# ALINTA ENERGY REEVES PLAINS POWER STATION

DEVELOPMENT APPLICATION


12 OCTOBER 2017

# APPENDIX F – AIR QUALITY IMPACT ASSESSMENT

This document has been prepared on behalf of **Arcadis Australia Pacific Pty Ltd** by:

**Northstar Air Quality Pty Ltd,**

**Level 40, 100 Miller Street, North Sydney, NSW 2060**

**www.northstarairquality.com | Tel: +61 (02) 9931 7870**

# Reeves Plains Power Station Project, Air Quality Impact Assessment

| | |
|---|---|
| **Addressee(s):** | Arcadis Australia Pacific Pty Ltd |
| **Report Reference:** | 17.1052.FR1V1 |
| **Date:** | 13 September 2017 |

## Disclaimer

This report has been prepared with the due care and attention of a suitably qualified consultant. Information is obtained from sources believed to be reliable, but is in no way guaranteed. No guarantee of any kind is implied or possible where predictions of future conditions are attempted. This report (including any enclosures and attachments) has been prepared for the exclusive use and benefit of the addressee(s) and solely for the purpose for which it is provided. Unless we provide express prior written consent, no part of this report should be reproduced, distributed or communicated to any third party. We do not accept any liability if this report is used for an alternative purpose from which it is intended, nor to any third party in respect of this report.

## Quality Control

| Study | Status | Prepared by | Checked by | Authorised by |
|---|---|---|---|---|
| INTRODUCTION | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |
| THE PROJECT | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |
| EXISTING CONDITIONS | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |
| METHODOLOGY | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |
| CONSTRUCTION PHASE RISK ASSESSMENT | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |
| OPERATIONAL PHASE IMPACT ASSESSMENT | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |
| DISCUSSION | Final | Northstar Air Quality | MD, EH, SW | GCG, MD |

## Report Status

| Northstar References | | Report Status | Report Reference | Version |
|---|---|---|---|---|
| Year | Job Number | (Draft: Final) | (R*x*) | (V*x*) |
| 17 | 1052 | F | R1 | V1 |
| Based upon the above, the specific reference for this version of the report is: | | | | **17.1052.FR1V1** |

## Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

**G. Graham** **13 September 2017**

# Non-Technical Summary

Arcadis Australia Pacific Pty Ltd, on behalf of Alinta Energy (Reeves Plains) Pty Ltd, has engaged Northstar Air Quality Pty Ltd to perform an impact assessment study of the potential impacts upon air quality of the construction and operation of the Reeves Plains Power Station Project (the Project).

The power station will be located at 1629 Redbanks Road on a 41 hectare greenfield site located in Reeves Plains, approximately 12 kilometres south-east of Mallala and 50 kilometre north of Adelaide (the Project site).

The purpose of this Air Quality Impact Assessment is to assess the impact of the construction and operation of the Project upon air quality, determine compliance (or otherwise) with the South Australia *Environmental Protection (Air Quality) Policy* (2016) and make recommendations for changes to operations where the studies show that there is an unacceptable risk to the environment.

The Project involves the construction and operation of a series of six (6) 50-megawatt dual-fuel gas turbines to generate peak-demand electricity for export to the electricity grid and each turbine will discharge exhaust gases to atmosphere via a dedicated 3.5 metre diameter emission stack at a discharge height of 15.5 metres above ground level. The proposed power station can be operated at various reduced load profiles, and emissions of air pollutants have been shown to vary according to the operating load. The Project is capable of operating on either natural gas or mineral diesel as fuel. The Project is to operate the power station on natural gas with an option to operate on mineral diesel in case of interruption of the gas supply and this AQIA considers the potential impacts of the operation of the power station operating on both fuels.

The Air Quality Impact Assessment presents an assessment of potential impacts during the construction and operation of the Project. The construction phase assessment uses a risk-based methodology adapted from the Institute of Air Quality Management (2014) *IAQM Guidance on the Assessment of Dust from Demolition and Construction*. Using this methodology, it is concluded that construction dust emissions may be adequately controlled through the application of a range of suitable construction management practices, and that these should be documented within a Construction Environmental Management Plan (CEMP).

The potential impacts from the operation of the Project have been assessed using a referenced dispersion modelling study, using meteorological data as specified by the Environmental Protection Authority, representative background monitoring data and using emission rates derived directly from Alinta Energy (Reeves Plains) Pty Ltd. Based upon the assumptions presented in the Air Quality Impact Assessment it is predicted that the operation of the power station on either gas or mineral diesel will not result in a breach of the standards prescribed in the South Australia *Environmental Protection (Air Quality) Policy* (2016).

It is recommended that a suitable campaign of compliance monitoring should be implemented to the satisfaction of the Environmental Protection Authority. It is considered that the demonstration that the engines are capable of being operated as set out in this Air Quality Impact Assessment is of critical importance, and that a program of emissions testing with the engines operating on gas and diesel and at various loads should be implemented as a condition of approval.

Whilst the Air Quality Impact Assessment predicts that the air quality risks associated with operation at full capacity (300 megawatts) are within acceptable limits, it is considered that the environmental risks are further managed by the proposed staged development. Implementing the recommended program of compliance emissions monitoring during the initial stage (150 megawatts installed capacity) would provide the Environmental Protection Authority with increased assurance that the proposed plant is able to achieve its performance objectives prior to operating the second stage (300 megawatt installed capacity).

In light of the above, and in consideration of the proposed verification studies, it is considered to be reasonable to conclude that the proposed construction and operation of the Project should not be refused on grounds of air quality.

## Contents

## Appendices

## Tables



## Figures

## Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol. For example:

- 3 milligrams per cubic metre would be presented as 3 mg·m$^{-3}$ and not 3 mg/m$^3$.
- 20 metres per second would be presented as 20 m·s$^{-1}$ and not 20 m/s.

The following prefixes are added to unit names to produce multiples and sub-multiples of SI units:

| Prefix | Symbol | Factor | Prefix | Symbol | Factor |
|---|---|---|---|---|---|
| T | tera- | $10^{12}$ | p | pico- | $10^{-12}$ |
| G | giga- | $10^{9}$ | n | nano- | $10^{-9}$ |
| M | mega- | $10^{6}$ | µ | micro- | $10^{-6}$ |
| k | kilo- | $10^{3}$ | m | milli- | $10^{-3}$ |
| h | hector- | $10^{2}$ | c | centi- | $10^{-2}$ |
| da | deca | $10^{1}$ | d | deci- | $10^{-1}$ |

## Common Abbreviations

| Abbreviation | Term |
|---|---|
| AGL | above ground level |
| AHD | Australian height datum |
| AQIA | air quality impact assessment |
| AQMS | air quality monitoring station |
| AWS | automatic weather station |
| BoM | Bureau of Meteorology |
| $CH_2O$ | formaldehyde |
| CO | carbon monoxide |
| CSIRO | Commonwealth Scientific and Industrial Research Organisation |
| EPA | Environmental Protection Authority |
| $g{\cdot}s^{-1}$ | gram per second |
| ha | hectare |
| HAP | hazardous air pollutant |
| K | degrees Kelvin |
| m | metre |
| $m{\cdot}s^{-1}$ | metres per second |
| $mg{\cdot}m^{-3}$ | milligram per cubic metre of air |
| $\mu g{\cdot}m^{-3}$ | micrograms per cubic metre of air |
| $mg{\cdot}Nm^{-3}$ | milligram per normalised cubic metre of air |
| MW | megawatt |
| NEPM | National Environment Protection Measure |
| NO | nitric oxide |
| $NO_X$ | total oxides of nitrogen |
| $NO_2$ | nitrogen dioxide |
| ppb | parts per billion ($1x10^{-9}$) |
| ppm | parts per million ($1x10^{-6}$) |
| $SO_2$ | sulphur dioxide |
| TAPM | The Air Pollution Model |
| TSP | total suspended particulates |
| US EPA | United States Environmental Protection Agency |
| UTM | Universal Transverse Mercator |

# 1. INTRODUCTION

Arcadis Australia Pacific Pty Ltd (Arcadis), on behalf of Alinta Energy (Reeves Plains) Pty Ltd (Alinta Energy), has engaged Northstar Air Quality Pty Ltd (Northstar) to perform an impact assessment study of the potential impacts upon air quality of the construction and operation of the Reeves Plains Power Station Project (the Project).

The Project involves the construction and operation of a series of six (6) 50-megawatt (MW) dual-fuel gas turbines to generate peak-demand electricity for export to the electricity grid.

The power station will be located at 1629 Redbanks Road on a 41 hectare (ha) greenfield site located in Reeves Plains, approximately 12 kilometres (km) south-east of Mallala and 50 km north of Adelaide (the Project site). The proposed site is located at 280,680 mE 6,179,275 mS (UTM).

The purpose of this Air Quality Impact Assessment is to assess the impact of the construction and operation of the Project upon air quality and determine compliance with the South Australia *Environmental Protection (Air Quality) Policy* (2016) (Air EPP).

## 1.1. Approach

During the preparation of this AQIA reference has been made to the South Australian Environment Protection Authority (EPA) specifications and requirements presented in Environment Protection Authority (2016) Ambient Air Quality Assessment[1] (EPA, 2016). That guidance publication sets out the EPA's requirements and expectations for an AQIA to adequately assess impacts upon air quality under the *Environment Protection Act* (1993) and the *Development Act* (1993).

**Appendix G** presents a Capability Statement, as specified in Appendix 1 of EPA 2016. **Appendix G** additionally presents the key requirements specified in EPA 2016 as relates to a dispersion modelling assessment.

## 1.2. Objective of the Study

The objective of this Air Quality Impact Assessment is to determine whether the proposed power station may be constructed and operated at the Project site without breaching the environmental objectives, evaluated as a risk in terms of construction dust, and compliance with the standards prescribed under the *Environment Protection (Air Quality) Policy* 2016 (Air EPP) during operation.

[1] http://www.epa.sa.gov.au/environmental_info/air_quality/assistance_and_advice

Where the AQIA identifies that those environmental objectives are not achievable, the objective is to identify further mitigation that may be applied to achieve those objectives, which may include changes to operational conditions, air pollution control or restricted operations, as appropriate.

## 1.3. Ambient Air Quality Standards

State air quality guidelines adopted by the South Australia EPA are published in the *Environment Protection (Air Quality) Policy* 2016 (Air EPP) under section 28 of the *Environment Protection Act* (1993). Where relevant to the expected potential scope of emissions to air from the operation of the power station (see **Section 2.3.2**), the ground level concentration standards are reproduced from Schedule 2 of the Air EPP in **Table 1** below:

**Table 1 Air EPP ambient air standards**

| Pollutant | Classification | Averaging time | Maximum concentration ($mg \cdot m^{-3}$) | Maximum concentration (ppm) |
|---|---|---|---|---|
| Carbon monoxide (CO) | Toxicity | 1 hour | 31.24 | 25 |
| | | 8 hours | 11.12 | 9.0 |
| Nitrogen dioxide ($NO_2$) | Toxicity | 1 hour | 0.25 | 0.12 |
| | | 12 months | 0.06 | 0.03 |
| Particles (as $PM_{10}$) | Toxicity; Group 1 carcinogen | 24 hours | 0.05 | - |
| Particles (as $PM_{2.5}$) | Toxicity; Group 1 carcinogen | 24 hours | 0.025 | - |
| | | 12 months | 0.008 | - |
| Sulphur dioxide ($SO_2$) | Toxicity | 1 hour | 0.57 | 0.2 |
| | | 24 hours | 0.23 | 0.08 |
| | | 12 months | 0.06 | 0.02 |
| Formaldehyde ($CH_2O$) | Toxicity; Group 1 carcinogen | 3 minutes | 0.044 | 0.033 |

The air quality standards presented in **Table 1** represent the standards to be achieved for the Project in this AQIA.

# 2. THE PROJECT

The following provides a description of the Project, the environmental setting and the identified potential emissions of air pollutants which may result from the construction and operation of the power station.

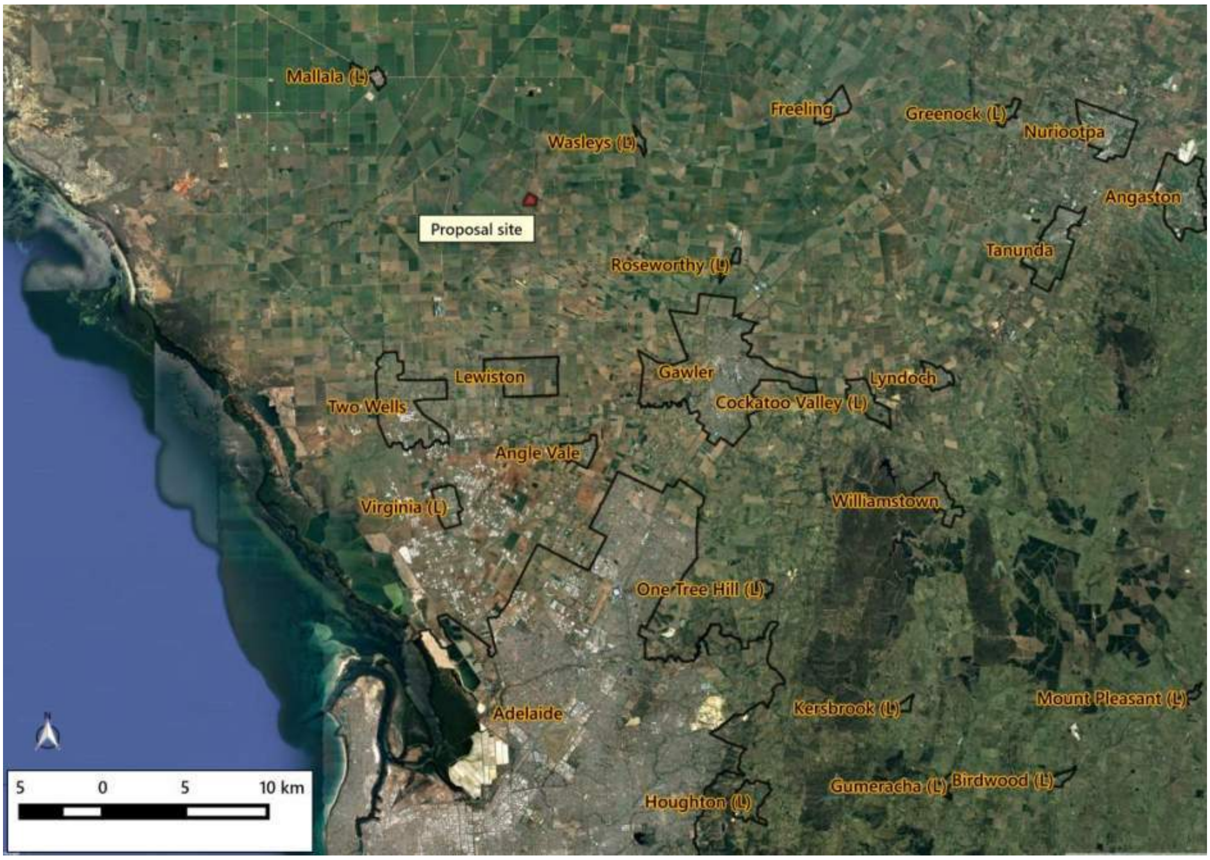
## 2.1. Environmental Setting

The Project site is located at Reeves Plains, approximately 12 km to the south-east of Mallala and approximately 14 km to the north-west of Gawler, as shown in **Figure 1**.

The 41 ha site is located to the south of the junction of Gawler Road and Days Road at Reeves Plains.

The Project site is located in a rural area, with mixed residential and agricultural land uses. The land at the Project site is flat and at a height of approximately 50-52 metres (m) Australian Height Datum (AHD).

**Figure 1 Project location and surrounds**




**Source**: Northstar Air Quality

## 2.2. Overview

The power station will operate as a 'peaker', providing electricity during periods of high demand, and is designed to generate up to 300 megawatts (MW) of power and will be delivered in two stages with up to 150 MW installed initially with further build out as required by prevailing market conditions. The Project includes the following infrastructure:

- A gas receival station;
- Up to six (6) dual fuel (gas and diesel) turbines each capable of generating 50 MW of power;
- Three (3) transformers designed to convert low voltage electricity into high voltage electricity
- Connection to the electricity network including a new substation, transmission tower and communications tower;
- Water supply and storage including:
  - Water treatment plant;
  - Water storage tanks;
  - Firefighting system;
- Evaporation pond; and
- Diesel storage.

Also included within the Project are the following:

- Control rooms, workshop and maintenance facilities and administration building;
- Security fencing and lighting;
- Onsite drainage works;
- Upgrade to the Redbanks Road and Day Road intersection and sealing of Day Road from Redbanks Road to the Project entrance;
- Carparking for employees and contractors;
- Demolition of existing buildings onsite; and
- Landscaping.

The Project is required to obtain development consent from the State Commission Assessment Panel before proceeding. Construction of the Project is scheduled to commence in 2018 with operation of the power station occurring in Q1 2020 at the earliest.

The power station will operate six (6) dual-fuel gas turbines and each turbine will discharge exhaust gases to atmosphere via a dedicated 3.5 metre (m) diameter emission stack at a discharge height of 15.5 m above ground level (AGL).

The proposed power station can be operated at various reduced load profiles, and emissions of air pollutants have been shown to vary according to the operating load (refer **Section 4.2**).

Further, the proposed power station is capable of operating on either natural gas or diesel as fuel. The Project is to operate the power station on natural gas with an option to operate on mineral diesel (hereafter referred to as 'diesel') in case of interruption of the gas supply and this AQIA considers the potential impacts of the operation of the power station operating on both fuels.

## 2.3. Potential for Emissions to Air

### 2.3.1. Construction

The potential emissions to air during the construction phase will be associated with the emission of particulates associated with the various construction activities, including: demolition; earthworks and enabling works; construction; track-out and construction traffic.

Additionally, the operation of construction vehicles and plant may give rise to short-term engine exhaust emissions, however given the low number of construction vehicles expected for such a development, these emissions have not been quantitatively assessed.

### 2.3.2. Operation

Potential emissions to air during operation of the power station are associated with products of combustion of the fuel. The power station will be equipped to operate principally on gas, but with a capability to operate on diesel should the gas supply not be available, and depending on the fuel consumed the rate of emissions may vary and consequently, the principal emissions during operation involve emissions of the following air pollutants:

- **Oxides of nitrogen**. Oxides of nitrogen ($NO_X$) are principally emitted as nitric oxide (NO), nitrogen dioxide ($NO_2$) and a small component of nitrous oxide ($N_2O$) and combined these gases are termed as total oxides of nitrogen ($NO_X$). These pollutants are formed in the combustion zone where the high operating temperatures generate thermal $NO_X$ from the nitrogen in the air, and are typically emitted as 90-95% NO and 5-10% $NO_2$. Upon emission to the atmosphere, secondary reactions occur that oxidise NO to $NO_2$.
- **Carbon monoxide**. Carbon monoxide (CO) is a colourless and odourless gas, formed due to the incomplete combustion of fuel.
- **Sulphur dioxide**. Sulphur dioxide ($SO_2$) emissions are generated from the oxidation of sulphur in the fuel during combustion. Australian Standard (AS/NZS 4564) provides a limit of sulphur in natural gas of 50 milligrams per cubic metre of air ($mg{\cdot}m^{-3}{}_{101.3kPa,\ 288\ K}$). The sulphur content of diesel is specified by the *Fuel Quality Standards Act (2000)* which limits the sulphur content to 10 parts per million (ppm).
- **Particulate matter**. Particulate matter (PM) may be generated through the combustion of fuels, and may be described in terms of the particle size fraction, including:

- TSP: Particulate matter with an aerodynamic diameter of (approximately) 30 micrometres (µm) to 10 µm;
- $PM_{10}$: Particulate matter with an aerodynamic diameter of 10 µm or less; and
- $PM_{2.5}$: Particulate matter with an aerodynamic diameter of 2.5 µm or less.

The combustion of gas creates extremely low rates of particle emissions due to the nature of the fuel. The US Environmental Protection Agency (US EPA) identifies that particulate emissions from gas turbines is principally composed of larger molecular weight hydrocarbons that have been incompletely combusted, and virtually 100% are less than 1 µm in diameter. For this project, given that virtually all particles emitted from the combustion of gas in a gas turbine are <1 µm, particulates from gas are assessed as $PM_{2.5}$, which is a subset of $PM_{10}$.

In regard to particulates from diesel, again virtually 100% of diesel particles are less than 1 µm in diameter, and given that virtually all particles emitted from the combustion of diesel are <1 µm, particulates from diesel are assessed as $PM_{2.5}$.

- **Hazardous air pollutants**. Hazardous air pollutants (HAP) is a term applied to a range of pollutants. The US EPA AP-42 states: "*available data indicate that emission levels of HAP are lower for gas turbines than for other combustion sources. This is due to the high combustion temperatures reached during normal operation. The emission data also indicate that formaldehyde is the most significant HAP emitted from combustion turbines. For natural gas fired turbines, formaldehyde accounts for about two-thirds of the total HAP emissions…*"

The rate at which pollutants are emitted to atmosphere will further vary by the load requirements on the power station. For the purposes of this assessment, the emission rates have been estimated for each fuel type (gas and diesel) at four load points: 100% load (maximum); 75% load; 50% load; and 25% load.

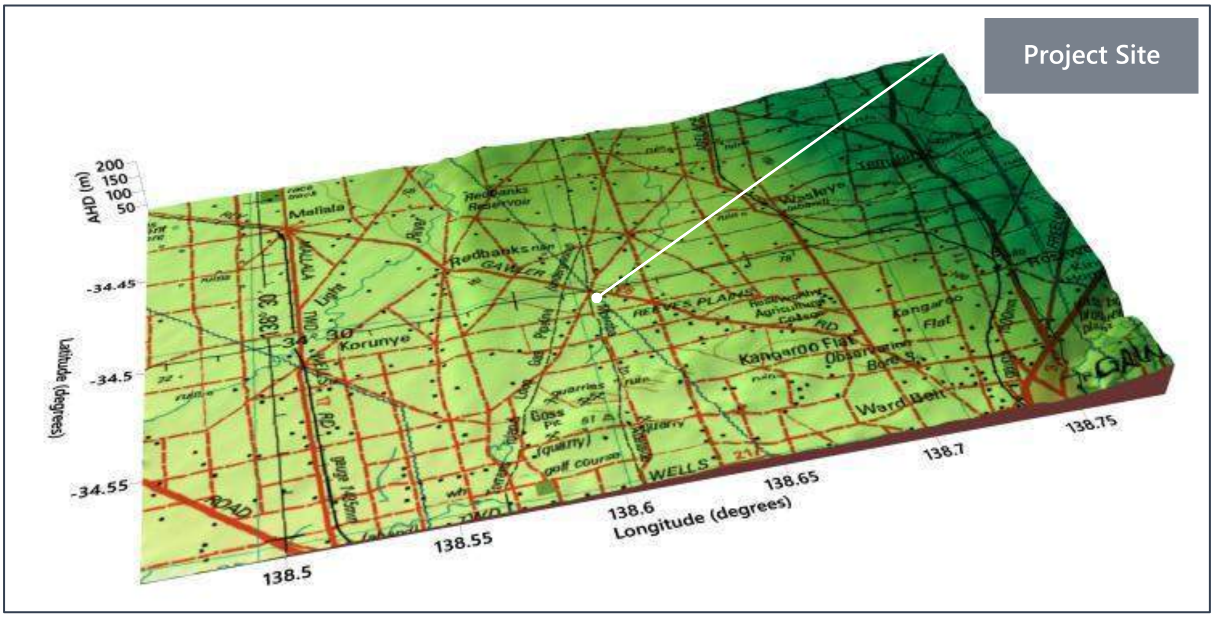
Further details regarding the estimation of emissions are provided in **Section 4.2**.

# 3. EXISTING CONDITIONS

## 3.1. Topography

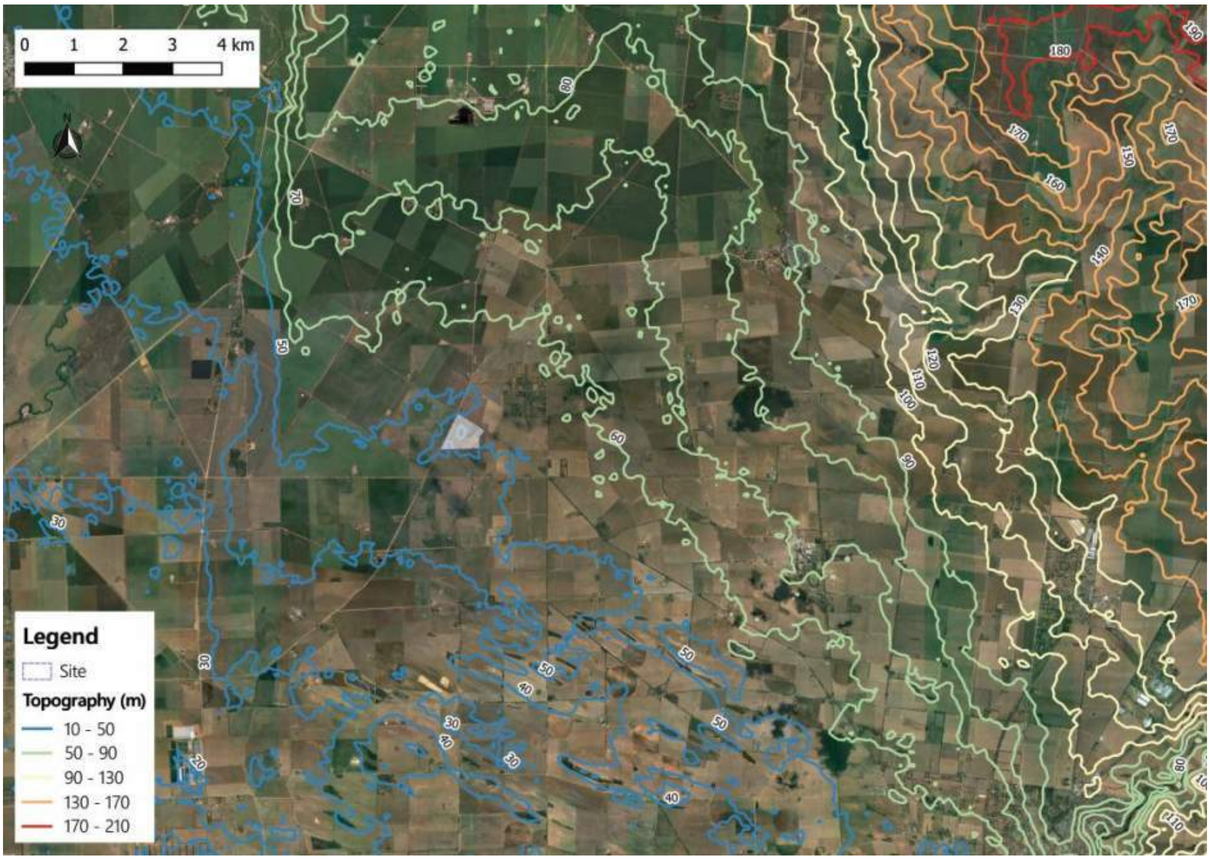
The elevation of the proposed site of the power station is approximately 51 m AHD. The topography of the surrounding area gradually increases with distance from the coast, but is generally flat, as shown in **Figure 2** and **Figure 3**.

**Figure 2 Topography surrounding the project site (3-D projection)**




**Source**: Northstar Air Quality

Figure 3 Topography surrounding the project site (2-D projection)




**Source**: Northstar Air Quality

## 3.2. Surrounding Land Sensitivity

### 3.2.1. Discrete Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

**Table 2** represents the discrete receptor locations that have been identified as part of this study (see also **Figure 4** and **Figure 5**).

The table and figures are not intended to represent a definitive list of sensitive land uses, but a cross section of available locations that are used to characterise larger areas, or selected as they represent more sensitive locations which may represent people who are more susceptible to changes in air pollution than the general population.

Table 2 Discrete sensitive receptor locations used in the study

| Receptor | Land Use | Location (m, UTM) | |
|---|---|---|---|
| | | m E | m S |
| R1 | 81 Woolsheds Rd | 280,802 | 6,180,445 |
| R2 | 30 Worden Rd | 280,887 | 6,180,723 |
| R3 | 228 Worden Rd | 281,208 | 6,182,691 |
| R4 | 1152 Wasleys Rd | 281,000 | 6,183,054 |
| R5 | 1149 Wasleys Rd | 280,988 | 6,183,329 |
| R6 | 1227 Wasleys Rd | 281,824 | 6,183,173 |
| R7 | 347 Wasleys Rd | 282,267 | 6,182,599 |
| R8 | 262 Woolsheds Rd | 282,132 | 6,181,850 |
| R9 | 64 Woolsheds Rd | 281,055 | 6,180,364 |
| R10 | 43 Dogleg Rd | 281,546 | 6,179,695 |
| R11 | 67 Dogleg Rd | 281,717 | 6,179,745 |
| R12 | 77 Dogleg Rd | 281,895 | 6,179,716 |
| R13 | 264 Boundary Rd | 282,355 | 6,179,801 |
| R14 | 236 Boundary Rd | 282,316 | 6,179,937 |
| R15 | 21-43 Bache Rd | 282,118 | 6,180,067 |
| R16 | 43 Bache Rd | 281,974 | 6,180,028 |
| R17 | 57 Bache Rd | 281,893 | 6,180,127 |
| R18 | 75 Bache Rd | 281,589 | 6,180,133 |
| R19 | 206 Boundary Rd | 282,292 | 6,180,331 |
| R20 | 164 Boundary Rd | 282,296 | 6,180,531 |
| R21 | 351 Boundary Rd | 282,439 | 6,178,681 |
| R22 | 312 Buckby Rd | 284,644 | 6,179,971 |
| R23 | 332 Selleck Rd | 285,286 | 6,180,921 |
| R24 | 448 Oliver Rd | 285,218 | 6,186,065 |
| R25 | 1 Wasleys Rd | 286,333 | 6,182,891 |
| R26 | 23 Henry Turton Circuit | 286,806 | 6,182,682 |
| R27 | 18 Pratt Rd | 287,518 | 6,182,285 |
| R28 | 11 Mitchell Rd | 287,817 | 6,180,228 |
| R29 | Roseworthy College Hall | 287,781 | 6,176,833 |
| R30 | 1357 Redbanks Rd | 282,991 | 6,177,713 |
| R31 | 1005 Redbanks Rd | 286,078 | 6,175,841 |
| R32 | 248 Fairlie Rd | 286,767 | 6,173,164 |
| R33 | 364 Mortimer Rd | 283,767 | 6,173,540 |
| R34 | Aunger Rd N | 280,940 | 6,178,220 |
| R35 | 236 Day Rd | 279,363 | 6,177,606 |
| R36 | 334 Day Rd | 279,072 | 6,176,764 |
| R37 | 206 Gregor Rd | 281,817 | 6,175,884 |
| R38 | 513 Day Rd | 277,563 | 6,175,602 |
| R39 | 560 Jenkin Rd | 275,398 | 6,174,285 |

| Receptor | Land Use | Location (m, UTM) | |
|---|---|---|---|
| | | m E | m S |
| R40 | 1061 Germantown Rd | 275,495 | 6,177,173 |
| R41 | 1321 Germantown Rd | 275,457 | 6,178,960 |
| R42 | 86 Hall Rd | 276,178 | 6,181,208 |
| R43 | 70 Hall Rd | 276,162 | 6,181,408 |
| R44 | 40 Hall Rd | 276,155 | 6,181,733 |
| R45 | 26 Hall Rd | 276,123 | 6,181,970 |
| R46 | 325 Hall Rd | 276,443 | 6,179,020 |
| R47 | 715 Verner Rd | 278,479 | 6,178,454 |
| R48 | 188 Cheek Rd | 277,319 | 6,183,792 |
| R49 | 1800 Redbanks Rd | 279,581 | 6,180,379 |
| R50 | 1561 Redbanks Rd | 281,638 | 6,179,015 |
| R51 | 1806 Redbanks Rd | 279,209 | 6,179,731 |

The receptors used in the study have been selected to include a range of receptor locations in all directions from the site, to account for the potential changes due to the prevailing meteorology.

The receptor closest to the boundary of the Project site is Receptor 10 [R10], located at 43 Dogleg Road which is approximately 500 m from the site.

Due to the geographical spread of the receptors used in this study, the maps showing the receptor locations have been replicated to show a closer view (larger scale) showing those receptor locations closer to the site boundary, and a wide view (smaller scale) showing those less proximate. The closer view is presented in **Figure 4** and the wide view is presented in **Figure 5**. Some receptors are identified on both Figures.

Figure 4 Discrete receptor locations used in the AQIA (close view)

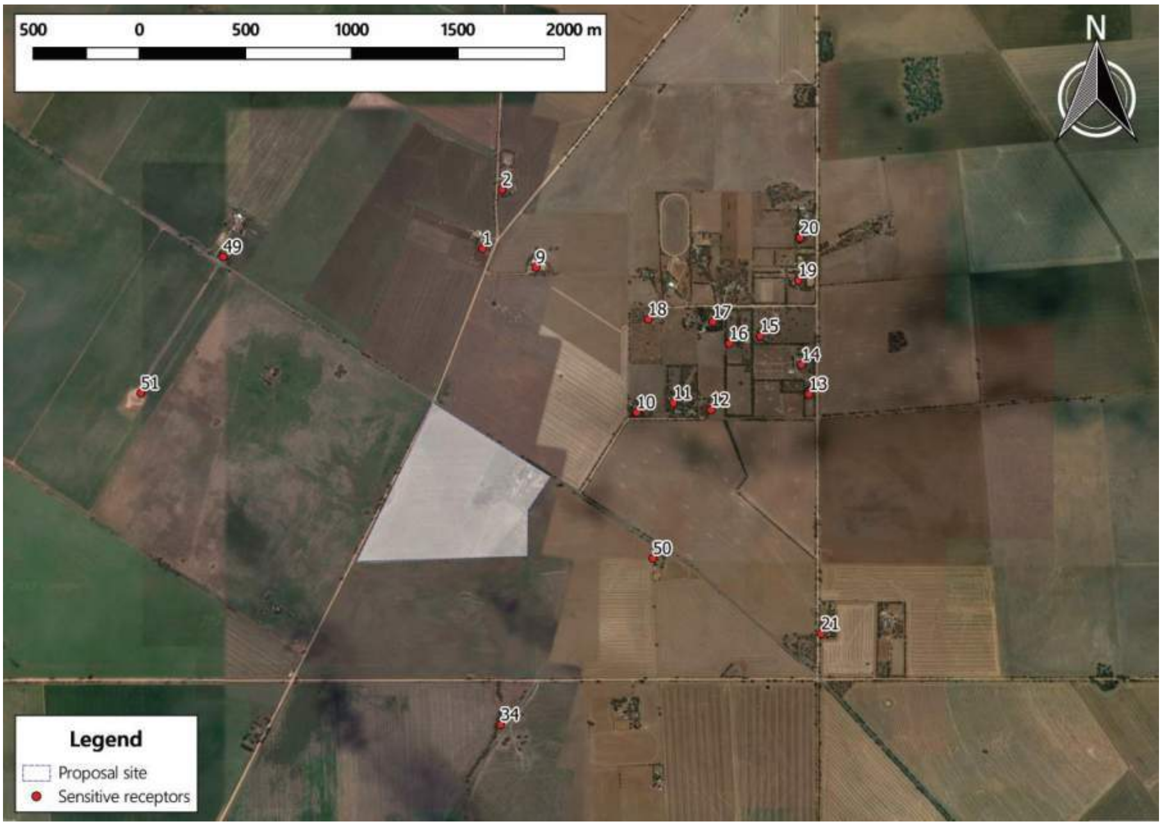
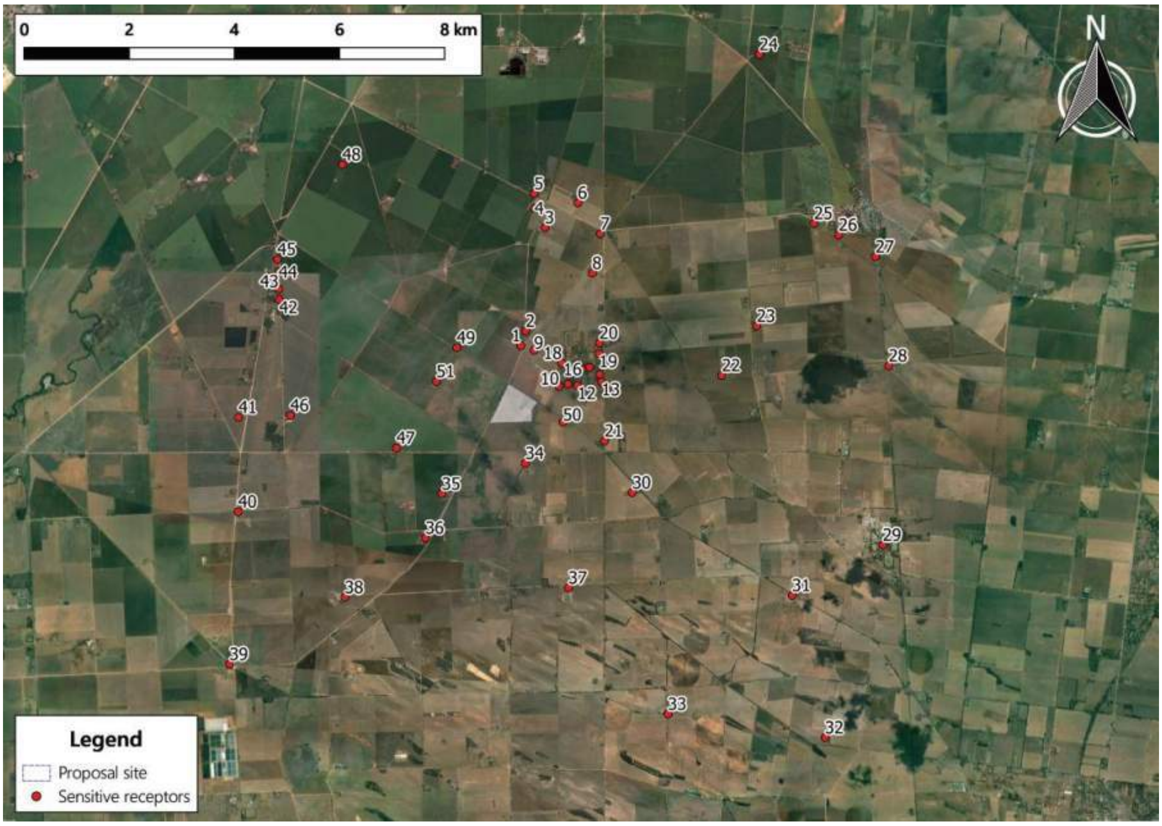



Figure 5 Discrete receptor locations used in the AQIA (wide view)




**Source**: Northstar Air Quality

### 3.2.2. Uniform Receptor Locations

Additional to the sensitive receptors identified in **Section 3.2.1**, a grid of receptor locations has been used in the AQIA to allow presentation of contour plots of predicted impacts.

The grid of uniform receptors covers a longitudinal and latitudinal distance of 20,000 m, covering an area of 400 square kilometres, from UTM 271,530 mE, 6,169,050 mS.

The grid resolution has been set at 25 m (approx. 1.5 × stack height) and this represents over 640,000 receptor locations.

## 3.3. Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

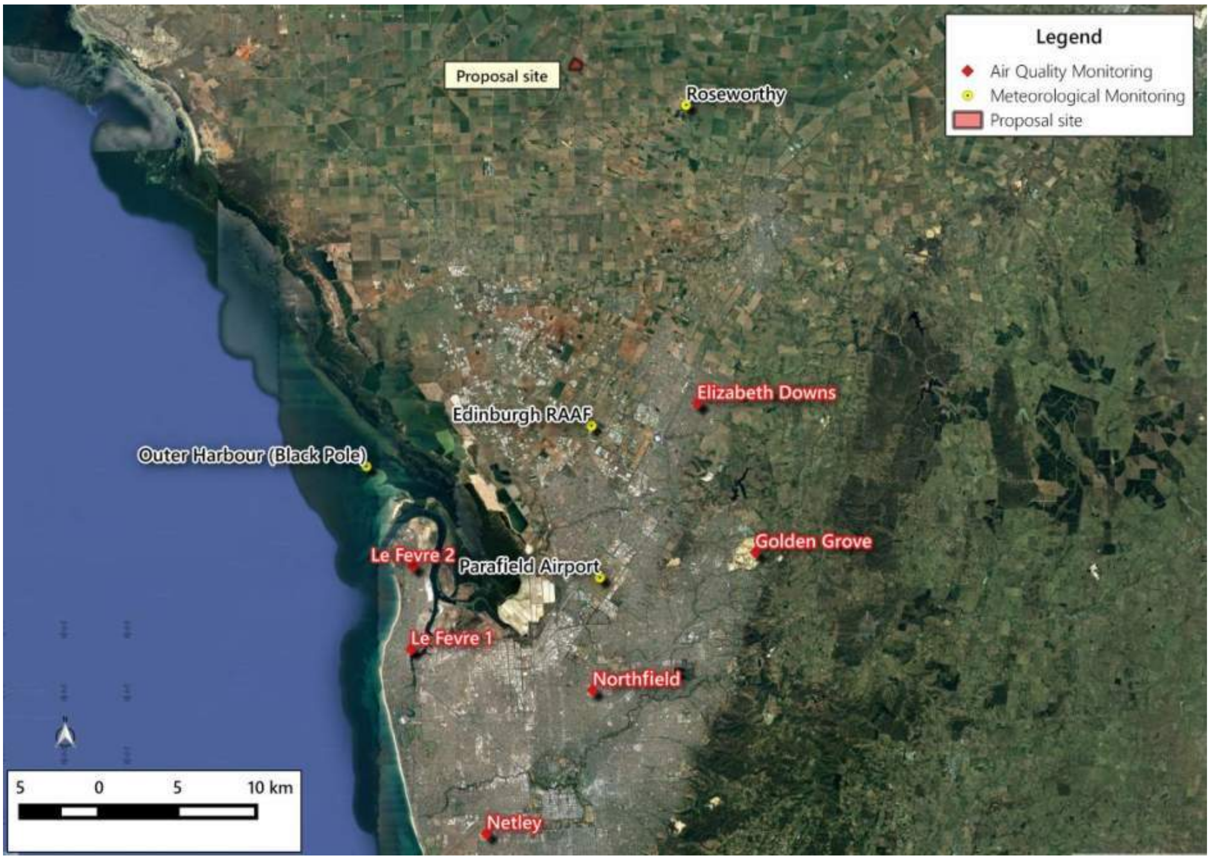
When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other local and regional sources of an individual pollutant must also be assessed. This 'background' air quality will vary depending on the pollutants to be assessed, and can often be characterised by using representative air quality monitoring data.

The EPA maintain and operate a number of ambient air quality monitoring stations (AQMS) across South Australia. The on-line data resource maintained by the EPA has been accessed from the South Australia Government Data Directory[2] and the data recorded at the various AQMS have been reviewed for the purposes of establishing a suitable and representative baseline assumption for use in this AQIA. The air quality (and meteorological) sources of data used in this AQIA are illustrated in **Figure 6**.

Further details, including summary statistics, distribution and graphs of measured background air pollutants are presented in **Appendix B**.

2 https://data.sa.gov.au/data/dataset?tags=air+quality&organization=environment-protection-authority-epa

**Figure 6 Sources of air quality and meteorological data used in the study**




**Source**: Northstar Air Quality

### 3.3.1. Source of Data for Background Gaseous Pollutants

The most proximate AQMS to the Project site is the Elizabeth Downs monitoring station, located in the grounds of Elizabeth Downs Primary School at 12 Heard Street, Elizabeth Downs, approximately 22.5 km to the south south-east of the Project site. The AQMS is located in the middle of a highly urbanised location, and as such the data measured at the site will be significantly influenced by urban emission sources, including road traffic. It is therefore considered that the use of this site as proxy data to represent the Project site would be conservative.

Elizabeth Downs AQMS does not measure $SO_2$ and so surrogate measurements taken at Adelaide Northfield have been used to characterise the background conditions.

### 3.3.2. Source of Data for Background Particulates

At the request of the EPA, Netley AQMS was referenced as the monitoring location to determine background particulate concentrations. Netley AQMS is located on a commercial lot near to the junction of Richmond Road and Transport Avenue in Netley, Western Adelaide. It is located approximately 50 km to the south south-west of the Project site in an urbanised location, and approximately 250 m from the boundary of Adelaide Airport and as such, it is considered that the use of this data to represent the Project site is highly conservative.

### 3.3.3. Application of Background Data

The application of recent background data to predicted dispersion modelling results for 2009 (the EPA's preferred 'reference' year [see **Section 3.4**]) needs to be undertaken with care. Clearly, applying a contemporaneous approach (as is used in other jurisdictional areas in Australia) is not appropriate as the conditions of meteorology during 2009 and background variations during 2015 are not concurrent and clearly not appropriate.

Alternative to this is to use a constant single value to represent the conditions at the Project site over the assessment year (2009). The application of the measured annual average background concentration to predictions of incremental annual average is clearly applicable, as this does not need to account for conditions that give rise to short-term elevations in emissions. However, that approach would also under-predict short term cumulative predictions although that approach has been used historically in South Australia, for example SA Water *Proposed Adelaide Desalination Plant Environmental Impact Statement, Chapter 9: Noise, Dust, Odour and Waste Management*. That assessment, performed by Connell Wagner, used the annual average $PM_{10}$ concentration as background to evaluate the 24-hour $PM_{10}$ impacts, and was approved on that basis.

Other recent studies, for example the AQIA for the Duplication of the Southern Expressway[3] has used the 90$^{th}$ percentile of short-term measurements, and this is considered to be conservative and appropriate for this study.

Summary details of air quality measurements at the Elizabeth Downs, Netley and Northfield AQMS are presented in **Appendix B**. The baseline data derived from the monitoring data is summarised in **Table 3**.

[3] https://dpti.sa.gov.au/__data/assets/pdf_file/0020/59402/Part_B_Chapter_16_Air_quality.pdf

**Table 3 Summary of assumed background concentrations**

| Pollutant | Averaging Period | Concentration Value Assumed | Notes |
|---|---|---|---|
| Carbon monoxide (CO) | 1-hour | 0.04 mg·m$^{-3}$ | 90%ile of 1-hour CO, Elizabeth Downs, 2015 |
| | 8-hour | 0.05 mg·m$^{-3}$ | 90%ile of 8-hour CO, Elizabeth Downs, 2015 |
| Nitrogen dioxide ($NO_2$) | 1 hour | 20.5 µg·m$^{-3}$ | 90%ile of 1-hour $NO_2$, Elizabeth Downs, 2015 |
| | annual average | 8.2 µg·m$^{-3}$ | Annual average $NO_2$, Elizabeth Downs, 2016 |
| Particulates (as $PM_{10}$) | 24-hour | 15.7 µg·m$^{-3}$ | 90%ile of 24-hour $PM_{10}$, Netley, 2015 |
| Particulates (as $PM_{2.5}$) | 24-hour | 10.4 µg·m$^{-3}$ | 90%ile of 24-hour $PM_{2.5}$, Netley, 2015 |
| | annual average | 7.3 µg·m$^{-3}$ | Annual average $PM_{2.5}$, Netley, 2015 |
| Sulphur dioxide ($SO_2$) | 1-hour | 28.6 µg·m$^{-3}$ | Maximum 1-hour $SO_2$, Northfield 2015 |
| | 24-hour | 5.8 µg·m$^{-3}$ | Maximum 24-hour $SO_2$, Northfield 2015 |
| | annual average | 0.2 µg·m$^{-3}$ | Annual average $SO_2$, Northfield 2015 |
| Formaldehyde ($CH_2O$) | 1-hour | 0 µg·m$^{-3}$ | Assumed to be negligible (zero) for the purposes of the AQIA |

Reference should be made to **Appendix B** for details of the background air quality conditions.

## 3.4. Meteorology

This section briefly discusses the existing meteorology in the area, using measurements taken from neighbouring Automatic Weather Stations (AWS) operated by the Australian Government Bureau of Meteorology (BoM). The meteorology used in the dispersion modelling assessment is discussed in **Section 4.2.5**.

