	3.62E-07	2.42E-06	1.16E-06	7.75E-06	2.87E-06	1.91E-05	3.70E-09	2.47E-08	3.25E-07	2.17E-06	7.39E-08	4.93E-07
HHRA-12	1.39E-07	8.48E-07	1.78E-07	1.09E-06	1.22E-06	7.46E-06	4.44E-08	2.71E-07	2.78E-08	1.70E-07	2.11E-06	1.46E-05	2.11E-06	1.46E-05	2.72E-07	1.66E-06	8.72E-07	5.33E-06	2.15E-06	1.32E-05	2.78E-09	1.70E-08	2.44E-07	1.49E-06	5.55E-08	3.39E-07
HHRA-13	1.29E-06	8.77E-06	1.65E-06	1.12E-05	1.13E-05	7.72E-05	4.12E-07	2.81E-06	2.57E-07	1.75E-06	1.40E-05	1.03E-04	1.40E-05	1.03E-04	2.52E-06	1.72E-05	8.08E-06	5.51E-05	2.00E-05	1.36E-04	2.57E-08	1.75E-07	2.27E-06	1.54E-05	5.15E-07	3.51E-06
HHRA-14	2.49E-07	1.75E-06	3.18E-07	2.24E-06	2.19E-06	1.54E-05	7.96E-08	5.61E-07	4.98E-08	3.50E-07	3.65E-06	2.85E-05	3.65E-06	2.85E-05	4.88E-07	3.43E-06	1.56E-06	1.10E-05	3.86E-06	2.72E-05	4.98E-09	3.50E-08	4.38E-07	3.08E-06	9.95E-08	7.01E-07

ID	Antimony (Sb)		Arsenic (As)		Barium (Ba)		Beryllium (Be)		Cadmium (Cd)		Chromium – Cr(III+VI)		Copper (Cu)		Lead (Pb)		Manganese (Mn)		Mercury (Hg)		Nickel (Ni)		Silver (Ag)		Zinc (Zn)	
	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total	Max month	Annual Total
HHRA-15	5.00E-08	3.26E-07	6.41E-08	4.17E-07	4.40E-07	2.87E-06	1.60E-08	1.04E-07	1.00E-08	6.51E-08	1.09E-06	6.51E-06	1.09E-06	6.51E-06	9.81E-08	6.38E-07	3.14E-07	2.04E-06	7.77E-07	5.05E-06	1.00E-09	6.51E-09	8.81E-08	5.73E-07	2.00E-08	1.30E-07
HHRA-16	2.45E-07	1.52E-06	3.13E-07	1.95E-06	2.15E-06	1.34E-05	7.83E-08	4.88E-07	4.89E-08	3.05E-07	5.16E-06	3.17E-05	5.16E-06	3.17E-05	4.79E-07	2.99E-06	1.54E-06	9.57E-06	3.80E-06	2.37E-05	4.89E-09	3.05E-08	4.31E-07	2.68E-06	9.79E-08	6.10E-07
HHRA-17	2.09E-07	1.36E-06	2.68E-07	1.74E-06	1.84E-06	1.20E-05	6.69E-08	4.36E-07	4.18E-08	2.72E-07	4.78E-06	3.02E-05	4.78E-06	3.02E-05	4.10E-07	2.67E-06	1.31E-06	8.56E-06	3.24E-06	2.11E-05	4.18E-09	2.72E-08	3.68E-07	2.40E-06	8.36E-08	5.45E-07
HHRA-18	1.51E-07	9.83E-07	1.94E-07	1.26E-06	1.33E-06	8.65E-06	4.84E-08	3.14E-07	3.03E-08	1.97E-07	3.59E-06	2.29E-05	3.59E-06	2.29E-05	2.97E-07	1.93E-06	9.51E-07	6.17E-06	2.35E-06	1.52E-05	3.03E-09	1.97E-08	2.66E-07	1.73E-06	6.06E-08	3.93E-07
HHRA-19	1.50E-07	9.63E-07	1.91E-07	1.23E-06	1.32E-06	8.48E-06	4.78E-08	3.08E-07	2.99E-08	1.93E-07	3.67E-06	2.39E-05	3.67E-06	2.39E-05	2.93E-07	1.89E-06	9.39E-07	6.05E-06	2.32E-06	1.50E-05	2.99E-09	1.93E-08	2.63E-07	1.70E-06	5.98E-08	3.85E-07