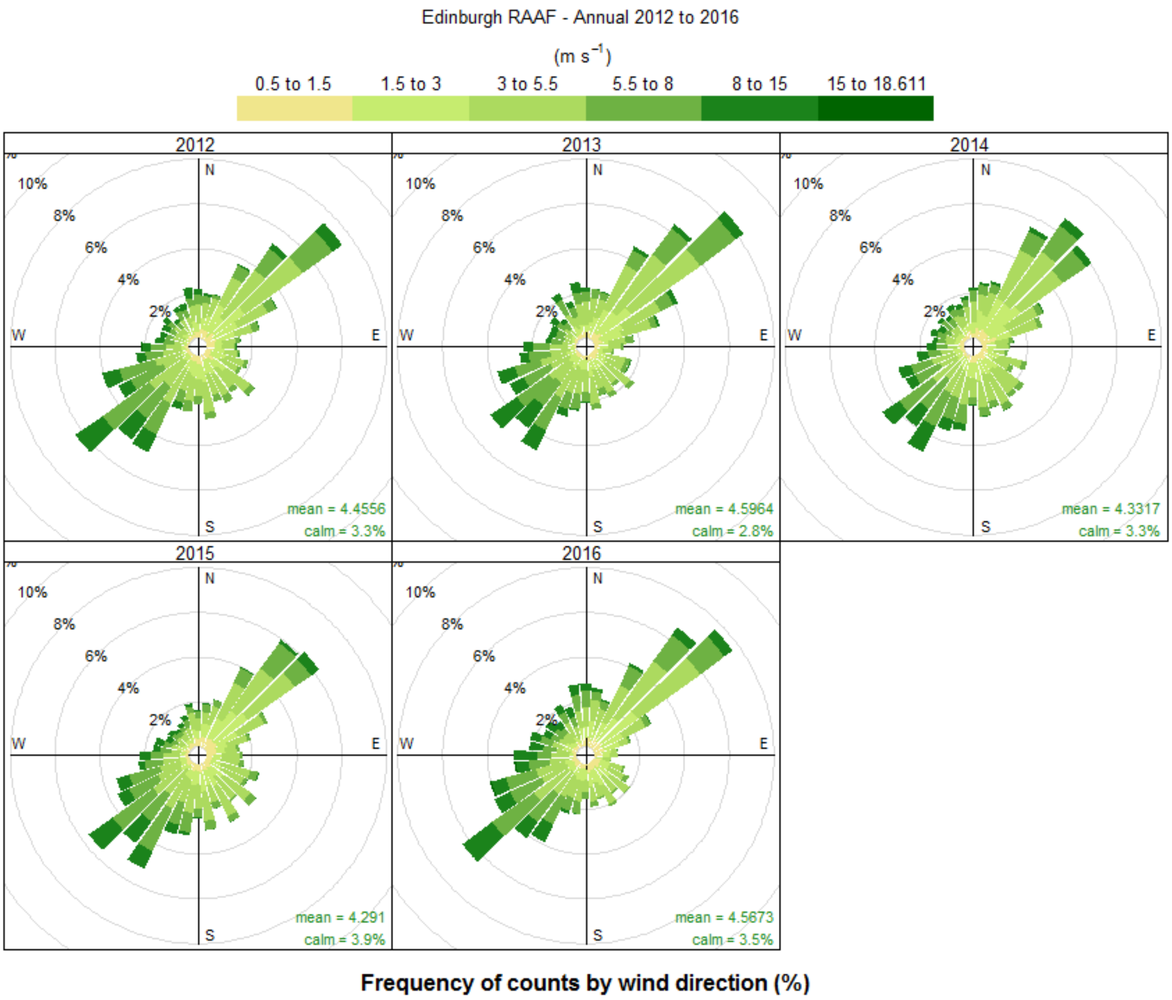
The meteorology experienced within an area can govern the dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological conditions surrounding the power station site have been characterised using data collected by the BoM, and a summary of the relevant AWS monitoring site locations is provided in **Table 4**.

**Table 4 Details of meteorological monitoring surrounding the power station**

| Site Name | Approximate Location (Latitude, Longitude) | |
|---|---|---|
| | ˚S | ˚E |
| Edinburgh RAAF – Station # 023083 | 34.71 | 138.62 |
| Outer Harbour – Station # 023052 | 34.73 | 138.47 |
| Parafield Airport – Station # 023013 | 34.80 | 138.63 |

Details of the prevailing meteorology are presented in **Appendix A**, however for clarity the wind roses for Edinburgh RAAF AWS are also presented in **Figure 7**.

Figure 7 Annual wind roses 2012 to 2016, Edinburgh RAAF AWS

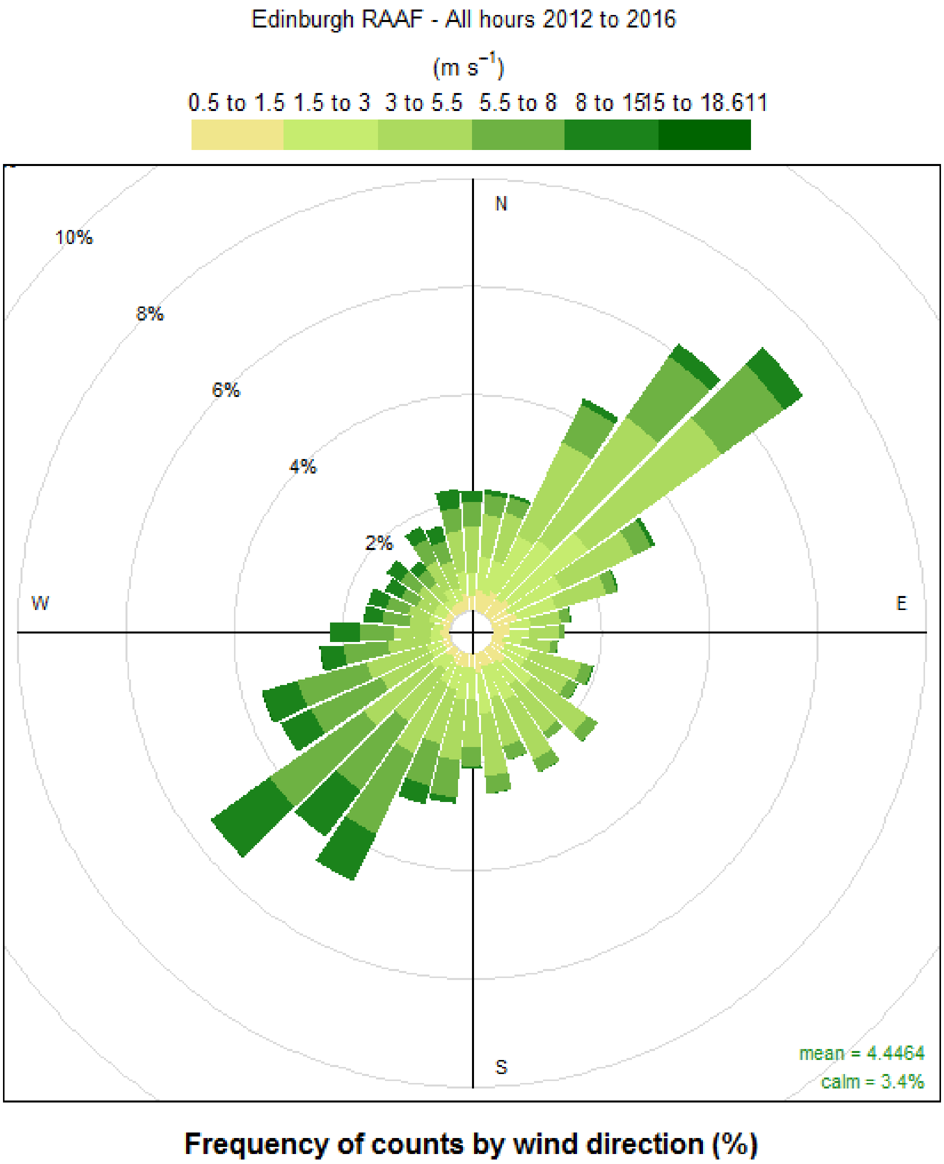



**Source**: Northstar Air Quality

The wind roses indicate that from 2012 to 2016, winds at Edinburgh RAAF AWS show a predominant southwesterly wind direction with a north-easterly and south-easterly components also evident, and there is little in the way of annual variation. The majority of wind speeds experienced at the Edinburgh RAAF AWS between 2012 and 2016 are generally in the range 1.5 metres per second ($m{\cdot}s^{-1}$) to 5.5 $m{\cdot}s^{-1}$ with the highest wind speeds (greater than 8 $m{\cdot}s^{-1}$) occurring from a south easterly direction. Winds of this speed are rare and occur during 1.1% of the observed hours during the years. Calm winds (<0.5 $m{\cdot}s^{-1}$) occur for less than 3.7% of hours across the years.

Presented in **Figure 8** is the long-term wind rose for the 2012 to 2016 period and the annual wind speed distribution for Edinburgh RAAF AWS.

Figure 8 Long-term wind rose (2012 to 2016), Edinburgh RAAF AWS




**Source**: Northstar Air Quality

Page left intentionally blank

# 4. METHODOLOGY

## 4.1. Construction Phase Risk Assessment

Construction phase activities have the potential to generate short-term emissions of particulates. Generally, these are associated with uncontrolled (or 'fugitive') emissions and are typically experienced by neighbours as amenity impacts, such as dust deposition and visible dust plumes, rather than associated with health-related impacts. Localised engine exhaust emissions from construction machinery and vehicles may also be experienced, but given the scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

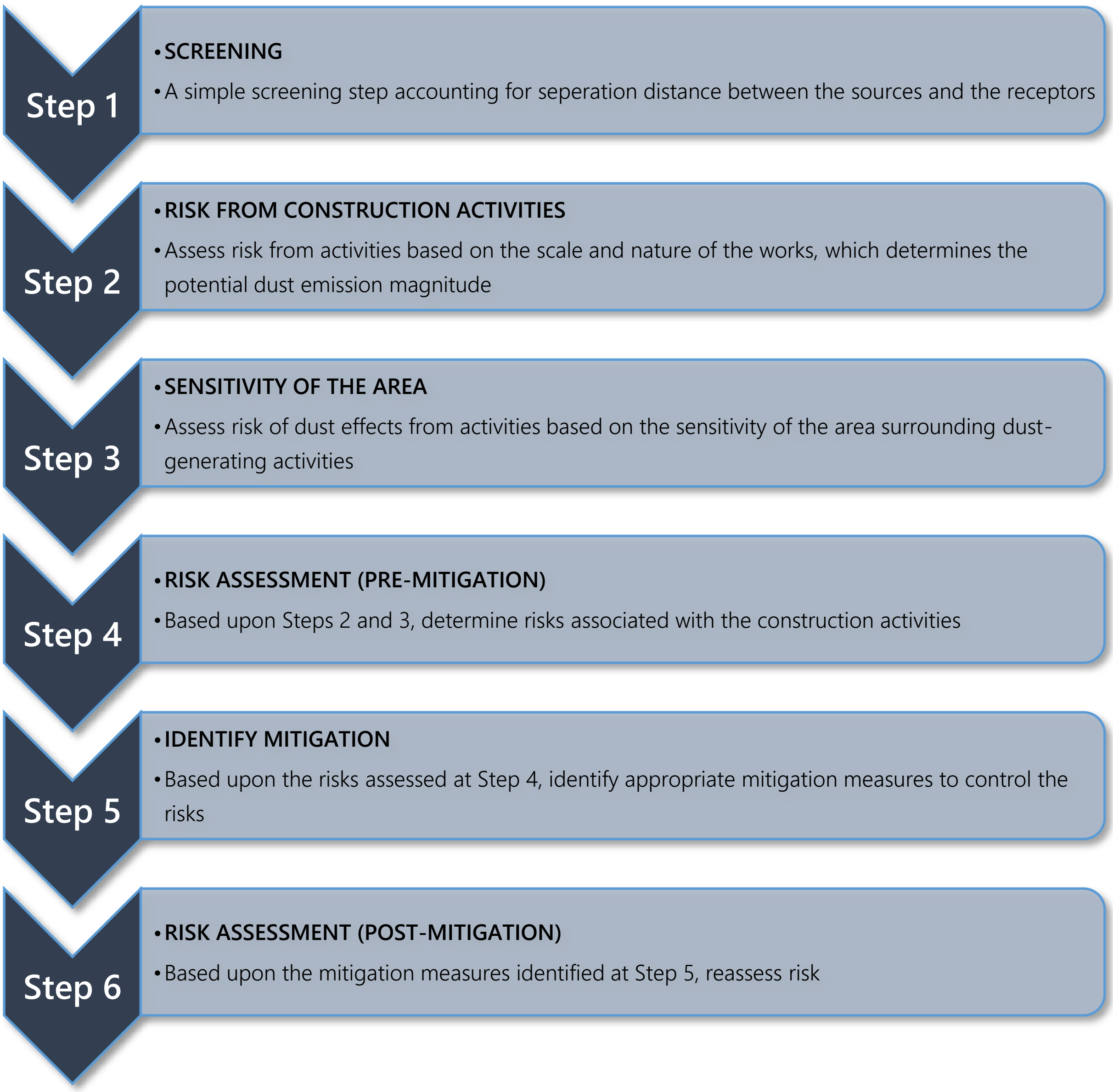
Modelling of dust from construction sites is generally not considered appropriate, as there is a lack of reliable emission factors from construction activities upon which to make predictive assessments, and the rates would vary significantly depending upon local conditions, construction practices and implemented dust mitigation measures. In lieu of a modelling assessment, the construction phase impacts associated with the Project have been assessed using a risk-based assessment procedure. The advantage of this approach is that it determines the activities that pose the greatest risk, which allows the Construction Environmental Management Plan (CEMP) to focus controls to manage that risk appropriately, and reduce the impact through proactive management.

For this risk assessment, Northstar has adapted a methodology presented in the Institute of Air Quality Management (2014) *IAQM Guidance on the Assessment of Dust from Demolition and Construction* (IAQM 2014) developed in the United Kingdom[4]. Reference should be made to **Appendix D** for the methodology.

Briefly, the adapted method uses a six-step process for assessing dust impact risks from construction activities, and to identify key activities for control, as illustrated in **Figure 9**.

[4] www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Figure 9 Construction phase risk assessment methodology




**Source**: Northstar Air Quality, adapted from IAQM 2014)

The assessment approach is detailed in **Appendix D**.

## 4.2. Operational Phase Impact Assessment

The following provides a brief description of the methodology used to assess the potential air quality impacts resulting from the operation of the proposed power station at the varying load profiles. The Project is to construct and operate six open-cycle gas turbines operating on gas, with a capacity to operate on diesel as a support fuel in case of interruption of the gas supply.

Reference has been made to the specifications and requirements presented in Environment Protection Authority (2016) Ambient Air Quality Assessment[5] and a practitioner capability statement has been presented in **Appendix G**.

The location to the six turbines will be as indicated in **Table 5**.

**Table 5 Turbine locations**

| Unit No | Type | Co-ordinates (MGAZ54) | |
|---|---|---|---|
| | | mE | mS |
| 1 | Point source | 280,541 | 6,179,051 |
| 2 | Point source | 280,538 | 6,179,091 |
| 3 | Point source | 280,535 | 6,179,127 |
| 4 | Point source | 280,532 | 6,179,167 |
| 5 | Point source | 280,530 | 6,179,205 |
| 6 | Point source | 280,527 | 6,179,242 |

5 http://www.epa.sa.gov.au/environmental_info/air_quality/assistance_and_advice

### 4.2.1. Emissions Estimation (Gas)

The estimation of emissions from the power station operating on gas has been informed from emission estimates provided by Alinta Energy, and assumed to be representative of the emissions from the Project.

**Table 6** below presents a summary of the emissions data estimates used in this assessment for gas operating at 100% load; 75% load; 50% load and 25% load. Full details are presented in **Appendix C**.

**Table 6 Emissions per engine operating on gas**

| Pollutant | Units | Reference Conditions | Engine Load (% of Capacity) | | | |
|---|---|---|---|---|---|---|
| | | | 100 | 75 | 50 | 25 |
| Gas Volumetric Discharge | | | | | | |
| Discharge rate | $Nm^3 \cdot hr^{-1}$ | STP, dry, 15% $O_2$ | 241,796.9 | 197,070.3 | 153,710.9 | 128,906.3 |
| Temperature | °C | | 395 | 390 | 434 | 421 |
| Velocity | $m \cdot s^{-1}$ | Stack temperature | 17.08 | 13.82 | 11.49 | 9.45 |
| Emission Rate | | | | | | |
| $NO_X$ (as $NO_2$) | $g \cdot s^{-1}$ | | 3.4389 | 2.8028 | 2.1861 | 1.8333 |
| CO | $g \cdot s^{-1}$ | | 2.0956 | 1.7079 | 1.3322 | 1.1172 |
| $SO_2$ | $g \cdot s^{-1}$ | | 0.5496 | 0.4488 | 0.3524 | 0.2935 |
| $PM_{2.5}$ | $g \cdot s^{-1}$ | | 0.3780 | 0.3780 | 0.3780 | 0.3780 |
| Formaldehyde | $g \cdot s^{-1}$ | | 0.0341 | 0.1192 | 0.0924 | 0.0684 |

Sulphur dioxide emissions operating on gas have been estimated from an assumed fuel sulphur content in natural gas of 50 $mg \cdot m^{-3}$ (101.3kPa, 288 K) as specified in Australian Standard (AS/NZS 4564), and the emission rates provided by Alinta Energy (assuming a nominal 0.1% sulphur) have been scaled accordingly to represent anticipated sulphur content.

Formaldehyde emissions operating on gas have been estimated from the emission rates published in US EPA (1995) *Compilation of Air Pollutant Emission Factors AP-42, Volume 1, Chapter 3: Stationary Internal Combustion Sources (fifth edition)* (USEPA 1995), Section 3.1, Table 3.1-3:

Formaldehyde $7.09 \times 10^{-4}$ $lb \cdot MMBtu^{-1}$ ($7.23 \times 10^{-1}$ $lb \cdot MMscf$) (loads >80%, i.e. 100% load) *(emission factor rating A)*

$3.12 \times 10^{-3}$ $lb \cdot MMBtu^{-1}$ ($3.18 \times 10^{0}$ $lb \cdot MMscf$) (all loads, i.e. 75%, 50% and 25% loads)

The above published formaldehyde emission factors were used in conjunction with provided gas consumption rates for all loads (see **Appendix F**), assuming an AP-42 derived natural gas reference temperature of 60°F (15.6°C), and a gas density of approximately 0.8 $kg \cdot m^{-3}$.

### 4.2.2. Emissions Estimation (Diesel)

The estimation of emissions from the power station operating on diesel has been informed from emission estimates provided by Alinta Energy, and assumed to be representative of the emissions from the Project.

**Table 7** below presents a summary of the emissions data estimates used in this assessment for gas operating at 100% load; 75% load; 50% load and 25% load. Full details are presented in **Appendix C**.

**Table 7 Emissions per engine operating on diesel**

| Pollutant | Units | Reference Conditions | Engine Load (% of Capacity) | | | |
|---|---|---|---|---|---|---|
| | | | 100 | 75 | 50 | 25 |
| Gas Volumetric Discharge | | | | | | |
| Discharge rate | $Nm^3 \cdot hr^{-1}$ | STP, dry, 15% $O_2$ | 216,179.0 | 178,415.6 | 163,453.8 | 122,732.5 |
| Temperature | °C | - | 399 | 413 | 437 | 423 |
| Velocity | $m \cdot s^{-1}$ | Stack temperature | 15.36 | 12.95 | 12.27 | 9.03 |
| Emission Rate | | | | | | |
| $NO_X$ (as $NO_2$) | $g \cdot s^{-1}$ | - | 10.4667 | 8.6333 | 7.9139 | 5.9389 |
| CO | $g \cdot s^{-1}$ | - | 1.8736 | 1.5463 | 1.4166 | 1.0637 |
| $SO_2$ | $g \cdot s^{-1}$ | - | 0.0468 | 0.0386 | 0.0361 | 0.0271 |
| $PM_{2.5}$ | $g \cdot s^{-1}$ | - | 0.3780 | 0.3780 | 0.3780 | 0.3780 |
| Formaldehyde | $g \cdot s^{-1}$ | - | 0.0063 | 0.0055 | 0.0058 | 0.0051 |

Sulphur dioxide emissions operating on diesel have been estimated from an assumed fuel sulphur content of 10 ppm (0.0001% v/v) as specified by the *Fuel Quality Standards Act (2000)* and the emission rates provided by Alinta Energy (assuming a nominal 0.1% sulphur) have been scaled accordingly to represent actual sulphur content.

Formaldehyde emissions operating on diesel have been estimated from the emission rates published in US EPA *AP-42, Volume 1, Chapter 3: Stationary Internal Combustion Sources*, Section 3.1, Table 3.1-4:

Formaldehyde $2.82 \times 10^{-4}$ $lb \cdot MMBtu^{-1}$ ($3.92 \times 10^{-2}$ $lb \cdot 1000gal$) (loads >80% i.e. 100% load) *(emission factor rating B)*

$2.45 \times 10^{-4}$ $lb \cdot MMBtu^{-1}$ ($3.41 \times 10^{-2}$ $lb \cdot 1000gal$) (all loads i.e. 75%, 50% and 25% loads)

The above published formaldehyde emission factors were used in conjunction with provided diesel consumption rates for all loads (see **Appendix F**), and assuming a diesel fuel density of approximately 0.832 $kg \cdot L^{-1}$.

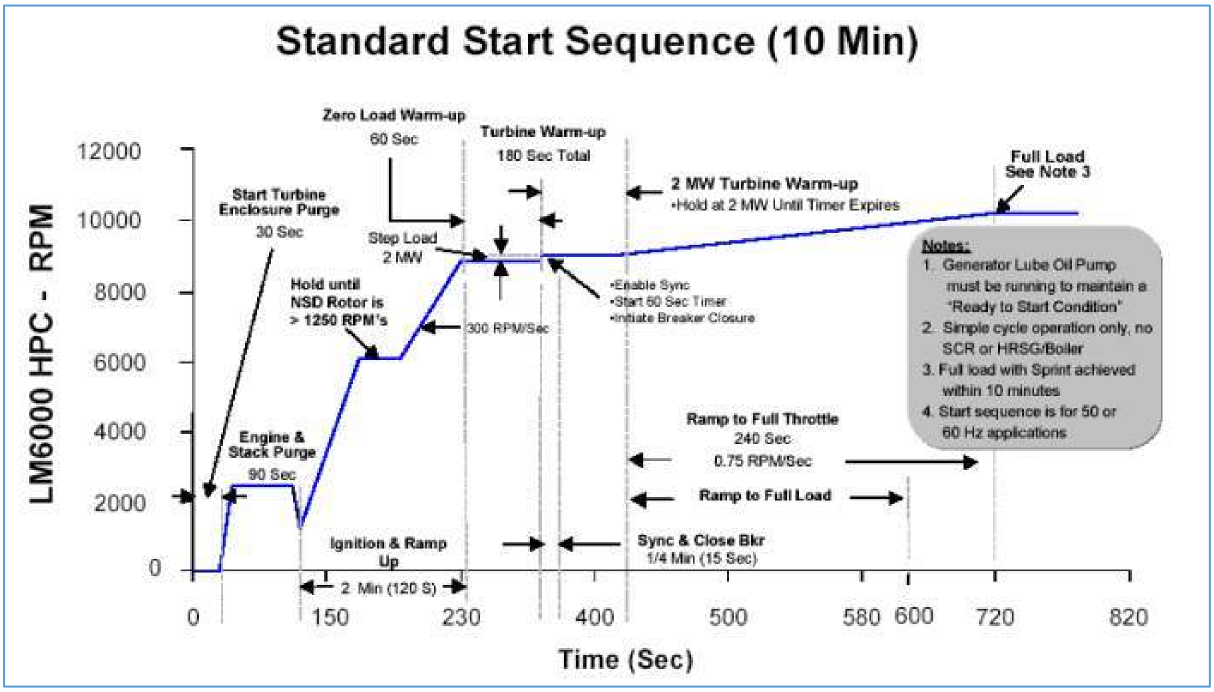
Further details are provided in **Appendix C**.

### 4.2.3. Start-Up Emissions

The figure below is reproduced from Figure 5-11 '*LM6000 10 minutes start cycle*' as presented in GE Energy (2008) LM6000-50/60 Hz Gas Turbine Generator Set Product Specification (GE Energy 2008), as reproduced in **Appendix H**. The product specification presented in **Appendix H** shows that the proposed LM6000 Sprint® turbines are capable of completing the start-up and ramp-up to full-load within a 10-minute start-up cycle.

> *"It can also start and stop easily for "peaking" or "dispatched" applications. Additionally, quick dispatchability is available in simple-cycle applications with the 10-minute fast start feature."*

**Figure 10 LM6000 Sprint® start up cycle**



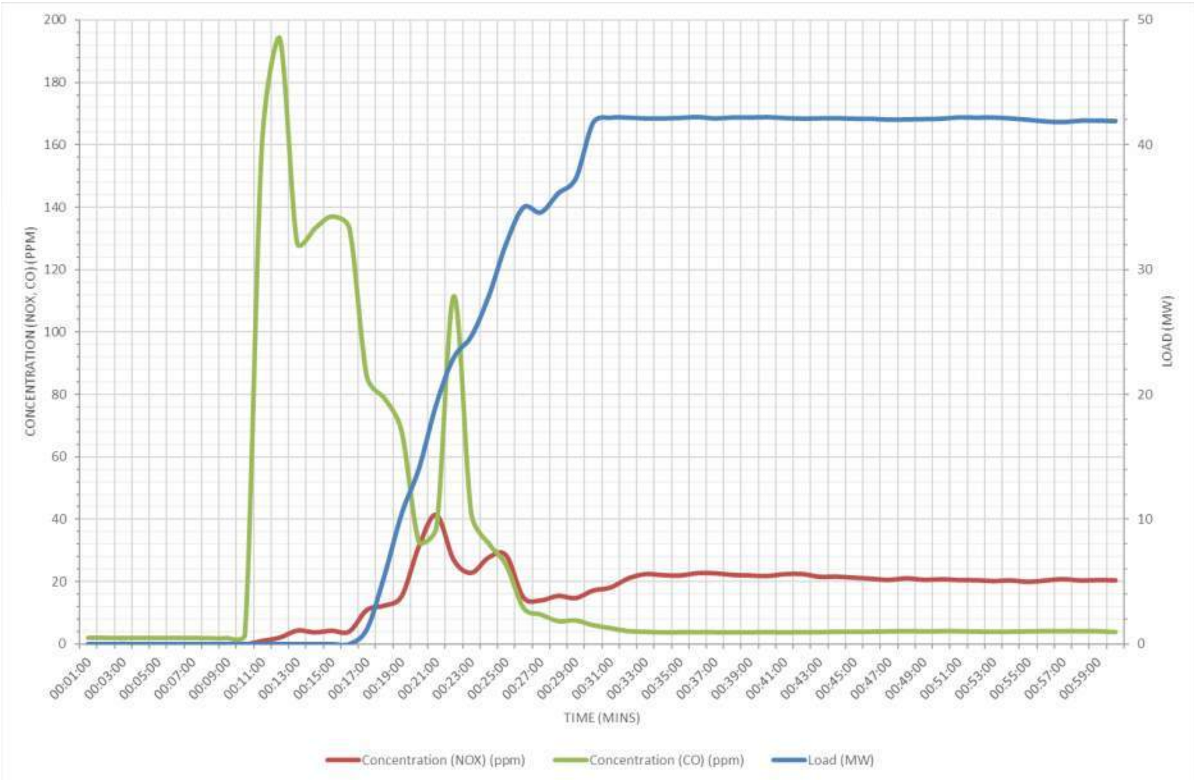

**Source:** GE Energy 2008

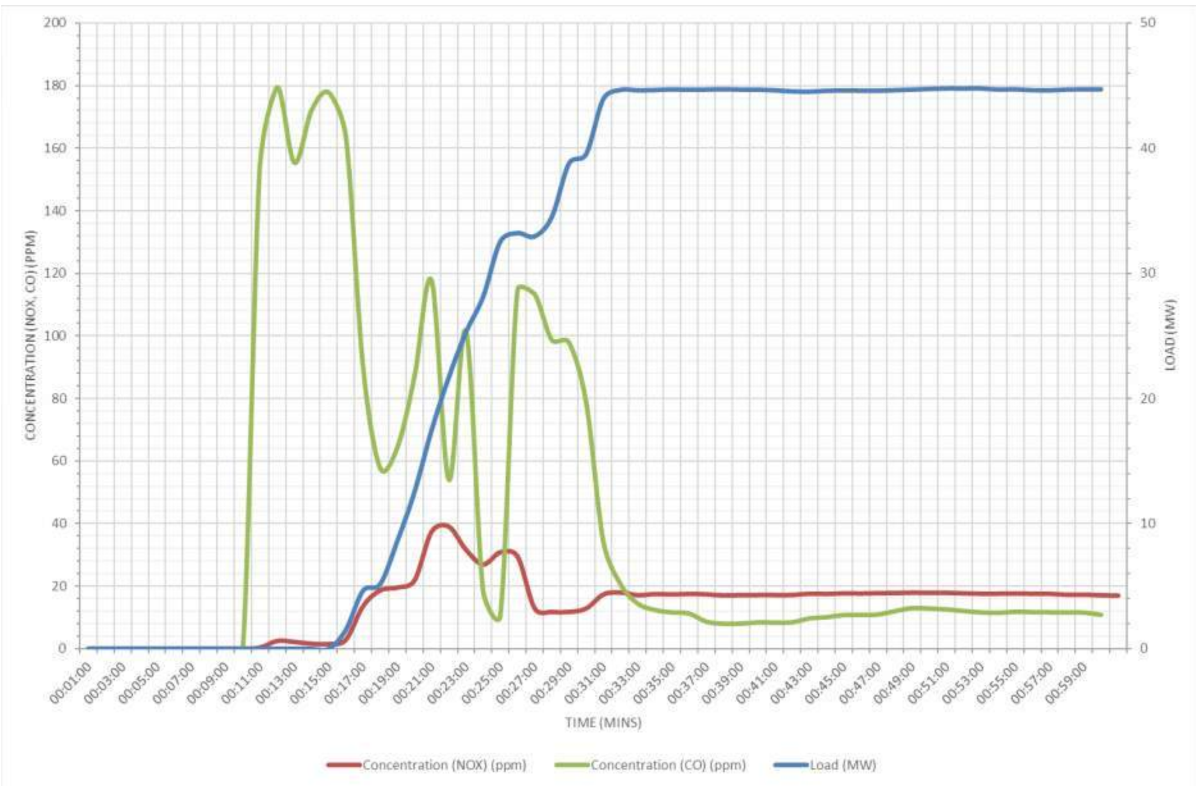
The start-up cycle is important, as the products of combustion during non-ideal conditions are different than those generated when the turbine is operating normally under load, and this is a significant consideration for a peaking plant.

The emission estimates presented in **Section 4.2.1** and **Section 4.2.2** for gas and diesel respectively, and presented in more detail in **Appendix C**, are derived from emissions data supplied directly by Alinta Energy.

To address the issue of start-up emissions, Alinta has provided emissions data from the Bairnsdale Power Station (using similar technology to that proposed at Reeves Plains), and those data are presented in **Figure 11** below for two turbine sets (names U1 and U2):

Figure 11 1-minute average emissions measured during start-up at Bairnsdale Power Station (engine U1 top) (engine U2 bottom)




**Source**: Northstar Air Quality

Based upon the data summarised above, the maximum 1-min peak CO and $NO_X$ measured data during the start-up cycle has been compared to the average steady-state emissions during normal operations. For the purposes of this AQIA, this cut-off time between start-up and normal operations has been assumed to be at 32 minutes (see **Figure 11**). It is the numerical relationship between the maximum value before 32 minutes and the average value after 32 minutes that is important, not the actual values.

**Table 8 Factor weighted emissions profiles for start-up and shut-down (U1 and U2)**

| Pollutant (*p*) | Operational Emission Rate | Start-Up Emission Rate | Start-Up Weighting *Fp* |
|---|---|---|---|
| CO | 7.4 | 186.8 | 25.12 |
| $NO_X$ (as $NO_2$) | 19.4 | 40.2 | 2.07 |

Considering the 10-minute start up cycle of the proposed generators (see **Appendix H**), the resultant hourly emission rates may be estimated assuming a time weighted averaging approach. Using the above, the results of the operational phase AQIA may be sequentially factored for start-up emissions to the determination short-term (1-hour) impacts during start-up. These factors have been used to conservatively estimate the predicted ground-level concentrations of CO and $NO_X$ (as $NO_2$) during the start-up cycle, and are used in **Section 6.2**.

The measured data shows that the engines may emit short-term spikes of CO during start-up and a smaller differential of $NO_X$ emissions (as represented in the start-up weighting factors presented in **Table 8**). The data presented in **Figure 11** also shows that the emission rate of CO and $NO_X$ does not vary significantly with load, supporting the assumptions presented in **Sections 4.2.1 - 4.2.2**.

### 4.2.4. Dispersion Modelling

Emissions from the power station have been modelled using the US EPA's AERMOD modelling system. The SA EPA makes the following observations regarding AERMOD (EPA 2016):

> *AERMOD*
>
> *AERMOD is a new generation Gaussian plume dispersion model developed by the US EPA. The model is an improvement on Ausplume in that it incorporates recent boundary layer theory and advanced methods for handling:*
> - *terrain*
> - *dispersion under stable and unstable conditions*
> - *plume rise and buoyancy*
> - *plume penetration into elevated inversions*
> - *treatment of elevated near-surface and surface-level sources*
> - *computation of vertical profiles of wind*
> - *turbulence*
> - *temperature*
> - *terrain effects on plume behaviour.*
>
> *AERMOD also includes algorithms to take into account the effects of any buildings near the emission source/s. EPA Victoria has recently changed its preferred regulatory model from Ausplume to AERMOD.*

Given the relatively flat and simple terrain of the study area surrounding the Project site, it is considered that AERMOD is an appropriate dispersion model for use in this study.

### 4.2.5. Meteorological Processing

Dispersion models require meteorological data as input to affect the dispersion and transport of pollutants emitted from a source.

A detailed summary of the application of local meteorology over the period from 2012 to 2016 is discussed in the Existing Conditions chapter in **Section 3.4** and discussed in further detail in **Appendix A**.

As required by the EPA, the dispersion modelling assessment that underpins the AQIA has used a reference calendar year of 2009. The EPA has requested that this year is used to provide a level of consistency between various studies, and to avoid the unintentional use of meteorological data not representative of long-term trends.

For clarity, this AQIA has used 2009 as the reference year, compliant with the requirements of the EPA.

Meteorological modelling using The Air Pollution Model (TAPM, v 4.0.5) has been performed to predict the meteorological parameters for 2009 that are required for AERMOD. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

The parameters used in TAPM modelling are presented in **Table 9** and presented in further detail in **Appendix A**.

**Table 9 Meteorological Parameters used for this Study**

| TAPM v 4.0.5 | |
|---|---|
| Modelling period | 1 January 2009 to 31 December 2009 |
| Centre of analysis | 280,713 mE, 6179,316 mN (UTM Coordinates) |
| Number of grid points | 70 × 70 × 25 |
| Number of grids (spacing) | 4 (20 km, 10 km, 3 km, 1 km) |
| Terrain | AUSLIG 9 second DEM |
| Data assimilation | None |

A comparison of the TAPM generated meteorological data, and BoM observations is presented in **Appendix A**. For completeness, the TAPM model predictions have been extracted and compared to BoM observations at the following locations:

- Edinburgh RAAF AWS
- Outer Harbour AWS

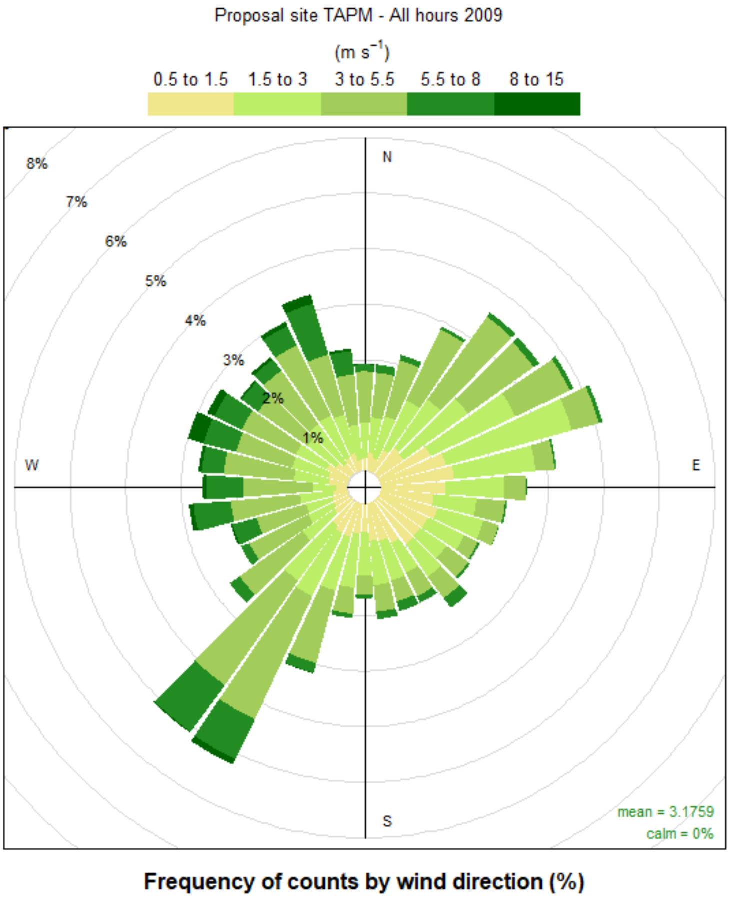
It is observed that these data generally compare well, and this provides confidence that the meteorological conditions modelled as part of this assessment are appropriate.

**Appendix A** provides graphical summaries of the TAPM predicted meteorological conditions at the Project site, including:

- Hourly mixing heights at the Project site for 2009;
- Hourly ambient temperatures at the Project site for 2009;
- Hourly wind speed and direction at the Project site for 2009.

The predicted wind-rose distribution of wind speed and direction data is presented in **Figure 12** below:

### Figure 12 Predicted wind speed and direction – Project site 2009




**Source**: Northstar Air Quality

For clarity, this data has been used by AERMET / AERMOD in the dispersion modelling.

### 4.2.6. Short-Term Impacts

The time resolution of dispersion modelling is defined by the hourly limitation of the meteorology, which uses hourly averaged data.

With regard to predicting the potential impacts of HAP (as formaldehyde) (see **Section 2.3.2**) the predicted impact is required to be compared against the 3-minute average criterion (see **Section 1.3**). To derive this prediction from the maximum 1-hour average prediction, the following Power Law adjustment has been applied[6]:

$$C_{p,t} = C_{p,60}\left[\frac{60}{t}\right]^{0.2}$$

Where:

$C_{p,t}$ = concentration of pollutant (p) at averaging time (mins) (t)

$C_{p,60}$ = concentration of pollutant (p) at modelled averaging time (60 mins)

$t$ = time (mins)

### 4.2.7. Particle Size Fractions

The technical specification documents indicate that the proposed turbines are capable of operating on dual fuel with a maximum particle emission rate of 3 pounds (lbs) per hour.

As outlined in **Section 2.3.2** , the USEPA has published that virtually 100% of particulates emitted from gas and diesel combustion in turbines is <1µm in diameter and correspondingly it is considered reasonable to assess the potential particulate emissions as $PM_{2.5}$.

As $PM_{2.5}$ is a 'subset', or a component of $PM_{10}$, the AQIA also presents the predicted $PM_{10}$ impacts albeit it that the predicted results are identical.

### 4.2.8. $NO_X$ to $NO_2$ Reactions

The emission rates of oxides of nitrogen ($NO_X$) have been modelled as nitrogen dioxide ($NO_2$). As discussed in **Section 2.3.2**, approximately 90% - 95% of $NO_X$ from a combustion process will be emitted as NO, with the remaining 5% - 10% emitted directly as $NO_2$. Over time and after the point of discharge, NO in ambient air will be transformed by secondary atmospheric reactions to form $NO_2$, and this reaction often occurs at a considerable distance downwind from the point of emission, and by which time the plume will have dispersed and diluted significantly from the concentration at point of discharge.

6 http://www.epa.vic.gov.au/~/media/Publications/1551.pdf

Air quality impact assessments need to account for the conversion of NO to $NO_2$ to enable a comparison against the air quality criterion for $NO_2$. To perform this, various techniques are common, which are briefly outlined below:

- **100% conversion**: the most conservative assumption is to assume that 100% of the total $NO_X$ emitted is discharged as $NO_2$, and that further reactions do not occur.
- **Jansen method**: where the location is represented by good monitoring data for NO and $NO_X$, the empirical relationship between NO and $NO_2$ may be used to derive 'steady state' relationships.
- **Ozone limiting method**: this method uses contemporaneous ozone data to estimate that rate at which NO is oxidised to $NO_2$ hour-on-hour using an established relationship.

This AQIA assumes that 100% of the emitted $NO_X$ is in the form of $NO_2$, which presents the most conservative approach.

# 5. CONSTRUCTION PHASE RISK ASSESSMENT

The area of the site as a whole is approximately 41 hectares (ha) although the footprint of the site which is to be affected by works and installed infrastructure is estimated as approximately 12 ha in area (120,000 $m^2$).

The Project would involve the preparation of the ground with some minor grading, and the construction of a piled concrete pad upon which the turbines and associated infrastructure will be located. The Project will not involve any demolition as the land is currently undeveloped.

The assumed supply route around the Project site during construction works may be up to 275 m one-way. It may be anticipated that >50 heavy vehicle movements would be required each day to service the Project site. For the purposes of the assessment, the route for construction traffic to/from the site is assumed to be along Wilton Road, in either direction of the site.

The screening criteria applied to the identified sensitive receptors are whether they are located in excess of:

- 350 m from the boundary of the site.
- 500 m from the site entrance.
- 50 m from the route used by construction vehicles on public roads.
- Track-out is assumed to affect roads up to 100 m from the site entrance.

**Table 10** presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

**Table 10 Construction phase impact screening criteria distances**

| Rec | Location | Land Use | Screening Distance (m) | | |
|---|---|---|---|---|---|
| | | | Boundary (350m) | Site Entrance (500m) | Construction route (50m) |
| R1 | 81 Woolsheds Rd | Residential | 757 | 1,041 | >50 |
| R2 | 30 Worden Rd | Residential | 1,048 | 1,300 | >50 |
| R3 | 228 Worden Rd | Residential | 3,036 | 3,262 | >50 |
| R4 | 1,152 Wasleys Rd | Residential | 3,361 | 3,622 | >50 |
| R5 | 1,149 Wasleys Rd | Residential | 3,633 | 3,897 | >50 |
| R6 | 1,227 Wasleys Rd | Residential | 3,669 | 3,820 | >50 |
| R7 | 347 Wasleys Rd | Residential | 3,334 | 3,393 | >50 |
| R8 | 262 Woolsheds Rd | Residential | 2,631 | 2,649 | >50 |
| R9 | 64 Woolsheds Rd | Residential | 796 | 931 | >50 |
| R10 | 43 Dogleg Rd | Residential | 516 | 564 | >50 |
| R11 | 67 Dogleg Rd | Residential | 685 | 739 | >50 |
| R12 | 77 Dogleg Rd | Residential | 831 | 894 | >50 |
| R13 | 264 Boundary Rd | Residential | 1,290 | 1,358 | >50 |

| Rec | Location | Land Use | Screening Distance (m) | | |
|---|---|---|---|---|---|
| | | | Boundary (350m) | Site Entrance (500m) | Construction route (50m) |
| R14 | 236 Boundary Rd | Residential | 1,305 | 1,366 | >50 |
| R15 | 21-43 Bache Rd | Residential | 1,198 | 1,245 | >50 |
| R16 | 43 Bache Rd | Residential | 1,058 | 1,102 | >50 |
| R17 | 57 Bache Rd | Residential | 1,062 | 1,095 | >50 |
| R18 | 75 Bache Rd | Residential | 875 | 885 | >50 |
| R19 | 206 Boundary Rd | Residential | 1,495 | 1,535 | >50 |
| R20 | 164 Boundary Rd | Residential | 1,632 | 1,663 | >50 |
| R21 | 351 Boundary Rd | Residential | 1,409 | 1,582 | >50 |
| R22 | 312 Buckby Rd | Residential | 3,559 | 3,637 | >50 |
| R23 | 332 Selleck Rd | Residential | 4,428 | 4,493 | >50 |
| R24 | 448 Oliver Rd | Residential | 7,829 | 7,835 | >50 |
| R25 | 1 Wasleys Rd | Residential | 6,271 | 6,316 | >50 |
| R26 | 23 Henry Turton Circuit | Residential | 6,561 | 6,612 | >50 |
| R27 | 18 Pratt Rd | Residential | 7,012 | 7,071 | >50 |
| R28 | 11 Mitchell Rd | Residential | 6,737 | 6,816 | >50 |
| R29 | Roseworthy College Hall | Educational | 7,057 | 7,218 | >50 |
| R30 | 1,357 Redbanks Rd | Residential | 2,322 | 2,595 | >50 |
| R31 | 1,005 Redbanks Rd | Residential | 5,931 | 6,182 | 36 |
| R32 | 248 Fairlie Rd | Residential | 8,169 | 8,486 | >50 |
| R33 | 364 Mortimer Rd | Residential | 6,107 | 6,490 | >50 |
| R34 | Aunger Rd N | Residential | 811 | 1,218 | >50 |
| R35 | 236 Day Rd | Residential | 1,623 | 2,485 | >50 |
| R36 | 334 Day Rd | Residential | 2,499 | 3,321 | >50 |
| R37 | 206 Gregor Rd | Residential | 3,223 | 3,631 | >50 |
| R38 | 513 Day Rd | Residential | 4,304 | 5,178 | >50 |
| R39 | 560 Jenkin Rd | Residential | 6,738 | 7,642 | >50 |
| R40 | 1,061 Germantown Rd | Residential | 5,073 | 5,995 | >50 |
| R41 | 1,321 Germantown Rd | Residential | 4,780 | 5,610 | >50 |
| R42 | 86 Hall Rd | Residential | 4,634 | 5,183 | >50 |
| R43 | 70 Hall Rd | Residential | 4,740 | 5,269 | >50 |
| R44 | 40 Hall Rd | Residential | 4,871 | 5,406 | >50 |
| R45 | 26 Hall Rd | Residential | 5,002 | 5,539 | >50 |
| R46 | 325 Hall Rd | Residential | 3,794 | 4,622 | >50 |
| R47 | 715 Verner Rd | Residential | 1,834 | 2,749 | >50 |
| R48 | 188 Cheek Rd | Residential | 5,224 | 5,736 | >50 |
| R49 | 1,800 Redbanks Rd | Residential | 1,206 | 1,744 | >50 |
| R50 | 1,561 Redbanks Rd | Residential | 567 | 724 | >50 |
| R51 | 1806 Redbanks Rd | Residential | 1,610 | 2,060 | >50 |

With reference to **Table 10**, no sensitive receptors are identified as being within the screening distance associated with either the site boundary or site entrance criteria and therefore no further assessment of construction phase impacts is required.

In relation to the construction route (assumed to be from the Project site to Gawler along Gawler Road), one receptor (R31) is within the 50 m screening distance, although once the construction route enters Gawler itself, multiple properties would be within the 50 m screening distance. Further assessment is therefore required for impacts associated with construction traffic as summarised in **Table 11**.

Although impacts associated with earthworks, construction and track-out have been screened from further assessment, dust control measures will still be implemented at the Project site to ensure that offsite impacts are minimised and best practice is implemented. It is noted that the two small structures located to the north-east of the site would be demolished as part of the proposed scope of construction works.

**Table 11 Application of step 1 screening**

| Construction Impact | Screening Criteria | Step 1 Screening | Comments |
|---|---|---|---|
| Earthworks | 350 m from boundary<br>500 m from site entrance | Screened | Receptors not identified within the screening distance |
| Construction | 350 m from boundary<br>500 m from site entrance | Screened | |
| Track-out | 100 m from site entrance | Screened | |
| Demolition | 350 m from boundary<br>500 m from site entrance | Screened | |
| Construction Traffic | 50 m from roadside | Not screened | Receptors identified within the screening distance |

## 5.1. Impact Magnitude

It may be anticipated that >50 heavy vehicle movements would be required each day to service the Project site during peak construction periods.

Based upon the above assumptions and the assessment criteria presented in **Appendix D**, the dust emission magnitudes are as presented in **Table 12**.

**Table 12 Construction phase impact categorisation of dust emission magnitude**

| Activity | Dust Emission Magnitude |
|---|---|
| Construction traffic routes | small |

**Note**: Earthworks, construction and track-out have been screened from further assessment (refer **Table 11**)

## 5.2. Sensitivity of an Area

### 5.2.1. Land Use Value

Based on the criteria listed in **Appendix D**, the land use value of the area surrounding the Project site is concluded to be high for health impacts and for dust soiling, based upon the following assumption:

- The receptor locations include residential properties where people may reasonably be expected to be present for eight to 24-hours.

Given that the highest sensitivity land uses would tend to define the level of control required to minimise impacts, it is considered that these sensitivity land uses are appropriately considered for both health and dust soiling effects. This value is used to derive *the sensitivity of the area*.

### 5.2.2. Sensitivity of an Area

Using the classifications shown in **Appendix D**, the sensitivity of the surrounding area to health effects and dust soiling may be identified.

The sensitivity of the area to dust soiling effects is assessed as being *low*.

The assumed existing background annual average $PM_{10}$ concentrations (as measured at Elizabeth Downs in 2015) are reported in **Section 3.3**. The annual average $PM_{10}$ concentration as measured at Elizabeth Downs in 2015 was 14.94 µg $m^{-3}$, which provides the sensitivity of the area as *low* for dust health impacts.

## 5.3. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as 'low' for dust soiling, and 'low' for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 12**, the resulting risk of air quality impacts (without mitigation) is as presented in **Table 13**.

**Table 13 Risk of air quality impacts from construction activities**

| Impact | Sensitivity of Area | Dust Emission Magnitude | Preliminary Risk |
|---|---|---|---|
| | | Construction Traffic | Construction Traffic |
| Dust Soiling | low | small | negl |
| Human Health | low | small | negl |

**Note**: Earthworks, construction and track-out have been screened from further assessment (refer **Table 11**)

The risks summarised in **Table 13** that there is a *negligible* risk of adverse dust soiling and human health impacts at all properties if no mitigation measures were to be applied to control emissions associated with construction traffic activities.

## 5.4. Identified Mitigation

**Table 14** lists the relevant mitigation measures identified, and have been presented as follows:

- **Not required** = not required (although they may be implemented voluntarily).
- **Desirable** = desirable (to be considered as part of the CEMP, but may be discounted if justification is provided).
- **Highly recommended** = highly recommended (to be implemented as part of the CEMP, and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

The following is presented as *highly recommended* (H) or *desirable* (D) by the IAQM methodology for a *low* risk site for demolition, earthworks, construction and construction traffic. A detailed review of the recommendations would be performed once details of the construction phase are available.

Once again, it is noted that the impacts associated with earthworks, construction and track-out have been screened from the assessment based on the distances to each receptor (**Table 10**). However, dust mitigation measures for those activities associated with a *low* risk site are presented in **Table 14** as those measures would be the minimum which should be applied to ensure best practice dust control for the Project.

**Table 14 Site-specific management measures**

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| | | Low |
| 1 | Communications | |
| 1.1 | Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. | Highly recommended |
| 1.1 | Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. | Highly recommended |
| 1.2 | Display the head or regional office contact information. | Highly recommended |
| 1.3 | Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies. | Desirable |
| 2 | Site Management | |
| 2.1 | Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. | Highly recommended |
| 2.2 | Make the complaints log available to the local authority when asked. | Highly recommended |

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| | | Low |
| 2.3 | Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book. | Highly recommended |
| 2.4 | Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes. | Not recommended |
| 3 | Monitoring | |
| 3.1 | Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary. | Desirable |
| 3.2 | Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked. | Highly recommended |
| 3.3 | Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. | Highly recommended |
| 3.4 | Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. | Not recommended |
| 4 | Preparing and Maintaining the Site | |
| 4.1 | Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. | Highly recommended |
| 4.2 | Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site. | Highly recommended |
| 4.3 | Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period. | Desirable |
| 4.4 | Avoid site runoff of water or mud. | Highly recommended |
| 4.5 | Keep site fencing, barriers and scaffolding clean using wet methods. | Desirable |
| 4.6 | Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below | Desirable |
| 4.7 | Cover, seed or fence stockpiles to prevent wind erosion | Desirable |

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| | | Low |
| 5 | Operating Vehicle/Machinery and Sustainable Travel | |
| 5.1 | Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable | Highly recommended |
| 5.2 | Ensure all vehicles switch off engines when stationary - no idling vehicles | Highly recommended |
| 5.3 | Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable | Highly recommended |
| 5.4 | Impose and signpost a maximum-speed-limit of 25 kmh on surfaced and 15 kmh on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate | Desirable |
| 5.5 | Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials. | Not recommended |
| 5.6 | Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing) | Not recommended |
| 6 | Operations | |
| 6.1 | Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems | Highly recommended |
| 6.2 | Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate | Highly recommended |
| 6.3 | Use enclosed chutes and conveyors and covered skips (where relevant). | Highly recommended |
| 6.4 | Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate (where relevant). | Highly recommended |
| 6.5 | Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods. | Desirable |
| 7 | Waste Management | |
| 7.1 | Avoid bonfires and burning of waste materials. | Highly recommended |
| 8 | Measures Specific to Construction | |
| 8.1 | Avoid scabbling (roughening of concrete surfaces) if possible | Desirable |
| 8.2 | Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place | Desirable |

| Identified Mitigation | | Unmitigated Risk |
|---|---|---|
| | | Low |
| 8.3 | Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. | Not recommended |
| 8.4 | For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust | Not recommended |
| 9 | Measures Specific to Track-Out | |
| 9.1 | Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site. | Desirable |
| 9.2 | Avoid dry sweeping of large areas. | Desirable |
| 9.3 | Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. | Desirable |
| 9.4 | Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. | Highly recommended |
| 9.5 | Record all inspections of haul routes and any subsequent action in a site log book. | Desirable |
| 9.6 | Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned. | Not recommended |
| 9.7 | Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). | Desirable |
| 9.8 | Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits. | Not recommended |
| 9.9 | Access gates to be located at least 10 m from receptors where possible. | Not recommended |
| 10 | Measures Specific to Construction Traffic (Adapted) | |
| 10.1 | Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable | Highly recommended |
| 10.2 | Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. | Desirable |
| 10.3 | Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. | Highly recommended |
| 10.4 | Record all inspections of haul routes and any subsequent action in a site log book. | Desirable |
| **Notes** | D = desirable (to be considered), H = highly recommended (to be implemented), N = not required (although can be voluntarily implemented) | |

## 5.5. Risk (Post-Mitigation)

For almost all construction activity, the adapted methodology notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

Given the limited size of the Project site, residual impacts associated with fugitive dust emissions from the Project would be anticipated to remain to be '*not significant*'.

Page left intentionally blank

# 6. OPERATIONAL PHASE IMPACT ASSESSMENT

The methodology used to assess impacts resulting from the power station operation at the various operational loads is discussed in **Section 4.2**. This section presents the results of the dispersion modelling assessment and uses the following terminology:

- Incremental impact – relates to the concentrations predicted as a result of the operation of the power station in isolation.
- Cumulative impact – relates to the concentrations predicted as a result of the operation of the power station plus the background air quality concentrations discussed in **Section 3.3**.

The results are presented in this manner to allow examination of the likely impact of the power station in isolation and the contribution to air quality impacts in a broader sense. Detailed results schedules and isopleth plots of predicted incremental impacts are presented in **Appendix E**.

## 6.1. Predicted Incremental Operational Impacts

### 6.1.1. Operating on Gas

**Table 15** presents a summary of the predicted incremental ground level concentrations (GLC) of the operation of the turbines operating on gas at various loads. For clarity, **Table 15** presents the maximum predicted incremental impact at any of the identified receptors.

**Table 15 Predicted maximum incremental GLC (all receptors) – gas**

| Pollutant | Averaging Period | 100% load, gas | 75% load, gas | 50% load, gas | 25% load, gas |
|---|---|---|---|---|---|
| CO | $\mu g \cdot m^{-3}$ 1-hour | 37.47 | 32.18 | 25.81 | 24.76 |
| | $\mu g \cdot m^{-3}$ 8-hour | 13.19 | 14.80 | 14.12 | 14.65 |
| $NO_X$ as $NO_2$ | $\mu g \cdot m^{-3}$ 1-hour | 61.49 | 52.81 | 42.35 | 40.64 |
| | $\mu g \cdot m^{-3}$ annual | 0.53 | 0.50 | 0.43 | 0.41 |
| $PM_{10}$ / $PM_{2.5}$ | $\mu g \cdot m^{-3}$ 24-hour | 0.81 | 1.12 | 1.37 | 1.98 |
| | $\mu g \cdot m^{-3}$ annual | 0.06 | 0.07 | 0.07 | 0.08 |
| $SO_2$ | $\mu g \cdot m^{-3}$ 1-hour | 9.83 | 8.46 | 6.83 | 6.51 |
| | $\mu g \cdot m^{-3}$ 24-hour | 1.18 | 1.13 | 1.28 | 1.53 |
| | $\mu g \cdot m^{-3}$ annual | 0.08 | 0.08 | 0.07 | 0.07 |
| Formaldehyde | $\mu g \cdot m^{-3}$ 1-hour | 0.61 | 2.25 | 1.79 | 1.52 |
| | $\mu g \cdot m^{-3}$ 3-min | 1.11 | 4.09 | 3.26 | 2.76 |

The incremental impacts presented in **Table 15** do not include a contribution from background sources (as presented in **Section 3.3.3** and **Table 3**), however, it is noted that there are no incremental exceedances of the Air EPP standards, as presented in **Table 1**.

### 6.1.2. Operating on Diesel

**Table 16** presents a summary of the predicted incremental ground level concentrations (GLC) of the operation of the turbines operating on various diesel loads. For clarity, **Table 15** presents the maximum predicted incremental impact at any of the identified receptors.

**Table 16 Predicted maximum incremental GLC (all receptors) – diesel**

| Pollutant | Averaging Period | 100% load, diesel | 75% load, diesel | 50% load, diesel | 25% load, diesel |
|---|---|---|---|---|---|
| CO | µg·m$^{-3}$ 1-hour | 34.27 | 29.37 | 27.04 | 23.74 |
| | µg·m$^{-3}$ 8-hour | 13.76 | 14.27 | 13.73 | 14.46 |
| $NO_X$ as $NO_2$ | µg·m$^{-3}$ 1-hour | 191.47 | 163.97 | 151.07 | 132.57 |
| | µg·m$^{-3}$ annual | 1.74 | 1.59 | 1.49 | 1.37 |
| $PM_{10}$ / $PM_{2.5}$ | µg·m$^{-3}$ 24-hour | 0.95 | 1.19 | 1.25 | 2.17 |
| | µg·m$^{-3}$ annual | 0.06 | 0.07 | 0.07 | 0.09 |
| $SO_2$ | µg·m$^{-3}$ 1-hour | 0.86 | 0.73 | 0.69 | 0.60 |
| | µg·m$^{-3}$ 24-hour | 0.12 | 0.12 | 0.12 | 0.16 |
| | µg·m$^{-3}$ annual | 0.01 | 0.01 | 0.01 | 0.01 |
| Formaldehyde | µg·m$^{-3}$ 1-hour | 0.12 | 0.1 | 0.11 | 0.11 |
| | µg·m$^{-3}$ 3-min | 0.21 | 0.19 | 0.2 | 0.21 |

The incremental impacts presented in **Table 16** do not include a contribution from background sources (as presented in **Section 3.3.3** and **Table 3**), however, it is noted that there are no incremental exceedances of the Air EPP standards, as presented in **Table 1**.

## 6.2. Predicted Cumulative Operational Impacts

The following represents the worst-case assessment of cumulative impacts, determined as:

$$\text{cumulative impact} = \text{incremental impact} + \text{background (BG)}$$

### 6.2.1. Operating on Gas

**Table 15** presents a summary of the predicted cumulative ground level concentrations (GLC) of the turbines operating on gas at various loads.

Detailed results schedules (of incremental impacts) are presented in **Appendix E** and summarised in **Table 15**, and background data is presented in **Section 3.3** and **Appendix B**.

The impact assessment criteria used in the AQIA are presented in **Section 1.3**

**Table 17 Predicted maximum cumulative impacts – gas**

| Pollutant | Averaging Period | BG | 100% load, gas | 75% load, gas | 50% load, gas | 25% load, gas | Criterion ($\mu g \cdot m^{-3}$) |
|---|---|---|---|---|---|---|---|
| CO | $\mu g \cdot m^{-3}$ 1-hour | 40 | 77.47 | 72.18 | 65.81 | 64.76 | 31,240 |
| | $\mu g \cdot m^{-3}$ 8-hour | 50 | 63.19 | 64.8 | 64.12 | 64.65 | 11,120 |
| $NO_X$ as $NO_2$ | $\mu g \cdot m^{-3}$ 1-hour | 20.5 | 81.99 | 73.31 | 62.85 | 61.14 | 250 |
| | $\mu g \cdot m^{-3}$ annual | 8.2 | 8.73 | 8.7 | 8.63 | 8.61 | 60 |
| $PM_{10}$ | $\mu g \cdot m^{-3}$ 24-hour | 15.7 | 16.51 | 16.82 | 17.07 | 17.68 | 50 |
| $PM_{10}$ / $PM_{2.5}$ | $\mu g \cdot m^{-3}$ 24-hour | 10.4 | 11.21 | 11.52 | 11.77 | 12.38 | 25 |
| | $\mu g \cdot m^{-3}$ annual | 7.3 | 7.36 | 7.37 | 7.37 | 7.38 | 8 |
| $SO_2$ | $\mu g \cdot m^{-3}$ 1-hour | 28.6 | 38.43 | 37.06 | 35.43 | 35.11 | 570 |
| | $\mu g \cdot m^{-3}$ 24-hour | 5.8 | 6.98 | 6.93 | 7.08 | 7.33 | 230 |
| | $\mu g \cdot m^{-3}$ annual | 0.2 | 0.28 | 0.28 | 0.27 | 0.27 | 60 |
| Formaldehyde | $\mu g \cdot m^{-3}$ 1-hour | 0.0 | 0.61 | 2.25 | 1.79 | 1.52 | n/a |
| | $\mu g \cdot m^{-3}$ 3-min | 0.0 | 1.11 | 4.09 | 3.26 | 2.76 | 44 |

**Note:** Exceedance of the relevant criterion is highlighted in **bold red text**

The cumulative impacts presented in **Table 17** include a contribution from background sources (as presented in **Section 3.3.3** and **Table 3**). There are no predicted exceedances of the Air EPP standards, as presented in **Table 1**.

### 6.2.2. Operating on Diesel

**Table 16** presents a summary of the predicted cumulative ground level concentrations (GLC) of the turbines operating on diesel at various loads.

Detailed results schedules (of incremental impacts) are presented in **Appendix E** and summarised in **Table 16**, and background data is presented in **Section 3.3** and **Appendix B**.

The impact assessment criteria used in the AQIA are presented in **Section 1.3**.

**Table 18 Predicted maximum incremental impacts – diesel**

| Pollutant | Averaging Period | BG | 100% load, diesel | 75% load, diesel | 50% load, diesel | 25% load, diesel | Criterion (µg·m⁻³) |
|---|---|---|---|---|---|---|---|
| CO | µg·m⁻³ 1-hour | 40 | 74.27 | 69.37 | 67.04 | 63.74 | 31,240 |
| | µg·m⁻³ 8-hour | 50 | 63.76 | 64.27 | 63.73 | 64.46 | 11,120 |
| $NO_X$ as $NO_2$ | µg·m⁻³ 1-hour | 20.5 | 211.97 | 184.47 | 171.57 | 153.07 | 250 |
| | µg·m⁻³ annual | 8.2 | 9.94 | 9.79 | 9.69 | 9.57 | 60 |
| $PM_{10}$ | µg·m⁻³ 24-hour | 15.7 | 16.65 | 16.89 | 16.95 | 17.87 | 50 |
| $PM_{2.5}$ | µg·m⁻³ 24-hour | 10.4 | 11.35 | 11.59 | 11.65 | 12.57 | 25 |
| | µg·m⁻³ annual | 7.3 | 7.36 | 7.37 | 7.37 | 7.39 | 8 |
| $SO_2$ | µg·m⁻³ 1-hour | 28.6 | 29.46 | 29.33 | 29.29 | 29.2 | 570 |
| | µg·m⁻³ 24-hour | 5.8 | 5.92 | 5.92 | 5.92 | 5.96 | 230 |
| | µg·m⁻³ annual | 0.2 | 0.21 | 0.21 | 0.21 | 0.21 | 60 |
| Formaldehyde | µg·m⁻³ 1-hour | 0.0 | 0.12 | 0.1 | 0.11 | 0.11 | n/a |
| | µg·m⁻³ 3-min | 0.0 | 0.21 | 0.19 | 0.2 | 0.21 | 44 |

**Note:** Exceedance of the relevant criterion is highlighted in **bold red text**

The cumulative impacts presented in **Table 18** include a contribution from background sources (as presented in **Section 3.3.3** and **Table 3**). There are no predicted exceedances of the Air EPP standards, as presented in **Table 1**.

## 6.3. Predicted Start-Up Impacts

The predicted start up impacts have been assessed as described in **Section 4.2.3**.

Using the data presented in **Figure 11** and **Table 8**, the predicted short-term effect of start-up emissions of CO and $NO_X$ (as $NO_2$) may be assessed using a time weighted averaging methodology:

$$SER_{p,60} = \frac{10(F_p \times ER_p) + 50(ER_p)}{60}$$

Where

$SER_{p,60}$ = time-weighted start-up emission rate for pollutant $p$ over 60-mins

$F_p$ = start-up weighting factor for pollutant $p$

$ER_p$ = emission rate for pollutant $p$

**Table 19 Predicted maximum start-up impacts (all receptors) – gas and diesel**

| Pollutant | BG | Increment | $F_p$ | TWA Start Up Impact | Start Up Impact | Criterion ($\mu g \cdot m^{-3}$) |
|---|---|---|---|---|---|---|
| Gas | | | | | | |
| CO $\mu g \cdot m^{-3}$ 1-hour | 40 | 37.47 at 100% load | 25.12 | $40 + \left(\frac{10(25.12 \times 37.47) + 50(1 \times 37.47)}{60}\right)$ | 228.1 | 31,240 |
| $NO_X$ as $NO_2$ $\mu g \cdot m^{-3}$ 1-hour | 20.5 | 61.49 at 100% load | 2.07 | $20.5 + \left(\frac{10(2.07 \times 61.49) + 50(1 \times 61.49)}{60}\right)$ | 93.0 ($NO_X$) | 250 ($NO_2$) |
| Diesel | | | | | | |
| CO $\mu g \cdot m^{-3}$ 1-hour | 40 | 34.27 at 100% load | 25.12 | $40 + \left(\frac{10(25.12 \times 34.27) + 50(1 \times 34.27)}{60}\right)$ | 212.0 | 31,240 |
| $NO_X$ as $NO_2$ $\mu g \cdot m^{-3}$ 1-hour | 20.5 | 191.47 at 100% load | 2.07 | $20.5 + \left(\frac{10(2.07 \times 191.47) + 50(1 \times 191.47)}{60}\right)$ | 246.1 ($NO_X$) | 250 ($NO_2$) |

**Note:** Exceedance of the relevant criterion is highlighted in **bold red text**

The cumulative impacts presented in **Table 19** include a contribution from background sources (as presented in **Section 3.3.3** and **Table 3**), and are time weighted by the start-up weighting factors discussed in **Section 4.2.3** and presented in **Table 8**.

There are no predicted exceedances of the Air EPP standards, as presented in **Table 1**.

As a conservative measure, the maximum ratio of measured 1-minute start up emissions to steady operational emissions has been assumed, and applied to the entire 10-minute start-up period.

Further conservatism assumes that 100% of all emitted $NO_X$ is $NO_2$, which is a highly conservative assumption.

Page left intentionally blank

# 7. DISCUSSION

Arcadis Australia Pacific Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform an assessment of the potential impacts upon air quality associated with the construction and operation of the Reeves Plains Power Station, South Australia.

## 7.1. Construction Phase Air Quality Impacts

Construction phase activities have the potential to generate short-term emissions of particulates. Generally, these are associated with uncontrolled dust emissions and are typically experienced by neighbours as amenity impacts, such as dust deposition and visible dust plumes, rather than associated with health-related impacts.

The construction phase impacts associated with the Project have been assessed using a risk-based assessment procedure. The advantage of this approach is that it determines the activities that pose the greatest risk, which allows the Construction Environmental Management Plan (CEMP) to focus controls to manage that risk appropriately, and reduce the impact through proactive management. For this risk assessment, Northstar has adapted a methodology presented in the *IAQM Guidance on the Assessment of Dust from Demolition and Construction*.

The risk assessment determined that the land use value (predominantly residential properties) was *high*, and taken in conjunction with the existing low background particulate concentrations the sensitivity of the area was *low*.

Given the nature, scale and location of the construction activities, the potential magnitude of impacts was assessed as being *negligible* (screened out) for earthworks, construction and dirt track-out onto Gawler Road, and *small* for the potential magnitude of impacts from construction traffic. Based upon the above, the risk from construction traffic was assessed as being *negligible*.

However, a range of construction mitigation measures have been proposed to ensure that off-site impacts are maintained at a level that would not give rise to complaints, and representative of effective and proper dust control. It is recommended that these are incorporated into a dust action plan as part of the Construction Environmental Management Plan (CEMP).

## 7.2. Operational Phase Air Quality Impacts

The operational phase air quality assessment has been performed using a dispersion modelling study, conducted in general accordance with Environment Protection Authority (2016) Ambient Air Quality Assessment[7] guidelines.

The impact assessment has used technical specifications provided by the proponent for the open cycle GE LM6000 Sprint® gas turbines. The primary focus is the assessment of emissions from the operation of the 6 turbines operating on natural gas as a peaking plant. In the event that the gas supply is unexpectedly interrupted, the turbines are specified so that they are able to operate using diesel as the fuel, and this AQIA has considered those emissions also.

The dispersion modelling has been performed using the CSIRO TAPM and the USEPA AERMOD models, and using multiple year meteorological data, validated against meteorological data measured by the Australian Bureau of Meteorology automatic weather stations at RAAF Edinburgh and Outer Harbour. Overall, **Appendix A** shows that the site-specific meteorological data used in this air quality impact assessment validates well.

To understand the existing conditions at the site, measured air pollutant concentration data measured by the Environment Protection Authority at Elizabeth Downs, Adelaide Northfield and Netley have been used. The measured data and the methodology used to use that data in the air quality impact assessment has been documented in **Appendix B**.

The emission estimations for the six turbines operating concurrently with (a) gas and (b) diesel has been assessed at various operating loads are outlined in **Appendix C**, and are discussed in **Section 4.2**. Further to this, the short-term emissions associated with start-up and shut-down have also been assessed, as the six turbines simultaneously warming through the start-up cycle to the point at which peak emission rates are achieved has also been assessed.

The emission estimations of the above, considers potential emissions of:

- carbon monoxide (CO);
- oxides of nitrogen ($NO_X$ as $NO_2$)
- particulate matter ($PM_{2.5}$)
- sulphur dioxide ($SO_2$)
- hazardous air pollutants, assessed as formaldehyde ($CH_2O$),

The above pollutants have been assessed for the six (6) turbines operating concurrently using:

- natural gas
- diesel

The emissions have been assessed for operations at:

- normal operating load (100%)

- normal operating load (75%)
- normal operating load (50%) normal operating load (25%)
- start up (idling to normal operating loads).

The predicted impacts have been predicted at 51 discrete receptor locations, as well as at a series of 25 m uniform receptors across the modelling domain which covers an area of 20 km by 20 km.

The results of the dispersion modelling assessment and have been presented as:

- Incremental impacts – relating to the concentrations predicted as a result of the operation of the power station in isolation.
- Cumulative impacts – relating to the concentrations predicted as a result of the operation of the power station plus the background air quality concentrations discussed in **Section 3.3**.

The results of the dispersion modelling, performed using a meteorological period from January-December 2015 are presented in **Appendix E** and summarised in **Section 6.2**.

### 7.2.1. Operating on Gas

**Table 20** presents a summary of the assumed background, maximum increment (of any receptor at any load operating on gas), and presents those values as a percentage of the standards applied to this AQIA (**Table 1**).

**Table 20 Summary of impacts (gas) and comparison against Air EPP**

| Pollutant (Gas) | Units / Ave | Back-ground | Maximum Increment | Air EPP | % of Air EPP Standard | | |
|---|---|---|---|---|---|---|---|
| | | | | | Back-ground | Maximum Increment | Cumu-lative |
| CO | $\mu g{\cdot}m^{-3}$ 1-hour | 40 | 37.47 | 31,240 | 0.13% | 0.12% | 0.25% |
| | $\mu g{\cdot}m^{-3}$ 8-hour | 50 | 14.8 | 11,120 | 0.45% | 0.13% | 0.58% |
| $NO_X$ as $NO_2$ | $\mu g{\cdot}m^{-3}$ 1-hour | 20.5 | 61.49 | 250 | 8.20% | 24.60% | 32.80% |
| | $\mu g{\cdot}m^{-3}$ annual | 8.2 | 0.53 | 60 | 13.67% | 0.88% | 14.55% |
| $PM_{10}$ | $\mu g{\cdot}m^{-3}$ 24-hour | 15.7 | 1.98 | 50 | 31.40% | 3.96% | 35.36% |
| $PM_{2.5}$ | $\mu g{\cdot}m^{-3}$ 24-hour | 10.4 | 1.98 | 25 | 41.60% | 7.92% | 49.52% |
| | $\mu g{\cdot}m^{-3}$ annual | 7.3 | 0.08 | 8 | 91.25% | 1.00% | 92.25% |
| $SO_2$ | $\mu g{\cdot}m^{-3}$ 1-hour | 28.6 | 9.83 | 570 | 5.02% | 1.72% | 6.74% |
| | $\mu g{\cdot}m^{-3}$ 24-hour | 5.8 | 1.53 | 230 | 2.52% | 0.67% | 3.19% |
| | $\mu g{\cdot}m^{-3}$ annual | 0.2 | 0.08 | 60 | 0.33% | 0.13% | 0.47% |
| $CH_2O$ | $\mu g{\cdot}m^{-3}$ 1-hour | 0 | 2.25 | n/a | n/a | n/a | n/a |
| | $\mu g{\cdot}m^{-3}$ 3-min | 0 | 4.09 | 44 | 0.00% | 9.30% | 9.30% |

**Note:** Exceedence of the relevant criterion is highlighted in **bold red text**

[7] http://www.epa.sa.gov.au/environmental_info/air_quality/assistance_and_advice

**Table 20** demonstrates that none of the discrete or cumulative impacts exceed the Air EPP standards. The maximum *incremental* impact may be seen to be 1-hour $NO_X$ as $NO_2$, which is estimated to represent 24.6% of the 250 µg·m$^{-3}$ 1-hour standard. It is noted that this assessment has assumed a conservative 100% conversion from $NO_X$ to $NO_2$, and as such the above evaluation may be seen as being highly conservative.

The most significant *cumulative* impacts (expressed as a fractions of the Air EPP standard) may be seen to be associated with the annual average $PM_{2.5}$ standard, but it may be seen that these are significantly driven by high background contributions with the associated increment being only 1% of the Air EPP standard.

### 7.2.2. Operating on Diesel

**Table 21** presents a summary of the assumed background, maximum increment (of any receptor at any load operating on diesel), and presents those values as a percentage of the Air EPP standard (or standard applied to this AQIA).

**Table 21 Summary of impacts (diesel) and comparison against Air EPP**

| Pollutant (Diesel) | Units / Ave | Back-ground | Maximum Increment | Air EPP | % of Air EPP Standard | | |
|---|---|---|---|---|---|---|---|
| | | | | | Back-ground | Maximum Increment | Cumu-lative |
| CO | µg·m$^{-3}$ 1-hour | 40 | 34.27 | 31,240 | 0.13% | 0.11% | 0.24% |
| | µg·m$^{-3}$ 8-hour | 50 | 14.46 | 11,120 | 0.45% | 0.13% | 0.58% |
| $NO_X$ as $NO_2$ | µg·m$^{-3}$ 1-hour | 20.5 | 191.47 | 250 | 8.20% | 76.59% | 84.79% |
| | µg·m$^{-3}$ annual | 8.2 | 1.74 | 60 | 13.67% | 2.90% | 16.57% |
| $PM_{10}$ | µg·m$^{-3}$ 24-hour | 15.7 | 2.17 | 50 | 31.40% | 4.34% | 35.74% |
| $PM_{2.5}$ | µg·m$^{-3}$ 24-hour | 10.4 | 2.17 | 25 | 41.60% | 8.68% | 50.28% |
| | µg·m$^{-3}$ annual | 7.3 | 0.09 | 8 | 91.25% | 1.13% | 92.38% |
| $SO_2$ | µg·m$^{-3}$ 1-hour | 28.6 | 0.86 | 570 | 5.02% | 0.15% | 5.17% |
| | µg·m$^{-3}$ 24-hour | 5.8 | 0.16 | 230 | 2.52% | 0.07% | 2.59% |
| | µg·m$^{-3}$ annual | 0.2 | 0.01 | 60 | 0.33% | 0.02% | 0.35% |
| $CH_2O$ | µg·m$^{-3}$ 1-hour | 0 | 0.12 | n/a | n/a | n/a | n/a |
| | µg·m$^{-3}$ 3-min | 0 | 0.21 | 44 | 0.00% | 0.48% | 0.48% |

**Note:** Exceedence of the relevant criterion is highlighted in **bold red text**

**Table 21** demonstrates that none of the discrete or cumulative impacts exceed the Air EPP standards. The maximum *incremental* impact may be seen to be 1-hour $NO_X$ as $NO_2$, at 76.6% of the 250 µg·m$^{-3}$ 1-hour standard. As noted above, this assessment has assumed a conservative 100% conversion from $NO_X$ to $NO_2$, and as such the above evaluation may be seen as being highly conservative.

The most significant *cumulative* impacts (as factions of the Air EPP standard) may be seen to be associated with the 1-hour $NO_X$ as $NO_2$, and the annual average $PM_{2.5}$ standards, but none are predicted to exceed the Air EPP standards.

### 7.2.3. Start Up Emissions

The conservative assessment of start-up impacts assumes that the maximum peak in emissions, relative to normal operations measured at the comparable Bairnsdale Power Station is applied to the entire 10-minute start-up cycle. It further assumes that 100% of $NO_X$ is emitted as $NO_2$, which is highly conservative.

The start-up emissions are not predicted to exceed the Air EPP standards.

## 7.3. Conclusions

Based upon the information and assumptions presented in this AQIA, it is concluded that construction dust emissions may be adequately controlled through the application of a range of suitable construction management practices, and that these should be documented within a Construction Environmental Management Plan (CEMP).

The potential impacts from the operation of the proposed power station have been assessed using a referenced dispersion modelling assessment, using meteorological data as requested by the EPA, representative background monitoring and using emission rates derived directly from Alinta Energy. Based upon the assumptions presented in the AQIA it is predicted that the operation of the power station on either gas or mineral diesel will not result in a breach of the standards prescribed in the Air EPP.

Notwithstanding the foregoing assessment, it is recommended that a suitable campaign of compliance monitoring should be implemented to the satisfaction of the EPA. It is considered that the demonstration that the engines are capable of being operated as set out in this AQIA is of critical importance, and that a program of emissions testing with the engines operating on gas and diesel and at various loads should be implemented as a condition of approval.

Whilst the AQIA predicts that the air quality risks associated with operation at full capacity (300 MW) are within acceptable limits, it is considered that the environmental risks are further managed by the proposed staged development. Implementing the recommended program of compliance emissions monitoring during the initial stage (150 MW installed capacity) would provide the EPA with increased assurance that the proposed plant is able to achieve its performance objectives prior to operating the second stage (300 MW installed capacity).

In light of the above, and in consideration of the proposed verification studies, it is considered to be reasonable to conclude that the proposed construction and operation of the Project should not be refused on grounds of air quality.

Page left intentionally blank

# 8. REFERENCES


Environment Protection Authority (2016) Ambient Air Quality Assessment (EPA 2016)

*Environment Protection (Air Quality) Policy* 2016 (Air EPP)

Environment Protection Authority (2016) Ambient Air Quality Assessment (EPA, 2016)

GE Energy (2008) *LM6000-50/60 Hz Gas Turbine Generator Set Product Specification* (GE Energy 2008),

Institute of Air Quality Management (2014) *Guidance on the Assessment of Dust from Demolition and Construction* (IAQM 2014)

US EPA (1995) *Compilation of Air Pollutant Emission Factors AP-42, Volume 1, Chapter 3: Stationary Internal Combustion Sources (fifth edition)* (USEPA 1995)

Page left intentionally blank

# APPENDIX A

# METEOROLOGY

As discussed in **Section 3.4** a meteorological modelling exercise has been performed to characterise the meteorology of the Project site in the absence of site specific measurements. The meteorological monitoring has been based on measurements taken at a number of surrounding automatic weather stations (AWS) operated by the Bureau of Meteorology (BoM). A summary of the relevant monitoring sites is provided in **Table A-1**.

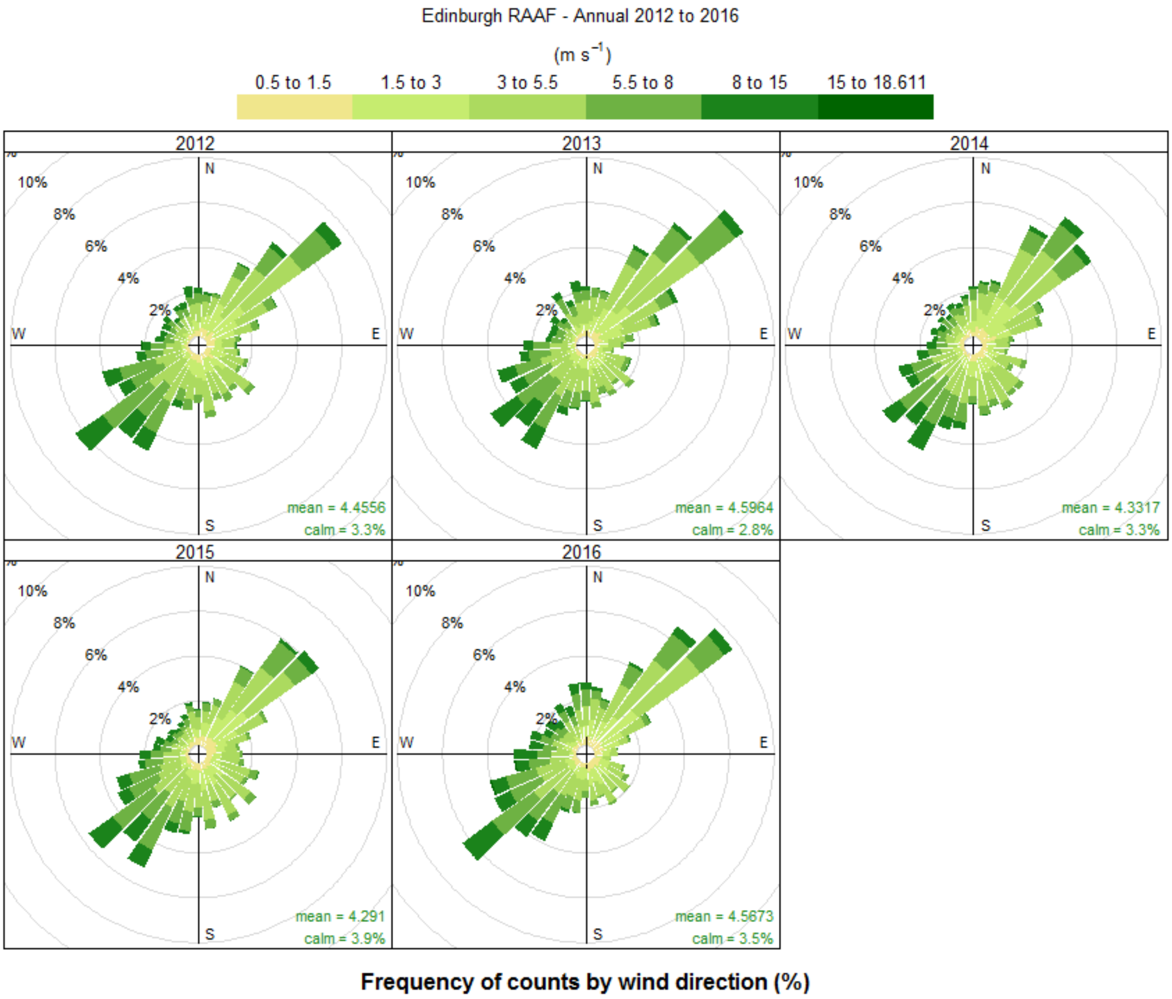
**Table A-1 Details of the Meteorological Monitoring Surrounding the Project Site**

| Site Name | Approximate Location (Latitude, Longitude) | |
|---|---|---|
| | ˚S | ˚E |
| Edinburgh RAAF – Station # 023083 | 34.71 | 138.62 |
| Outer Harbour – Station # 023052 | 34.73 | 138.47 |

Meteorological conditions at Edinburgh RAAF AWS have been examined to determine a 'typical' or representative dataset for use in dispersion modelling.

Annual wind roses for the most recent years of data measured at Edinburgh RAAF AWS over the period from 2012 to 2016 are presented in **Figure A-1**.

## Figure A-1 Annual wind roses 2012 to 2016, Edinburgh RAAF AWS

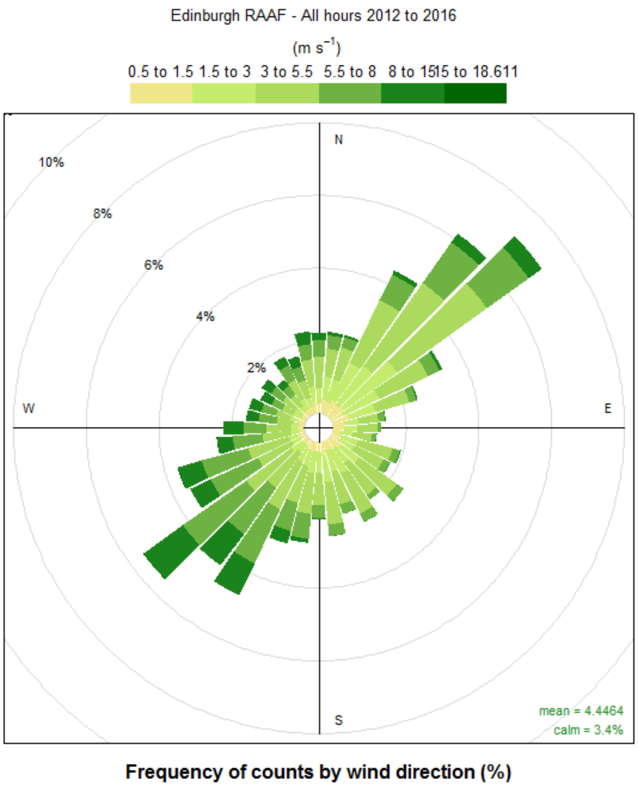



**Source**: Northstar Air Quality

The wind roses indicate that from 2012 to 2016, winds at Edinburgh RAAF AWS show a predominant southwesterly wind direction with a north-easterly and south-easterly components also evident. The majority of wind speeds experienced at the Edinburgh RAAF AWS between 2012 and 2016 are generally in the range 1.5 metres per second ($m{\cdot}s^{-1}$) to 5.5 $m{\cdot}s^{-1}$ with the highest wind speeds (greater than 8 $m{\cdot}s^{-1}$) occurring from a south easterly direction. Winds of this speed are rare and occur during 1.1% of the observed hours during the years. Calm winds (<0.5 $m{\cdot}s^{-1}$) occur for less than 3.7% of hours across the years.

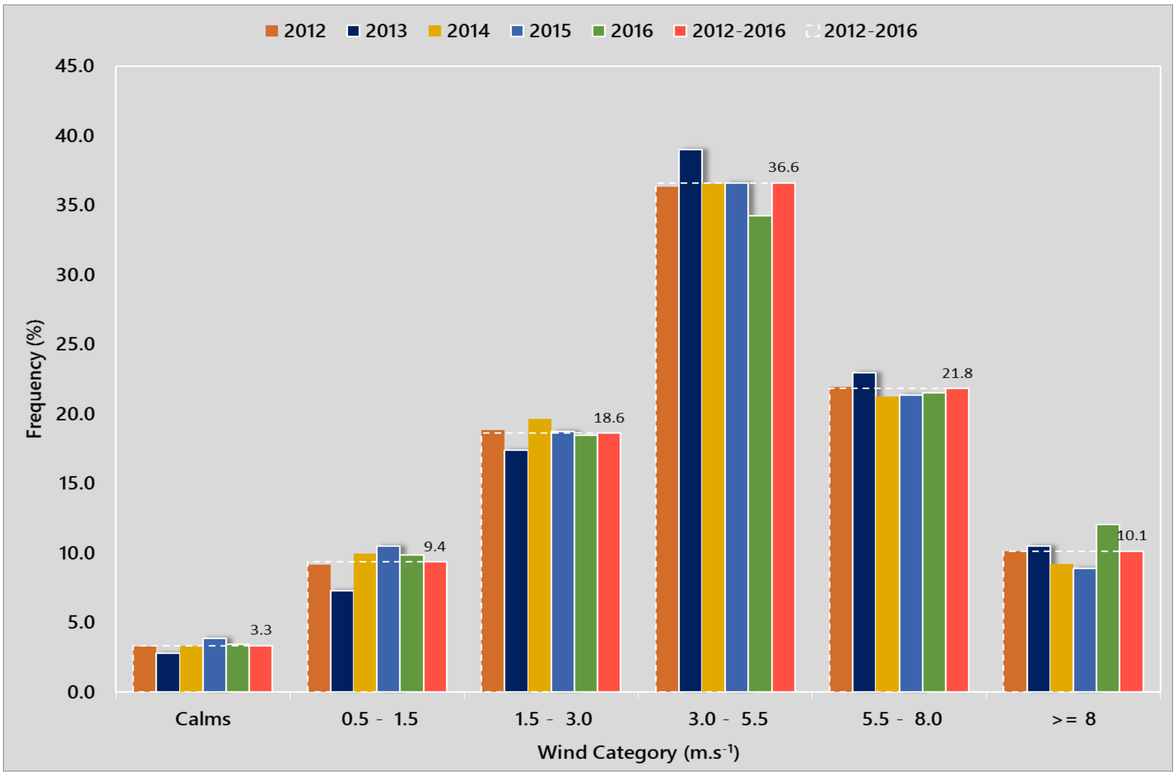
Presented in **Figure A-2** is the long-term wind rose for the 2012 to 2016 period and the annual wind speed distribution for Edinburgh RAAF AWS.

## Figure A-2 Long-term wind rose (2012 to 2016), Edinburgh RAAF AWS




**Source**: Northstar Air Quality

## Figure A-3 Annual wind speed distribution Edinburgh RAAF AWS




**Source**: Northstar Air Quality

## Meteorological Processing

The BoM data adequately covers the issues of data quality assurance, however it is limited by its location compared to the Project site. To address these uncertainties, a multi-phased assessment of the meteorology data has been performed.

In absence of any measured onsite meteorological data, site representative meteorological data for this Project was generated using the TAPM meteorological model (refer **Section 4.2**).

Meteorological modelling using The Air Pollution Model (TAPM, v 4.0.5) has been performed to predict the meteorological parameters required for AERMOD. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

The parameters used in TAPM modelling are presented in **Table A-2**.

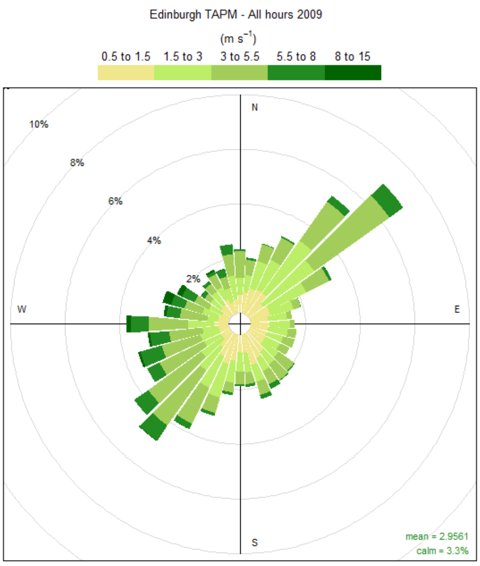
**Table A-2 Meteorological Parameters used for this Study**

| TAPM v 4.0.5 | |
|---|---|
| Modelling period | 1 January 2009 to 31 December 2009 |
| Centre of analysis | 280,713 mE, 6179,316 mN (UTM Coordinates) |
| Number of grid points | 70 × 70 × 25 |
| Number of grids (spacing) | 4 (20 km, 10 km, 3 km, 1 km) |
| Terrain | AUSLIG 9 second DEM |
| Data assimilation | None |

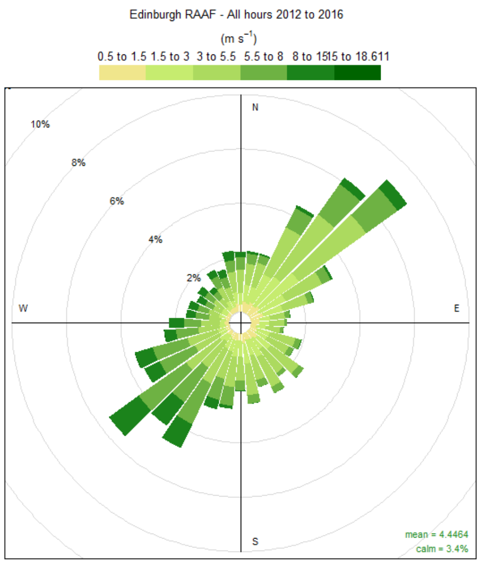
A comparison of the TAPM generated meteorological data, and that observed at the Edinburgh RAAF AWS is presented in **Figure A-4**. These data generally compare well which provides confidence that the meteorological conditions modelled as part of this assessment are appropriate.

## Figure A-4 Modelled and observed meteorological data –2009, 2012-2016

| TAPM generated windrose | Observations at Edinburgh RAAF AWS |
| --- | --- |

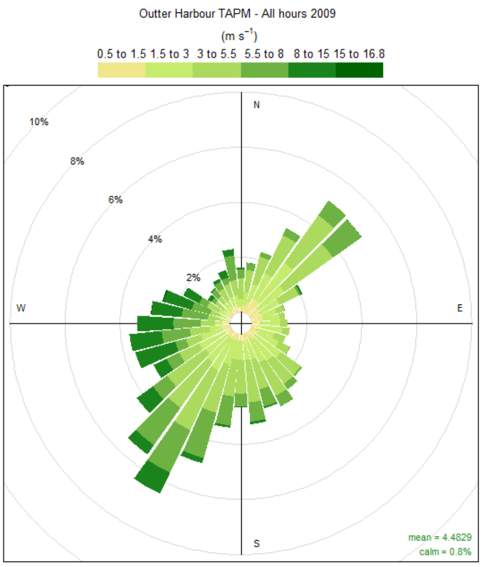



Frequency of counts by wind direction (%)

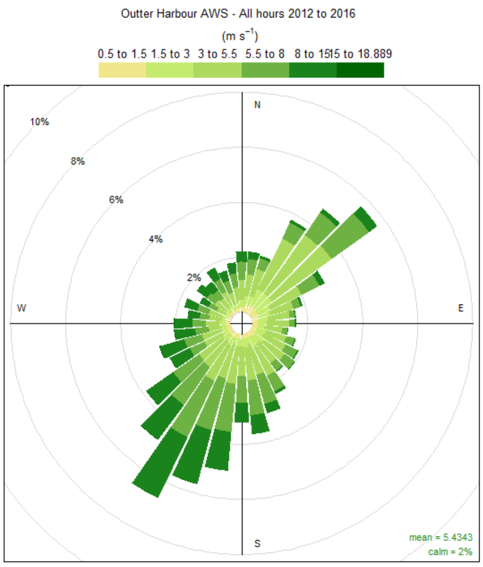



Frequency of counts by wind direction (%)

| TAPM generated windrose | Observations at Outer Harbour AWS |
| --- | --- |




Frequency of counts by wind direction (%)




Frequency of counts by wind direction (%)

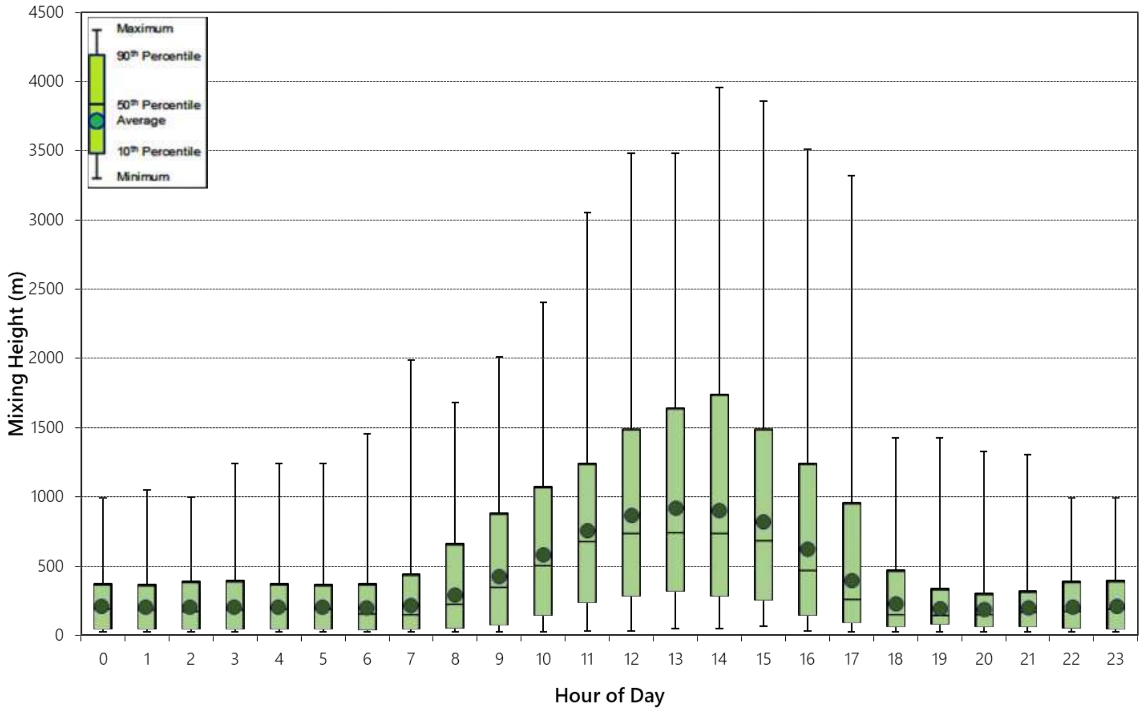
**Source**: Northstar Air Quality

The following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Project site, detailed discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirulation potential of the Project site has not been provided. Details of the predictions of wind speed and direction, mixing height and temperature at the Project site are provided below.

Diurnal variations in maximum and average mixing heights predicted by TAPM at the Project site during 2009 period are illustrated in **Figure A-5**.

As expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

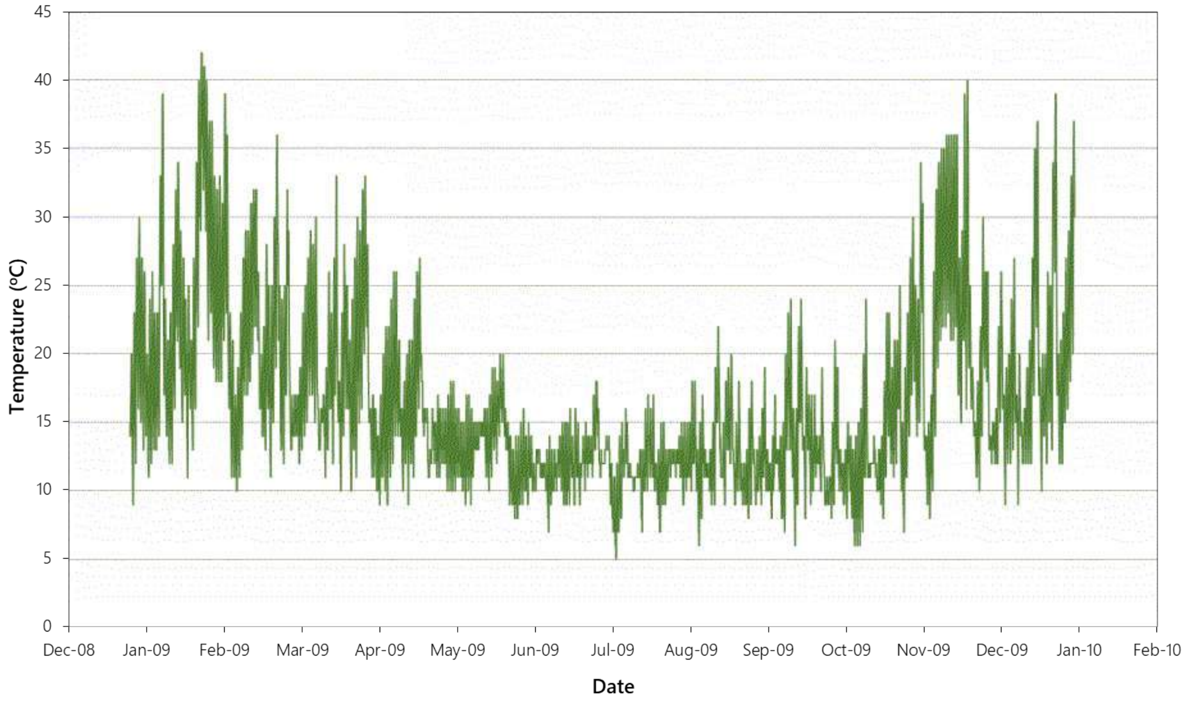
**Figure A-5 Predicted mixing height – Project site 2009**




**Source**: Northstar Air Quality

The modelled temperature variations predicted at the Project site during 2009 are presented in **Figure A-6**. The maximum temperature of 42°C was predicted on 9 January 2009 and the minimum temperature of 5°C was predicted on 7 July 2009.

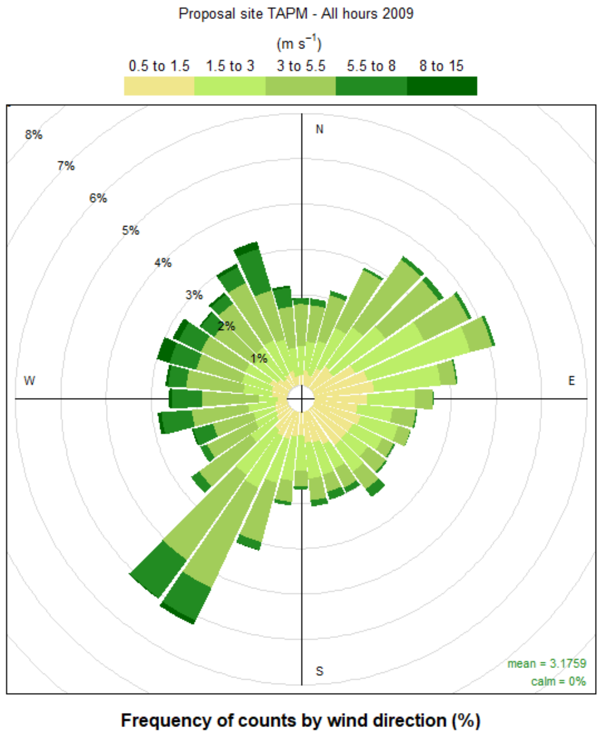
### Figure A-6 Predicted temperature – Project site 2009




**Source**: Northstar Air Quality

The modelled wind speed and direction at the Project site during 2009 are presented in **Figure A-7**.

### Figure A-7 Predicted wind speed and direction – Project site 2009




**Source**: Northstar Air Quality

# APPENDIX B

# BACKGROUND AIR QUALITY

Background air quality assumptions are introduced in **Section 3.3** of the AQIA. The data presented below presents a summary of the measured air quality concentrations at Elizabeth Downs air quality monitoring station (AQMS) and at Netley AQMS during 2015. The data has been accessed and the summary statistics derived from the Data SA website, maintained by the SA Government.

Elizabeth Downs AQMS has been used to represent background air quality at the Project site as it is the closest monitoring station. The EPA raised questions about the applicability of particulate data at Elizabeth Downs AQMS, and recommended that Netley AQMS was used instead to characterise background particulate concentrations.

The data accessed from the Data SA web resource[8] was downloaded and is summarised in **Table B-1** below:

[8] https://data.sa.gov.au/

**Table B-1 Summary background air quality data (Elizabeth Downs & Netley AQMS, 2015)**

| Polltnt: | $PM_{10}$ | | $PM_{2.5}$ | NO | $NO_2$ | $NO_X$ | CO | |
|---|---|---|---|---|---|---|---|---|
| Average Period | 24-h all | 24-h Air EPP[D] | 24-h all | 1-h | 1-h | 1-h | 1-h | 8-h |
| AQMS | Netley | Netley | Netley | Elizabeth Downs | | | Elizabeth Downs | |
| Units[A] | $\mu g.m^{-3}{}_{TEOM}$ | $\mu g.m^{-3}{}_{TEOM}$ | $\mu g.m^{-3}{}_{TEOM}$ | ppm | ppm | ppm | ppm | ppm |
| Mean | 15.7 | 15.5 | 7.3 | 0.001 | 0.004 | 0.005 | 0.022 | 0.022 |
| Std Deviation | 7.5 | 6.1 | 2.5 | 0.002 | 0.004 | 0.006 | 0.072 | 0.051 |
| Skew[B] | *4.2* | *1.0* | *1.2* | *8.5* | *2.1* | *3.3* | *16.4* | *9.7* |
| Kurtosis[C] | *41.2* | *1.2* | *2.1* | *112.3* | *5.2* | *16.8* | *411.6* | *137.7* |
| Minimum | 1.4 | 1.4 | 1.8 | -0.001 | -0.001 | -0.001 | -0.040 | -0.040 |
| Percentile 1 | 5.4 | 5.4 | 3.4 | 0.000 | 0.000 | 0.000 | -0.020 | -0.020 |
| Percentile 2 | 6.2 | 6.2 | 3.7 | 0.000 | 0.000 | 0.000 | -0.020 | -0.010 |
| Percentile 3 | 6.8 | 6.8 | 3.8 | 0.000 | 0.000 | 0.000 | -0.020 | -0.010 |
| Percentile 4 | 7.4 | 7.4 | 3.9 | 0.000 | 0.000 | 0.000 | -0.010 | -0.010 |
| Percentile 5 | 7.8 | 7.7 | 4.0 | 0.000 | 0.000 | 0.000 | -0.010 | -0.010 |
| Percentile 10 | 9.2 | 9.2 | 4.6 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 |
| Percentile 25 | 11.1 | 11.1 | 5.5 | 0.000 | 0.001 | 0.002 | 0.000 | 0.000 |
| Percentile 50 | 14.8 | 14.8 | 6.9 | 0.000 | 0.003 | 0.003 | 0.010 | 0.010 |
| Percentile 75 | 18.2 | 18.1 | 8.4 | 0.001 | 0.005 | 0.006 | 0.020 | 0.020 |
| Percentile 90 | 23.8 | 23.7 | 10.4 | 0.002 | 0.010 | 0.011 | 0.040 | 0.050 |
| Percentile 95 | 28.1 | 28.0 | 11.8 | 0.003 | 0.013 | 0.016 | 0.080 | 0.080 |
| Percentile 96 | 29.2 | 28.8 | 12.3 | 0.004 | 0.014 | 0.017 | 0.100 | 0.090 |
| Percentile 97 | 30.2 | 30.1 | 13.5 | 0.005 | 0.016 | 0.020 | 0.130 | 0.110 |
| Percentile 98 | 31.2 | 30.6 | 15.1 | 0.007 | 0.017 | 0.023 | 0.160 | 0.130 |
| Percentile 99 | 35.1 | 34.8 | 15.9 | 0.011 | 0.020 | 0.030 | 0.240 | 0.170 |
| Maximum | 98.7 | 39.6 | 17.1 | 0.056 | 0.028 | 0.079 | 2.580 | 0.980 |
| Count | 365 | 364 | 345 | 8,337 | 8,337 | 8,337 | 8,528 | 8,561 |
| Capture | 100% | 99.7% | 95% | 95% | 95% | 95% | 97% | 98% |

Note: A. All data is presented in the stated units except skew and kurtosis, which are dimensionless, count which is a numerical value and capture which is expressed as a percentage.

B. Skew is a dimensionless metric describing the distribution of the measured values in the range to a normal distribution.

C. Kurtosis is a dimensionless metric describing the 'peakedness' of the distribution to a normal distribution.

D. Data presented excluding the maximum measured value of 98.7 $\mu g{\cdot}m^{-3}$.

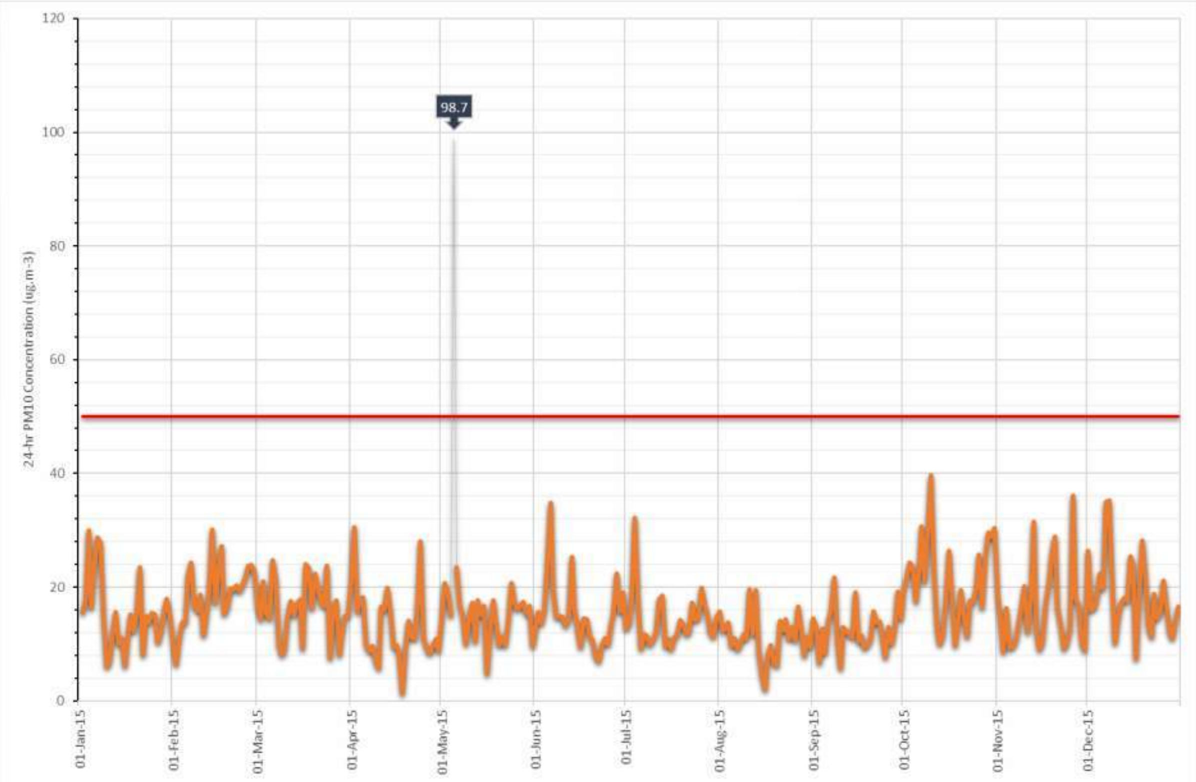
The data accessed for Elizabeth Downs AQMS and Netley AQMS did not contain measured $SO_2$ data.

**Particulates (as $PM_{10}$)**

The data for $PM_{10}$ measured at Netley AQMS during 2015 is presented as measured 24-hour average data. It may be seen that the 24-hour $PM_{10}$ concentration exceeds the Air EPP 24-hour criterion of 50 µg·m$^{-3}$ on one occasion during 2015.

The time-series plot for the measured 24-hour $PM_{10}$ concentration is illustrated in **Figure B-1**.

**Figure B-1 Time series plot of measured 24-hour $PM_{10}$ (Netley AQMS 2015)**




**Source**: Northstar Air Quality

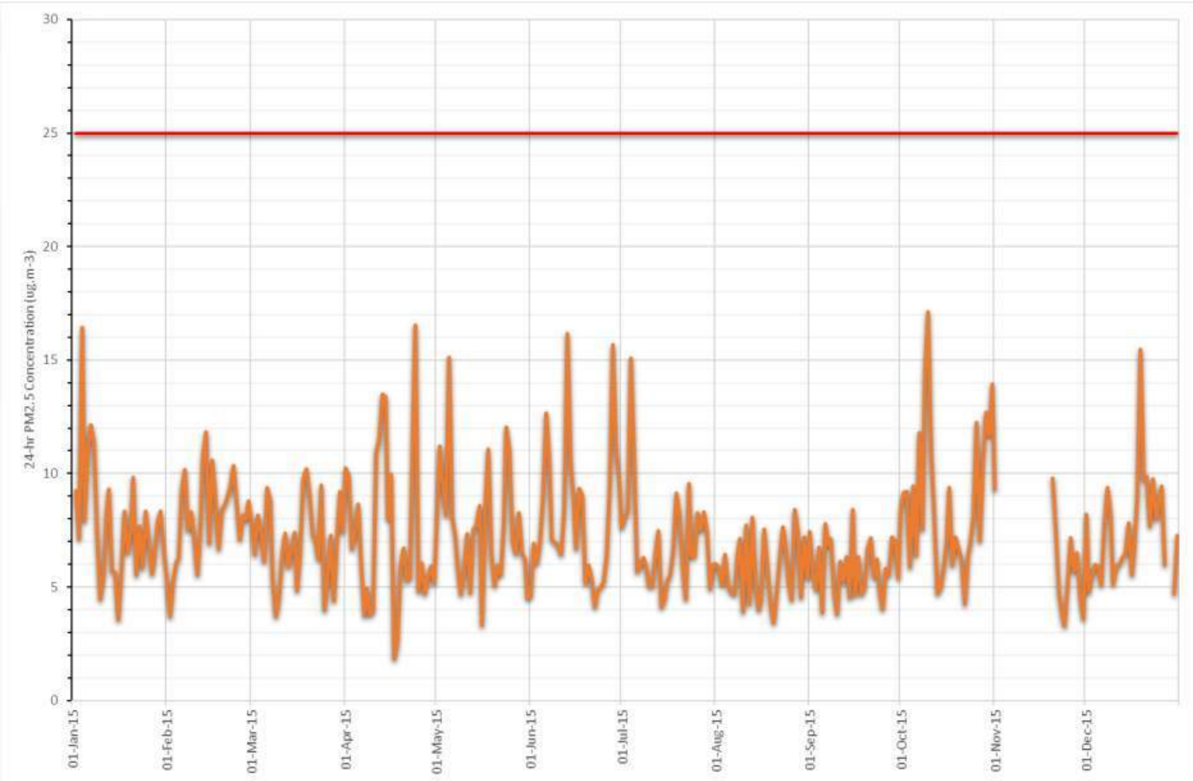
The single exceedences of the Air EPP 24-hour $PM_{10}$ criterion of 50 µg·m$^{-3}$ is indicated as 98.7 µg·m$^{-3}$ on 4 May 2015. To use this data meaningfully, the period of exceedence of the Air EPP standard has been removed and the resultant dataset recalculated (listed in the table as "24-h Air EPP").

Consequentially, the maximum background 24-hour $PM_{10}$ concentration value for 2015 is 39.6 µg·m$^{-3}$ with an annual average $PM_{10}$ concentration of 15.7 µg·m$^{-3}$. The 90th percentile of 24-hour $PM_{10}$ measured at Netley AQMS is 23.8 µg·m$^{-3}$, including the Air EPP exceedance value in that calculation.

### Particulates (as $PM_{2.5}$)

The corresponding background $PM_{2.5}$ measurements at Netley AQMS in 2015 are presented in **Figure B-2** below:

**Figure B-2 Time series plot of measured 24-hour $PM_{2.5}$ (Netley AQMS 2015)**




**Source**: Northstar Air Quality

There are no exceedences of the Air EPP 24-hour $PM_{2.5}$ criterion of 25 $\mu g{\cdot}m^{-3}$ measured at Netley AQMS is 2015.

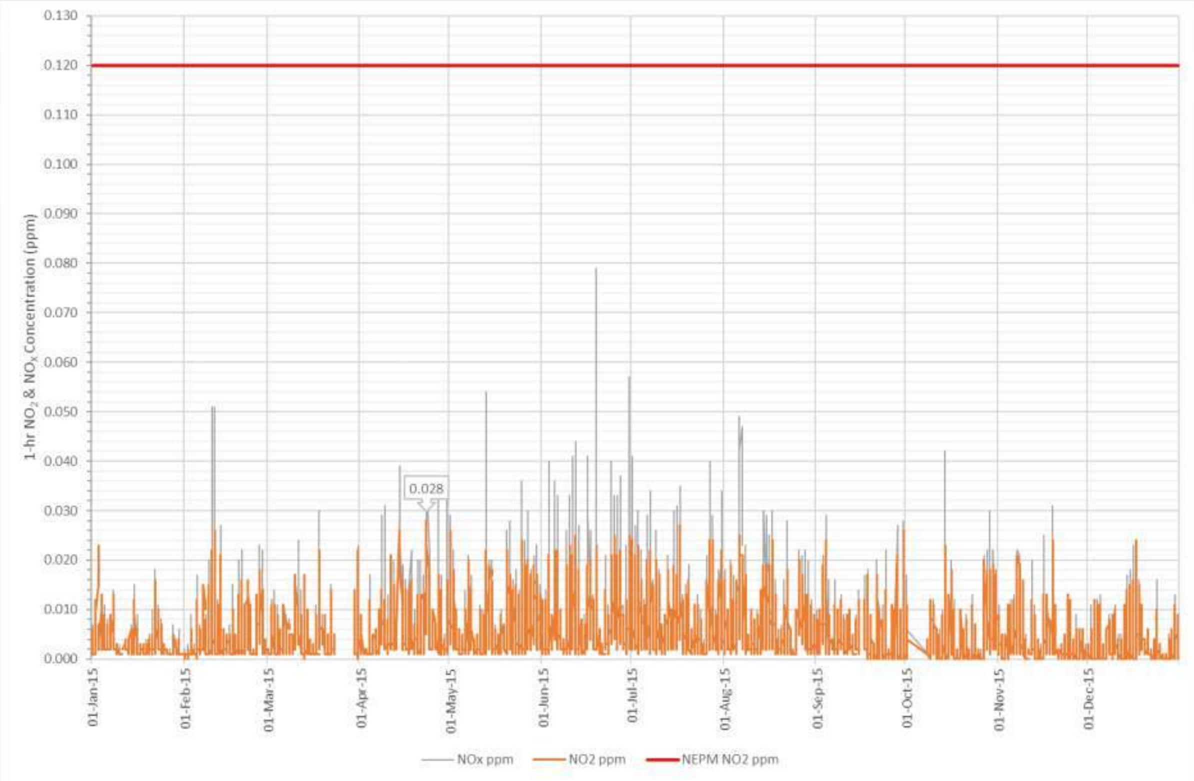
The maximum background 24-hour $PM_{2.5}$ concentration value for 2015 is 17.1 $\mu g{\cdot}m^{-3}$ with an annual average $PM_{10}$ concentration of 7.3 $\mu g{\cdot}m^{-3}$.

The 90th percentile of 24-hour $PM_{2.5}$ measured at Netley AQMS is 10.4 $\mu g{\cdot}m^{-3}$.

## Nitrogen Dioxide

The time series plot of the measured $NO_2$ and $NO_X$ is shown in **Figure B-3** below:

**Figure B-3 Time series plot of measured 1-hour NO2 and NOX (Elizabeth Downs AQMS 2015)**




**Source**: Northstar Air Quality

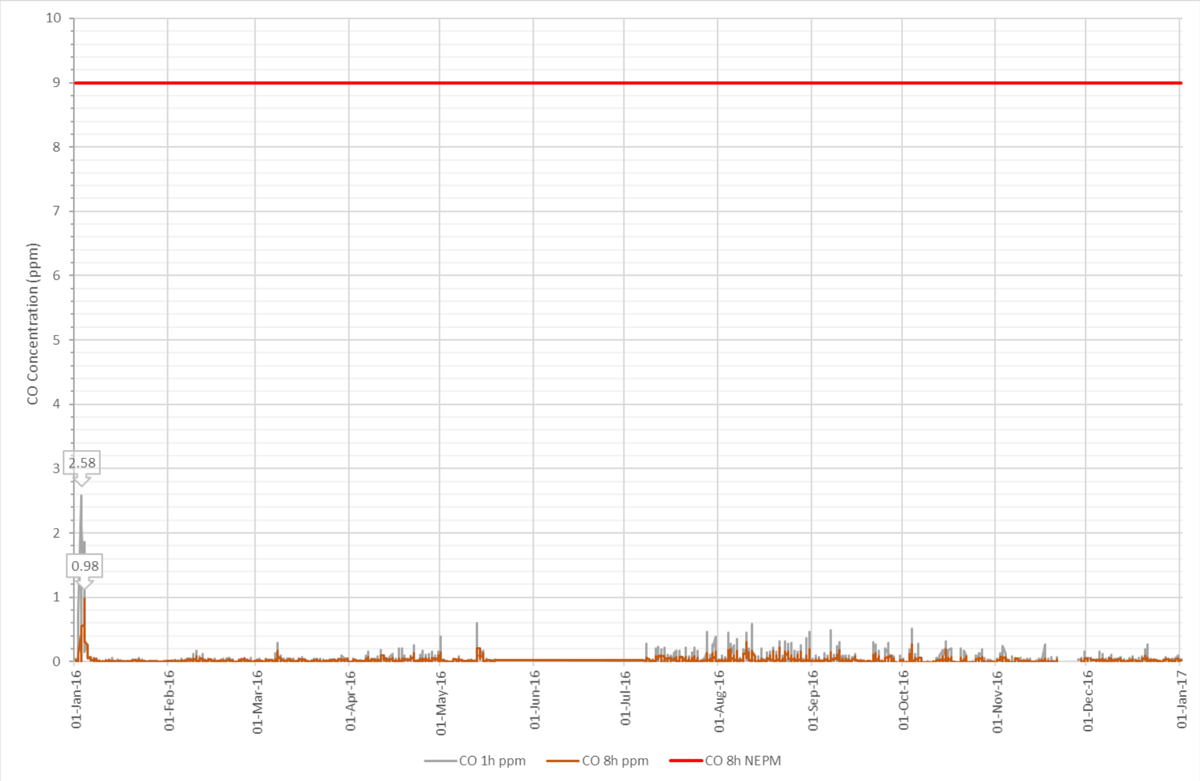
The maximum 1-hour $NO_2$ concentration measured at Elizabeth Downs over the 2015 monitoring period was 0.028 ppm (57.4 $\mu g \cdot m^{-3}$), measured on 23 April 2015 and the 90th percentile value was 0.010 ppm (20.5 $\mu g \cdot m^{-3}$).

The annual average $NO_2$ concentration was measured as 0.004 ppm (8.2 $\mu g \cdot m^{-3}$).

### Carbon Monoxide

The time series plot of the measured 1-hour and 8-hour CO concentrations is shown in **Figure B-4** below:

**Figure B-4 Time series plot of measured 1-hour and 8-hour CO (Elizabeth Downs AQMS 2015)**




**Source**: Northstar Air Quality

The maximum 1-hour CO concentration measured at Elizabeth Downs over the 2015 monitoring period was 2.58 ppm (3.23 mg·m$^{-3}$), measured on 3 January 2015 and the corresponding maximum rolling 8-hour average was measured as 0.98 ppm (1.23 mg·m$^{-3}$) measured on 4 January 2015. The corresponding 90$^{th}$ percentile 1-hour and 8-hour average values were 0.040 ppm (0.05 mg·m$^{-3}$) and 0.050 ppm (0.06 mg·m$^{-3}$) respectively.

### Sulphur Dioxide

Sulphur dioxide ($SO_2$) monitoring is performed by the EPA in SA at the following AQMS:

- Adelaide – Northfield (NOR01)
- Adelaide – North Haven (NHV01)
- Spencer – Port Pirie Oliver Street (PTP01)

The National Environment Protection Council (NEPC) annual report[9] makes the following comments regarding $SO_2$ in SA (2014-15):

[9] http://www.nepc.gov.au/system/files/resources/e3da1ed8-68f0-48e5-937a-5de0045feb62/files/nepc-annual-report-2014-15.pdf

*"In Port Pirie, exceedences of the 1-hour $SO_2$ standard were recorded on 68 occasions on 38 different days. There were 4 exceedences of the 24-hr standard for $SO_2$. Therefore, the 1-hour and 24-hour $SO_2$ standards and goals were not met at Oliver Street* [Port Pirie] *station. However there was not an exceedence of the 1-year standard for $SO_2$."*

*"For $SO_2$ the 1-hour, 1-day and 1-year standards and goals were met at the Adelaide metropolitan stations. The 1-year standard and goal was met at Port Pirie Oliver Street station, however there were 38 exceedences of the 1-hour and 4 exceedences of the 1-day standards at Oliver Street station so the 1-hour and 1-day goals were not achieved."*

In order to represent background $SO_2$ concentrations at the Project site, the data from Adelaide Northfield has been accessed. For the year 2015 the following maximum concentration values were determined:

- 1-hour maximum: 28.6 $\mu g \cdot m^{-3}$
- 1-day maximum: 5.8 $\mu g \cdot m^{-3}$
- Annual average: 0.2 $\mu g \cdot m^{-3}$

In lieu of more site-specific measurements, the assumption that background $SO_2$ is comparable to that measured at Northfield is considered to be highly conservative.

Page left intentionally blank

# APPENDIX C

# EMISSIONS ESTIMATION

Presented below is a breakdown of the emissions data used in the AQIA for operations using natural gas and diesel.

The estimated emission rates for oxides of nitrogen ($NO_X$), carbon monoxide (CO), sulphur dioxide ($SO_2$) and particulate matter ($PM_{2.5}$) for natural gas are presented in **Table C-1**. The corresponding estimations for formaldehyde as derived from emission estimates published in US EPA *AP-42 Volume 1, Chapter 3, Section 3.1* are presented in **Table C-2**. The graphical representation of emission rates by load are presented in **Figure C-1**.

The estimated emission rates for oxides of nitrogen ($NO_X$), carbon monoxide (CO), sulphur dioxide ($SO_2$) and particulate matter ($PM_{2.5}$) for diesel are presented in **Table C-3**. The corresponding estimations for formaldehyde as derived from emission estimates published in US EPA *AP-42 Volume 1, Chapter 3, Section 3.1* are presented in **Table C-4**. The graphical representation of emission rates by load are presented in **Figure C-2**.

The estimated gas discharge rate and temperature profile variance with operating load is presented in **Figure C-3**.

**Table C-1 Estimated emission rates ($NO_X$, CO, $SO_2$, $PM_{2.5}$) with load (%) on gas**

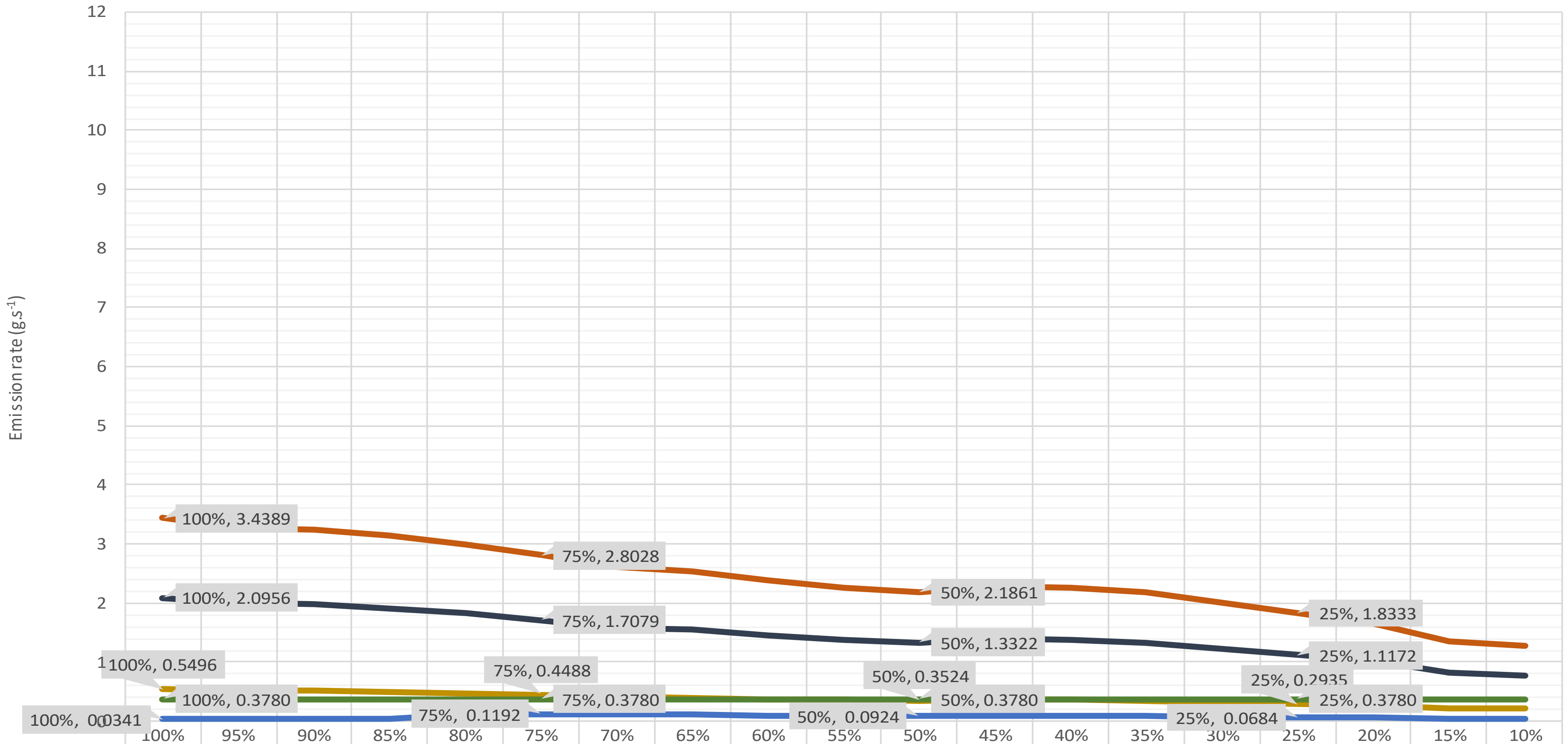
| Fuel | Units | Load (%) | | | |
|---|---|---|---|---|---|
| | | 100% | 75% | 50% | 25% |
| Stack temperature | degrees C | 395 | 390 | 434 | 421 |
| $NO_X$ (as $NO_2$) | $mg.Nm^{-3}$ ref $O_2$ | 51.2 | 51.2 | 51.2 | 51.2 |
| CO | $mg.Nm^{-3}$ ref $O_2$ | 31.2 | 31.2 | 31.2 | 31.2 |
| $NO_X$ (as $NO_2$) | $kg.hr^{-1}$ | 12.38 | 10.09 | 7.87 | 6.6 |
| $SO_2$ | $kg.hr^{-1}$ | 1.98 | 1.62 | 1.27 | 1.06 |
| Discharge rate | $Nm^3.hr^{-1}$ ref $O_2$ | 241796.9 | 197070.3 | 153710.9 | 128906.3 |
| Stack diameter | m | 3.50 | 3.50 | 3.50 | 3.50 |
| Velocity | $m.s^{-1}$ | 17.08 | 13.82 | 11.49 | 9.45 |
| $NO_X$ (as $NO_2$) | $g.s^{-1}$ | 3.4389 | 2.8028 | 2.1861 | 1.8333 |
| CO | $g.s^{-1}$ | 2.0956 | 1.7079 | 1.3322 | 1.1172 |
| $SO_2$ | $g.s^{-1}$ | 0.5496 | 0.4488 | 0.3524 | 0.2935 |
| $PM_{2.5}$ | $g.s^{-1}$ | 0.3780 | 0.3780 | 0.3780 | 0.3780 |

**Note:** $PM_{2.5}$ emissions are derived from a constant maximum emission rate of 3 pounds (lb) per hour. It is reasonably assumed that 100% of particulate is <1µm, and represented as $PM_{2.5}$.

**Table C-2 Estimated emission rates (Formaldehyde) with load (%) on gas**

| Fuel | Units | Load (%) | | | |
|---|---|---|---|---|---|
| | | 100% | 75% | 50% | 25% |
| Stack temperature | degrees C | 395 | 390 | 434 | 421 |
| Formaldehyde | $lb \cdot MMscf^{-1}{}_{(fuel)}$ | 0.723 | 3.18 | 3.18 | 3.18 |
| Formaldehyde | $g \cdot m^{-3}{}_{(fuel,\ 60°F)}$ | 0.011 | 0.048 | 0.048 | 0.048 |
| Fuel consumption | $Nm^3 \cdot hr^{-1}$ | 11,215 | 8,904 | 6,904 | 5,109 |
| Discharge rate | $Nm^3.hr^{-1}$ ref $O_2$ | 241796.9 | 197070.3 | 153710.9 | 128906.3 |
| Stack diameter | m | 3.50 | 3.50 | 3.50 | 3.50 |
| Velocity | $m.s^{-1}$ | 17.08 | 13.82 | 11.49 | 9.45 |
| Formaldehyde | $g.s^{-1}$ | 0.034 | 0.119 | 0.092 | 0.068 |

**Figure C-1** Estimated emission rates ($NO_X$, CO, $SO_2$, $PM_{2.5}$, $CH_2O$) with load (%) on gas




| | 100% | 95% | 90% | 85% | 80% | 75% | 70% | 65% | 60% | 55% | 50% | 45% | 40% | 35% | 30% | 25% | 20% | 15% | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NOX | 3.4389 | 3.2778 | 3.2472 | 3.1306 | 2.9861 | 2.8028 | 2.6111 | 2.5472 | 2.3944 | 2.2667 | 2.1861 | 2.2917 | 2.2556 | 2.1833 | 2.0111 | 1.8333 | 1.6611 | 1.3444 | 1.2778 |
| CO | 2.0956 | 1.9974 | 1.9788 | 1.9077 | 1.8197 | 1.7079 | 1.5911 | 1.5522 | 1.4591 | 1.3813 | 1.3322 | 1.3965 | 1.3745 | 1.3305 | 1.2255 | 1.1172 | 1.0122 | 0.8193 | 0.7786 |
| SO2 | 0.5496 | 0.5282 | 0.5155 | 0.5048 | 0.4812 | 0.4488 | 0.4250 | 0.4042 | 0.3801 | 0.3655 | 0.3524 | 0.3608 | 0.3603 | 0.3438 | 0.3193 | 0.2935 | 0.2644 | 0.2210 | 0.2099 |
| PM2.5 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 |
| CH2O | 0.0341 | 0.0326 | 0.0314 | 0.0304 | 0.1285 | 0.1192 | 0.1134 | 0.1074 | 0.1018 | 0.0968 | 0.0924 | 0.0890 | 0.0854 | 0.0807 | 0.0744 | 0.0684 | 0.0621 | 0.0532 | 0.0486 |

Load (%)

**Source**: Northstar Air Quality

**Table C-3 Estimated emission rates ($NO_X$, CO, $SO_2$, $PM_{2.5}$) with load (%) on diesel**

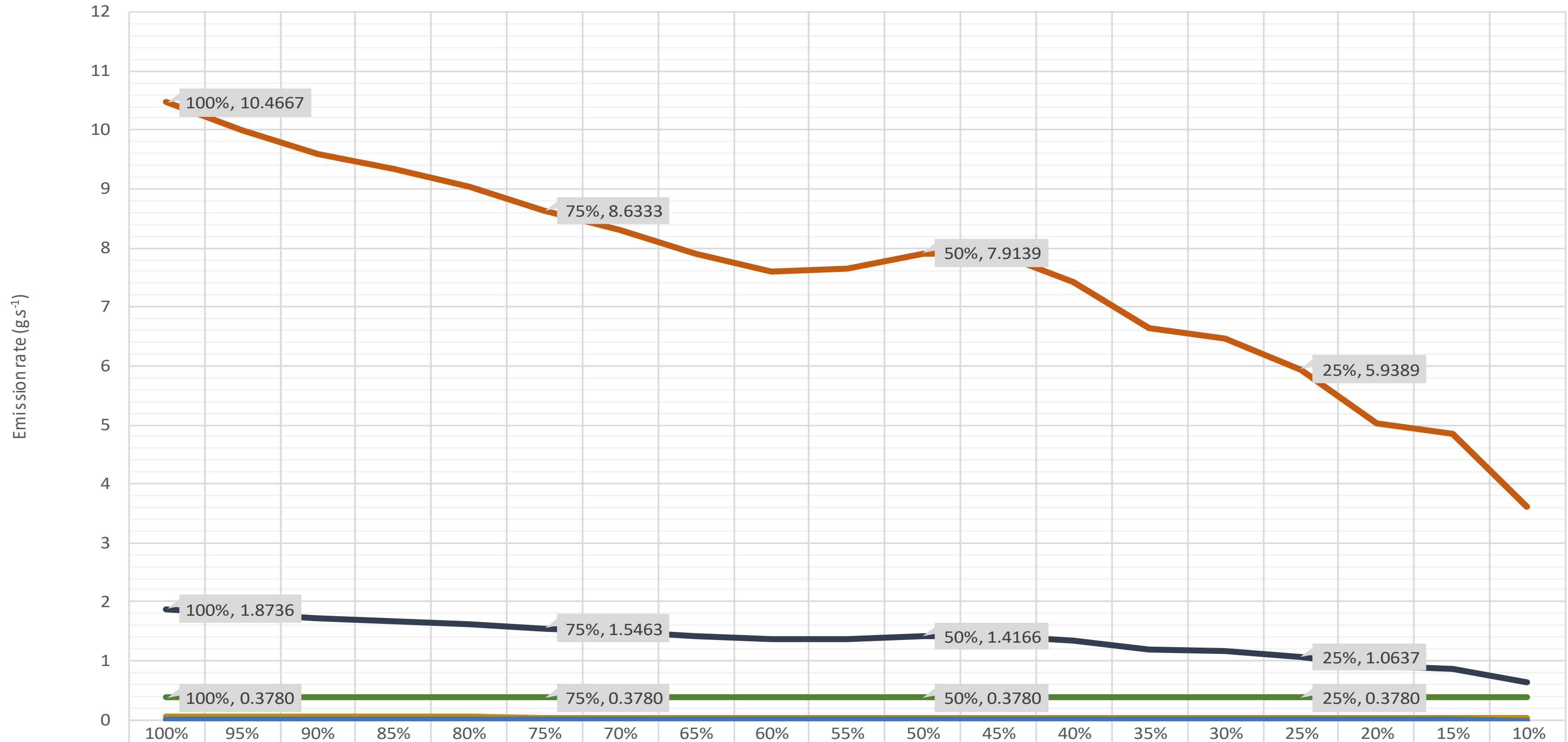
| Fuel | Units | Load (%) | | | |
|---|---|---|---|---|---|
| | | 100% | 75% | 50% | 25% |
| Stack temperature | degrees C | 399 | 413 | 437 | 423 |
| $NO_X$ (as $NO_2$) | $mg.Nm^{-3}$ ref $O_2$ | 174.3 | 174.2 | 174.3 | 174.2 |
| CO | $mg.Nm^{-3}$ ref $O_2$ | 31.2 | 31.2 | 31.2 | 31.2 |
| $NO_X$ (as $NO_2$) | $kg.h^{-1}$ | 37.68 | 31.08 | 28.49 | 21.38 |
| $SO_2$ | $kg.h^{-1}$ | 0.17 | 0.14 | 0.13 | 0.10 |
| Discharge rate | $Nm^3.hr^{-1}$ ref $O_2$ | 216179.0 | 178415.6 | 163453.8 | 122732.5 |
| Stack diameter | m | 3.50 | 3.50 | 3.50 | 3.50 |
| Velocity | $m.s^{-1}$ | 15.36 | 12.95 | 12.40 | 9.03 |
| $NO_X$ (as $NO_2$) | $g.s^{-1}$ | 10.4667 | 8.6333 | 7.9139 | 5.9389 |
| CO | $g.s^{-1}$ | 1.8736 | 1.5463 | 1.4166 | 1.0637 |
| $SO_2$ | $g.s^{-1}$ | 0.0468 | 0.0386 | 0.0361 | 0.0271 |
| $PM_{2.5}$ | $g.s^{-1}$ | 0.3780 | 0.3780 | 0.3780 | 0.3780 |

**Note:** $PM_{2.5}$ emissions are derived from a constant maximum emission rate of 3 pounds (lb) per hour. It is reasonably assumed that 100% of particulate is <1µm, and represented as $PM_{2.5}$.

**Table C-4 Estimated emission rates (formaldehyde) with load (%) on diesel**

| Fuel | Units | Load (%) | | | |
|---|---|---|---|---|---|
| | | 100% | 75% | 50% | 25% |
| Stack temperature | degrees C | 399 | 413 | 437 | 423 |
| Formaldehyde | $lb \cdot 1000\ gal^{-1}_{(fuel)}$ | 0.039 | 0.034 | 0.034 | 0.034 |
| Formaldehyde | $g \cdot kg^{-1}_{(fuel,\ 60°F)}$ | 0.005639 | 0.00491 | 0.00491 | 0.00491 |
| Fuel consumption | $kg \cdot hr^{-1}_{(fuel)}$ | 8,473 | 6,891 | 5,708 | 4,168 |
| Discharge rate | $Nm^3.hr^{-1}$ ref $O_2$ | 216179.0 | 178415.6 | 163453.8 | 122732.5 |
| Stack diameter | m | 3.50 | 3.50 | 3.50 | 3.50 |
| Velocity | $m.s^{-1}$ | 15.36 | 12.95 | 12.40 | 9.03 |
| Formaldehyde | $g.s^{-1}$ | 0.013 | 0.009 | 0.008 | 0.006 |

**Figure C-2** Estimated emission rates ($NO_X$, CO, $SO_2$, $PM_{2.5}$, $CH_2O$) with load (%) on diesel

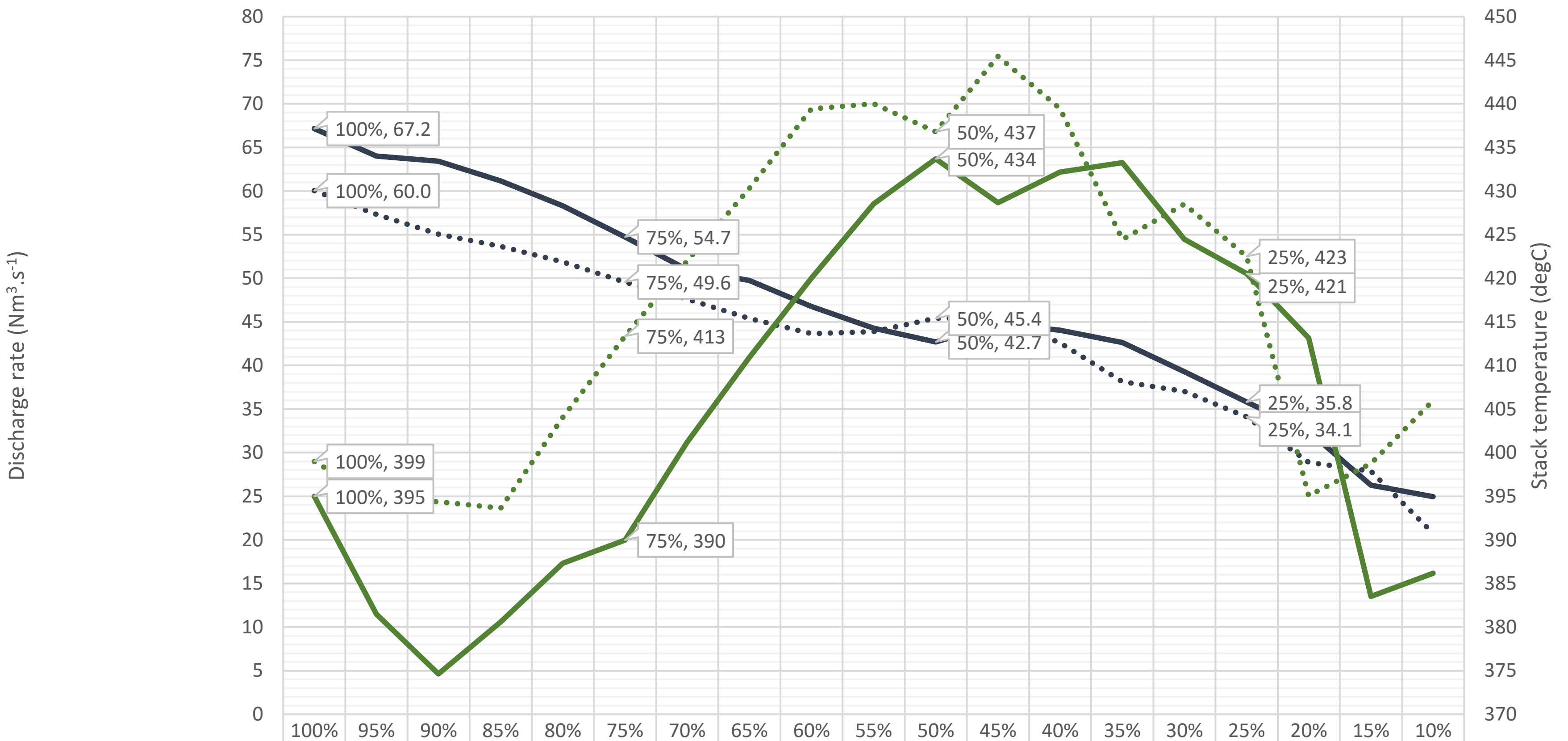



| | 100% | 95% | 90% | 85% | 80% | 75% | 70% | 65% | 60% | 55% | 50% | 45% | 40% | 35% | 30% | 25% | 20% | 15% | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NOX | 10.4667 | 9.9861 | 9.5917 | 9.3472 | 9.0361 | 8.6333 | 8.2972 | 7.9083 | 7.6083 | 7.6472 | 7.9139 | 7.9028 | 7.4278 | 6.6500 | 6.4556 | 5.9389 | 5.0333 | 4.8556 | 3.6111 |
| CO | 1.8736 | 1.7886 | 1.7179 | 1.6741 | 1.6184 | 1.5463 | 1.4861 | 1.4156 | 1.3619 | 1.3689 | 1.4166 | 1.4146 | 1.3296 | 1.1904 | 1.1556 | 1.0637 | 0.9015 | 0.8697 | 0.6451 |
| SO2 | 0.0468 | 0.0457 | 0.0433 | 0.0422 | 0.0409 | 0.0386 | 0.0376 | 0.0359 | 0.0341 | 0.0348 | 0.0361 | 0.0352 | 0.0334 | 0.0301 | 0.0292 | 0.0271 | 0.0228 | 0.0219 | 0.0167 |
| PM2.5 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 |
| CH2O | 0.013 | 0.013 | 0.012 | 0.012 | 0.010 | 0.009 | 0.009 | 0.009 | 0.008 | 0.008 | 0.008 | 0.008 | 0.007 | 0.006 | 0.006 | 0.006 | 0.005 | 0.005 | 0.004 |

Load (%)

**Source**: Northstar Air Quality

**Figure C-3** Estimated discharge rates and temperature with load (%)




| | 100% | 95% | 90% | 85% | 80% | 75% | 70% | 65% | 60% | 55% | 50% | 45% | 40% | 35% | 30% | 25% | 20% | 15% | 10% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gas: discharge rate | 67.2 | 64.0 | 63.4 | 61.1 | 58.3 | 54.7 | 51.0 | 49.8 | 46.8 | 44.3 | 42.7 | 44.8 | 44.1 | 42.6 | 39.3 | 35.8 | 32.4 | 26.3 | 25.0 |
| Diesel: Discharge rate | 60.0 | 57.3 | 55.1 | 53.7 | 51.9 | 49.6 | 47.6 | 45.4 | 43.7 | 43.9 | 45.4 | 45.3 | 42.6 | 38.2 | 37.0 | 34.1 | 28.9 | 27.9 | 20.7 |
| Gas: stack temp | 395 | 381 | 375 | 381 | 387 | 390 | 401 | 411 | 420 | 429 | 434 | 429 | 432 | 433 | 424 | 421 | 413 | 384 | 386 |
| Diesel: stack temp | 399 | 395 | 394 | 394 | 404 | 413 | 422 | 430 | 439 | 440 | 437 | 445 | 439 | 424 | 428 | 423 | 395 | 399 | 406 |

**Source**: Northstar Air Quality

# APPENDIX D

# CONSTRUCTION PHASE RISK ASSESSMENT METHODOLOGY

Provided below is a summary of the risk assessment methodology used in this assessment. It is based upon IAQM (2016) *Guidance on the assessment of dust from demolition and construction* (version 1.1), and adapted by Northstar Air Quality.

### Adaptions to the Published Methodology Made by Northstar Air Quality

The adaptions made by Northstar Air Quality from the IAQM published methodology are:

- **$PM_{10}$ criterion:** an amended criterion representing the annual average $PM_{10}$ criterion relevant to Australia rather than the UK;
- **Nomenclature:** a change in nomenclature from "receptor sensitivity" to "land use value" to avoid misinterpretation of values attributed to "receptor sensitivity" and "sensitivity of the area" which may be assessed as having different values;
- **Construction traffic:** the separation of construction vehicle movements as a discrete risk assessment profile from those associated with the 'on-site' activities of demolition, earthworks and construction. The IAQM methodology considers five risk profiles of: "demolition", "earthworks", "construction" and "trackout". The adaption by Northstar Air Quality introduces a fifth risk assessment profile of "construction traffic" to the existing four risk profiles; and,
- **Tables:** minor adjustments in the visualisation of some tables.

## Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located:

- more than 350 m from the boundary of the site;
- more than 50 m from the route used by construction vehicles on public roads; and,
- more than 500 m from the site entrance.

This step is noted as having deliberately been chosen to be conservative, and would require assessments for most developments.

## Step 2 – Risk from Construction Activities

Step 2 of the assessment provides "dust emissions magnitudes" for each of the dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles) and construction traffic.

The magnitudes are: Large; Medium; or Small, with suggested definitions for each category as follows:

**Table D-1 Dust Emission Magnitude Activities**

| Activity | Large | Medium | Small |
|---|---|---|---|
| **Demolition** | | | |
| - total building volume* | • >50,000 $m^3$ | • 20,000 $m^3$ to 50,000 $m^3$ | • <20,000 $m^3$ |
| - demolition height | • > 20m AGL | • 10 m and 20 m AGL | • <10 m AGL |
| - onsite crushing | • yes | • no | • no |
| - onsite screening | • yes | • no | • no |
| - demolition of materials with high dust potential | • yes | • yes | • no |
| - demolition timing | • any time of the year | • any time of the year | • wet months only |
| **Earthworks** | | | |
| - total area | • >10,000 $m^2$ | • 2,500 $m^2$ to 10,000 $m^2$ | • <2,500 $m^2$ |
| - soil types | • potentially dusty soil type (e.g., clay, which would be prone to suspension when dry due to small particle size | • moderately dusty soil type (e.g., silt), | • soil type with large grain size (e.g., sand |
| - heavy earth moving vehicles | • >10 heavy earth moving vehicles active at any time | • 5 to 10 heavy earth moving vehicles active at any one time | • <5 heavy earth moving vehicles active at any one time |
| - formation of bunds | • >8m AGL | • 4m to 8m AGL | • <4m AGL |
| - material moved | • >100,000 t | • 20,000 t to 100,000 t | • <20,000 t |
| - earthworks timing | • any time of the year | • any time of the year | • wet months only |
| **Construction** | | | |
| - total building volume | • 100,000 $m^3$ | • 25,000 $m^3$ to 100,000 $m^3$ | • <25,000 $m^3$ |
| - piling | • yes | • yes | • no |
| - concrete batching | • yes | • yes | • no |
| - sandblasting | • yes | • no | • no |
| - materials | • concrete | • concrete | • metal cladding or timber |
| **Trackout (within 100 m of construction site entrance)** | | | |
| - outward heavy vehicles movements per day | • >50 | • 10 to 50 | • <10 |
| - surface materials | • high potential | • moderate potential | • low potential |

| Activity | Large | Medium | Small |
|---|---|---|---|
| - unpaved road length | • >100m | • 50m to 100m | • <50m |
| **Construction Traffic (from construction site entrance to construction vehicle origin)** | | | |
| Demolition traffic<br>- total building volume | • >50,000 $m^3$ | • 20,000 $m^3$ to 50,000 $m^3$ | • <10,000 $m^3$ |
| Earthworks traffic<br>- total area | • >10,000 $m^2$ | • 2,500 $m^2$ to 10,000 $m^2$ | • <2,500 $m^2$ |
| Earthworks traffic<br>- soil types | • potentially dusty soil type (e.g., clay, which would be prone to suspension when dry due to small particle size | • moderately dusty soil type (e.g., silt), | • soil type with large grain size (e.g., sand |
| Earthworks traffic<br>- material moved | • >100,000 t | • 20,000 t to 100,000 t | • <20,000 t |
| Construction traffic<br>- total building volume | • 100,000 $m^3$ | • 25,000 $m^3$ to 100,000 $m^3$ | • <25,000 $m^3$ |
| Total traffic<br>- heavy vehicles movements per day when compared to existing heavy vehicle traffic | • >50% of heavy vehicle movement contribution by Project | • 10% to 50% of heavy vehicle movement contribution by Project | • <10% of heavy vehicle movement contribution by Project |

## Step 3 – Sensitivity of the Area

Step 3 of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified land use values have to dust deposition and human health impacts;
- The proximity and number of those receptors locations;
- In the case of $PM_{10}$, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

### Land Use Value

Individual receptor locations may be attributed different land use values based on the land use of the land, and may be classified as having high, medium or low values relative to dust deposition and human health impacts (ecological receptors are not addressed using this approach).

Essentially, land use value is a metric of the level of amenity expectations for that land use.

The IAQM method provides guidance on the land use value with regard to dust soiling and health effects and is shown in the table below. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

**Table D-2 IAQM Guidance for Categorising Land Use Value**

| Value | High Land Use Value | Medium Land Use Value | Low Land Use Value |
|---|---|---|---|
| Health effects | • Locations where the public are exposed over a time period relevant to the air quality objective for $PM_{10}$ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).<br>*Examples: Residential properties, hospitals, schools and residential care homes.* | • Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for $PM_{10}$ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).<br>*Examples: Office and shop workers, but would generally not include workers occupationally exposed to $PM_{10}$.* | • Locations where human exposure is transient.<br>*Examples: Public footpaths, playing fields, parks and shopping street.* |

| Value | High Land Use Value | Medium Land Use Value | Low Land Use Value |
|---|---|---|---|
| Dust soiling | • Users can reasonably expect a high level of amenity; or<br>• The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.<br><br>*Examples: Dwellings, museums, medium and long term car parks and car showrooms.* | • Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or<br>• The appearance, aesthetics or value of their property could be diminished by soiling; or<br>• The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.<br><br>*Examples: Parks and places of work.* | • The enjoyment of amenity would not reasonably be expected; or<br>• Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or<br>• There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.<br><br>*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.* |

### Sensitivity of the Area

The assessed land use value (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background $PM_{10}$ concentration (in the case of potential health impacts) and other site-specific factors.

Additional factors to consider when determining the sensitivity of the area include:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant, the season during which the works would take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document

## Sensitivity of the Area - Health Impacts

For high land use values, the method takes the existing background concentrations of $PM_{10}$ (as an annual average) experienced in the area of interest into account, and professional judgement may be used to determine alternative sensitivity categories, taking into account the following:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local / seasonal meteorological data;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

**Tabld D-3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects**

| Land Use Value | Annual Mean $PM_{10}$ Concentration ($\mu g \cdot m^{-3}$) | Number of Receptors[a] | Distance from the Source (m)[b] | | | | |
|---|---|---|---|---|---|---|---|
| | | | <20 | <50 | <100 | <200 | <350 |
| High | >30 | >100 | High | High | High | Medium | Low |
| | | 10-100 | High | High | Medium | Low | Low |
| | | 1-10 | High | Medium | Low | Low | Low |
| | 26 – 30 | >100 | High | High | Medium | Low | Low |
| | | 10-100 | High | Medium | Low | Low | Low |
| | | 1-10 | High | Medium | Low | Low | Low |
| | 22 – 26 | >100 | High | Medium | Low | Low | Low |
| | | 10-100 | High | Medium | Low | Low | Low |
| | | 1-10 | Medium | Low | Low | Low | Low |
| | ≤22 | >100 | Medium | Low | Low | Low | Low |
| | | 10-100 | Low | Low | Low | Low | Low |
| | | 1-10 | Low | Low | Low | Low | Low |
| Medium | - | >10 | High | Medium | Low | Low | Low |
| | - | 1-10 | Medium | Low | Low | Low | Low |
| Low | - | >1 | Low | Low | Low | Low | Low |

Note: (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m), noting that only the highest level of area sensitivity from the table needs to be considered. In the case of high sensitivity areas with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

(b) With regard to potential 'construction traffic' impacts, the distance criteria of <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

## Sensitivity of the Area - Dust Soiling

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in the table below

**Tabld D-4 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects**

| Land Use Values | Number of receptors[a] | Distance from the source (m)[b] | | | |
|---|---|---|---|---|---|
| | | <20 | <50 | <100 | <350 |
| High | >100 | High | High | Medium | Low |
| | 10-100 | High | Medium | Low | Low |
| | 1-10 | Medium | Low | Low | Low |
| Medium | >1 | Medium | Low | Low | Low |
| Low | >1 | Low | Low | Low | Low |

Note: (a) Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered.

(b) With regard to potential 'construction traffic' impacts, the distance criteria of <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

## Step 4 - Risk Assessment (Pre-Mitigation)

The matrices shown for each activity determine the risk category with no mitigation applied.

**Table D-5 Risk of dust impacts from earthworks**

| Sensitivity of Area | Pre-Mitigated Dust Emission Magnitude (**Earthworks**) | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Low Risk |
| Medium | Medium Risk | Medium Risk | Low Risk |
| Low | Low Risk | Low Risk | Negligible |

**Table D-6 Risk of dust impacts from construction activities**

| Sensitivity of Area | Pre-Mitigated Dust Emission Magnitude (**Construction**) | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Low Risk |
| Medium | Medium Risk | Medium Risk | Low Risk |
| Low | Low Risk | Low Risk | Negligible |

**Table D-7 Risk of dust impacts from demolition activities**

| Sensitivity of Area | Pre-Mitigated Dust Emission Magnitude (**Demolition**) | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Medium Risk |
| Medium | High Risk | Medium Risk | Low Risk |
| Low | Medium Risk | Low Risk | Negligible |

**Table D-8 Risk of dust impacts from trackout (within 100m of construction site entrance)**

| Sensitivity of Area | Pre-Mitigated Dust Emission Magnitude (**Trackout**) | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Low Risk |
| Medium | Medium Risk | Low Risk | Negligible |
| Low | Low Risk | Low Risk | Negligible |

**Table D-9 Risk of dust impacts from construction traffic (from construction site entrance to origin)**

| Sensitivity of Area | Pre-Mitigated Dust Emission Magnitude (**Construction Traffic**) | | |
|---|---|---|---|
| | Large | Medium | Small |
| High | High Risk | Medium Risk | Low Risk |
| Medium | Medium Risk | Low Risk | Negligible |
| Low | Low Risk | Low Risk | Negligible |

## Step 5 – Identify Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the site is a low, medium or high risk site.

The identified mitigation measures are presented as follows:

- **N** = not required (although they may be implemented voluntarily)
- **D** = desirable (to be considered as part of the CEMP, but may be discounted if justification is provided);
- **H** = highly recommended (to be implemented as part of the CEMP, and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

The table below presents the complete mitigation table, not that assessed as required for any specific project or activity:

**Table D-10 Construction dust mitigation requirements (by risk)**

| Identified Mitigation | | Unmitigated Risk | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| 1 | Communications | | | |
| 1.1 | Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. | N | H | H |
| 1.1 | Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. | H | H | H |
| 1.2 | Display the head or regional office contact information. | H | H | H |
| 1.3 | Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies. | D | H | H |
| 2 | Site Management | | | |
| 2.1 | Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. | H | H | H |
| 2.2 | Make the complaints log available to the local authority when asked. | H | H | H |
| 2.3 | Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book. | H | H | H |
| 2.4 | Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes. | N | N | H |

| Identified Mitigation | | Unmitigated Risk | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| 3 | Monitoring | | | |
| 3.1 | Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary. | D | D | H |
| 3.2 | Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local authority when asked. | H | H | H |
| 3.3 | Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. | H | H | H |
| 3.4 | Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. | N | H | H |
| 4 | Preparing and Maintaining the Site | | | |
| 4.1 | Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. | H | H | H |
| 4.2 | Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site. | H | H | H |
| 4.3 | Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period. | D | H | H |
| 4.4 | Avoid site runoff of water or mud. | H | H | H |
| 4.5 | Keep site fencing, barriers and scaffolding clean using wet methods. | D | H | H |
| 4.6 | Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below | D | H | H |
| 4.7 | Cover, seed or fence stockpiles to prevent wind erosion | D | H | H |
| 5 | Operating Vehicle/Machinery and Sustainable Travel | | | |
| 5.1 | Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable | H | H | H |
| 5.2 | Ensure all vehicles switch off engines when stationary - no idling vehicles | H | H | H |
| 5.3 | Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable | H | H | H |

| Identified Mitigation | | Unmitigated Risk | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| 5.4 | Impose and signpost a maximum-speed-limit of 25 km·h$^{-1}$ on surfaced and 15 km·h$^{-1}$ on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate | D | D | H |
| 5.4 | Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials. | N | H | H |
| 5.5 | Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing) | N | D | H |
| 6 | Operations | | | |
| 6.1 | Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems | H | H | H |
| 6.2 | Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate | H | H | H |
| 6.3 | Use enclosed chutes and conveyors and covered skips | H | H | H |
| 6.4 | Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate | H | H | H |
| 6.5 | Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods. | D | H | H |
| 7 | Waste Management | | | |
| 7.1 | Avoid bonfires and burning of waste materials. | H | H | H |
| 8 | Measures Specific to Demolition | | | |
| 8.1 | Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust). | D | D | H |
| 8.2 | Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground. | H | H | H |
| 8.3 | Avoid explosive blasting, using appropriate manual or mechanical alternatives. | H | H | H |
| 8.4 | Bag and remove any biological debris or damp down such material before demolition. | H | H | H |

| Identified Mitigation | | Unmitigated Risk | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| 8.5 | Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable. | N | D | H |
| 8.6 | Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. | N | D | H |
| 8.7 | Only remove the cover in small areas during work and not all at once | N | D | H |
| 9 | Measures Specific to Construction | | | |
| 8.1 | Avoid scabbling (roughening of concrete surfaces) if possible | D | D | H |
| 8.2 | Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place | D | H | H |
| 8.3 | Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. | N | D | H |
| 8.4 | For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust | N | D | D |
| 10 | Measures Specific to Track-Out | | | |
| 10.1 | Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site. | D | H | H |
| 10.2 | Avoid dry sweeping of large areas. | D | H | H |
| 10.3 | Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. | D | H | H |
| 10.4 | Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. | H | H | H |
| 10.5 | Record all inspections of haul routes and any subsequent action in a site log book. | D | H | H |
| 10.6 | Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned. | N | H | H |
| 10.7 | Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). | D | H | H |
| 10.8 | Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits. | N | H | H |
| 10.9 | Access gates to be located at least 10 m from receptors where possible. | N | H | H |
| 11 | Specific Measures to Construction Traffic (adapted) | | | |
| 5.1 | Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable | H | H | H |

| Identified Mitigation | | Unmitigated Risk | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| 8.3 | Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. | N | D | H |
| 10.3 | Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. | D | H | H |
| 10.4 | Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. | H | H | H |
| 10.5 | Record all inspections of haul routes and any subsequent action in a site log book. | D | H | H |

## Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

The objective of the mitigation is to manage the construction phase risks to an acceptable level, and therefore it is assumed that application of the identified mitigation would result in a *low* or *negligible* residual risk (post mitigation).

# APPENDIX E

# DISPERSION MODELLING RESULTS

## Tabulated Results – Ground Level Concentration Values

The predicted ground level concentration (GLC) results of the dispersion modelling are presented in the following tables:

### Six turbines operating on gas

- Table E-1 Predicted incremental impact, CO, gas
- Table E-2 Predicted incremental impact, $NO_2$, gas
- Table E-3 Predicted incremental impact, $PM_{2.5}$, gas
- Table E-4 Predicted incremental impact, $SO_2$, gas
- Table E-5 Predicted incremental impact, formaldehyde, gas

### Six turbines operating on diesel

- Table E-6 Predicted incremental impact, CO, diesel
- Table E-7 Predicted incremental impact, $NO_2$, diesel
- Table E-8 Predicted incremental impact, $PM_{10}$ / $PM_{2.5}$, diesel
- Table E-9 Predicted incremental impact, $SO_2$, diesel
- Table E-10 Predicted incremental impact, formaldehyde, diesel

## Isopleth Plots – Selected Ground Level Concentration Values

The isopleth plots of predicted ground level concentrations (GLC) are presented in a series of figures. Not all results have been presented as plots, due to the large number that would need to be generated to cover off all the predictions (96 plots). For each pollutant, the respective maximum prediction for each fuel and operating load have generally been plotted however due to the low-order of impacts, some pollutants (e.g. CO) and some averaging periods (e.g. annual average $NO_X$) have not been presented.

Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values. This has been necessary to illustrate the predicted concentration values on a scale with the relevant Air EPP criterion.

### Six turbines operating on gas

- Figure E-1 Predicted incremental impact, CO, 1-hour, gas
- Figure E-2 Predicted incremental impact, CO, 8-hour, gas
- Figure E-3 Predicted incremental impact, $NO_X$ as $NO_2$, 1-hour, gas
- Figure E-4 Predicted incremental impact, $NO_X$ as $NO_2$, annual average
- Figure E-5 Predicted incremental impact, $PM_{10}$, 24-hour, gas

**Six turbines operating on diesel**

**Table E-1 Predicted incremental impact, CO, gas**

| Load | CO, 100% load, gas | | CO, 75% load, gas | | CO, 50% load, gas | | CO, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour |
| R1 | 27.84 | 7.35 | 32.18 | 6.55 | 24.39 | 5.66 | 17.19 | 4.95 |
| R2 | 29.12 | 6.58 | 31.30 | 5.94 | 22.44 | 5.16 | 17.83 | 4.26 |
| R3 | 21.82 | 4.61 | 21.71 | 3.87 | 15.70 | 3.16 | 11.60 | 2.54 |
| R4 | 27.35 | 5.69 | 22.06 | 4.13 | 16.76 | 3.36 | 10.35 | 2.88 |
| R5 | 26.70 | 5.60 | 21.90 | 4.02 | 16.00 | 3.24 | 10.24 | 2.78 |
| R6 | 21.58 | 4.89 | 17.61 | 4.30 | 11.55 | 3.73 | 10.82 | 2.79 |
| R7 | 18.48 | 3.80 | 13.98 | 3.71 | 11.22 | 3.37 | 10.14 | 2.86 |
| R8 | 23.96 | 3.45 | 17.04 | 3.51 | 13.75 | 3.15 | 12.09 | 3.14 |
| R9 | 31.71 | 5.91 | 26.55 | 6.00 | 22.66 | 5.66 | 21.01 | 5.00 |
| R10 | 20.97 | 4.99 | 15.84 | 4.77 | 13.36 | 4.37 | 17.77 | 4.57 |
| R11 | 20.31 | 4.63 | 16.68 | 4.41 | 15.11 | 4.12 | 17.43 | 4.85 |
| R12 | 19.23 | 5.35 | 14.02 | 6.18 | 17.45 | 5.97 | 14.76 | 6.59 |
| R13 | 15.21 | 6.34 | 16.14 | 6.63 | 16.36 | 6.01 | 10.75 | 6.12 |
| R14 | 15.60 | 4.88 | 14.72 | 5.17 | 15.52 | 4.73 | 13.83 | 4.88 |
| R15 | 19.19 | 3.45 | 17.30 | 3.41 | 13.37 | 2.94 | 15.79 | 2.79 |
| R16 | 19.38 | 3.71 | 16.85 | 3.76 | 12.64 | 3.29 | 15.97 | 3.17 |
| R17 | 22.20 | 4.18 | 17.93 | 3.55 | 14.30 | 3.14 | 13.14 | 3.08 |
| R18 | 37.47 | 5.51 | 32.09 | 4.93 | 25.81 | 3.87 | 22.64 | 3.46 |

| Load | CO, 100% load, gas | | CO, 75% load, gas | | CO, 50% load, gas | | CO, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour |
| R19 | 17.83 | 3.38 | 13.84 | 2.98 | 9.48 | 2.54 | 12.82 | 2.47 |
| R20 | 26.67 | 4.89 | 21.66 | 4.20 | 17.24 | 3.42 | 15.52 | 3.07 |
| R21 | 13.68 | 6.94 | 11.57 | 6.98 | 9.18 | 6.23 | 7.83 | 6.05 |
| R22 | 7.85 | 4.74 | 11.44 | 4.44 | 6.26 | 3.74 | 5.60 | 3.49 |
| R23 | 11.28 | 3.53 | 7.40 | 3.08 | 8.30 | 2.55 | 5.59 | 2.19 |
| R24 | 11.04 | 1.82 | 8.03 | 2.08 | 8.25 | 1.85 | 5.93 | 1.75 |
| R25 | 8.09 | 4.45 | 6.65 | 3.02 | 4.90 | 2.67 | 4.80 | 2.61 |
| R26 | 7.75 | 4.39 | 6.77 | 2.61 | 5.04 | 2.21 | 5.26 | 2.30 |
| R27 | 12.70 | 1.84 | 6.18 | 3.15 | 5.07 | 2.01 | 4.26 | 1.95 |
| R28 | 5.45 | 2.62 | 5.61 | 2.59 | 3.80 | 2.24 | 4.60 | 2.16 |
| R29 | 7.05 | 2.01 | 6.27 | 1.72 | 4.92 | 1.43 | 4.05 | 1.31 |
| R30 | 20.57 | 6.51 | 17.08 | 5.55 | 12.92 | 4.42 | 11.83 | 4.16 |
| R31 | 10.25 | 2.91 | 7.77 | 2.55 | 5.61 | 2.07 | 5.52 | 1.86 |
| R32 | 6.58 | 2.69 | 5.61 | 2.07 | 4.55 | 1.85 | 3.81 | 1.86 |
| R33 | 12.76 | 3.34 | 9.36 | 3.15 | 8.40 | 2.82 | 5.98 | 2.79 |
| R34 | 23.93 | 13.19 | 20.19 | 14.80 | 17.77 | 14.12 | 16.95 | 14.65 |
| R35 | 8.43 | 2.47 | 7.45 | 2.60 | 7.14 | 2.48 | 6.68 | 2.78 |
| R36 | 6.89 | 2.15 | 6.47 | 2.46 | 9.37 | 2.35 | 5.40 | 2.62 |
| R37 | 15.06 | 4.72 | 12.55 | 4.05 | 13.79 | 3.38 | 10.47 | 3.40 |

| Load | CO, 100% load, gas | | CO, 75% load, gas | | CO, 50% load, gas | | CO, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour |
| R38 | 9.84 | 4.25 | 8.55 | 4.07 | 7.47 | 3.46 | 7.34 | 3.25 |
| R39 | 7.20 | 2.90 | 7.61 | 2.69 | 6.87 | 2.27 | 6.87 | 2.26 |
| R40 | 7.33 | 1.50 | 8.19 | 1.71 | 7.19 | 1.50 | 10.74 | 1.80 |
| R41 | 18.78 | 3.10 | 8.82 | 2.34 | 6.95 | 2.17 | 6.16 | 1.85 |
| R42 | 11.83 | 2.43 | 11.24 | 2.36 | 11.29 | 1.92 | 12.42 | 1.92 |
| R43 | 12.27 | 2.68 | 13.17 | 2.26 | 12.77 | 2.00 | 14.29 | 1.80 |
| R44 | 15.73 | 2.42 | 15.74 | 2.47 | 15.70 | 1.99 | 13.57 | 1.74 |
| R45 | 16.79 | 2.25 | 18.19 | 2.42 | 14.75 | 1.89 | 10.88 | 1.68 |
| R46 | 22.40 | 3.72 | 11.75 | 2.26 | 7.76 | 2.02 | 6.91 | 1.98 |
| R47 | 10.44 | 2.46 | 8.94 | 2.61 | 13.28 | 2.29 | 8.49 | 2.47 |
| R48 | 10.43 | 2.43 | 8.93 | 3.08 | 8.27 | 2.67 | 9.95 | 2.16 |
| R49 | 17.61 | 5.20 | 16.69 | 4.18 | 14.93 | 3.90 | 14.35 | 3.69 |
| R50 | 18.25 | 7.13 | 16.28 | 7.98 | 14.90 | 7.55 | 14.51 | 7.89 |
| R51 | 23.25 | 3.58 | 25.71 | 4.79 | 24.95 | 4.46 | 24.76 | 4.14 |
| Max (µg·m$^{-3}$) | 37.47 | 13.19 | 32.18 | 14.80 | 25.81 | 14.12 | 24.76 | 14.65 |
| Criterion(A) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) |
| Plotted | No | No | No | No | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context. (B) Exceedence of the criterion is indicated by red highlighting

**Table E-2 Predicted incremental impact, NO2, gas**

| Load | $NO_X$ (as $NO_2$), 100% load, gas | | $NO_X$ (as $NO_2$), 75% load, gas | | $NO_X$ (as $NO_2$), 50% load, gas | | $NO_X$ (as $NO_2$), 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual |
| R1 | 45.68 | 0.33 | 52.81 | 0.32 | 40.03 | 0.27 | 28.21 | 0.26 |
| R2 | 47.79 | 0.30 | 51.37 | 0.28 | 36.82 | 0.24 | 29.25 | 0.23 |
| R3 | 35.81 | 0.17 | 35.62 | 0.16 | 25.76 | 0.14 | 19.04 | 0.13 |
| R4 | 44.88 | 0.16 | 36.20 | 0.14 | 27.50 | 0.12 | 16.99 | 0.11 |
| R5 | 43.81 | 0.15 | 35.94 | 0.14 | 26.26 | 0.12 | 16.80 | 0.11 |
| R6 | 35.42 | 0.19 | 28.91 | 0.18 | 18.96 | 0.15 | 17.75 | 0.14 |
| R7 | 30.33 | 0.24 | 22.94 | 0.22 | 18.42 | 0.19 | 16.64 | 0.18 |
| R8 | 39.32 | 0.29 | 27.96 | 0.27 | 22.56 | 0.23 | 19.85 | 0.22 |
| R9 | 52.04 | 0.53 | 43.57 | 0.50 | 37.19 | 0.43 | 34.47 | 0.41 |
| R10 | 34.41 | 0.32 | 25.99 | 0.30 | 21.92 | 0.26 | 29.16 | 0.26 |
| R11 | 33.34 | 0.27 | 27.37 | 0.26 | 24.80 | 0.22 | 28.60 | 0.22 |
| R12 | 31.56 | 0.24 | 23.01 | 0.23 | 28.63 | 0.20 | 24.23 | 0.21 |
| R13 | 24.96 | 0.21 | 26.49 | 0.20 | 26.84 | 0.18 | 17.64 | 0.18 |
| R14 | 25.60 | 0.20 | 24.15 | 0.20 | 25.46 | 0.17 | 22.70 | 0.17 |
| R15 | 31.49 | 0.23 | 28.39 | 0.21 | 21.93 | 0.18 | 25.92 | 0.18 |
| R16 | 31.81 | 0.25 | 27.66 | 0.23 | 20.74 | 0.20 | 26.21 | 0.19 |
| R17 | 36.43 | 0.28 | 29.42 | 0.26 | 23.46 | 0.22 | 21.56 | 0.21 |
| R18 | 61.49 | 0.41 | 52.67 | 0.39 | 42.35 | 0.33 | 37.15 | 0.32 |
| R19 | 29.27 | 0.22 | 22.72 | 0.21 | 15.56 | 0.17 | 21.04 | 0.17 |

| Load | $NO_X$ (as $NO_2$), 100% load, gas | | $NO_X$ (as $NO_2$), 75% load, gas | | $NO_X$ (as $NO_2$), 50% load, gas | | $NO_X$ (as $NO_2$), 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual |
| R20 | 43.76 | 0.24 | 35.55 | 0.22 | 28.29 | 0.19 | 25.47 | 0.18 |
| R21 | 22.44 | 0.26 | 18.98 | 0.26 | 15.07 | 0.23 | 12.86 | 0.23 |
| R22 | 12.88 | 0.19 | 18.77 | 0.18 | 10.28 | 0.16 | 9.20 | 0.15 |
| R23 | 18.51 | 0.14 | 12.15 | 0.13 | 13.62 | 0.11 | 9.18 | 0.11 |
| R24 | 18.12 | 0.15 | 13.17 | 0.14 | 13.54 | 0.12 | 9.74 | 0.11 |
| R25 | 13.28 | 0.12 | 10.91 | 0.11 | 8.03 | 0.09 | 7.87 | 0.09 |
| R26 | 12.72 | 0.12 | 11.11 | 0.11 | 8.28 | 0.09 | 8.63 | 0.08 |
| R27 | 20.85 | 0.11 | 10.14 | 0.10 | 8.32 | 0.09 | 7.00 | 0.08 |
| R28 | 8.94 | 0.14 | 9.20 | 0.13 | 6.24 | 0.11 | 7.55 | 0.11 |
| R29 | 11.57 | 0.14 | 10.28 | 0.13 | 8.07 | 0.11 | 6.65 | 0.10 |
| R30 | 33.76 | 0.23 | 28.03 | 0.21 | 21.21 | 0.18 | 19.42 | 0.18 |
| R31 | 16.82 | 0.15 | 12.76 | 0.14 | 9.20 | 0.12 | 9.05 | 0.11 |
| R32 | 10.80 | 0.14 | 9.21 | 0.13 | 7.46 | 0.11 | 6.25 | 0.10 |
| R33 | 20.95 | 0.17 | 15.36 | 0.15 | 13.79 | 0.13 | 9.81 | 0.12 |
| R34 | 39.26 | 0.36 | 33.13 | 0.37 | 29.16 | 0.33 | 27.81 | 0.35 |
| R35 | 13.83 | 0.16 | 12.23 | 0.16 | 11.71 | 0.14 | 10.96 | 0.15 |
| R36 | 11.31 | 0.16 | 10.62 | 0.16 | 15.38 | 0.15 | 8.86 | 0.15 |
| R37 | 24.71 | 0.25 | 20.60 | 0.24 | 22.63 | 0.20 | 17.17 | 0.19 |
| R38 | 16.15 | 0.18 | 14.03 | 0.18 | 12.26 | 0.16 | 12.04 | 0.16 |

| Load | $NO_X$ (as $NO_2$), 100% load, gas | | $NO_X$ (as $NO_2$), 75% load, gas | | $NO_X$ (as $NO_2$), 50% load, gas | | $NO_X$ (as $NO_2$), 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual |
| R39 | 11.81 | 0.18 | 12.49 | 0.17 | 11.28 | 0.15 | 11.27 | 0.15 |
| R40 | 12.03 | 0.13 | 13.45 | 0.13 | 11.80 | 0.12 | 17.63 | 0.12 |
| R41 | 30.83 | 0.13 | 14.47 | 0.12 | 11.40 | 0.10 | 10.11 | 0.10 |
| R42 | 19.41 | 0.12 | 18.44 | 0.11 | 18.52 | 0.10 | 20.38 | 0.09 |
| R43 | 20.14 | 0.12 | 21.61 | 0.11 | 20.95 | 0.09 | 23.45 | 0.09 |
| R44 | 25.81 | 0.12 | 25.83 | 0.11 | 25.76 | 0.09 | 22.27 | 0.09 |
| R45 | 27.56 | 0.12 | 29.86 | 0.11 | 24.21 | 0.09 | 17.85 | 0.08 |
| R46 | 36.76 | 0.14 | 19.29 | 0.13 | 12.73 | 0.11 | 11.33 | 0.11 |
| R47 | 17.13 | 0.15 | 14.67 | 0.14 | 21.80 | 0.13 | 13.93 | 0.13 |
| R48 | 17.11 | 0.12 | 14.65 | 0.11 | 13.56 | 0.10 | 16.34 | 0.09 |
| R49 | 28.91 | 0.24 | 27.38 | 0.23 | 24.49 | 0.19 | 23.55 | 0.18 |
| R50 | 29.95 | 0.29 | 26.71 | 0.30 | 24.45 | 0.28 | 23.82 | 0.30 |
| R51 | 38.15 | 0.22 | 42.20 | 0.21 | 40.94 | 0.18 | 40.64 | 0.17 |
| Max ($\mu g \cdot m^{-3}$) | 61.49 | 0.53 | 52.81 | 0.50 | 42.35 | 0.43 | 40.64 | 0.41 |
| Criterion[(A)] | 250 $\mu g \cdot m^{-3}$ (0.25 $mg \cdot m^{-3}$) | 60 $\mu g \cdot m^{-3}$ (0.06 $mg \cdot m^{-3}$) | 250 $\mu g \cdot m^{-3}$ (0.25 $mg \cdot m^{-3}$) | 60 $\mu g \cdot m^{-3}$ (0.06 $mg \cdot m^{-3}$) | 250 $\mu g \cdot m^{-3}$ (0.25 $mg \cdot m^{-3}$) | 60 $\mu g \cdot m^{-3}$ (0.06 $mg \cdot m^{-3}$) | 250 $\mu g \cdot m^{-3}$ (0.25 $mg \cdot m^{-3}$) | 60 $\mu g \cdot m^{-3}$ (0.06 $mg \cdot m^{-3}$) |
| Plotted | Yes | Yes | No | No | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context. (B) Exceedence of the criterion is indicated by red highlighting (C) Assumes a 100% $NO_X$ to $NO_2$ conversion

**Table E-3 Predicted incremental impact, PM10 / PM2.5, gas**

| Load | PM, 100% load, gas | | PM, 75% load, gas | | PM, 50% load, gas | | PM, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual |
| R1 | 0.44 | 0.04 | 0.57 | 0.04 | 0.65 | 0.05 | 0.64 | 0.05 |
| R2 | 0.40 | 0.03 | 0.54 | 0.04 | 0.59 | 0.04 | 0.54 | 0.05 |
| R3 | 0.28 | 0.02 | 0.31 | 0.02 | 0.34 | 0.02 | 0.30 | 0.03 |
| R4 | 0.34 | 0.02 | 0.31 | 0.02 | 0.32 | 0.02 | 0.33 | 0.02 |
| R5 | 0.34 | 0.02 | 0.30 | 0.02 | 0.31 | 0.02 | 0.31 | 0.02 |
| R6 | 0.30 | 0.02 | 0.32 | 0.02 | 0.35 | 0.03 | 0.32 | 0.03 |
| R7 | 0.27 | 0.03 | 0.29 | 0.03 | 0.32 | 0.03 | 0.33 | 0.04 |
| R8 | 0.33 | 0.03 | 0.38 | 0.04 | 0.40 | 0.04 | 0.44 | 0.04 |
| R9 | 0.57 | 0.06 | 0.62 | 0.07 | 0.65 | 0.07 | 0.77 | 0.08 |
| R10 | 0.38 | 0.03 | 0.42 | 0.04 | 0.45 | 0.04 | 0.52 | 0.05 |
| R11 | 0.32 | 0.03 | 0.34 | 0.04 | 0.40 | 0.04 | 0.56 | 0.05 |
| R12 | 0.33 | 0.03 | 0.47 | 0.03 | 0.58 | 0.04 | 0.76 | 0.04 |
| R13 | 0.40 | 0.02 | 0.51 | 0.03 | 0.59 | 0.03 | 0.72 | 0.04 |
| R14 | 0.30 | 0.02 | 0.39 | 0.03 | 0.45 | 0.03 | 0.56 | 0.04 |
| R15 | 0.28 | 0.02 | 0.28 | 0.03 | 0.30 | 0.03 | 0.38 | 0.04 |
| R16 | 0.28 | 0.03 | 0.32 | 0.03 | 0.32 | 0.03 | 0.37 | 0.04 |
| R17 | 0.34 | 0.03 | 0.38 | 0.04 | 0.40 | 0.04 | 0.44 | 0.04 |
| R18 | 0.49 | 0.05 | 0.54 | 0.05 | 0.57 | 0.06 | 0.61 | 0.07 |
| R19 | 0.26 | 0.02 | 0.31 | 0.03 | 0.34 | 0.03 | 0.48 | 0.04 |

| Load | PM, 100% load, gas | | PM, 75% load, gas | | PM, 50% load, gas | | PM, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual |
| R20 | 0.38 | 0.03 | 0.40 | 0.03 | 0.42 | 0.03 | 0.51 | 0.04 |
| R21 | 0.63 | 0.03 | 0.80 | 0.03 | 0.96 | 0.04 | 1.23 | 0.05 |
| R22 | 0.54 | 0.02 | 0.66 | 0.02 | 0.74 | 0.03 | 0.86 | 0.03 |
| R23 | 0.22 | 0.02 | 0.23 | 0.02 | 0.25 | 0.02 | 0.27 | 0.02 |
| R24 | 0.17 | 0.02 | 0.21 | 0.02 | 0.25 | 0.02 | 0.29 | 0.02 |
| R25 | 0.34 | 0.01 | 0.42 | 0.01 | 0.47 | 0.02 | 0.54 | 0.02 |
| R26 | 0.38 | 0.01 | 0.44 | 0.01 | 0.47 | 0.02 | 0.55 | 0.02 |
| R27 | 0.23 | 0.01 | 0.28 | 0.01 | 0.34 | 0.01 | 0.43 | 0.02 |
| R28 | 0.34 | 0.02 | 0.42 | 0.02 | 0.46 | 0.02 | 0.53 | 0.02 |
| R29 | 0.32 | 0.02 | 0.35 | 0.02 | 0.37 | 0.02 | 0.41 | 0.02 |
| R30 | 0.61 | 0.02 | 0.68 | 0.03 | 0.72 | 0.03 | 0.78 | 0.04 |
| R31 | 0.26 | 0.02 | 0.27 | 0.02 | 0.29 | 0.02 | 0.35 | 0.02 |
| R32 | 0.24 | 0.02 | 0.25 | 0.02 | 0.24 | 0.02 | 0.24 | 0.02 |
| R33 | 0.30 | 0.02 | 0.29 | 0.02 | 0.33 | 0.02 | 0.38 | 0.03 |
| R34 | 0.81 | 0.04 | 1.12 | 0.05 | 1.37 | 0.06 | 1.73 | 0.07 |
| R35 | 0.28 | 0.02 | 0.39 | 0.02 | 0.48 | 0.02 | 0.64 | 0.03 |
| R36 | 0.28 | 0.02 | 0.38 | 0.02 | 0.45 | 0.03 | 0.56 | 0.03 |
| R37 | 0.46 | 0.03 | 0.55 | 0.03 | 0.62 | 0.04 | 0.74 | 0.04 |
| R38 | 0.51 | 0.02 | 0.61 | 0.02 | 0.66 | 0.03 | 0.75 | 0.03 |

| Load | PM, 100% load, gas | | PM, 75% load, gas | | PM, 50% load, gas | | PM, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | $\mu g \cdot m^{-3}$ 24-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 24-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 24-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 24-hour | $\mu g \cdot m^{-3}$ annual |
| R39 | 0.29 | 0.02 | 0.34 | 0.02 | 0.39 | 0.03 | 0.45 | 0.03 |
| R40 | 0.16 | 0.01 | 0.23 | 0.02 | 0.29 | 0.02 | 0.40 | 0.02 |
| R41 | 0.23 | 0.01 | 0.27 | 0.02 | 0.31 | 0.02 | 0.36 | 0.02 |
| R42 | 0.17 | 0.01 | 0.20 | 0.02 | 0.20 | 0.02 | 0.28 | 0.02 |
| R43 | 0.18 | 0.01 | 0.19 | 0.02 | 0.21 | 0.02 | 0.31 | 0.02 |
| R44 | 0.16 | 0.01 | 0.20 | 0.01 | 0.24 | 0.02 | 0.30 | 0.02 |
| R45 | 0.15 | 0.01 | 0.20 | 0.01 | 0.24 | 0.02 | 0.25 | 0.02 |
| R46 | 0.26 | 0.02 | 0.28 | 0.02 | 0.32 | 0.02 | 0.38 | 0.02 |
| R47 | 0.20 | 0.02 | 0.23 | 0.02 | 0.27 | 0.02 | 0.39 | 0.03 |
| R48 | 0.16 | 0.01 | 0.23 | 0.02 | 0.26 | 0.02 | 0.25 | 0.02 |
| R49 | 0.35 | 0.03 | 0.39 | 0.03 | 0.42 | 0.03 | 0.47 | 0.04 |
| R50 | 0.45 | 0.03 | 0.74 | 0.04 | 1.15 | 0.05 | 1.98 | 0.06 |
| R51 | 0.31 | 0.02 | 0.42 | 0.03 | 0.49 | 0.03 | 0.54 | 0.04 |
| Max ($\mu g \cdot m^{-3}$) | 0.81 | 0.06 | 1.12 | 0.07 | 1.37 | 0.07 | 1.98 | 0.08 |
| Criterion (B) | 25 $\mu g \cdot m^{-3}$ (0.025 $mg \cdot m^{-3}$) | 8 $\mu g \cdot m^{-3}$ (0.008 $mg \cdot m^{-3}$) | 25 $\mu g \cdot m^{-3}$ (0.025 $mg \cdot m^{-3}$) | 8 $\mu g \cdot m^{-3}$ (0.008 $mg \cdot m^{-3}$) | 25 $\mu g \cdot m^{-3}$ (0.025 $mg \cdot m^{-3}$) | 8 $\mu g \cdot m^{-3}$ (0.008 $mg \cdot m^{-3}$) | 25 $\mu g \cdot m^{-3}$ (0.025 $mg \cdot m^{-3}$) | 8 $\mu g \cdot m^{-3}$ (0.008 $mg \cdot m^{-3}$) |
| Plotted | No | No | No | No | No | No | Yes | Yes |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context. (B) Exceedence of the criterion is indicated by red highlighting

**Table E-4 Predicted incremental impact, $SO_2$, gas**

| Load | $SO_2$, 100% load, gas | | | $SO_2$, 75% load, gas | | | $SO_2$, 50% load, gas | | | $SO_2$, 25% load, gas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann |
| R1 | 7.30 | 0.65 | 0.05 | 8.46 | 0.68 | 0.05 | 6.45 | 0.61 | 0.04 | 4.52 | 0.49 | 0.04 |
| R2 | 7.64 | 0.58 | 0.05 | 8.23 | 0.64 | 0.05 | 5.94 | 0.55 | 0.04 | 4.68 | 0.42 | 0.04 |
| R3 | 5.72 | 0.41 | 0.03 | 5.70 | 0.37 | 0.03 | 4.15 | 0.32 | 0.02 | 3.05 | 0.23 | 0.02 |
| R4 | 7.17 | 0.50 | 0.02 | 5.80 | 0.36 | 0.02 | 4.43 | 0.30 | 0.02 | 2.72 | 0.25 | 0.02 |
| R5 | 7.00 | 0.49 | 0.02 | 5.75 | 0.35 | 0.02 | 4.23 | 0.29 | 0.02 | 2.69 | 0.24 | 0.02 |
| R6 | 5.66 | 0.43 | 0.03 | 4.63 | 0.38 | 0.03 | 3.06 | 0.33 | 0.02 | 2.84 | 0.25 | 0.02 |
| R7 | 4.85 | 0.40 | 0.04 | 3.67 | 0.34 | 0.04 | 2.97 | 0.30 | 0.03 | 2.66 | 0.26 | 0.03 |
| R8 | 6.28 | 0.48 | 0.05 | 4.48 | 0.45 | 0.04 | 3.64 | 0.37 | 0.04 | 3.18 | 0.34 | 0.03 |
| R9 | 8.32 | 0.83 | 0.08 | 6.98 | 0.74 | 0.08 | 5.99 | 0.60 | 0.07 | 5.52 | 0.60 | 0.07 |
| R10 | 5.50 | 0.55 | 0.05 | 4.16 | 0.50 | 0.05 | 3.53 | 0.42 | 0.04 | 4.67 | 0.40 | 0.04 |
| R11 | 5.33 | 0.46 | 0.04 | 4.38 | 0.41 | 0.04 | 4.00 | 0.37 | 0.04 | 4.58 | 0.43 | 0.04 |
| R12 | 5.04 | 0.48 | 0.04 | 3.68 | 0.56 | 0.04 | 4.62 | 0.54 | 0.03 | 3.88 | 0.59 | 0.03 |
| R13 | 3.99 | 0.57 | 0.03 | 4.24 | 0.60 | 0.03 | 4.33 | 0.55 | 0.03 | 2.82 | 0.56 | 0.03 |
| R14 | 4.09 | 0.43 | 0.03 | 3.87 | 0.46 | 0.03 | 4.10 | 0.42 | 0.03 | 3.63 | 0.43 | 0.03 |
| R15 | 5.03 | 0.40 | 0.04 | 4.55 | 0.33 | 0.03 | 3.54 | 0.28 | 0.03 | 4.15 | 0.29 | 0.03 |
| R16 | 5.08 | 0.41 | 0.04 | 4.43 | 0.38 | 0.04 | 3.34 | 0.30 | 0.03 | 4.20 | 0.29 | 0.03 |
| R17 | 5.82 | 0.49 | 0.04 | 4.71 | 0.46 | 0.04 | 3.78 | 0.37 | 0.04 | 3.45 | 0.34 | 0.03 |
| R18 | 9.83 | 0.71 | 0.07 | 8.43 | 0.64 | 0.06 | 6.83 | 0.53 | 0.05 | 5.95 | 0.47 | 0.05 |
| R19 | 4.68 | 0.38 | 0.04 | 3.64 | 0.37 | 0.03 | 2.51 | 0.32 | 0.03 | 3.37 | 0.37 | 0.03 |

| Load | $SO_2$, 100% load, gas | | | $SO_2$, 75% load, gas | | | $SO_2$, 50% load, gas | | | $SO_2$, 25% load, gas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann |
| R20 | 6.99 | 0.55 | 0.04 | 5.69 | 0.48 | 0.04 | 4.56 | 0.39 | 0.03 | 4.08 | 0.39 | 0.03 |
| R21 | 3.59 | 0.92 | 0.04 | 3.04 | 0.95 | 0.04 | 2.43 | 0.89 | 0.04 | 2.06 | 0.95 | 0.04 |
| R22 | 2.06 | 0.78 | 0.03 | 3.01 | 0.78 | 0.03 | 1.66 | 0.69 | 0.03 | 1.47 | 0.67 | 0.02 |
| R23 | 2.96 | 0.31 | 0.02 | 1.95 | 0.27 | 0.02 | 2.20 | 0.23 | 0.02 | 1.47 | 0.21 | 0.02 |
| R24 | 2.90 | 0.24 | 0.02 | 2.11 | 0.25 | 0.02 | 2.18 | 0.24 | 0.02 | 1.56 | 0.22 | 0.02 |
| R25 | 2.12 | 0.50 | 0.02 | 1.75 | 0.49 | 0.02 | 1.30 | 0.43 | 0.01 | 1.26 | 0.42 | 0.01 |
| R26 | 2.03 | 0.55 | 0.02 | 1.78 | 0.52 | 0.02 | 1.33 | 0.44 | 0.01 | 1.38 | 0.43 | 0.01 |
| R27 | 3.33 | 0.33 | 0.02 | 1.62 | 0.33 | 0.02 | 1.34 | 0.31 | 0.01 | 1.12 | 0.33 | 0.01 |
| R28 | 1.43 | 0.50 | 0.02 | 1.47 | 0.49 | 0.02 | 1.01 | 0.43 | 0.02 | 1.21 | 0.41 | 0.02 |
| R29 | 1.85 | 0.46 | 0.02 | 1.65 | 0.41 | 0.02 | 1.30 | 0.34 | 0.02 | 1.06 | 0.32 | 0.02 |
| R30 | 5.39 | 0.89 | 0.04 | 4.49 | 0.81 | 0.03 | 3.42 | 0.67 | 0.03 | 3.11 | 0.61 | 0.03 |
| R31 | 2.69 | 0.38 | 0.02 | 2.04 | 0.32 | 0.02 | 1.48 | 0.27 | 0.02 | 1.45 | 0.27 | 0.02 |
| R32 | 1.73 | 0.35 | 0.02 | 1.47 | 0.29 | 0.02 | 1.20 | 0.22 | 0.02 | 1.00 | 0.19 | 0.02 |
| R33 | 3.35 | 0.44 | 0.03 | 2.46 | 0.34 | 0.02 | 2.22 | 0.31 | 0.02 | 1.57 | 0.30 | 0.02 |
| R34 | 6.27 | 1.18 | 0.06 | 5.30 | 1.33 | 0.06 | 4.70 | 1.28 | 0.05 | 4.45 | 1.34 | 0.06 |
| R35 | 2.21 | 0.40 | 0.03 | 1.96 | 0.46 | 0.02 | 1.89 | 0.45 | 0.02 | 1.76 | 0.50 | 0.02 |
| R36 | 1.81 | 0.41 | 0.03 | 1.70 | 0.45 | 0.03 | 2.48 | 0.42 | 0.02 | 1.42 | 0.44 | 0.02 |
| R37 | 3.95 | 0.67 | 0.04 | 3.30 | 0.65 | 0.04 | 3.65 | 0.58 | 0.03 | 2.75 | 0.57 | 0.03 |
| R38 | 2.58 | 0.75 | 0.03 | 2.25 | 0.72 | 0.03 | 1.98 | 0.62 | 0.03 | 1.93 | 0.58 | 0.03 |

| Load | $SO_2$, 100% load, gas | | | $SO_2$, 75% load, gas | | | $SO_2$, 50% load, gas | | | $SO_2$, 25% load, gas | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann |
| R39 | 1.89 | 0.42 | 0.03 | 2.00 | 0.41 | 0.03 | 1.82 | 0.36 | 0.02 | 1.80 | 0.35 | 0.02 |
| R40 | 1.92 | 0.23 | 0.02 | 2.15 | 0.28 | 0.02 | 1.90 | 0.27 | 0.02 | 2.82 | 0.31 | 0.02 |
| R41 | 4.93 | 0.33 | 0.02 | 2.32 | 0.33 | 0.02 | 1.84 | 0.29 | 0.02 | 1.62 | 0.28 | 0.02 |
| R42 | 3.10 | 0.25 | 0.02 | 2.95 | 0.24 | 0.02 | 2.99 | 0.19 | 0.02 | 3.26 | 0.22 | 0.02 |
| R43 | 3.22 | 0.27 | 0.02 | 3.46 | 0.22 | 0.02 | 3.38 | 0.20 | 0.02 | 3.75 | 0.24 | 0.01 |
| R44 | 4.12 | 0.23 | 0.02 | 4.14 | 0.24 | 0.02 | 4.15 | 0.23 | 0.01 | 3.57 | 0.23 | 0.01 |
| R45 | 4.40 | 0.22 | 0.02 | 4.78 | 0.24 | 0.02 | 3.90 | 0.22 | 0.01 | 2.86 | 0.20 | 0.01 |
| R46 | 5.87 | 0.38 | 0.02 | 3.09 | 0.33 | 0.02 | 2.05 | 0.30 | 0.02 | 1.81 | 0.30 | 0.02 |
| R47 | 2.74 | 0.29 | 0.02 | 2.35 | 0.27 | 0.02 | 3.51 | 0.25 | 0.02 | 2.23 | 0.30 | 0.02 |
| R48 | 2.73 | 0.23 | 0.02 | 2.35 | 0.28 | 0.02 | 2.19 | 0.24 | 0.02 | 2.62 | 0.19 | 0.01 |
| R49 | 4.62 | 0.51 | 0.04 | 4.38 | 0.47 | 0.04 | 3.95 | 0.39 | 0.03 | 3.77 | 0.36 | 0.03 |
| R50 | 4.79 | 0.65 | 0.05 | 4.28 | 0.88 | 0.05 | 3.94 | 1.07 | 0.05 | 3.81 | 1.53 | 0.05 |
| R51 | 6.10 | 0.45 | 0.03 | 6.76 | 0.50 | 0.03 | 6.60 | 0.46 | 0.03 | 6.51 | 0.42 | 0.03 |
| Max (µg·m$^{-3}$) | 9.83 | 1.18 | 0.08 | 8.46 | 1.33 | 0.08 | 6.83 | 1.28 | 0.07 | 6.51 | 1.53 | 0.07 |
| Criterion(A) | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ |
| Plotted | Yes | No | No | No | No | No | No | No | No | No | Yes | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context.