HHRA-20	1.14E-07	7.40E-07	1.46E-07	9.47E-07	1.00E-06	6.51E-06	3.64E-08	2.37E-07	2.27E-08	1.48E-07	2.72E-06	1.78E-05	2.72E-06	1.78E-05	2.23E-07	1.45E-06	7.14E-07	4.65E-06	1.77E-06	1.15E-05	2.27E-09	1.48E-08	2.00E-07	1.30E-06	4.55E-08	2.96E-07
HHRA-21	1.19E-07	7.92E-07	1.52E-07	1.01E-06	1.04E-06	6.97E-06	3.80E-08	2.54E-07	2.37E-08	1.58E-07	3.16E-06	2.09E-05	3.16E-06	2.09E-05	2.33E-07	1.55E-06	7.46E-07	4.98E-06	1.84E-06	1.23E-05	2.37E-09	1.58E-08	2.09E-07	1.39E-06	4.75E-08	3.17E-07
HHRA-22	1.06E-07	7.31E-07	1.36E-07	9.36E-07	9.33E-07	6.44E-06	3.39E-08	2.34E-07	2.12E-08	1.46E-07	3.06E-06	2.00E-05	3.06E-06	2.00E-05	2.08E-07	1.43E-06	6.66E-07	4.59E-06	1.65E-06	1.14E-05	2.12E-09	1.46E-08	1.87E-07	1.29E-06	4.24E-08	2.93E-07
HHRA-23	2.55E-07	1.66E-06	3.26E-07	2.13E-06	2.24E-06	1.46E-05	8.15E-08	5.32E-07	5.09E-08	3.33E-07	6.30E-06	4.06E-05	6.30E-06	4.06E-05	4.99E-07	3.26E-06	1.60E-06	1.04E-05	3.95E-06	2.58E-05	5.09E-09	3.33E-08	4.48E-07	2.93E-06	1.02E-07	6.65E-07
HHRA-24	2.25E-07	1.38E-06	2.88E-07	1.77E-06	1.98E-06	1.22E-05	7.20E-08	4.43E-07	4.50E-08	2.77E-07	4.53E-06	2.86E-05	4.53E-06	2.86E-05	4.41E-07	2.71E-06	1.41E-06	8.70E-06	3.49E-06	2.15E-05	4.50E-09	2.77E-08	3.96E-07	2.44E-06	8.99E-08	5.54E-07
HHRA-25	6.56E-08	3.57E-07	8.40E-08	4.57E-07	5.78E-07	3.14E-06	2.10E-08	1.14E-07	1.31E-08	7.15E-08	1.04E-06	6.21E-06	1.04E-06	6.21E-06	1.29E-07	7.00E-07	4.12E-07	2.24E-06	1.02E-06	5.54E-06	1.31E-09	7.15E-09	1.16E-07	6.29E-07	2.63E-08	1.43E-07
GC_1	1.39E-08	9.60E-08	1.78E-08	1.23E-07	1.22E-07	8.45E-07	4.45E-09	3.07E-08	2.78E-09	1.92E-08	4.09E-07	3.47E-06	4.09E-07	3.47E-06	2.72E-08	1.88E-07	8.73E-08	6.03E-07	2.16E-07	1.49E-06	2.78E-10	1.92E-09	2.45E-08	1.69E-07	5.56E-09	3.84E-08
GC_2	1.63E-08	1.15E-07	2.09E-08	1.47E-07	1.44E-07	1.01E-06	5.22E-09	3.67E-08	3.26E-09	2.30E-08	5.19E-07	4.30E-06	5.19E-07	4.30E-06	3.20E-08	2.25E-07	1.02E-07	7.21E-07	2.53E-07	1.78E-06	3.26E-10	2.30E-09	2.87E-08	2.02E-07	6.53E-09	4.59E-08
GC_3	1.95E-08	1.53E-07	2.49E-08	1.96E-07	1.71E-07	1.35E-06	6.23E-09	4.90E-08	3.89E-09	3.06E-08	7.54E-07	6.08E-06	7.54E-07	6.08E-06	3.82E-08	3.00E-07	1.22E-07	9.61E-07	3.02E-07	2.38E-06	3.89E-10	3.06E-09	3.43E-08	2.69E-07	7.79E-09	6.12E-08