(B) Exceedence of the criterion is indicated by red highlighting

Table E-5 Predicted incremental impact, formaldehyde, gas

| Load | Formaldehyde, 100% load, gas | | Formaldehyde, 75% load, gas | | Formaldehyde, 50% load, gas | | Formaldehyde, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min |
| R1 | 0.45 | 0.82 | 2.25 | 4.09 | 1.69 | 3.08 | 1.05 | 1.92 |
| R2 | 0.47 | 0.86 | 2.18 | 3.98 | 1.56 | 2.83 | 1.09 | 1.99 |
| R3 | 0.36 | 0.65 | 1.52 | 2.76 | 1.09 | 1.98 | 0.71 | 1.29 |
| R4 | 0.45 | 0.81 | 1.54 | 2.80 | 1.16 | 2.12 | 0.63 | 1.15 |
| R5 | 0.43 | 0.79 | 1.53 | 2.78 | 1.11 | 2.02 | 0.63 | 1.14 |
| R6 | 0.35 | 0.64 | 1.23 | 2.24 | 0.80 | 1.46 | 0.66 | 1.21 |
| R7 | 0.30 | 0.55 | 0.98 | 1.78 | 0.78 | 1.42 | 0.62 | 1.13 |
| R8 | 0.39 | 0.71 | 1.19 | 2.16 | 0.95 | 1.74 | 0.74 | 1.35 |
| R9 | 0.52 | 0.94 | 1.85 | 3.37 | 1.57 | 2.86 | 1.29 | 2.34 |
| R10 | 0.34 | 0.62 | 1.11 | 2.01 | 0.93 | 1.69 | 1.09 | 1.98 |
| R11 | 0.33 | 0.60 | 1.16 | 2.12 | 1.05 | 1.91 | 1.07 | 1.94 |
| R12 | 0.31 | 0.57 | 0.98 | 1.78 | 1.21 | 2.20 | 0.90 | 1.65 |
| R13 | 0.25 | 0.45 | 1.13 | 2.05 | 1.13 | 2.07 | 0.66 | 1.20 |
| R14 | 0.25 | 0.46 | 1.03 | 1.87 | 1.08 | 1.96 | 0.85 | 1.54 |
| R15 | 0.31 | 0.57 | 1.21 | 2.20 | 0.93 | 1.69 | 0.97 | 1.76 |
| R16 | 0.32 | 0.57 | 1.18 | 2.14 | 0.88 | 1.60 | 0.98 | 1.78 |
| R17 | 0.36 | 0.66 | 1.25 | 2.28 | 0.99 | 1.81 | 0.80 | 1.46 |
| R18 | 0.61 | 1.11 | 2.24 | 4.08 | 1.79 | 3.26 | 1.39 | 2.52 |
| R19 | 0.29 | 0.53 | 0.97 | 1.76 | 0.66 | 1.20 | 0.79 | 1.43 |

| Load | Formaldehyde, 100% load, gas | | Formaldehyde, 75% load, gas | | Formaldehyde, 50% load, gas | | Formaldehyde, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ 3-min | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ 3-min | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ 3-min | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ 3-min |
| R20 | 0.43 | 0.79 | 1.51 | 2.75 | 1.20 | 2.18 | 0.95 | 1.73 |
| R21 | 0.22 | 0.41 | 0.81 | 1.47 | 0.64 | 1.16 | 0.48 | 0.87 |
| R22 | 0.13 | 0.23 | 0.80 | 1.45 | 0.43 | 0.79 | 0.34 | 0.62 |
| R23 | 0.18 | 0.33 | 0.52 | 0.94 | 0.58 | 1.05 | 0.34 | 0.62 |
| R24 | 0.18 | 0.33 | 0.56 | 1.02 | 0.57 | 1.04 | 0.36 | 0.66 |
| R25 | 0.13 | 0.24 | 0.46 | 0.84 | 0.34 | 0.62 | 0.29 | 0.53 |
| R26 | 0.13 | 0.23 | 0.47 | 0.86 | 0.35 | 0.64 | 0.32 | 0.59 |
| R27 | 0.21 | 0.38 | 0.43 | 0.79 | 0.35 | 0.64 | 0.26 | 0.48 |
| R28 | 0.09 | 0.16 | 0.39 | 0.71 | 0.26 | 0.48 | 0.28 | 0.51 |
| R29 | 0.11 | 0.21 | 0.44 | 0.80 | 0.34 | 0.62 | 0.25 | 0.45 |
| R30 | 0.33 | 0.61 | 1.19 | 2.17 | 0.90 | 1.63 | 0.72 | 1.32 |
| R31 | 0.17 | 0.30 | 0.54 | 0.99 | 0.39 | 0.71 | 0.34 | 0.61 |
| R32 | 0.11 | 0.19 | 0.39 | 0.71 | 0.32 | 0.57 | 0.23 | 0.42 |
| R33 | 0.21 | 0.38 | 0.65 | 1.19 | 0.58 | 1.06 | 0.37 | 0.67 |
| R34 | 0.39 | 0.71 | 1.41 | 2.57 | 1.23 | 2.24 | 1.04 | 1.89 |
| R35 | 0.14 | 0.25 | 0.52 | 0.95 | 0.49 | 0.90 | 0.41 | 0.74 |
| R36 | 0.11 | 0.20 | 0.45 | 0.82 | 0.65 | 1.18 | 0.33 | 0.60 |
| R37 | 0.25 | 0.45 | 0.88 | 1.60 | 0.96 | 1.74 | 0.64 | 1.17 |
| R38 | 0.16 | 0.29 | 0.60 | 1.09 | 0.52 | 0.94 | 0.45 | 0.82 |

| Load | Formaldehyde, 100% load, gas | | Formaldehyde, 75% load, gas | | Formaldehyde, 50% load, gas | | Formaldehyde, 25% load, gas | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min |
| R39 | 0.12 | 0.21 | 0.53 | 0.97 | 0.48 | 0.87 | 0.42 | 0.77 |
| R40 | 0.12 | 0.22 | 0.57 | 1.04 | 0.50 | 0.91 | 0.66 | 1.20 |
| R41 | 0.31 | 0.56 | 0.62 | 1.12 | 0.48 | 0.88 | 0.38 | 0.69 |
| R42 | 0.19 | 0.35 | 0.78 | 1.43 | 0.78 | 1.43 | 0.76 | 1.38 |
| R43 | 0.20 | 0.36 | 0.92 | 1.67 | 0.89 | 1.61 | 0.88 | 1.59 |
| R44 | 0.26 | 0.47 | 1.10 | 2.00 | 1.09 | 1.98 | 0.83 | 1.51 |
| R45 | 0.27 | 0.50 | 1.27 | 2.31 | 1.02 | 1.86 | 0.67 | 1.21 |
| R46 | 0.36 | 0.66 | 0.82 | 1.49 | 0.54 | 0.98 | 0.42 | 0.77 |
| R47 | 0.17 | 0.31 | 0.62 | 1.14 | 0.92 | 1.68 | 0.52 | 0.95 |
| R48 | 0.17 | 0.31 | 0.62 | 1.13 | 0.57 | 1.04 | 0.61 | 1.11 |
| R49 | 0.29 | 0.52 | 1.16 | 2.12 | 1.04 | 1.88 | 0.88 | 1.60 |
| R50 | 0.30 | 0.54 | 1.14 | 2.07 | 1.03 | 1.88 | 0.89 | 1.62 |
| R51 | 0.38 | 0.69 | 1.79 | 3.27 | 1.73 | 3.15 | 1.52 | 2.76 |
| Max (µg·m$^{-3}$) | 0.61 | 1.11 | 2.25 | 4.09 | 1.79 | 3.26 | 1.52 | 2.76 |
| Criterion[(A)] | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) |
| Potted | No | No | No | Yes | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact as a 3-minute average, but has been provided for context. This has been converted using the method outlined in **Section 4.2.6**

(B) Exceedence of the criterion is indicated by red highlighting

**Table E-6 Predicted incremental impact, CO, diesel**

| Load | CO, 100% load, diesel | | CO, 75% load, diesel | | CO, 50% load, diesel | | CO, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour |
| R1 | 31.51 | 6.71 | 29.37 | 6.10 | 26.83 | 5.73 | 16.15 | 4.74 |
| R2 | 31.95 | 5.98 | 28.14 | 5.55 | 25.41 | 5.20 | 16.84 | 4.06 |
| R3 | 20.70 | 4.08 | 19.69 | 3.55 | 17.84 | 3.28 | 10.51 | 2.42 |
| R4 | 24.34 | 4.68 | 19.88 | 3.74 | 18.14 | 3.48 | 9.96 | 2.76 |
| R5 | 23.99 | 4.62 | 19.78 | 3.62 | 18.07 | 3.36 | 9.70 | 2.67 |
| R6 | 19.32 | 4.37 | 15.39 | 4.03 | 12.13 | 3.78 | 10.80 | 2.67 |
| R7 | 19.70 | 3.62 | 12.49 | 3.53 | 11.60 | 3.35 | 9.77 | 2.63 |
| R8 | 20.43 | 3.42 | 15.59 | 3.33 | 14.39 | 3.15 | 11.63 | 2.89 |
| R9 | 28.11 | 5.67 | 24.71 | 5.77 | 23.09 | 5.52 | 20.44 | 4.73 |
| R10 | 19.98 | 4.79 | 14.73 | 4.48 | 13.74 | 4.27 | 17.33 | 4.52 |
| R11 | 18.30 | 4.46 | 15.65 | 4.10 | 14.68 | 3.87 | 16.55 | 4.91 |
| R12 | 15.75 | 5.67 | 15.46 | 5.97 | 15.87 | 5.75 | 13.24 | 6.59 |
| R13 | 11.56 | 6.42 | 16.72 | 6.28 | 16.37 | 5.96 | 11.08 | 6.04 |
| R14 | 13.42 | 4.97 | 14.05 | 4.91 | 13.58 | 4.67 | 12.44 | 4.83 |
| R15 | 18.19 | 3.40 | 15.75 | 3.18 | 14.44 | 2.98 | 15.56 | 2.71 |
| R16 | 18.19 | 3.70 | 15.21 | 3.52 | 13.86 | 3.31 | 16.06 | 3.09 |
| R17 | 19.43 | 3.81 | 16.33 | 3.33 | 15.03 | 3.14 | 14.09 | 3.01 |
| R18 | 34.27 | 5.04 | 29.32 | 4.51 | 27.04 | 4.12 | 21.76 | 3.34 |
| R19 | 16.11 | 3.01 | 12.17 | 2.77 | 10.88 | 2.59 | 13.39 | 2.60 |

| Load | CO, 100% load, diesel | | CO, 75% load, diesel | | CO, 50% load, diesel | | CO, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour |
| R20 | 23.49 | 4.44 | 19.72 | 3.86 | 18.15 | 3.57 | 15.30 | 3.00 |
| R21 | 12.48 | 6.82 | 10.51 | 6.57 | 9.67 | 6.22 | 8.37 | 5.90 |
| R22 | 11.33 | 4.54 | 9.45 | 4.11 | 7.78 | 3.83 | 5.34 | 3.40 |
| R23 | 6.06 | 3.27 | 8.10 | 2.84 | 8.15 | 2.70 | 5.77 | 2.10 |
| R24 | 7.03 | 1.95 | 7.92 | 1.98 | 7.63 | 1.86 | 5.37 | 1.71 |
| R25 | 12.17 | 3.16 | 6.07 | 2.84 | 5.36 | 2.67 | 5.01 | 2.55 |
| R26 | 10.64 | 3.90 | 6.10 | 2.28 | 5.54 | 2.16 | 5.06 | 2.28 |
| R27 | 6.14 | 2.96 | 5.29 | 2.69 | 5.01 | 2.37 | 3.94 | 1.95 |
| R28 | 7.69 | 2.58 | 4.35 | 2.42 | 4.01 | 2.27 | 4.38 | 2.11 |
| R29 | 6.59 | 1.81 | 5.71 | 1.59 | 5.24 | 1.48 | 3.96 | 1.27 |
| R30 | 18.77 | 5.96 | 15.37 | 5.07 | 13.99 | 4.66 | 11.39 | 4.07 |
| R31 | 9.01 | 2.69 | 6.85 | 2.33 | 6.14 | 2.16 | 5.20 | 1.87 |
| R32 | 6.03 | 2.37 | 5.13 | 1.93 | 5.25 | 1.83 | 3.78 | 1.83 |
| R33 | 10.11 | 3.09 | 9.04 | 2.97 | 8.57 | 2.81 | 5.19 | 2.73 |
| R34 | 21.90 | 13.76 | 18.92 | 14.27 | 17.89 | 13.73 | 17.61 | 14.46 |
| R35 | 7.01 | 2.39 | 7.04 | 2.49 | 6.65 | 2.39 | 6.62 | 2.82 |
| R36 | 6.64 | 2.26 | 5.97 | 2.36 | 6.16 | 2.26 | 5.47 | 2.63 |
| R37 | 13.69 | 4.34 | 12.25 | 3.70 | 12.61 | 3.41 | 10.76 | 3.35 |
| R38 | 8.49 | 4.12 | 8.04 | 3.78 | 7.51 | 3.52 | 7.21 | 3.17 |

| Load | CO, 100% load, diesel | | CO, 75% load, diesel | | CO, 50% load, diesel | | CO, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 8-hour |
| R39 | 7.24 | 2.75 | 7.20 | 2.50 | 6.80 | 2.33 | 6.75 | 2.23 |
| R40 | 7.48 | 1.61 | 7.73 | 1.61 | 7.26 | 1.52 | 11.02 | 1.83 |
| R41 | 14.10 | 2.42 | 8.85 | 2.34 | 7.23 | 2.25 | 6.28 | 1.82 |
| R42 | 9.21 | 2.61 | 11.09 | 2.05 | 10.76 | 1.89 | 12.60 | 1.93 |
| R43 | 11.59 | 2.46 | 12.66 | 2.16 | 12.05 | 2.04 | 14.08 | 1.78 |
| R44 | 14.65 | 2.08 | 15.85 | 2.27 | 15.43 | 2.08 | 12.77 | 1.64 |
| R45 | 15.50 | 2.21 | 17.17 | 2.18 | 15.93 | 2.03 | 9.95 | 1.66 |
| R46 | 17.58 | 3.01 | 10.25 | 2.23 | 8.07 | 2.12 | 6.65 | 1.97 |
| R47 | 8.51 | 2.54 | 8.59 | 2.45 | 8.18 | 2.31 | 7.61 | 2.51 |
| R48 | 9.55 | 2.78 | 8.59 | 2.92 | 8.14 | 2.74 | 10.21 | 1.96 |
| R49 | 15.37 | 4.41 | 15.82 | 4.03 | 14.94 | 3.85 | 13.94 | 3.52 |
| R50 | 16.94 | 7.41 | 15.56 | 7.69 | 14.83 | 7.38 | 14.15 | 8.23 |
| R51 | 22.29 | 3.45 | 25.02 | 4.62 | 24.06 | 4.40 | 23.74 | 3.97 |
| Max (µg·m$^{-3}$) | 34.27 | 13.76 | 29.37 | 14.27 | 27.04 | 13.73 | 23.74 | 14.46 |
| Criterion(A) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) | 31,240 µg·m$^{-3}$ (31.24 mg·m$^{-3}$) | 11,120 µg·m$^{-3}$ (11.12 mg·m$^{-3}$) |
| Plotted | No | No | No | No | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context.

(B) Exceedence of the criterion is indicated by red highlighting

**Table E-7 Predicted incremental impact, NO2, diesel**

| Load | $NO_X$ (as $NO_2$), 100% load, diesel | | $NO_X$ (as $NO_2$), 75% load, diesel | | $NO_X$ (as $NO_2$), 50% load, diesel | | $NO_X$ (as $NO_2$), 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual | $\mu g \cdot m^{-3}$ 1-hour | $\mu g \cdot m^{-3}$ annual |
| R1 | 176.04 | 1.09 | 163.97 | 1.01 | 149.88 | 0.95 | 90.17 | 0.86 |
| R2 | 178.50 | 0.97 | 157.10 | 0.90 | 141.93 | 0.84 | 94.01 | 0.75 |
| R3 | 115.67 | 0.55 | 109.96 | 0.51 | 99.67 | 0.48 | 58.68 | 0.43 |
| R4 | 135.96 | 0.49 | 111.02 | 0.46 | 101.34 | 0.43 | 55.61 | 0.38 |
| R5 | 134.05 | 0.47 | 110.43 | 0.44 | 100.96 | 0.41 | 54.18 | 0.36 |
| R6 | 107.92 | 0.61 | 85.92 | 0.55 | 67.76 | 0.52 | 60.28 | 0.48 |
| R7 | 110.07 | 0.77 | 69.74 | 0.69 | 64.78 | 0.65 | 54.53 | 0.59 |
| R8 | 114.13 | 0.94 | 87.02 | 0.86 | 80.37 | 0.80 | 64.95 | 0.72 |
| R9 | 157.07 | 1.74 | 137.94 | 1.59 | 128.98 | 1.49 | 114.13 | 1.37 |
| R10 | 111.61 | 1.04 | 82.25 | 0.95 | 76.73 | 0.89 | 96.76 | 0.86 |
| R11 | 102.25 | 0.89 | 87.36 | 0.82 | 82.01 | 0.77 | 92.42 | 0.75 |
| R12 | 88.00 | 0.79 | 86.31 | 0.74 | 88.67 | 0.69 | 73.90 | 0.70 |
| R13 | 64.56 | 0.69 | 93.35 | 0.65 | 91.47 | 0.61 | 61.84 | 0.62 |
| R14 | 74.97 | 0.67 | 78.44 | 0.62 | 75.88 | 0.58 | 69.46 | 0.58 |
| R15 | 101.61 | 0.74 | 87.92 | 0.67 | 80.69 | 0.63 | 86.89 | 0.60 |
| R16 | 101.60 | 0.81 | 84.92 | 0.73 | 77.44 | 0.68 | 89.67 | 0.65 |
| R17 | 108.53 | 0.91 | 91.20 | 0.82 | 83.99 | 0.76 | 78.66 | 0.71 |
| R18 | 191.47 | 1.35 | 163.71 | 1.23 | 151.07 | 1.14 | 121.51 | 1.05 |
| R19 | 90.01 | 0.73 | 67.95 | 0.65 | 60.76 | 0.61 | 74.77 | 0.57 |

| Load | $NO_X$ (as $NO_2$), 100% load, diesel | | $NO_X$ (as $NO_2$), 75% load, diesel | | $NO_X$ (as $NO_2$), 50% load, diesel | | $NO_X$ (as $NO_2$), 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual |
| R20 | 131.22 | 0.78 | 110.13 | 0.70 | 101.38 | 0.65 | 85.40 | 0.60 |
| R21 | 69.73 | 0.87 | 58.70 | 0.83 | 54.05 | 0.78 | 46.73 | 0.78 |
| R22 | 63.27 | 0.62 | 52.74 | 0.57 | 43.48 | 0.54 | 29.84 | 0.51 |
| R23 | 33.85 | 0.45 | 45.20 | 0.42 | 45.52 | 0.39 | 32.23 | 0.36 |
| R24 | 39.26 | 0.50 | 44.21 | 0.46 | 42.60 | 0.43 | 29.98 | 0.37 |
| R25 | 68.01 | 0.40 | 33.90 | 0.35 | 29.93 | 0.32 | 27.99 | 0.29 |
| R26 | 59.43 | 0.39 | 34.05 | 0.34 | 30.96 | 0.31 | 28.24 | 0.28 |
| R27 | 34.33 | 0.36 | 29.54 | 0.32 | 27.99 | 0.30 | 21.99 | 0.27 |
| R28 | 42.98 | 0.46 | 24.31 | 0.42 | 22.41 | 0.39 | 24.45 | 0.36 |
| R29 | 36.81 | 0.45 | 31.89 | 0.41 | 29.29 | 0.38 | 22.12 | 0.34 |
| R30 | 104.86 | 0.73 | 85.80 | 0.67 | 78.16 | 0.63 | 63.61 | 0.59 |
| R31 | 50.36 | 0.48 | 38.25 | 0.43 | 34.29 | 0.41 | 29.03 | 0.37 |
| R32 | 33.66 | 0.44 | 28.64 | 0.40 | 29.34 | 0.38 | 21.08 | 0.33 |
| R33 | 56.47 | 0.54 | 50.46 | 0.48 | 47.88 | 0.44 | 28.99 | 0.41 |
| R34 | 122.34 | 1.21 | 105.65 | 1.18 | 99.95 | 1.11 | 98.33 | 1.21 |
| R35 | 39.16 | 0.52 | 39.31 | 0.50 | 37.13 | 0.48 | 36.97 | 0.50 |
| R36 | 37.08 | 0.53 | 33.32 | 0.52 | 34.40 | 0.50 | 30.55 | 0.53 |
| R37 | 76.48 | 0.84 | 68.42 | 0.76 | 70.47 | 0.71 | 60.05 | 0.64 |
| R38 | 47.45 | 0.59 | 44.86 | 0.57 | 41.97 | 0.54 | 40.28 | 0.55 |

| Load | $NO_X$ (as $NO_2$), 100% load, diesel | | $NO_X$ (as $NO_2$), 75% load, diesel | | $NO_X$ (as $NO_2$), 50% load, diesel | | $NO_X$ (as $NO_2$), 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ annual |
| R39 | 40.47 | 0.60 | 40.17 | 0.55 | 38.00 | 0.52 | 37.67 | 0.50 |
| R40 | 41.81 | 0.43 | 43.17 | 0.42 | 40.57 | 0.39 | 61.50 | 0.41 |
| R41 | 78.75 | 0.42 | 49.40 | 0.39 | 40.41 | 0.36 | 35.07 | 0.34 |
| R42 | 51.46 | 0.39 | 61.93 | 0.36 | 60.09 | 0.34 | 70.37 | 0.31 |
| R43 | 64.74 | 0.39 | 70.70 | 0.35 | 67.30 | 0.33 | 78.60 | 0.30 |
| R44 | 81.84 | 0.38 | 88.50 | 0.34 | 86.18 | 0.32 | 71.29 | 0.29 |
| R45 | 86.58 | 0.38 | 95.87 | 0.34 | 89.01 | 0.31 | 55.58 | 0.28 |
| R46 | 98.21 | 0.45 | 57.21 | 0.42 | 45.08 | 0.39 | 37.13 | 0.37 |
| R47 | 47.56 | 0.49 | 47.98 | 0.46 | 45.69 | 0.43 | 42.48 | 0.42 |
| R48 | 53.36 | 0.39 | 47.97 | 0.35 | 45.48 | 0.33 | 57.01 | 0.31 |
| R49 | 85.88 | 0.78 | 88.31 | 0.71 | 83.46 | 0.66 | 77.85 | 0.61 |
| R50 | 94.65 | 0.99 | 86.90 | 0.98 | 82.83 | 0.93 | 78.99 | 1.03 |
| R51 | 124.56 | 0.72 | 139.70 | 0.67 | 134.43 | 0.63 | 132.57 | 0.58 |
| Max (µg·m$^{-3}$) | 191.47 | 1.74 | 163.97 | 1.59 | 151.07 | 1.49 | 132.57 | 1.37 |
| Criterion[(A)] | 250 µg·m$^{-3}$ (0.25 mg·m$^{-3}$) | 60 µg·m$^{-3}$ (0.06 mg·m$^{-3}$) | 250 µg·m$^{-3}$ (0.25 mg·m$^{-3}$) | 60 µg·m$^{-3}$ (0.06 mg·m$^{-3}$) | 250 µg·m$^{-3}$ (0.25 mg·m$^{-3}$) | 60 µg·m$^{-3}$ (0.06 mg·m$^{-3}$) | 250 µg·m$^{-3}$ (0.25 mg·m$^{-3}$) | 60 µg·m$^{-3}$ (0.06 mg·m$^{-3}$) |
| Plotted | Yes | Yes | No | No | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context. (B) Exceedence of the criterion is indicated by red highlighting (C) Assumes a 100% $NO_X$ to $NO_2$ conversion

**Table E-8 Predicted incremental impact, PM10 / PM2.5, diesel**

| Load | PM, 100% load, diesel | | PM, 75% load, diesel | | PM, 50% load, diesel | | PM, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual |
| R1 | 0.48 | 0.04 | 0.60 | 0.04 | 0.62 | 0.05 | 0.61 | 0.05 |
| R2 | 0.47 | 0.04 | 0.56 | 0.04 | 0.57 | 0.04 | 0.51 | 0.05 |
| R3 | 0.28 | 0.02 | 0.32 | 0.02 | 0.33 | 0.02 | 0.29 | 0.03 |
| R4 | 0.32 | 0.02 | 0.31 | 0.02 | 0.31 | 0.02 | 0.33 | 0.02 |
| R5 | 0.31 | 0.02 | 0.30 | 0.02 | 0.30 | 0.02 | 0.32 | 0.02 |
| R6 | 0.30 | 0.02 | 0.33 | 0.02 | 0.34 | 0.02 | 0.32 | 0.03 |
| R7 | 0.28 | 0.03 | 0.29 | 0.03 | 0.30 | 0.03 | 0.34 | 0.04 |
| R8 | 0.35 | 0.03 | 0.38 | 0.04 | 0.39 | 0.04 | 0.45 | 0.05 |
| R9 | 0.61 | 0.06 | 0.63 | 0.07 | 0.64 | 0.07 | 0.79 | 0.09 |
| R10 | 0.40 | 0.04 | 0.43 | 0.04 | 0.44 | 0.04 | 0.54 | 0.06 |
| R11 | 0.34 | 0.03 | 0.35 | 0.04 | 0.36 | 0.04 | 0.59 | 0.05 |
| R12 | 0.39 | 0.03 | 0.50 | 0.03 | 0.53 | 0.03 | 0.80 | 0.04 |
| R13 | 0.45 | 0.02 | 0.53 | 0.03 | 0.55 | 0.03 | 0.74 | 0.04 |
| R14 | 0.34 | 0.02 | 0.41 | 0.03 | 0.42 | 0.03 | 0.58 | 0.04 |
| R15 | 0.33 | 0.03 | 0.27 | 0.03 | 0.28 | 0.03 | 0.40 | 0.04 |
| R16 | 0.35 | 0.03 | 0.30 | 0.03 | 0.30 | 0.03 | 0.40 | 0.04 |
| R17 | 0.36 | 0.03 | 0.38 | 0.04 | 0.38 | 0.04 | 0.46 | 0.05 |
| R18 | 0.51 | 0.05 | 0.54 | 0.05 | 0.55 | 0.05 | 0.61 | 0.07 |
| R19 | 0.32 | 0.03 | 0.29 | 0.03 | 0.30 | 0.03 | 0.52 | 0.04 |

| Load | PM, 100% load, diesel | | PM, 75% load, diesel | | PM, 50% load, diesel | | PM, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual |
| R20 | 0.39 | 0.03 | 0.41 | 0.03 | 0.41 | 0.03 | 0.55 | 0.04 |
| R21 | 0.70 | 0.03 | 0.84 | 0.04 | 0.87 | 0.04 | 1.29 | 0.05 |
| R22 | 0.59 | 0.02 | 0.68 | 0.03 | 0.70 | 0.03 | 0.89 | 0.03 |
| R23 | 0.22 | 0.02 | 0.24 | 0.02 | 0.24 | 0.02 | 0.28 | 0.02 |
| R24 | 0.17 | 0.02 | 0.23 | 0.02 | 0.24 | 0.02 | 0.30 | 0.02 |
| R25 | 0.38 | 0.01 | 0.43 | 0.02 | 0.44 | 0.02 | 0.55 | 0.02 |
| R26 | 0.41 | 0.01 | 0.45 | 0.01 | 0.45 | 0.01 | 0.57 | 0.02 |
| R27 | 0.25 | 0.01 | 0.30 | 0.01 | 0.31 | 0.01 | 0.45 | 0.02 |
| R28 | 0.38 | 0.02 | 0.43 | 0.02 | 0.44 | 0.02 | 0.55 | 0.02 |
| R29 | 0.33 | 0.02 | 0.35 | 0.02 | 0.35 | 0.02 | 0.42 | 0.02 |
| R30 | 0.64 | 0.03 | 0.69 | 0.03 | 0.70 | 0.03 | 0.80 | 0.04 |
| R31 | 0.27 | 0.02 | 0.27 | 0.02 | 0.28 | 0.02 | 0.37 | 0.02 |
| R32 | 0.25 | 0.02 | 0.24 | 0.02 | 0.24 | 0.02 | 0.25 | 0.02 |
| R33 | 0.28 | 0.02 | 0.30 | 0.02 | 0.31 | 0.02 | 0.39 | 0.03 |
| R34 | 0.95 | 0.04 | 1.19 | 0.05 | 1.25 | 0.05 | 1.80 | 0.08 |
| R35 | 0.33 | 0.02 | 0.41 | 0.02 | 0.43 | 0.02 | 0.69 | 0.03 |
| R36 | 0.32 | 0.02 | 0.39 | 0.02 | 0.41 | 0.02 | 0.59 | 0.03 |
| R37 | 0.49 | 0.03 | 0.57 | 0.03 | 0.58 | 0.03 | 0.76 | 0.04 |
| R38 | 0.56 | 0.02 | 0.62 | 0.02 | 0.64 | 0.03 | 0.77 | 0.03 |

| Load | PM, 100% load, diesel | | PM, 75% load, diesel | | PM, 50% load, diesel | | PM, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual | µg·m$^{-3}$ 24-hour | µg·m$^{-3}$ annual |
| R39 | 0.31 | 0.02 | 0.36 | 0.02 | 0.36 | 0.02 | 0.46 | 0.03 |
| R40 | 0.19 | 0.02 | 0.25 | 0.02 | 0.26 | 0.02 | 0.43 | 0.03 |
| R41 | 0.25 | 0.02 | 0.28 | 0.02 | 0.29 | 0.02 | 0.37 | 0.02 |
| R42 | 0.20 | 0.01 | 0.20 | 0.02 | 0.19 | 0.02 | 0.30 | 0.02 |
| R43 | 0.19 | 0.01 | 0.20 | 0.02 | 0.20 | 0.02 | 0.32 | 0.02 |
| R44 | 0.16 | 0.01 | 0.21 | 0.02 | 0.21 | 0.02 | 0.30 | 0.02 |
| R45 | 0.17 | 0.01 | 0.21 | 0.01 | 0.22 | 0.02 | 0.25 | 0.02 |
| R46 | 0.25 | 0.02 | 0.29 | 0.02 | 0.30 | 0.02 | 0.40 | 0.02 |
| R47 | 0.21 | 0.02 | 0.23 | 0.02 | 0.24 | 0.02 | 0.42 | 0.03 |
| R48 | 0.19 | 0.01 | 0.24 | 0.02 | 0.25 | 0.02 | 0.24 | 0.02 |
| R49 | 0.37 | 0.03 | 0.40 | 0.03 | 0.41 | 0.03 | 0.48 | 0.04 |
| R50 | 0.52 | 0.04 | 0.84 | 0.04 | 0.93 | 0.04 | 2.17 | 0.07 |
| R51 | 0.32 | 0.03 | 0.45 | 0.03 | 0.46 | 0.03 | 0.54 | 0.04 |
| Max (µg·m$^{-3}$) | 0.95 | 0.06 | 1.19 | 0.07 | 1.25 | 0.07 | 2.17 | 0.09 |
| Criterion $PM_{2.5}$ (B) | 25 µg·m$^{-3}$ (0.025 mg·m$^{-3}$) | 8 µg·m$^{-3}$ (0.008 mg·m$^{-3}$) | 25 µg·m$^{-3}$ (0.025 mg·m$^{-3}$) | 8 µg·m$^{-3}$ (0.008 mg·m$^{-3}$) | 25 µg·m$^{-3}$ (0.025 mg·m$^{-3}$) | 8 µg·m$^{-3}$ (0.008 mg·m$^{-3}$) | 25 µg·m$^{-3}$ (0.025 mg·m$^{-3}$) | 8 µg·m$^{-3}$ (0.008 mg·m$^{-3}$) |
| Plotted | No | No | No | No | No | No | Yes | Yes |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context. (B) Exceedence of the criterion is indicated by red highlighting

**Table E-9 Predicted incremental impact, $SO_2$, diesel**

| Load | $SO_2$, 100% load, diesel | | | $SO_2$, 75% load, diesel | | | $SO_2$, 50% load, diesel | | | $SO_2$, 25% load, diesel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | $\mu g \cdot m^{-3}$ 1h | $\mu g \cdot m^{-3}$ 24h | $\mu g \cdot m^{-3}$ ann | $\mu g \cdot m^{-3}$ 1h | $\mu g \cdot m^{-3}$ 24h | $\mu g \cdot m^{-3}$ ann | $\mu g \cdot m^{-3}$ 1h | $\mu g \cdot m^{-3}$ 24h | $\mu g \cdot m^{-3}$ ann | $\mu g \cdot m^{-3}$ 1h | $\mu g \cdot m^{-3}$ 24h | $\mu g \cdot m^{-3}$ ann |
| R1 | 0.79 | 0.06 | 0.00 | 0.73 | 0.06 | 0.00 | 0.68 | 0.06 | 0.00 | 0.41 | 0.04 | 0.00 |
| R2 | 0.80 | 0.06 | 0.00 | 0.70 | 0.06 | 0.00 | 0.65 | 0.05 | 0.00 | 0.43 | 0.04 | 0.00 |
| R3 | 0.52 | 0.03 | 0.00 | 0.49 | 0.03 | 0.00 | 0.45 | 0.03 | 0.00 | 0.27 | 0.02 | 0.00 |
| R4 | 0.61 | 0.04 | 0.00 | 0.50 | 0.03 | 0.00 | 0.46 | 0.03 | 0.00 | 0.25 | 0.02 | 0.00 |
| R5 | 0.60 | 0.04 | 0.00 | 0.49 | 0.03 | 0.00 | 0.46 | 0.03 | 0.00 | 0.25 | 0.02 | 0.00 |
| R6 | 0.48 | 0.04 | 0.00 | 0.38 | 0.03 | 0.00 | 0.31 | 0.03 | 0.00 | 0.28 | 0.02 | 0.00 |
| R7 | 0.49 | 0.03 | 0.00 | 0.31 | 0.03 | 0.00 | 0.30 | 0.03 | 0.00 | 0.25 | 0.02 | 0.00 |
| R8 | 0.51 | 0.04 | 0.00 | 0.39 | 0.04 | 0.00 | 0.37 | 0.04 | 0.00 | 0.30 | 0.03 | 0.00 |
| R9 | 0.70 | 0.07 | 0.01 | 0.62 | 0.06 | 0.01 | 0.59 | 0.06 | 0.01 | 0.52 | 0.06 | 0.01 |
| R10 | 0.50 | 0.05 | 0.00 | 0.37 | 0.04 | 0.00 | 0.35 | 0.04 | 0.00 | 0.44 | 0.04 | 0.00 |
| R11 | 0.46 | 0.04 | 0.00 | 0.39 | 0.04 | 0.00 | 0.37 | 0.03 | 0.00 | 0.42 | 0.04 | 0.00 |
| R12 | 0.39 | 0.05 | 0.00 | 0.39 | 0.05 | 0.00 | 0.40 | 0.05 | 0.00 | 0.34 | 0.06 | 0.00 |
| R13 | 0.29 | 0.06 | 0.00 | 0.42 | 0.05 | 0.00 | 0.42 | 0.05 | 0.00 | 0.28 | 0.05 | 0.00 |
| R14 | 0.34 | 0.04 | 0.00 | 0.35 | 0.04 | 0.00 | 0.35 | 0.04 | 0.00 | 0.32 | 0.04 | 0.00 |
| R15 | 0.45 | 0.04 | 0.00 | 0.39 | 0.03 | 0.00 | 0.37 | 0.03 | 0.00 | 0.40 | 0.03 | 0.00 |
| R16 | 0.45 | 0.04 | 0.00 | 0.38 | 0.03 | 0.00 | 0.35 | 0.03 | 0.00 | 0.41 | 0.03 | 0.00 |
| R17 | 0.49 | 0.05 | 0.00 | 0.41 | 0.04 | 0.00 | 0.38 | 0.04 | 0.00 | 0.36 | 0.03 | 0.00 |
| R18 | 0.86 | 0.06 | 0.01 | 0.73 | 0.06 | 0.01 | 0.69 | 0.05 | 0.01 | 0.55 | 0.04 | 0.00 |
| R19 | 0.40 | 0.04 | 0.00 | 0.30 | 0.03 | 0.00 | 0.28 | 0.03 | 0.00 | 0.34 | 0.04 | 0.00 |

| Load | $SO_2$, 100% load, diesel | | | $SO_2$, 75% load, diesel | | | $SO_2$, 50% load, diesel | | | $SO_2$, 25% load, diesel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann |
| R20 | 0.59 | 0.05 | 0.00 | 0.49 | 0.04 | 0.00 | 0.46 | 0.04 | 0.00 | 0.39 | 0.04 | 0.00 |
| R21 | 0.31 | 0.09 | 0.00 | 0.26 | 0.09 | 0.00 | 0.25 | 0.08 | 0.00 | 0.21 | 0.09 | 0.00 |
| R22 | 0.28 | 0.07 | 0.00 | 0.24 | 0.07 | 0.00 | 0.20 | 0.07 | 0.00 | 0.14 | 0.06 | 0.00 |
| R23 | 0.15 | 0.03 | 0.00 | 0.20 | 0.02 | 0.00 | 0.21 | 0.02 | 0.00 | 0.15 | 0.02 | 0.00 |
| R24 | 0.18 | 0.02 | 0.00 | 0.20 | 0.02 | 0.00 | 0.19 | 0.02 | 0.00 | 0.14 | 0.02 | 0.00 |
| R25 | 0.30 | 0.05 | 0.00 | 0.15 | 0.04 | 0.00 | 0.14 | 0.04 | 0.00 | 0.13 | 0.04 | 0.00 |
| R26 | 0.27 | 0.05 | 0.00 | 0.15 | 0.05 | 0.00 | 0.14 | 0.04 | 0.00 | 0.13 | 0.04 | 0.00 |
| R27 | 0.15 | 0.03 | 0.00 | 0.13 | 0.03 | 0.00 | 0.13 | 0.03 | 0.00 | 0.10 | 0.03 | 0.00 |
| R28 | 0.19 | 0.05 | 0.00 | 0.11 | 0.04 | 0.00 | 0.10 | 0.04 | 0.00 | 0.11 | 0.04 | 0.00 |
| R29 | 0.16 | 0.04 | 0.00 | 0.14 | 0.04 | 0.00 | 0.13 | 0.03 | 0.00 | 0.10 | 0.03 | 0.00 |
| R30 | 0.47 | 0.08 | 0.00 | 0.38 | 0.07 | 0.00 | 0.36 | 0.07 | 0.00 | 0.29 | 0.06 | 0.00 |
| R31 | 0.23 | 0.03 | 0.00 | 0.17 | 0.03 | 0.00 | 0.16 | 0.03 | 0.00 | 0.13 | 0.03 | 0.00 |
| R32 | 0.15 | 0.03 | 0.00 | 0.13 | 0.02 | 0.00 | 0.13 | 0.02 | 0.00 | 0.10 | 0.02 | 0.00 |
| R33 | 0.25 | 0.03 | 0.00 | 0.23 | 0.03 | 0.00 | 0.22 | 0.03 | 0.00 | 0.13 | 0.03 | 0.00 |
| R34 | 0.55 | 0.12 | 0.01 | 0.47 | 0.12 | 0.01 | 0.46 | 0.12 | 0.01 | 0.45 | 0.13 | 0.01 |
| R35 | 0.18 | 0.04 | 0.00 | 0.18 | 0.04 | 0.00 | 0.17 | 0.04 | 0.00 | 0.17 | 0.05 | 0.00 |
| R36 | 0.17 | 0.04 | 0.00 | 0.15 | 0.04 | 0.00 | 0.16 | 0.04 | 0.00 | 0.14 | 0.04 | 0.00 |
| R37 | 0.34 | 0.06 | 0.00 | 0.31 | 0.06 | 0.00 | 0.32 | 0.06 | 0.00 | 0.27 | 0.05 | 0.00 |
| R38 | 0.21 | 0.07 | 0.00 | 0.20 | 0.06 | 0.00 | 0.19 | 0.06 | 0.00 | 0.18 | 0.06 | 0.00 |

| Load | $SO_2$, 100% load, diesel | | | $SO_2$, 75% load, diesel | | | $SO_2$, 50% load, diesel | | | $SO_2$, 25% load, diesel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann | µg·m$^{-3}$ 1h | µg·m$^{-3}$ 24h | µg·m$^{-3}$ ann |
| R39 | 0.18 | 0.04 | 0.00 | 0.18 | 0.04 | 0.00 | 0.17 | 0.03 | 0.00 | 0.17 | 0.03 | 0.00 |
| R40 | 0.19 | 0.02 | 0.00 | 0.19 | 0.03 | 0.00 | 0.19 | 0.03 | 0.00 | 0.28 | 0.03 | 0.00 |
| R41 | 0.35 | 0.03 | 0.00 | 0.22 | 0.03 | 0.00 | 0.18 | 0.03 | 0.00 | 0.16 | 0.03 | 0.00 |
| R42 | 0.23 | 0.03 | 0.00 | 0.28 | 0.02 | 0.00 | 0.27 | 0.02 | 0.00 | 0.32 | 0.02 | 0.00 |
| R43 | 0.29 | 0.02 | 0.00 | 0.32 | 0.02 | 0.00 | 0.31 | 0.02 | 0.00 | 0.36 | 0.02 | 0.00 |
| R44 | 0.37 | 0.02 | 0.00 | 0.40 | 0.02 | 0.00 | 0.39 | 0.02 | 0.00 | 0.33 | 0.02 | 0.00 |
| R45 | 0.39 | 0.02 | 0.00 | 0.43 | 0.02 | 0.00 | 0.41 | 0.02 | 0.00 | 0.25 | 0.02 | 0.00 |
| R46 | 0.44 | 0.03 | 0.00 | 0.26 | 0.03 | 0.00 | 0.21 | 0.03 | 0.00 | 0.17 | 0.03 | 0.00 |
| R47 | 0.21 | 0.03 | 0.00 | 0.21 | 0.02 | 0.00 | 0.21 | 0.02 | 0.00 | 0.19 | 0.03 | 0.00 |
| R48 | 0.24 | 0.02 | 0.00 | 0.21 | 0.02 | 0.00 | 0.21 | 0.02 | 0.00 | 0.26 | 0.02 | 0.00 |
| R49 | 0.38 | 0.05 | 0.00 | 0.39 | 0.04 | 0.00 | 0.38 | 0.04 | 0.00 | 0.36 | 0.03 | 0.00 |
| R50 | 0.42 | 0.06 | 0.00 | 0.39 | 0.09 | 0.00 | 0.38 | 0.09 | 0.00 | 0.36 | 0.16 | 0.00 |
| R51 | 0.56 | 0.04 | 0.00 | 0.62 | 0.05 | 0.00 | 0.61 | 0.04 | 0.00 | 0.60 | 0.04 | 0.00 |
| Max (µg·m$^{-3}$) | 0.86 | 0.12 | 0.01 | 0.73 | 0.12 | 0.01 | 0.69 | 0.12 | 0.01 | 0.60 | 0.16 | 0.01 |
| Criterion(A) | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ | 570 µg·m$^{-3}$ 0.57 mg·m$^{-3}$ | 230 µg·m$^{-3}$ 0.23 mg·m$^{-3}$ | 60 µg·m$^{-3}$ 0.06 mg·m$^{-3}$ |
| Plotted | No | No | No | No | No | No | No | No | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact, but has been provided for context.

(B) Exceedence of the criterion is indicated by red highlighting

Table E-10 Predicted incremental impact, formaldehyde, diesel

| Load | Formaldehyde, 100% load, diesel | | Formaldehyde, 75% load, diesel | | Formaldehyde, 50% load, diesel | | Formaldehyde, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min |
| R1 | 0.11 | 0.19 | 0.10 | 0.19 | 0.11 | 0.20 | 0.08 | 0.14 |
| R2 | 0.11 | 0.20 | 0.10 | 0.18 | 0.10 | 0.19 | 0.08 | 0.15 |
| R3 | 0.07 | 0.13 | 0.07 | 0.13 | 0.07 | 0.13 | 0.05 | 0.09 |
| R4 | 0.08 | 0.15 | 0.07 | 0.13 | 0.07 | 0.14 | 0.05 | 0.09 |
| R5 | 0.08 | 0.15 | 0.07 | 0.13 | 0.07 | 0.13 | 0.05 | 0.08 |
| R6 | 0.06 | 0.12 | 0.05 | 0.10 | 0.05 | 0.09 | 0.05 | 0.09 |
| R7 | 0.07 | 0.12 | 0.04 | 0.08 | 0.05 | 0.09 | 0.05 | 0.09 |
| R8 | 0.07 | 0.13 | 0.06 | 0.10 | 0.06 | 0.11 | 0.06 | 0.10 |
| R9 | 0.09 | 0.17 | 0.09 | 0.16 | 0.09 | 0.17 | 0.10 | 0.18 |
| R10 | 0.07 | 0.12 | 0.05 | 0.10 | 0.06 | 0.10 | 0.08 | 0.15 |
| R11 | 0.06 | 0.11 | 0.06 | 0.10 | 0.06 | 0.11 | 0.08 | 0.14 |
| R12 | 0.05 | 0.10 | 0.05 | 0.10 | 0.06 | 0.12 | 0.06 | 0.12 |
| R13 | 0.04 | 0.07 | 0.06 | 0.11 | 0.07 | 0.12 | 0.05 | 0.10 |
| R14 | 0.05 | 0.08 | 0.05 | 0.09 | 0.06 | 0.10 | 0.06 | 0.11 |
| R15 | 0.06 | 0.11 | 0.06 | 0.10 | 0.06 | 0.11 | 0.07 | 0.14 |
| R16 | 0.06 | 0.11 | 0.05 | 0.10 | 0.06 | 0.10 | 0.08 | 0.14 |
| R17 | 0.07 | 0.12 | 0.06 | 0.11 | 0.06 | 0.11 | 0.07 | 0.12 |
| R18 | 0.12 | 0.21 | 0.10 | 0.19 | 0.11 | 0.20 | 0.10 | 0.19 |
| R19 | 0.05 | 0.10 | 0.04 | 0.08 | 0.04 | 0.08 | 0.06 | 0.12 |

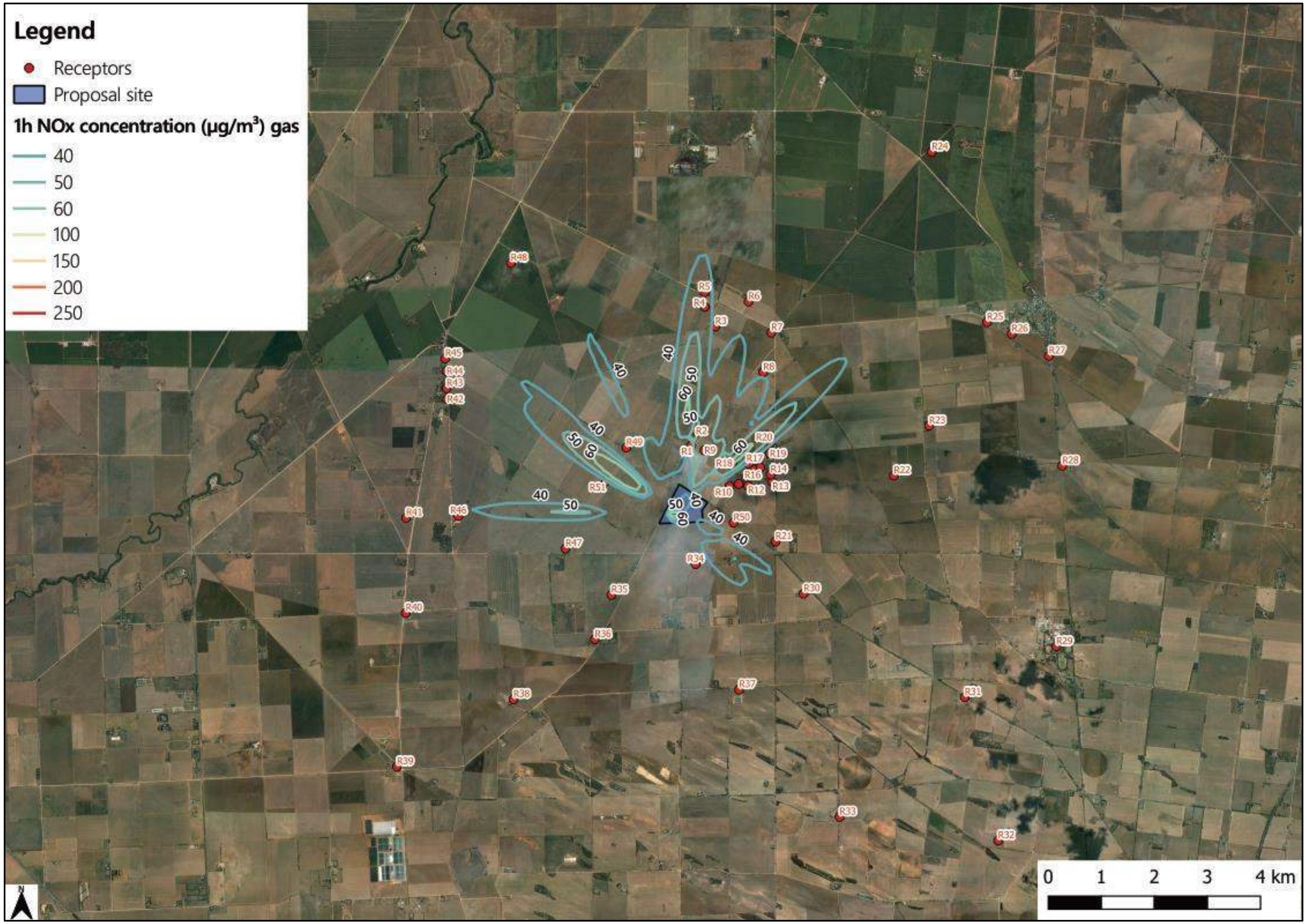
| Load | Formaldehyde, 100% load, diesel | | Formaldehyde, 75% load, diesel | | Formaldehyde, 50% load, diesel | | Formaldehyde, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min |
| R20 | 0.08 | 0.14 | 0.07 | 0.13 | 0.07 | 0.14 | 0.07 | 0.13 |
| R21 | 0.04 | 0.08 | 0.04 | 0.07 | 0.04 | 0.07 | 0.04 | 0.07 |
| R22 | 0.04 | 0.07 | 0.03 | 0.06 | 0.03 | 0.06 | 0.03 | 0.05 |
| R23 | 0.02 | 0.04 | 0.03 | 0.05 | 0.03 | 0.06 | 0.03 | 0.05 |
| R24 | 0.02 | 0.04 | 0.03 | 0.05 | 0.03 | 0.06 | 0.03 | 0.05 |
| R25 | 0.04 | 0.07 | 0.02 | 0.04 | 0.02 | 0.04 | 0.02 | 0.04 |
| R26 | 0.04 | 0.07 | 0.02 | 0.04 | 0.02 | 0.04 | 0.02 | 0.04 |
| R27 | 0.02 | 0.04 | 0.02 | 0.03 | 0.02 | 0.04 | 0.02 | 0.03 |
| R28 | 0.03 | 0.05 | 0.02 | 0.03 | 0.02 | 0.03 | 0.02 | 0.04 |
| R29 | 0.02 | 0.04 | 0.02 | 0.04 | 0.02 | 0.04 | 0.02 | 0.03 |
| R30 | 0.06 | 0.11 | 0.05 | 0.10 | 0.06 | 0.10 | 0.05 | 0.10 |
| R31 | 0.03 | 0.06 | 0.02 | 0.04 | 0.03 | 0.05 | 0.02 | 0.05 |
| R32 | 0.02 | 0.04 | 0.02 | 0.03 | 0.02 | 0.04 | 0.02 | 0.03 |
| R33 | 0.03 | 0.06 | 0.03 | 0.06 | 0.04 | 0.06 | 0.02 | 0.05 |
| R34 | 0.07 | 0.13 | 0.07 | 0.12 | 0.07 | 0.13 | 0.08 | 0.15 |
| R35 | 0.02 | 0.04 | 0.03 | 0.05 | 0.03 | 0.05 | 0.03 | 0.06 |
| R36 | 0.02 | 0.04 | 0.02 | 0.04 | 0.03 | 0.05 | 0.03 | 0.05 |
| R37 | 0.05 | 0.08 | 0.04 | 0.08 | 0.05 | 0.09 | 0.05 | 0.09 |
| R38 | 0.03 | 0.05 | 0.03 | 0.05 | 0.03 | 0.06 | 0.03 | 0.06 |

| Load | Formaldehyde, 100% load, diesel | | Formaldehyde, 75% load, diesel | | Formaldehyde, 50% load, diesel | | Formaldehyde, 25% load, diesel | |
|---|---|---|---|---|---|---|---|---|
| Units | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min | µg·m$^{-3}$ 1-hour | µg·m$^{-3}$ 3-min |
| R39 | 0.02 | 0.04 | 0.03 | 0.05 | 0.03 | 0.05 | 0.03 | 0.06 |
| R40 | 0.03 | 0.05 | 0.03 | 0.05 | 0.03 | 0.05 | 0.05 | 0.10 |
| R41 | 0.05 | 0.09 | 0.03 | 0.06 | 0.03 | 0.05 | 0.03 | 0.05 |
| R42 | 0.03 | 0.06 | 0.04 | 0.07 | 0.04 | 0.08 | 0.06 | 0.11 |
| R43 | 0.04 | 0.07 | 0.05 | 0.08 | 0.05 | 0.09 | 0.07 | 0.12 |
| R44 | 0.05 | 0.09 | 0.06 | 0.10 | 0.06 | 0.11 | 0.06 | 0.11 |
| R45 | 0.05 | 0.09 | 0.06 | 0.11 | 0.07 | 0.12 | 0.05 | 0.09 |
| R46 | 0.06 | 0.11 | 0.04 | 0.07 | 0.03 | 0.06 | 0.03 | 0.06 |
| R47 | 0.03 | 0.05 | 0.03 | 0.06 | 0.03 | 0.06 | 0.04 | 0.07 |
| R48 | 0.03 | 0.06 | 0.03 | 0.06 | 0.03 | 0.06 | 0.05 | 0.09 |
| R49 | 0.05 | 0.09 | 0.06 | 0.10 | 0.06 | 0.11 | 0.07 | 0.12 |
| R50 | 0.06 | 0.10 | 0.06 | 0.10 | 0.06 | 0.11 | 0.07 | 0.12 |
| R51 | 0.07 | 0.14 | 0.09 | 0.16 | 0.10 | 0.18 | 0.11 | 0.21 |
| Max (µg·m$^{-3}$) | 0.12 | 0.21 | 0.10 | 0.19 | 0.11 | 0.20 | 0.11 | 0.21 |
| Criterion(A) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) | - | 44 µg·m$^{-3}$ (0.044 mg·m$^{-3}$) |
| Plotted | No | No | No | No | No | No | No | No |

**Note:** (A) The criterion is applicable to the predicted cumulative impact as a 3-minute average, but has been provided for context. This has been converted using the method outlined in **Section 4.2.6**

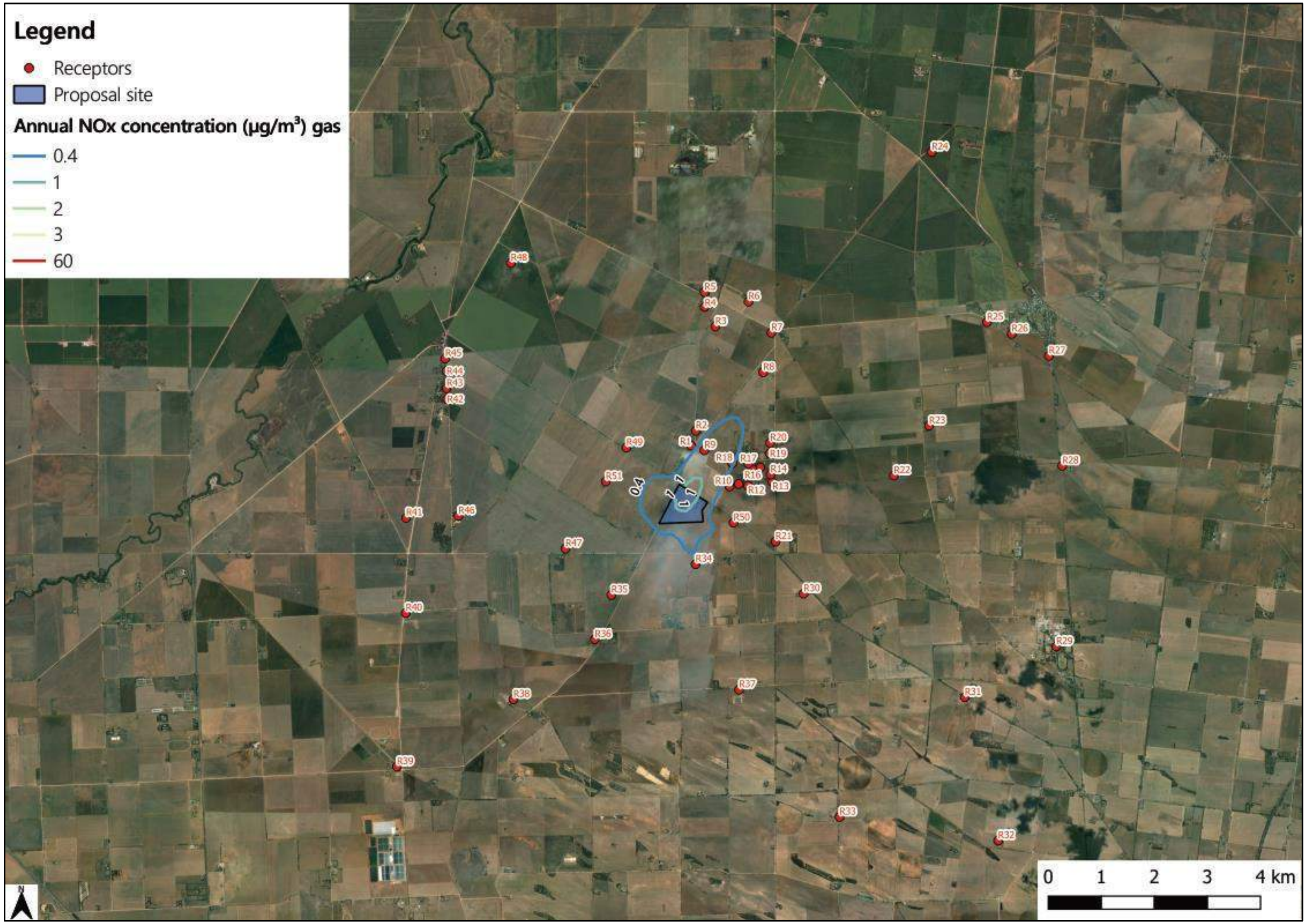
(B) Exceedence of the criterion is indicated by red highlighting

Figure E-1 Predicted incremental impact, $NO_X$ (as $NO_2$), 1-hour, 100%, gas



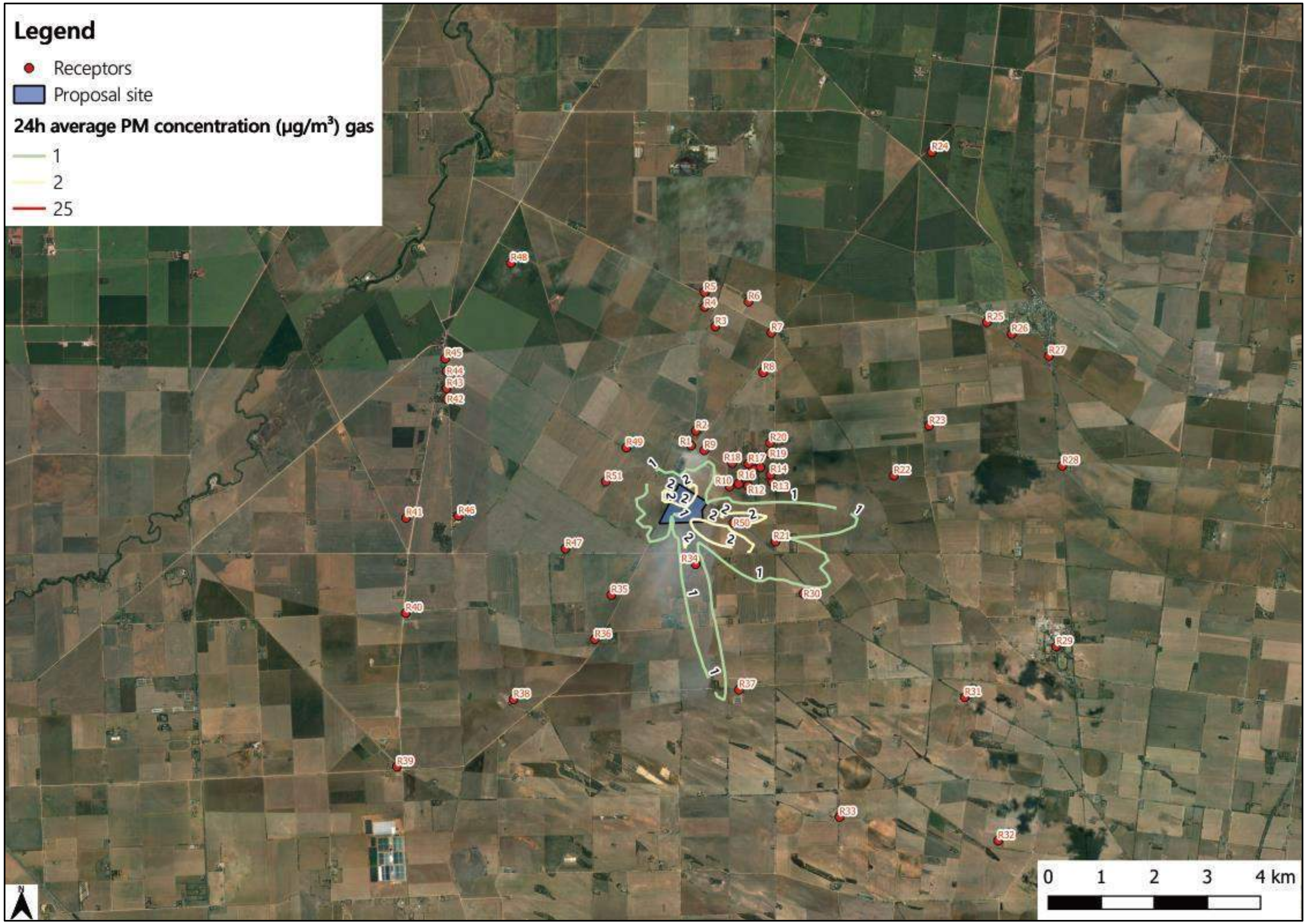

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

**Figure E-2 Predicted incremental impact, $NO_X$ (as $NO_2$), annual average, 100%, gas**



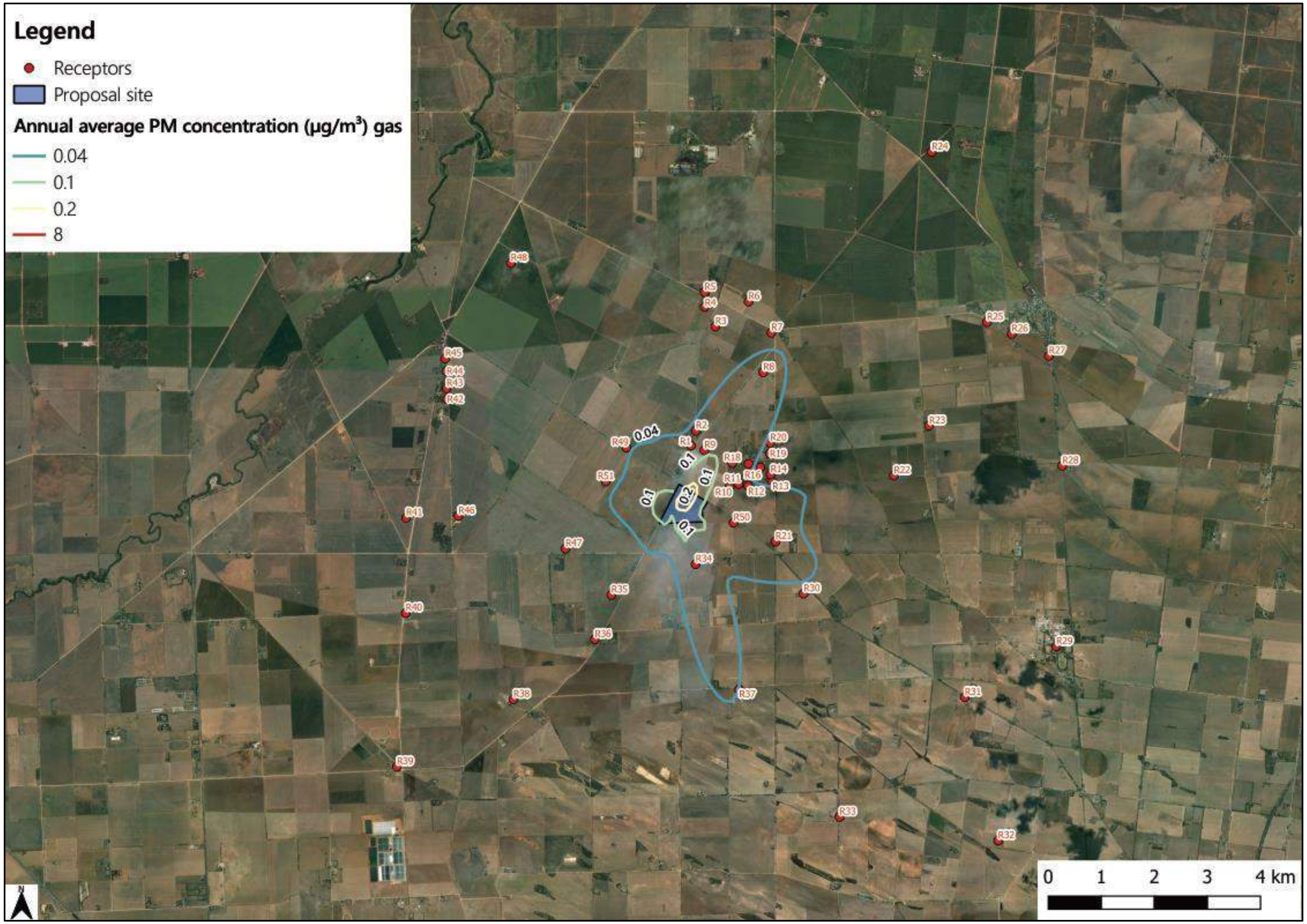

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

Figure E-3 Predicted incremental impact, PM, 24-hour, 25%, gas



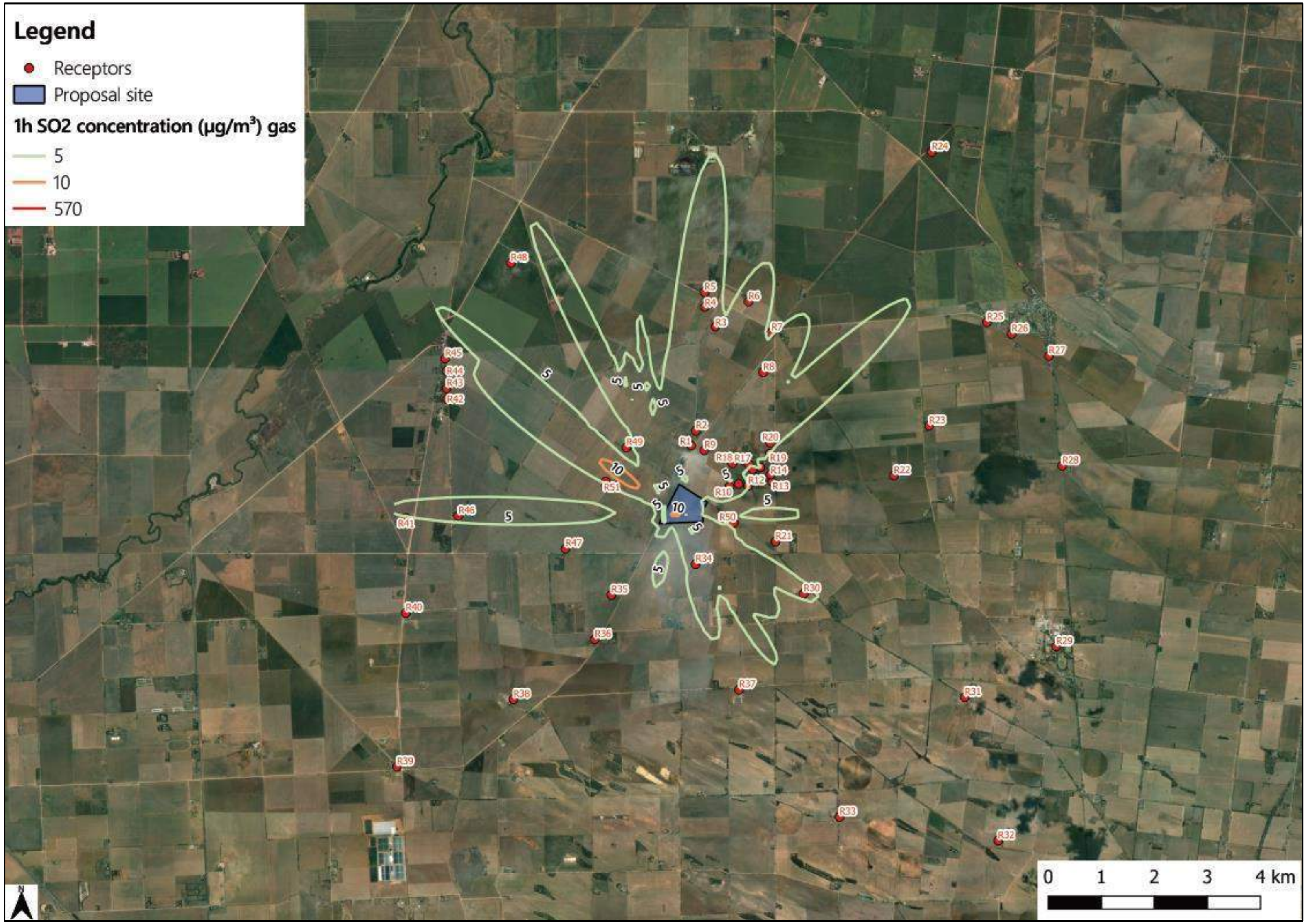

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

Figure E-4 Predicted incremental impact, PM, annual average, 25%, gas



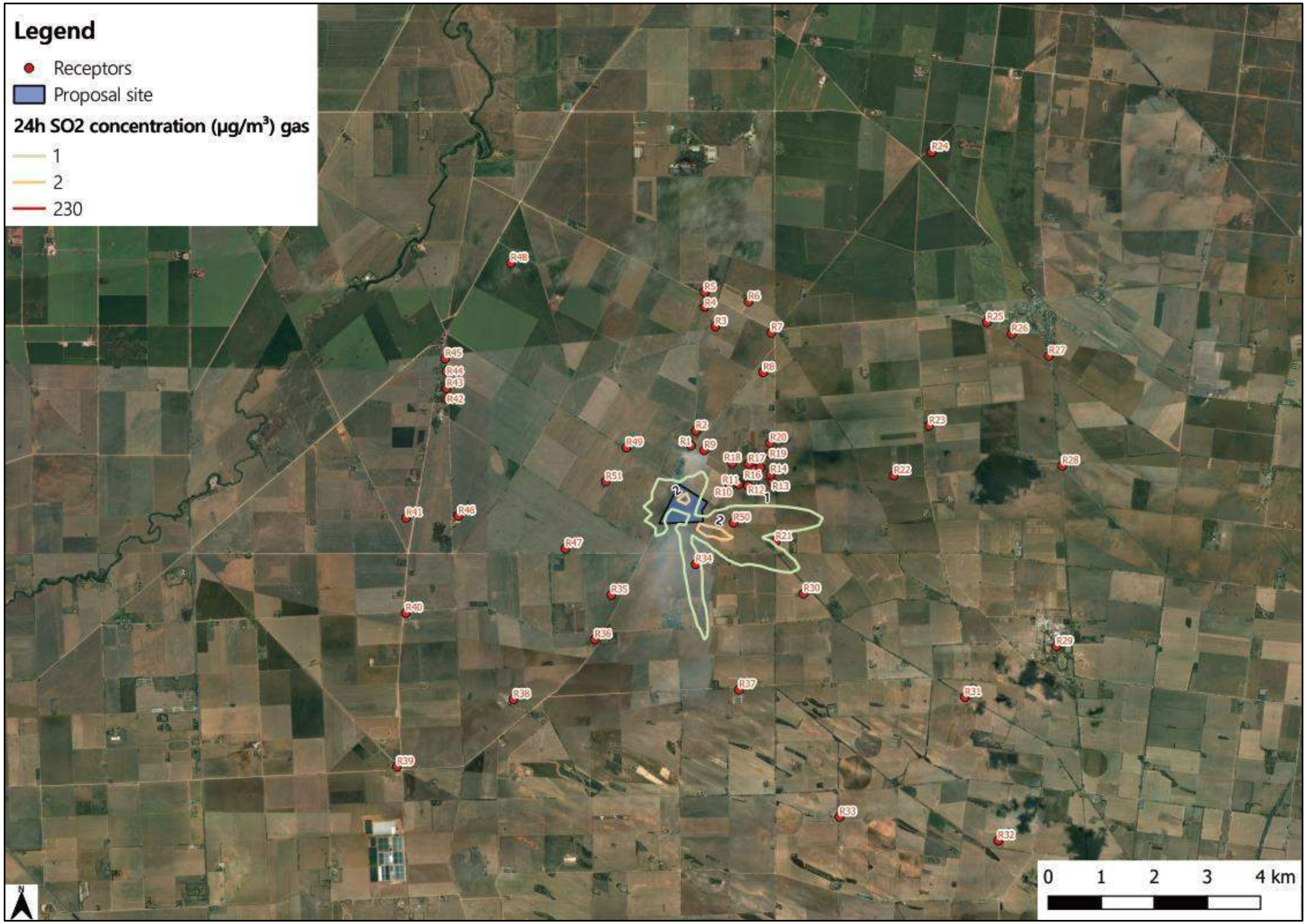

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

**Figure E-5** **Predicted incremental impact, $SO_2$, 1-hour, 100%, gas**



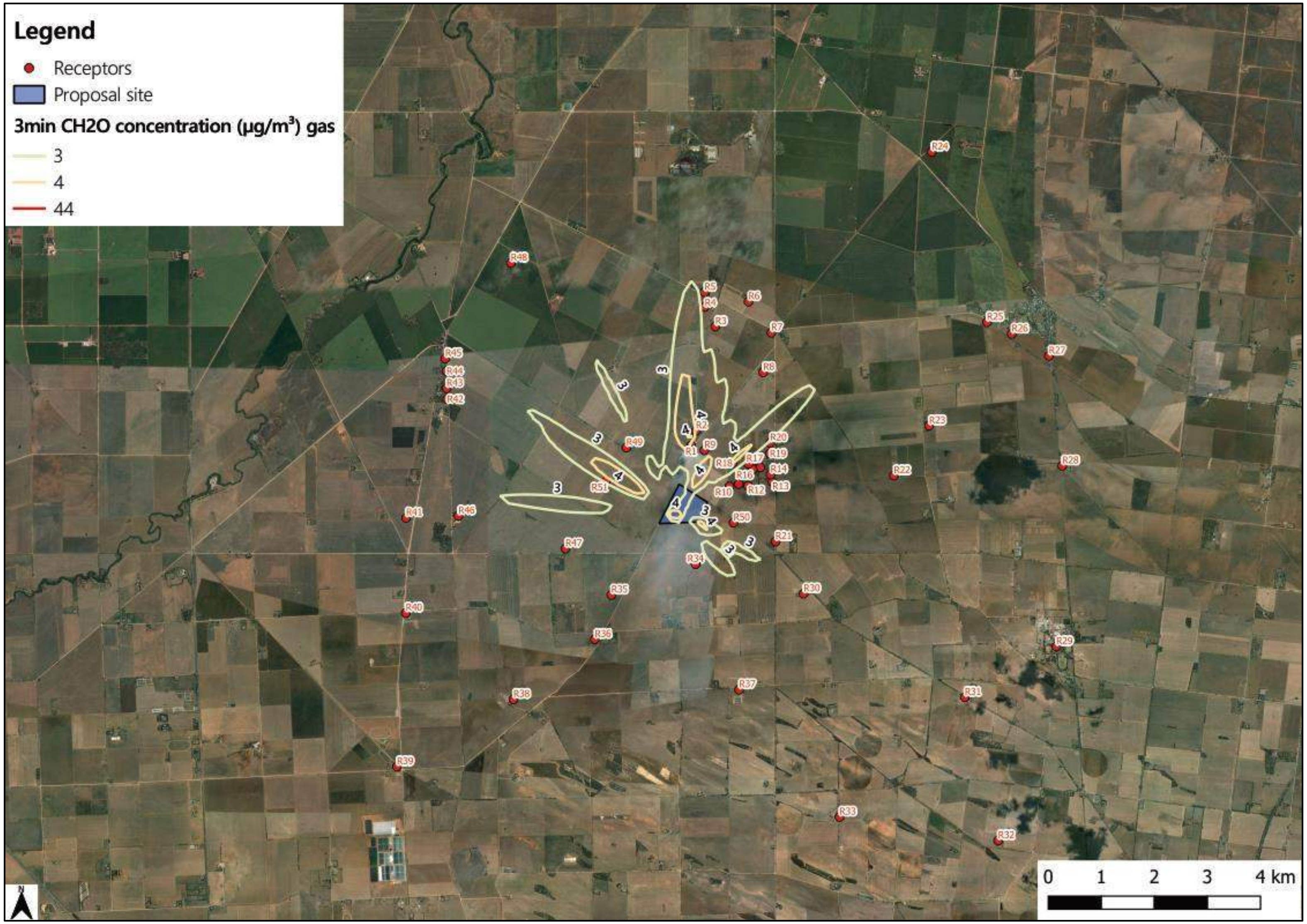

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

**Figure E-6 Predicted incremental impact, $SO_2$ 24-hour, 25%, gas**



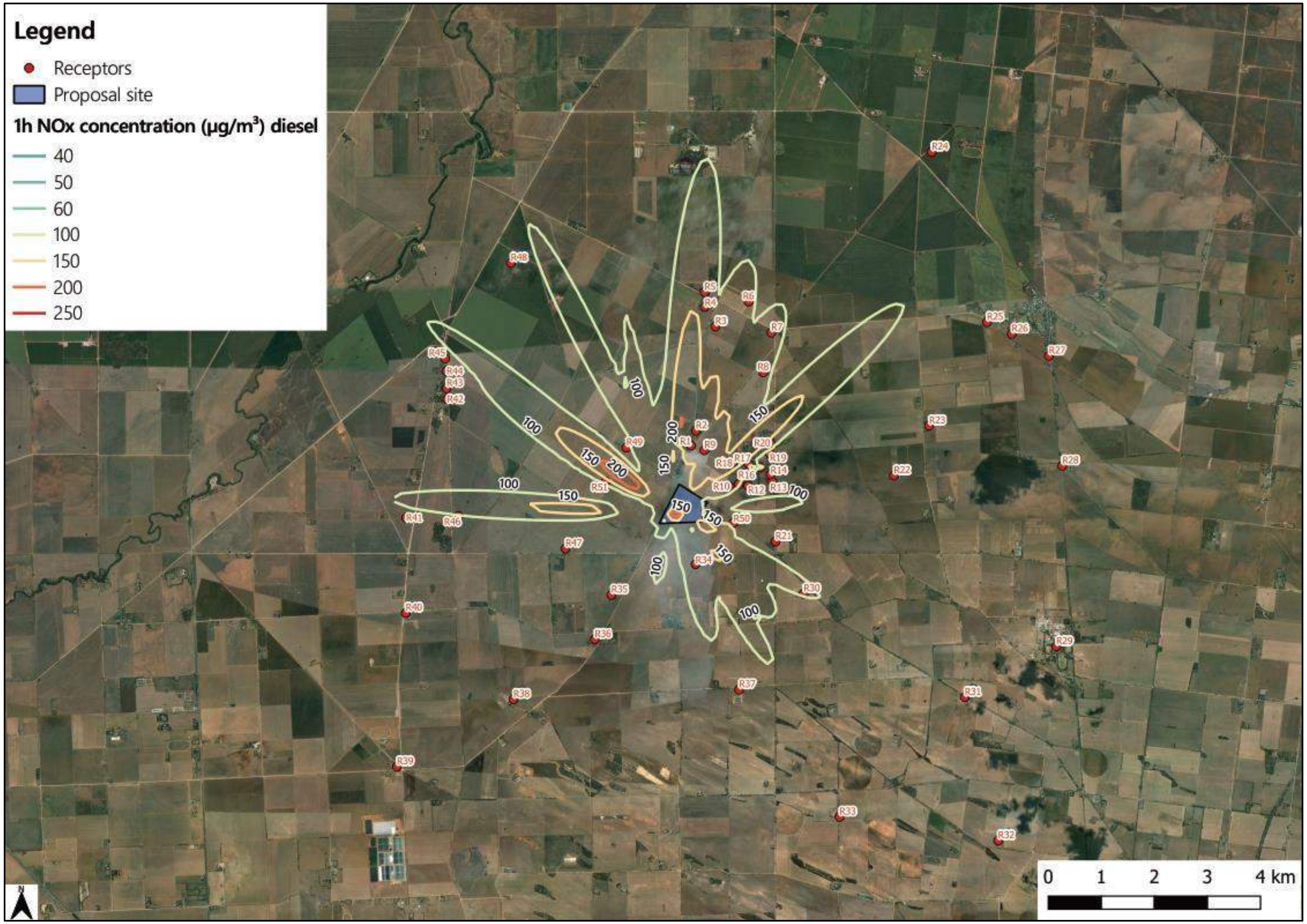

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

Figure E-7 Predicted incremental impact, $CH_2O$, 3-minute, 75%, gas



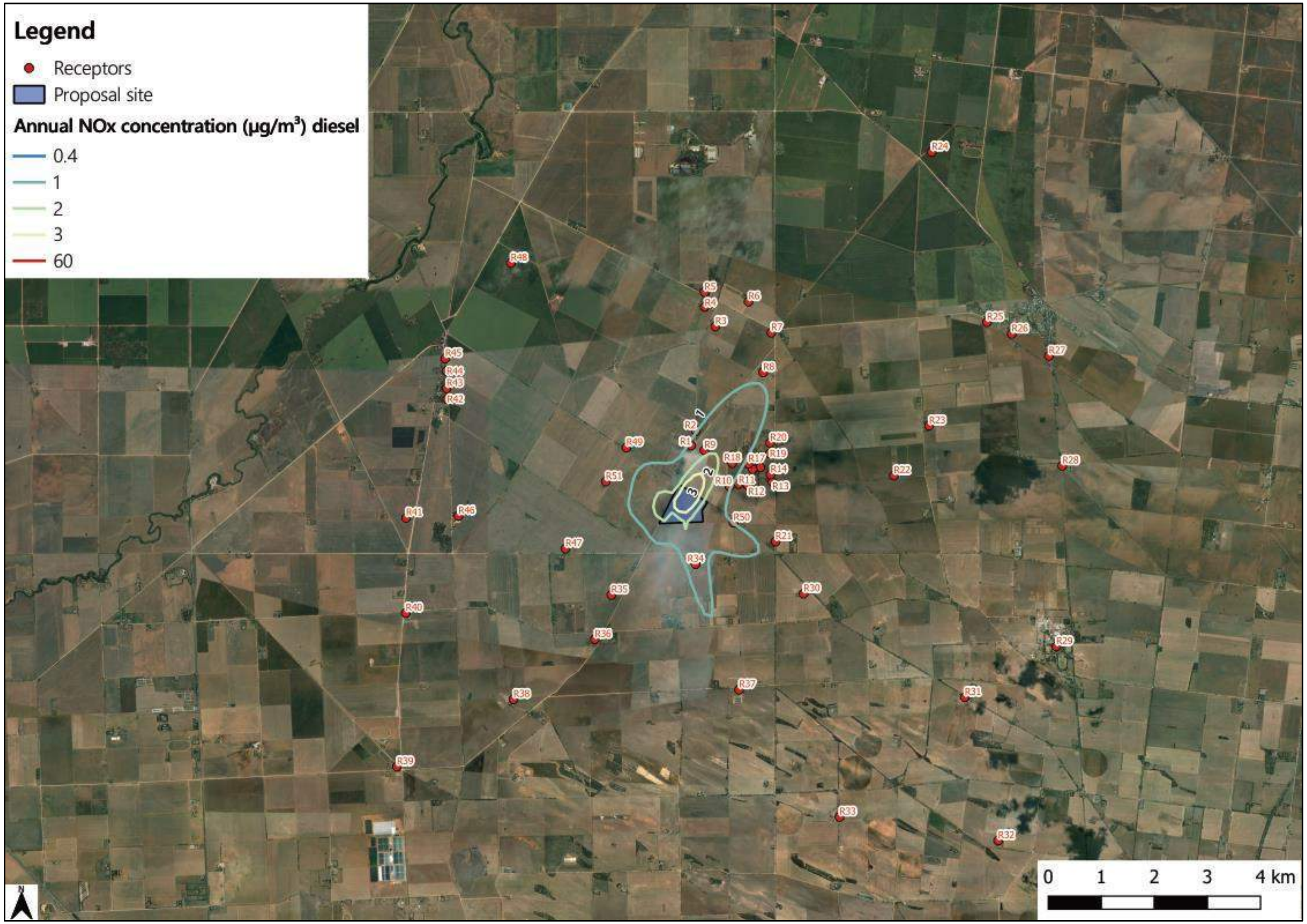

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

Figure E-8 Predicted incremental impact, $NO_X$ (as $NO_2$), 1-hour, 100%, diesel



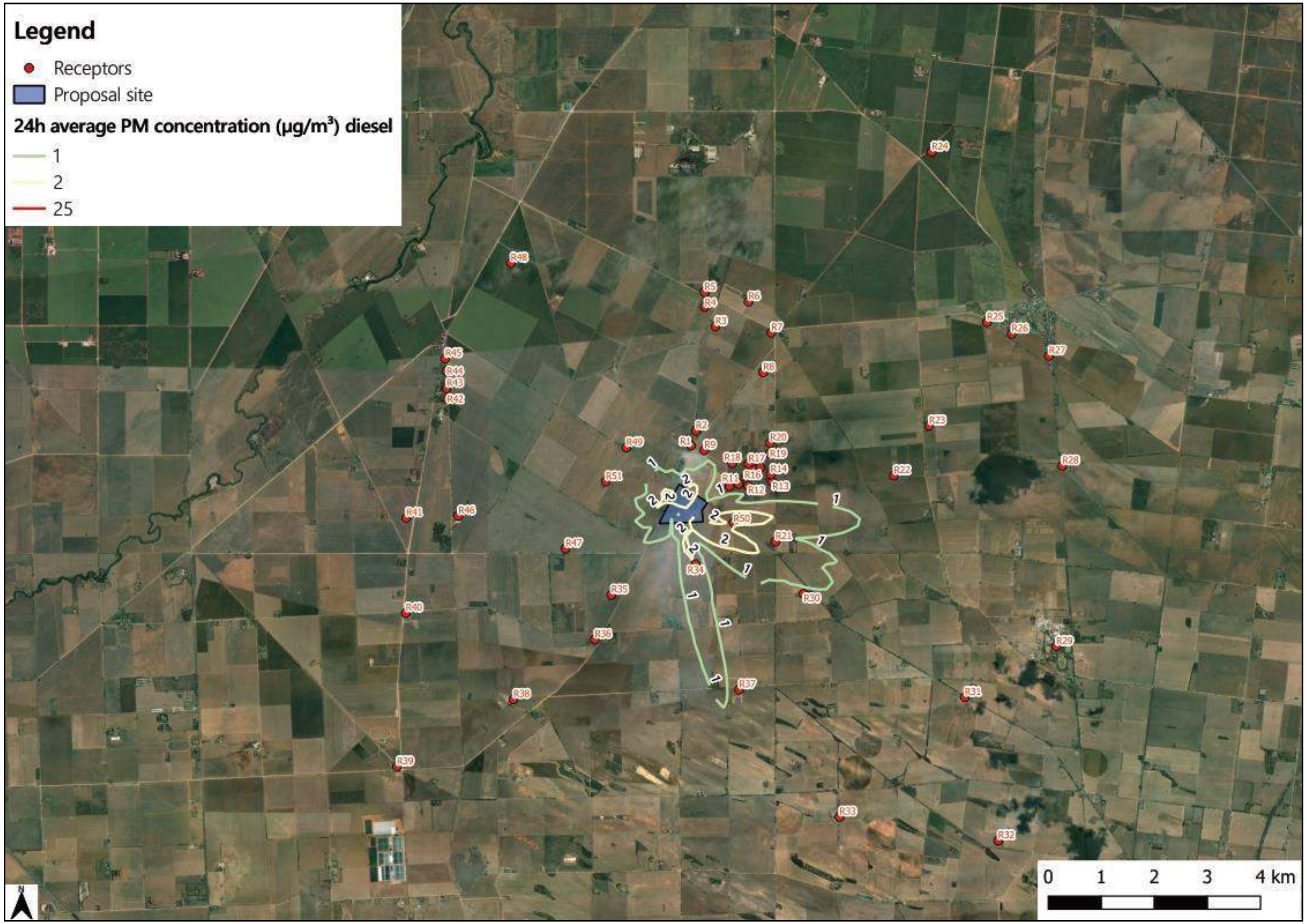

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

Figure E-9 Predicted incremental impact, $NO_X$ (as $NO_2$), annual average, 100%, diesel



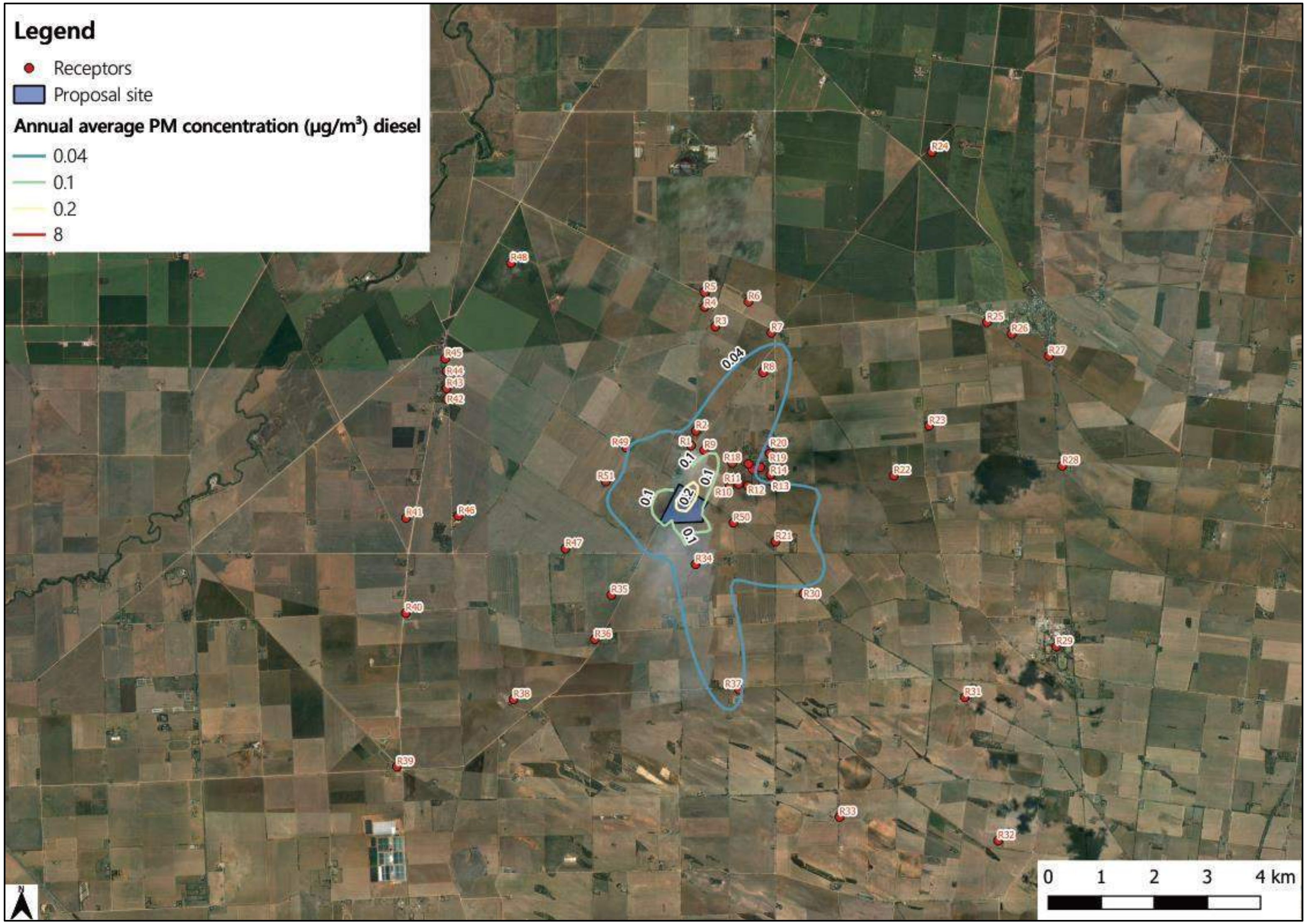

**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

**Figure E-10 Predicted incremental impact, PM, 24-hour, 25%, diesel**




**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

**Figure E-11 Predicted incremental impact, PM, annual average, 25%, diesel**




**Source**: Northstar Air Quality. | **Note:** Please note that the scale and scale bar used to depict the concentrations may not be linear, and care must be applied when interpreting the illustrated values.

# APPENDIX F

## Product Specifications and Drawings

NOTES:

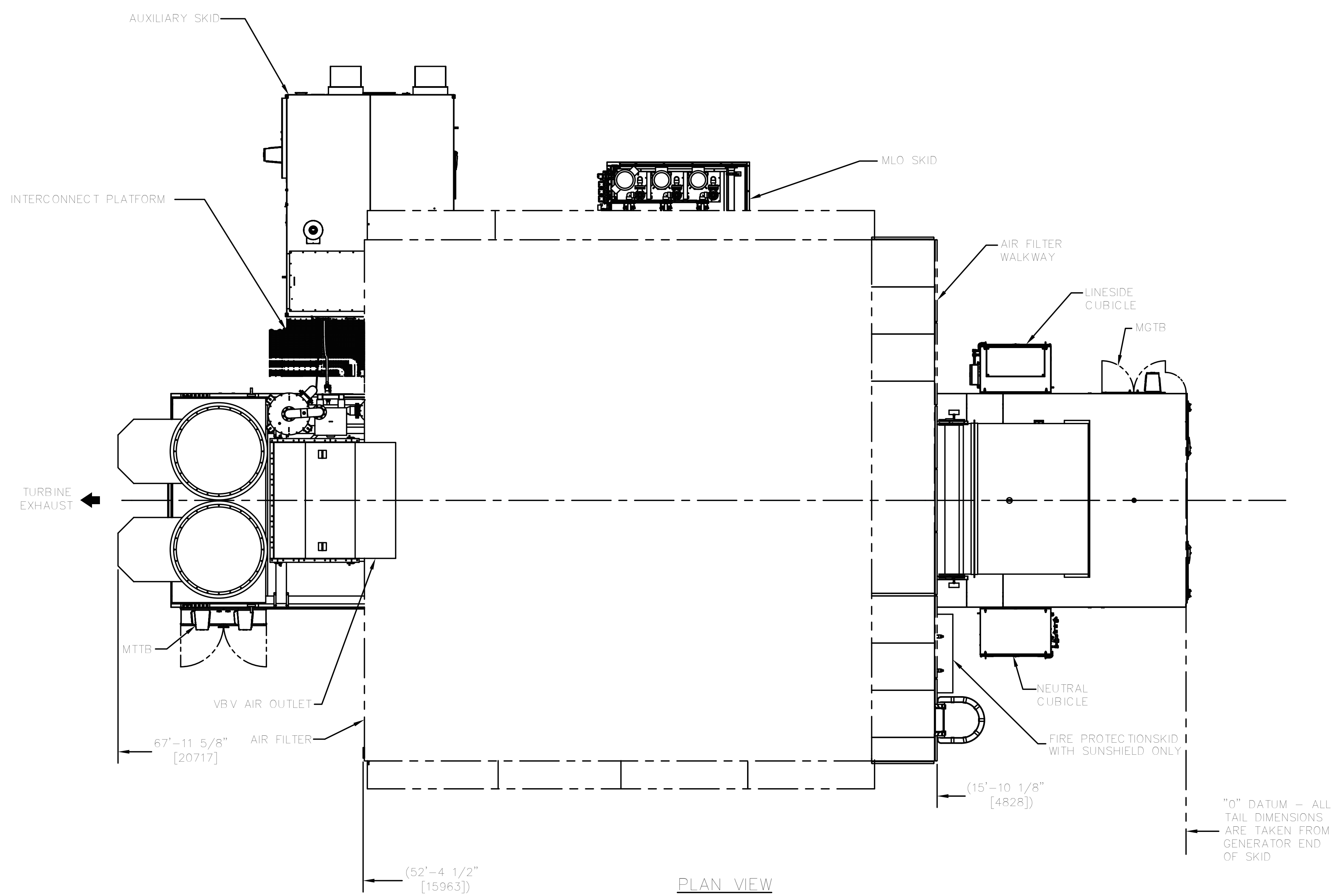
1. TOLERANCE ON FLANGE CONNECTIONS ±1/8" [3]
   TOLERANCE ON ELECTRICAL CONNECTIONS ±1/8" [3]
   TOLERANCE ON BOLT HOLES ±1/16" [2] TRUE POSITION
2. DIMENSIONS AND VALUES IN [ ] ARE SI UNITS AND ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
3. ADDITIONAL EXTERIOR LIGHTING TO BE SUPPLIED BY CUSTOMER.
4. MAXIMUM LOAD ON EACH ENGINE REMOVAL FOOT PAD IS 12,000 LBS [5443 kg], (24000 LBS [10886 kg] TOTAL ENGINE REMOVAL LOAD). MAXIMUM LOAD ON EACH GEARBOX REMOVAL PAD IS 28,000 LBS [12700 kg].
5. AUXILIARY SKID & FIRE PROTECTION SKID FOUNDATIONS MUST BE AT THE SAME ELEVATION AS THE MAIN SKID FOUNDATION.
6. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
7. PIPING AND/OR TUBING MATERIAL SPECIFICATION LISTED IN CONNECTION LEGEND SHALL BE USED BY CUSTOMER AS A RECOMMENDATION IN DESIGN OF THEIR PLANT INTERCONNECT PIPING SYSTEM.
8. MLO SKID FOUNDATION MUST BE 1' - 2" [356] LOWER THAN MAIN UNIT
9. AIR FILTER SHOWN AS REFERENCE, FOR ACTUAL CONFIGURATION SEE GA AIR FILTER DRAWING/SUPPLIER DRAWING
10. AUXILIARY SKID CONFIGURATIONS ARE LOCATED IN X-504218.
11. PRECAUTION MOST BE TAKEN WHEN OPENING ENGINE REMOVAL DOORS TO AVOID SURROUNDING EQUIPMENT DAMAGE.