GC_4	2.96E-08	2.14E-07	3.78E-08	2.74E-07	2.60E-07	1.88E-06	9.46E-09	6.85E-08	5.91E-09	4.28E-08	1.15E-06	8.69E-06	1.15E-06	8.69E-06	5.80E-08	4.19E-07	1.86E-07	1.34E-06	4.59E-07	3.32E-06	5.91E-10	4.28E-09	5.20E-08	3.77E-07	1.18E-08	8.56E-08
GC_5	3.98E-08	2.94E-07	5.10E-08	3.77E-07	3.51E-07	2.59E-06	1.27E-08	9.42E-08	7.97E-09	5.89E-08	1.78E-06	1.24E-05	1.78E-06	1.24E-05	7.81E-08	5.77E-07	2.50E-07	1.85E-06	6.18E-07	4.57E-06	7.97E-10	5.89E-09	7.01E-08	5.18E-07	1.59E-08	1.18E-07
GC_6	4.30E-08	3.69E-07	5.51E-08	4.72E-07	3.79E-07	3.24E-06	1.38E-08	1.18E-07	8.60E-09	7.37E-08	2.17E-06	1.55E-05	2.17E-06	1.55E-05	8.43E-08	7.23E-07	2.70E-07	2.32E-06	6.68E-07	5.72E-06	8.60E-10	7.37E-09	7.57E-08	6.49E-07	1.72E-08	1.47E-07
GC_7	4.89E-08	3.90E-07	6.26E-08	4.99E-07	4.31E-07	3.43E-06	1.57E-08	1.25E-07	9.79E-09	7.80E-08	1.88E-06	1.53E-05	1.88E-06	1.53E-05	9.59E-08	7.64E-07	3.07E-07	2.45E-06	7.59E-07	6.05E-06	9.79E-10	7.80E-09	8.61E-08	6.86E-07	1.96E-08	1.56E-07
GC_L_8	1.96E-08	1.70E-07	2.51E-08	2.18E-07	1.72E-07	1.50E-06	6.27E-09	5.44E-08	3.92E-09	3.40E-08	1.02E-06	7.41E-06	1.02E-06	7.41E-06	3.84E-08	3.33E-07	1.23E-07	1.07E-06	3.04E-07	2.64E-06	3.92E-10	3.40E-09	3.45E-08	2.99E-07	7.83E-09	6.80E-08
GC_L_9	2.05E-08	1.44E-07	2.62E-08	1.84E-07	1.80E-07	1.27E-06	6.56E-09	4.60E-08	4.10E-09	2.88E-08	7.26E-07	6.00E-06	7.26E-07	6.00E-06	4.02E-08	2.82E-07	1.29E-07	9.04E-07	3.18E-07	2.23E-06	4.10E-10	2.88E-09	3.61E-08	2.53E-07	8.20E-09	5.76E-08
GC_L_10	1.71E-08	1.20E-07	2.19E-08	1.54E-07	1.50E-07	1.06E-06	5.47E-09	3.85E-08	3.42E-09	2.41E-08	6.37E-07	5.17E-06	6.37E-07	5.17E-06	3.35E-08	2.36E-07	1.07E-07	7.56E-07	2.65E-07	1.87E-06	3.42E-10	2.41E-09	3.01E-08	2.12E-07	6.84E-09	4.82E-08
GC_11	9.51E-09	5.92E-08	1.22E-08	7.58E-08	8.37E-08	5.21E-07	3.04E-09	1.89E-08	1.90E-09	1.18E-08	2.98E-07	2.59E-06	2.98E-07	2.59E-06	1.86E-08	1.16E-07	5.97E-08	3.72E-07	1.48E-07	9.19E-07	1.90E-10	1.18E-09	1.67E-08	1.04E-07	3.80E-09	2.37E-08
GC_12	1.26E-08	9.37E-08	1.62E-08	1.20E-07	1.11E-07	8.25E-07	4.05E-09	3.00E-08	2.53E-09	1.87E-08	4.35E-07	3.48E-06	4.35E-07	3.48E-06	2.48E-08	1.84E-07	7.94E-08	5.89E-07	1.96E-07	1.45E-06	2.53E-10	1.87E-09	2.23E-08	1.65E-07	5.06E-09	3.75E-08

12 APPENDIX D

HHIA assessment report