SAFETY NOTE: CAUTION

1. GEPPLP SHALL NOT BE LIABLE FOR DAMAGE CAUSED BY EXCESSIVE FLANGE LOADS OR INADEQUATE EXPANSION JOINT DESIGN. FAILURE TO PROVIDE FOR ADEQUATE THERMAL EXPANSION OR EXCEEDING ALLOWABLE FLANGE LOADS MAY RESULT IN DAMAGE TO OR DESTRUCTION OF FASTENERS AND ENGINE/EXHAUST SYSTEM RELATED HARDWARE RESULTING IN EXHAUST LEAKS AND ACCELERATED WEAR ON THE EXHAUST DIFFUSER ASSEMBLY. IT IS THE CUSTOMER'S RESPONSIBILITY TO ALLOW A CONSERVATIVE AMOUNT OF EXPANSION CAPABILITY TO ACCOMMODATE INSTALLATION ERRORS AND TOLERANCE STACK-UPS FOR THE COMPLETE EXHAUST SYSTEM.
2. IN THE REMOTE CHANCE OF A HP ROTOR FAILURE THE ENGINE CASING MAY NOT CONTAIN THE ENTIRE FAILURE. IT IS HIGHLY RECOMMENDED THAT NO PERMANENTLY MANNED SPACES BE LOCATED IN THE PLANE OF THE HP TURBINE. IT IS ALSO HIGHLY RECOMMENDED THAT ALL POTENTIALLY HAZARDOUS LINES (i.e. FUEL) OR EQUIPMENT (i.e. SHUTOFF VALVES, CONTROL VALVES) ALSO BE LOCATED OUTSIDE THE PLANE OF THE HP TURBINE.

REFERENCE DRAWINGS:

X-504204 GENERAL ARRANGEMENT, AIR FILTER
X-504218 GENERAL ARRANGEMENT, AUXILIARY SKID
X-504221 GENERAL ARRANGEMENT, GENERATOR/GEARBOX MINERAL LUBE OIL SKID




PLAN VIEW

50Hz PF



REVISIONS

| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | UPDATED LINE SIDE CUBICLE | | MR | 11/04/16 | EN |
| C | UPDATED LINE SIDE CUBICLE TO RH | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ± 1/8"; ANGULAR ± 1°

NEXT ASSY.

UNIT TYPE: LM6000®

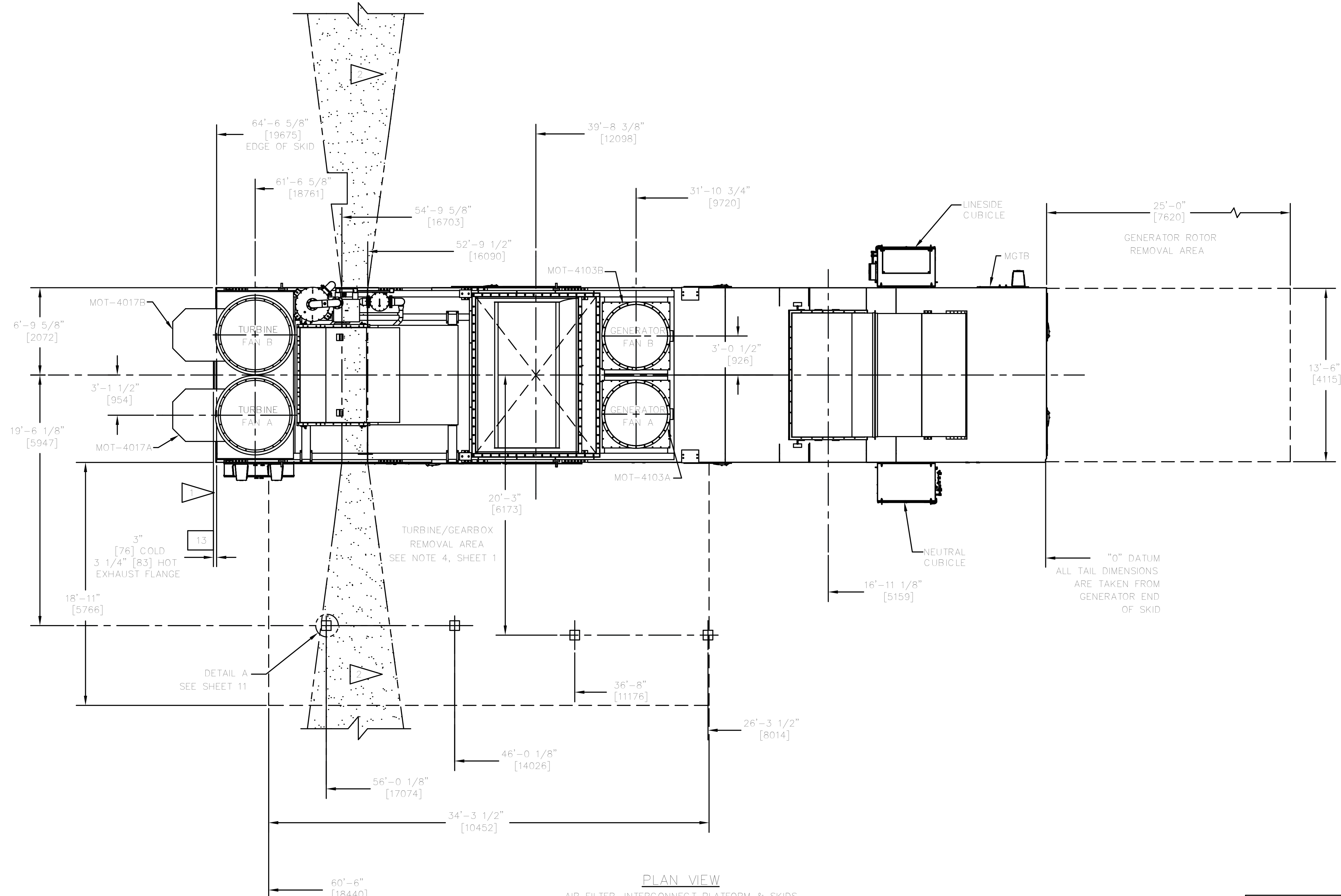
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT - RH

DWG NO. 7262875-504200 REV. F

SCALE 1/4" = 1'-0" SHEET 1 OF 17




50Hz PF

PLAN VIEW

AIR FILTER, INTERCONNECT PLATFORM & SKIDS REMOVED FOR CLARITY



REVISIONS

| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | ADDED MOT-4017A/B AND MOT-4103A/B TAG | | MR | 12/14/16 | EN |
| D | UPDATED DIMENSION AT ZONE B5 AND B6 | | MR | 11/04/16 | EN |
| C | UPDATED LINE SIDE CUBICLE TO RH | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ± 1/8"; ANGULAR ± 1°

NEXT ASSY:

UNIT TYPE: LM6000®

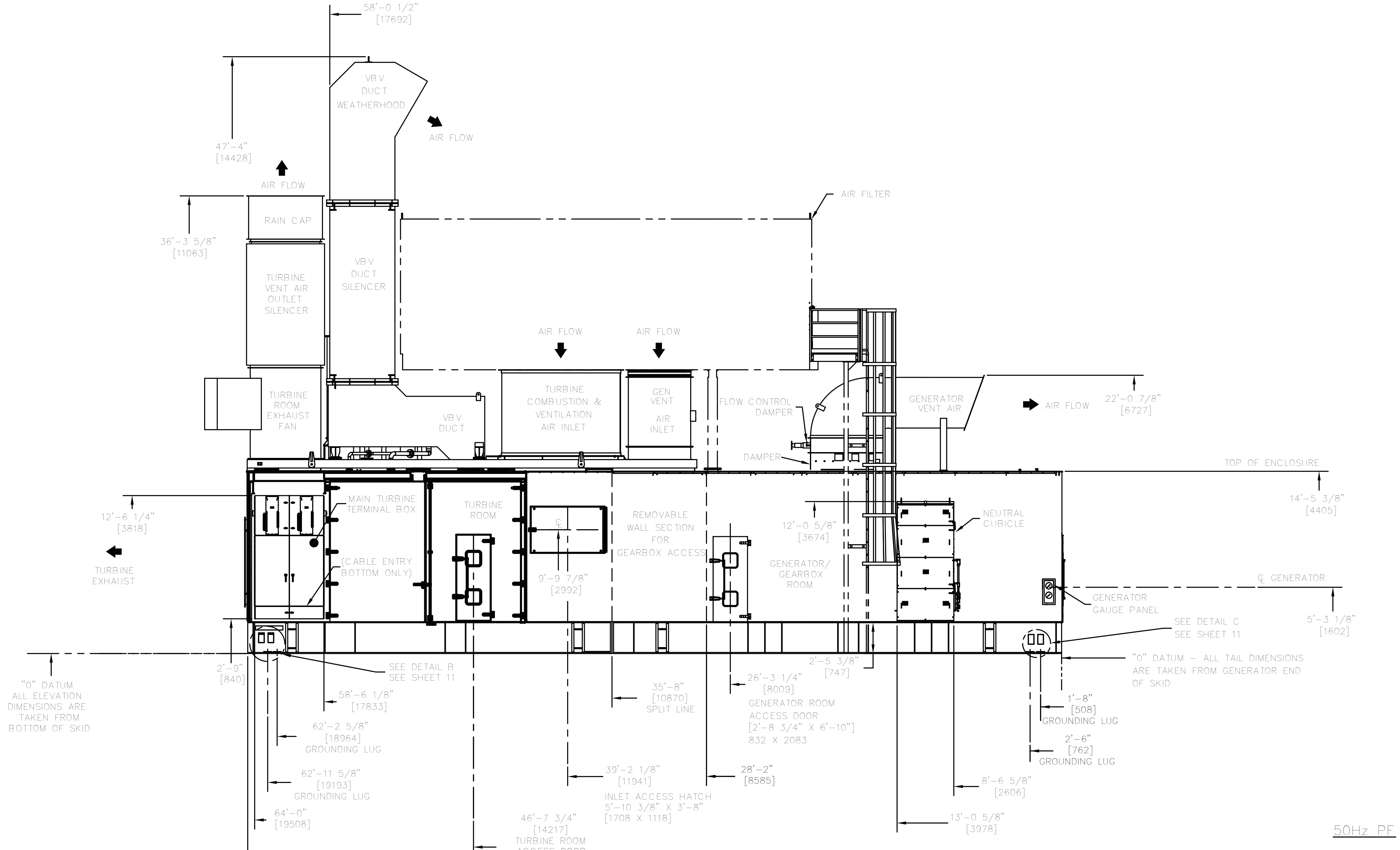
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875-504200 REV. F

SCALE 1/4" = 1'-0" SHEET 2 OF 17




50Hz PF

LEFT SIDE ELEVATION

FIRE PROTECTION SKID NOT SHOWN FOR CLAIRTY

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED TO NEUTRAL SIDE CUBICLE | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010 FRACTIONAL ±1/8" ANGULAR ±1°

NEXT ASSY:

UNIT TYPE LM6000®

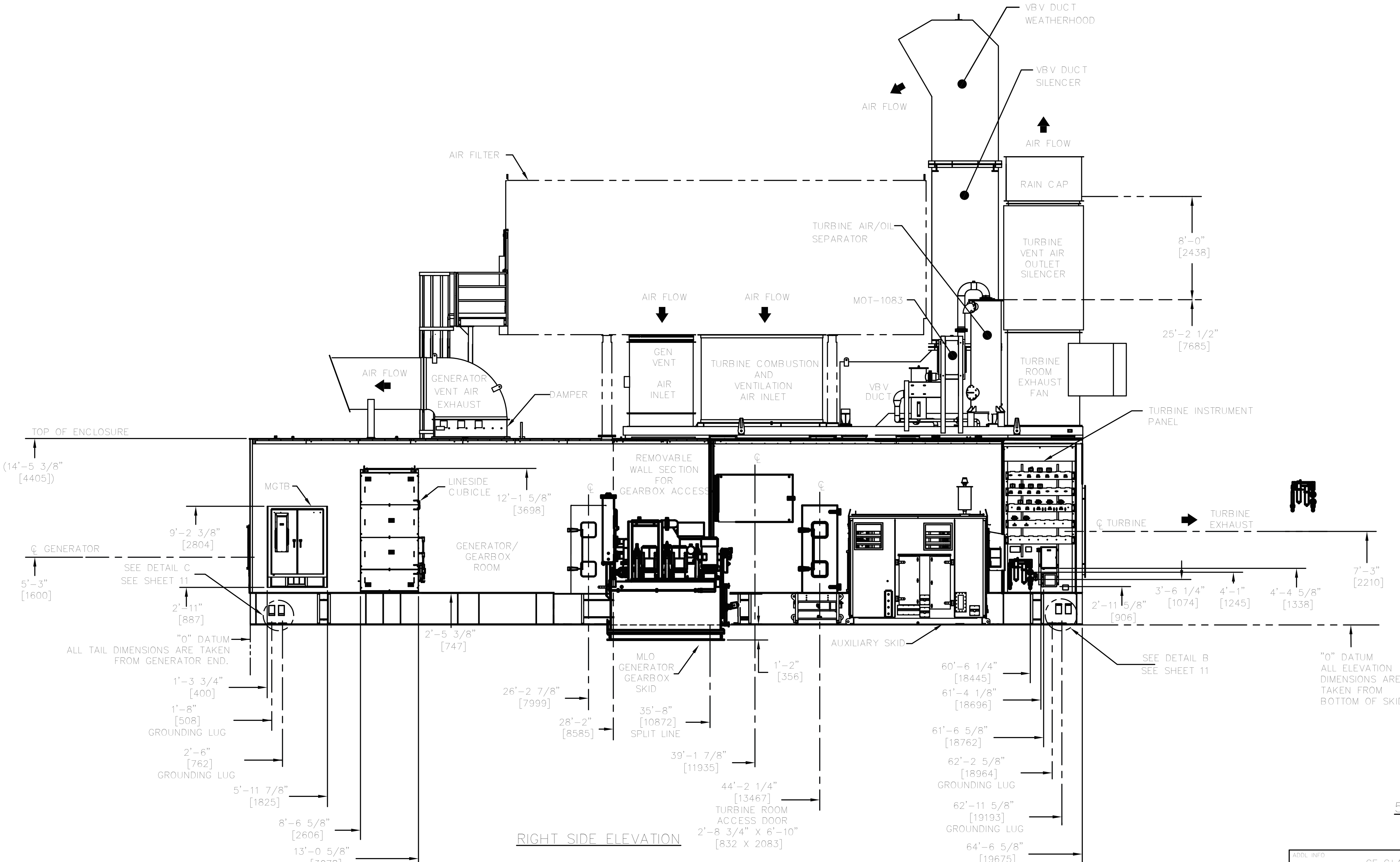
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875–504200 REV. F

SCALE 1/4" = 1'-0" SHEET 3 OF 17




RIGHT SIDE ELEVATION

50Hz PF



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | ADDED DIMENSION DETAILS AT ZONE B2 & B3 | | MR | 02/16/17 | EN |
| E | ADDED MOT-1083 TAG NUMBER | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED VIEW AUXILIARY AND MLO SKID | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY:

UNIT TYPE: LM6000®

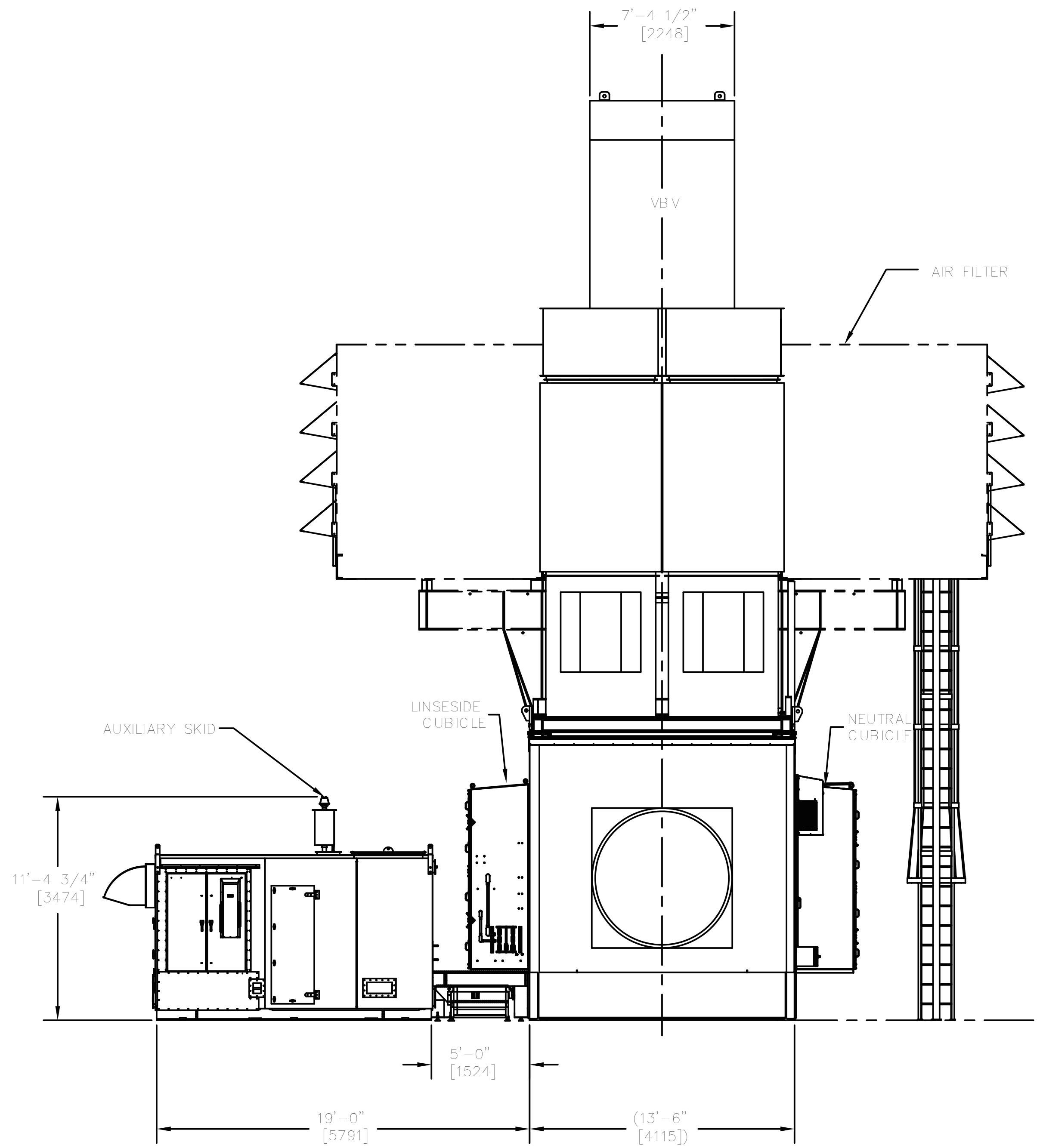
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

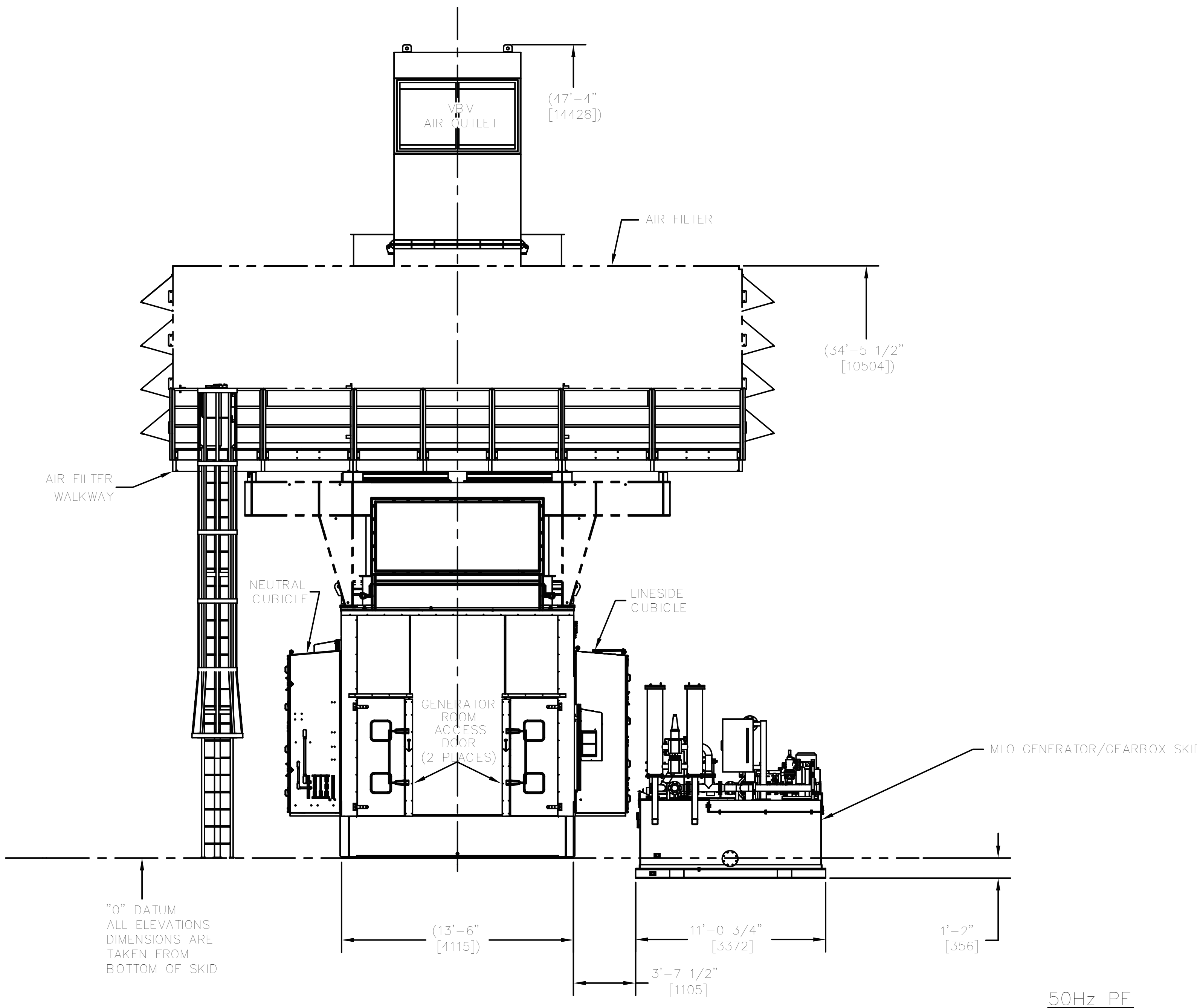
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875-504200 REV. F

SCALE 1/4" = 1'-0" SHEET 4 OF 17




EXHAUST END VIEW
SOME SKIDS NOT SHOWN FOR CLARITY




GENERATOR END VIEW
SOME SKIDS & INTERCONNECT PLATFORM
NOT SHOWN FOR CLARITY

50Hz PF



RESERVED

| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED VIEW | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY:

UNIT TYPE
LM6000®

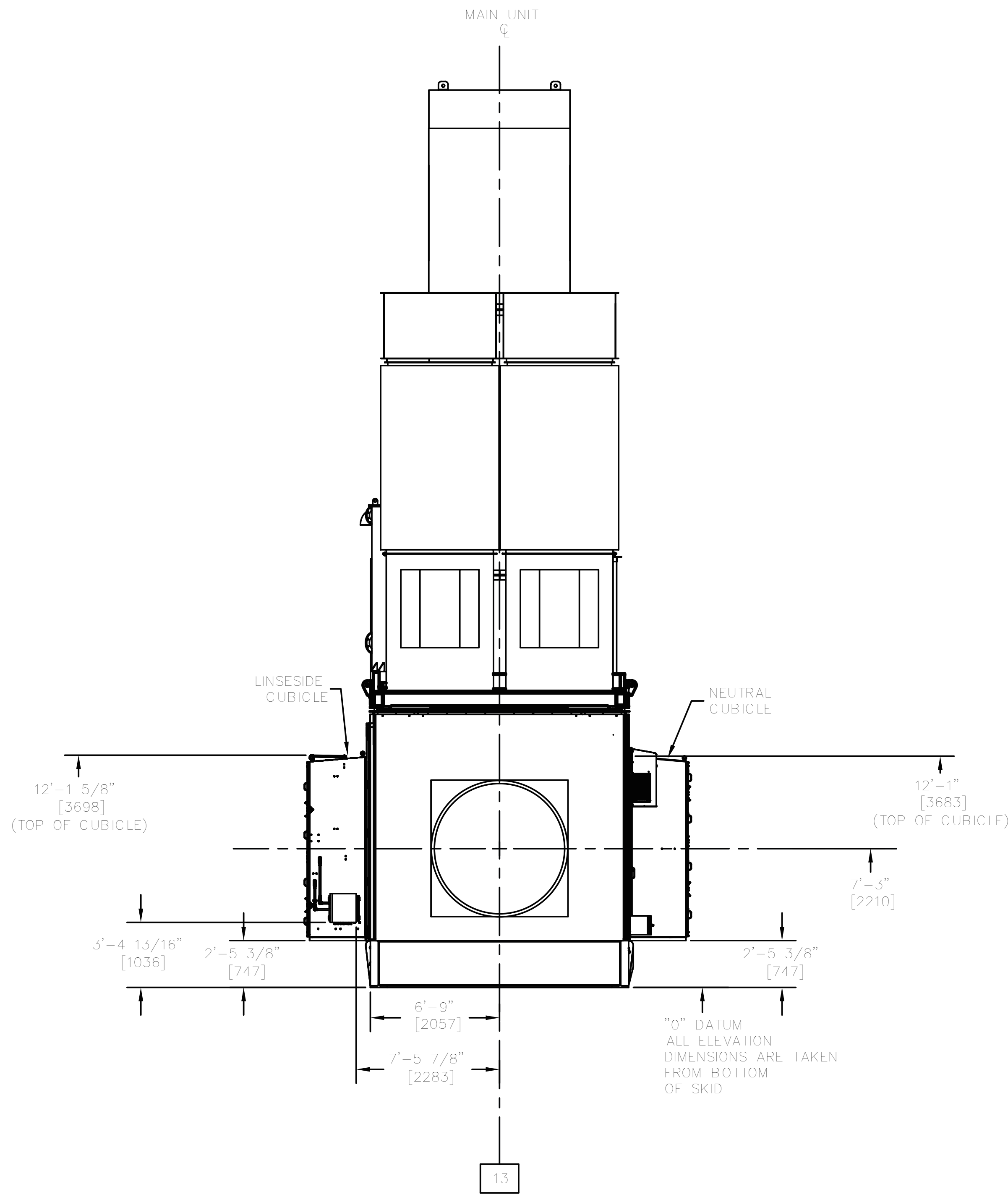
ADDL INFO
GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE
GENERAL ARRANGEMENT
MAIN UNIT – RH

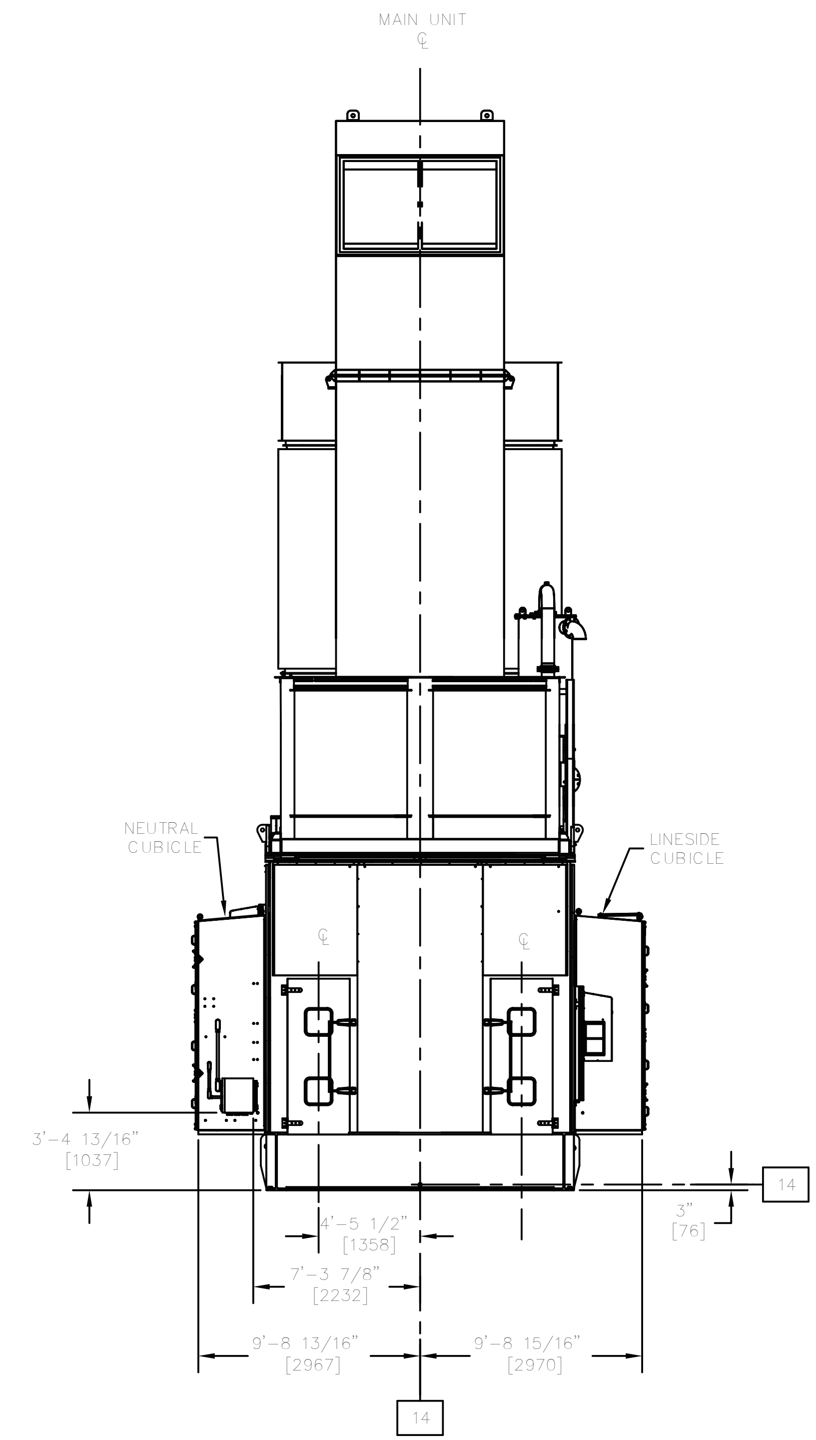
DWG NO. 7262875-504200
REV. F

SCALE 1/4" = 1'-0"
SHEET 5 OF 17




VIEW FROM EXHAUST END

AIR FILTER, INTERCONNECT PLATFORM & SKIDS REMOVED FOR CLARITY




VIEW FROM GENERATOR END

AIR FILTER, GENERATOR EXHAUST, INTERCONNECT PLATFORM & SKIDS REMOVED FOR CLARITY

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED LINE SIDE CUBICLE TO RH SIDE | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES

DECIMALS .XX ± .03 .XXX ± .010 FRACTIONAL ± 1/8" ANGULAR ± 1°

NEXT ASSY:

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

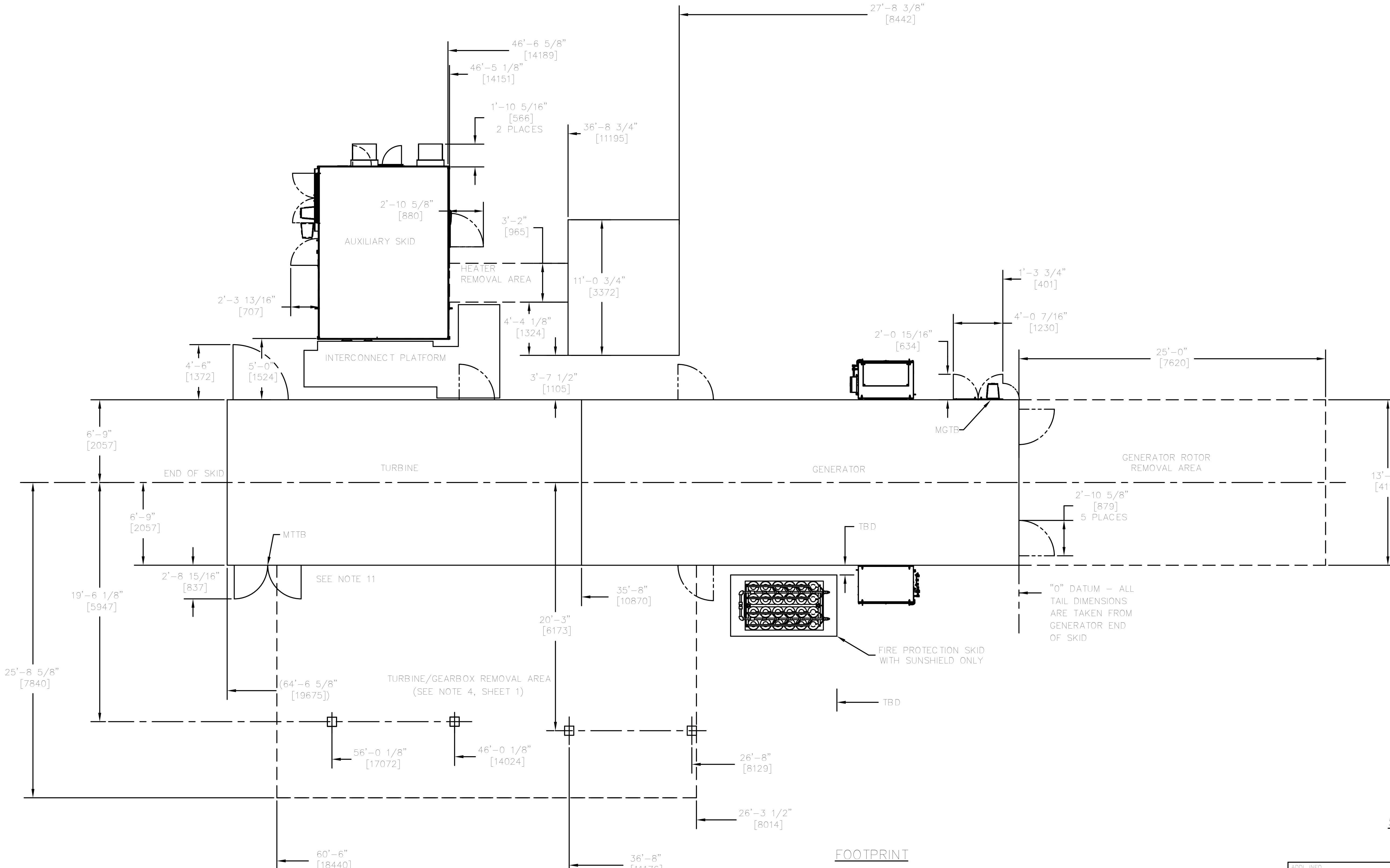
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875–504200

REV. F

SCALE 1/4" = 1'-0"

SHEET 6 OF 17




FOOTPRINT

50Hz PF

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | UPDATED DIMENSION AT ZONE B6 | | MR | 11/04/16 | EN |
| C | UPDATED VIEW | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ± 1/8"; ANGULAR ± 1°

NEXT ASSY:

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

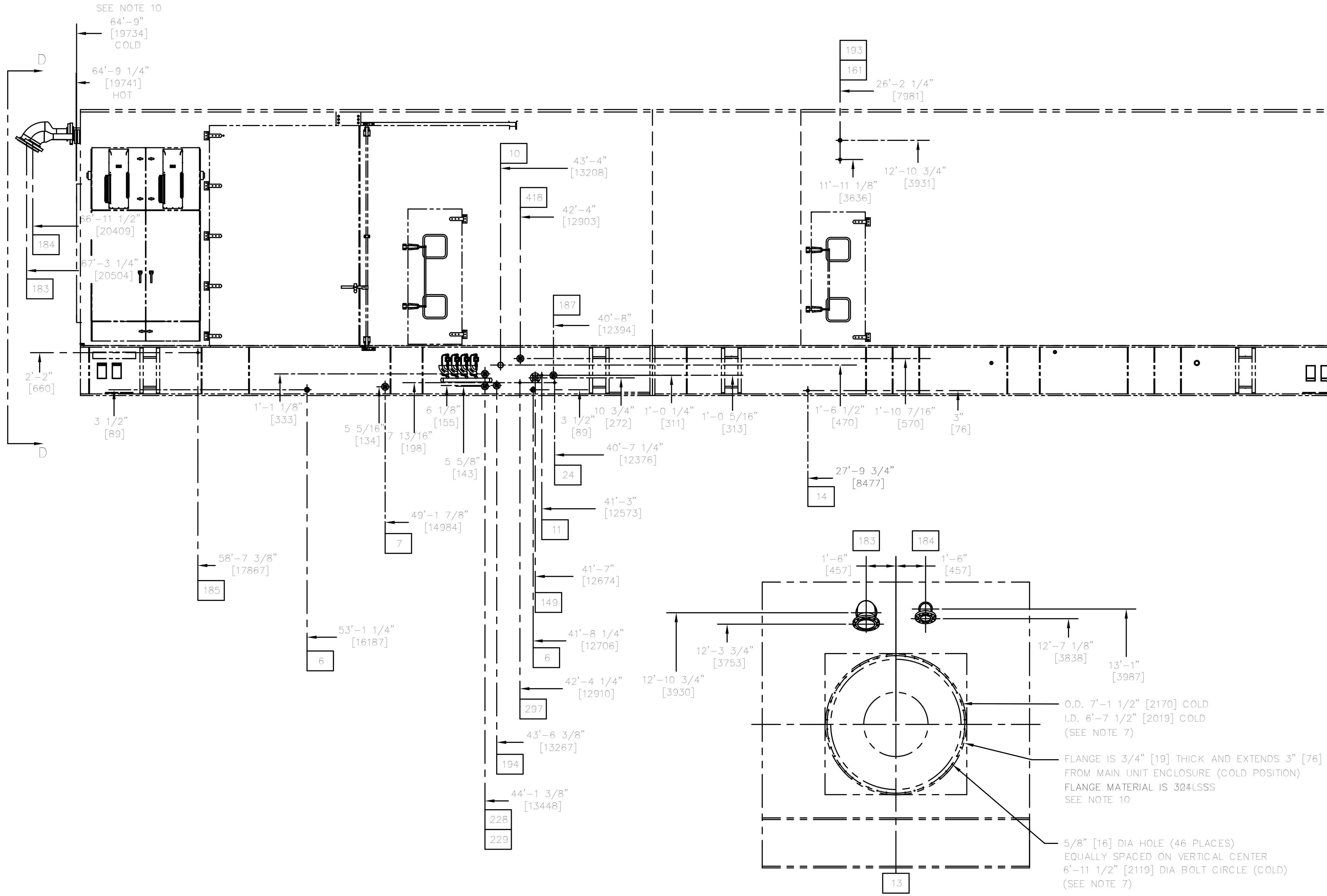
TITLE: GENERAL ARRANGEMENT MAIN UNIT - RH

DWG NO. 7262875-504200 | REV. F

SCALE 1/4" = 1'-0" | SHEET 7 OF 17

LEGEND

☐ INDICATES CUSTOMER CONNECTION.




LEFT SIDE ELEVATION

VIEW D-D

(TURBINE EXHAUST INTERFACE BOLT PATTERN)

14

3" [76]

"0" DATUM
ALL ELEVATION DIMENSIONS ARE TAKEN FROM BOTTOM OF SKID.

"0" DATUM
ALL TAIL DIMENSIONS ARE TAKEN FROM GENERATOR END OF SKID.

NOTES:

1. MAXIMUM LOAD ON EXHAUST FLANGE TO BE 500 LBS [227 kg] VERTICAL AND 50 LBS [23 kg] AXIAL. TRANSITION FROM EXHAUST COLLECTOR TO OUTLET FLANGE IS SOLID. FOR EXPECTED THERMAL GROWTH, SEE EXHAUST OUTLET LOCATION DIMENSIONS.
2. ALL MAIN UNIT FLANGED CUSTOMER CONNECTIONS ARE LOCATED 6'-8 1/2" [2045] FROM CENTERLINE OF UNIT, EXCEPT:
   - 10: 1 3/16" [155] FROM EDGE OF SKID TO THE INSIDE
   - 11, 24 & 297: 3 5/16" [84] FROM EDGE OF SKID TO THE INSIDE
   - 14: ALIGNED WITH CENTERLINE. THE OTHER TWO ARE LOCATED ON SAME SIDE AS CONNECTION 6.
   - 149: 7'-0 1/4" [2140] FROM CENTERLINE
   - 228: 6'-10 1/2" [2092] FROM CENTERLINE
   - 229: 6'-10 1/2" [2092] FROM CENTERLINE
3. ALL MAIN UNIT NPT COUPLINGS EXTEND 6'-5 1/8" [1959] FROM CENTERLINE OF UNIT, EXCEPT CONNECTION 14 AND 161. FOR CONNECTION 161, PUT NPT COUPLING FLUSH WITH PANEL.
4. FOR CONNECTION DESCRIPTIONS, SEE SHEET 10.
5. REFERENCE OTHER APPLICABLE GENERAL ARRANGEMENTS FOR LOCATIONS AND DESCRIPTIONS OF ADDITIONAL CONNECTIONS. THOSE CONNECTIONS NOT LISTED ARE NOT USED ON THIS PROJECT.
6. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
7. "HOT" INTERFACE MATING FLANGE SHOULD BE EXTERNALLY INSULATED AND 304L SS.
8. HARDWARE CONNECTION 13 IS SUPPLIED BY EXHAUST STACK / EXPANSION JOINT SUPPLIER.

10. FINAL 13 EXHAUST FLANGE LOCATION MAY VARY, DEPENDING ON ENGINE ALIGMENT, EXPANSION JOINT DESIGN SHOULD ALLOW FOR THERMAL GROWTH AND ALIGNMENT APPROXIMATELY 1" IN ALL DIRECTIONS.

ADDL INFO: GE CLASS II (INTERNAL)

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | UPDATED GAS FUEL CUSTOMER CONNECTION 10 | | MR | 11/04/16 | EN |
| C | UPDATED WITH GAS FUEL AND PF OPTION | | MR | 08/18/16 | EN |
| B | ADDED CO2 EXTENDED DISCHARGE OPTION | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ± 1/8"; ANGULAR ± 1°

NEXT ASSY:

UNIT TYPE: LM6000®

GE P&W DISTRIBUTED POWER

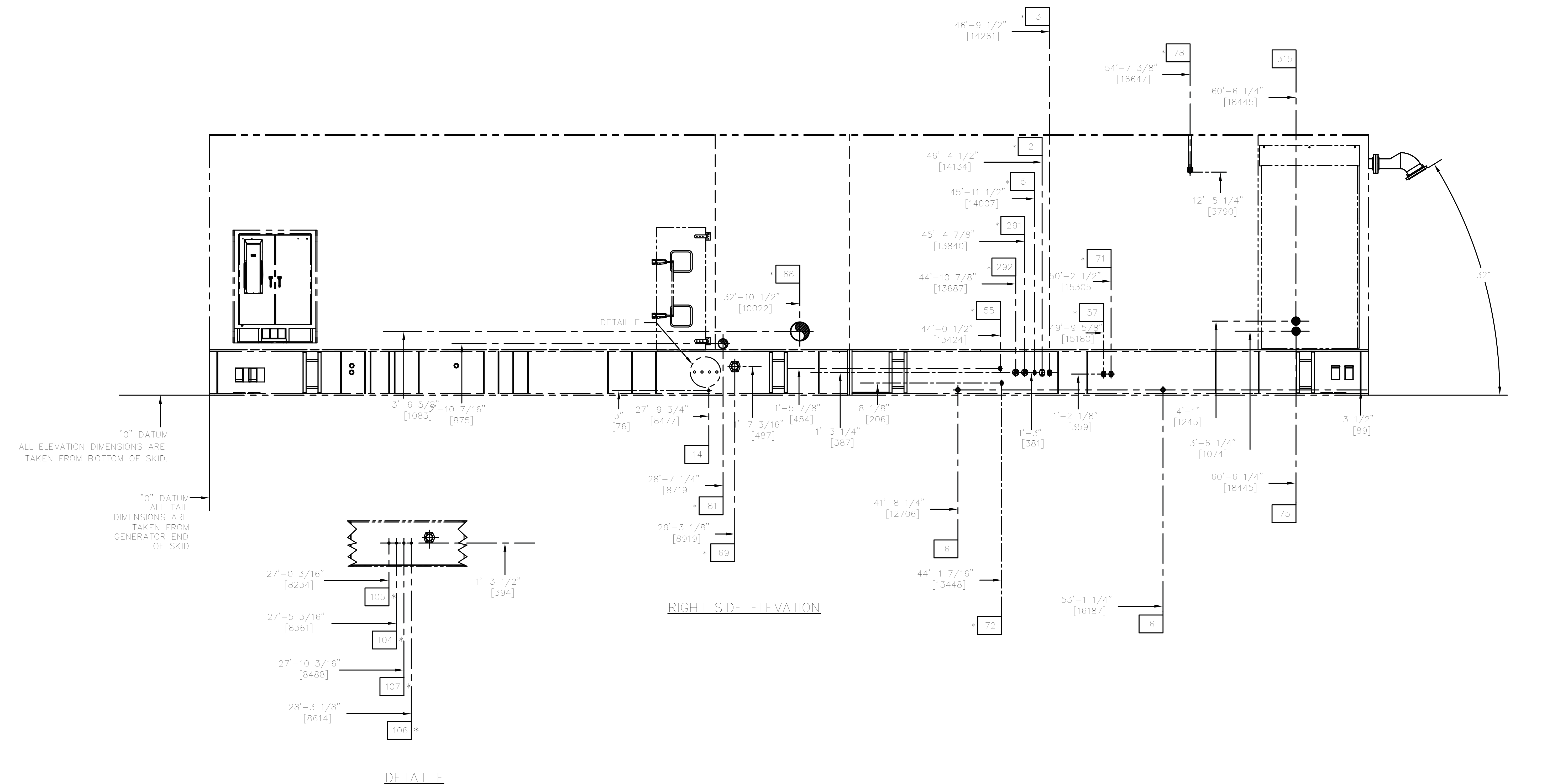
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875-504200

REV. F

SCALE 3/8" = 1'-0"

SHEET 8 OF 17




50Hz PF



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | ADDED CUSTOMER CONNECTION 75 & 315 | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED WITH GAS FUEL AND PF OPTION | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03 .XXX ± .010; FRACTIONAL ±1/16"; ANGULAR ±1°

NEXT ASSY:

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875-504200 REV. F

SCALE 3/8" = 1'-0" SHEET 9 OF 17

## CUSTOMER CONNECTION LEGEND:

- * 2 — HYDRAULIC STARTER SUPPLY – 1 1/2"–6000# FF, SAE CODE 62, TP304 PIPE SCH XXS
- * 3 — HYDRAULIC STARTER RETURN – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- * 5 — HYDRAULIC STARTER CASE DRAIN – 1"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- 6 — TURBINE SUMP DRAIN – 2" FNPT 3000#, CPLG, 304SS
- 7 — EXHAUST DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
- 10 — GAS FUEL INLET – 3" WELDED PIPE, TP304 SCH 40S
- 11 — GAS FUEL VENT – 1" WELDED PIPE, TP304 SCH 40S
- 13 — TURBINE EXHAUST DUCT CONNECTION – N/A
- 14 — GENERATOR/GEARBOX SUMP DRAIN – 1" FNPT 3000#, CPLG, 304SS
- 24 — GAS FUEL VENT – 1" WELDED PIPE, TP304 SCH 40S
- * 55 — INSTRUMENT AIR SUPPLY – 1"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- * 57 — SCAVENGE LUBE OIL FILTER/COOLER SUPPLY – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- * 68 — GEARBOX LUBE OIL RETURN LINE – 12" PIPE, TP304 SCH 10S
- * 69 — GENERATOR LUBE OIL SUPPLY – 4"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- * 71 — TURBINE LUBE OIL PUMP SUPPLY – 1 1/2"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- * 72 — WATER WASH SUPPLY – 1"–3000# FF, SAE CODE 61, TP304 PIPE SCH 40S
- 75 — TURBINE LUBE OIL HEAT EXCHANGER SUPPLY – 1 1/2"–150# RF, TP304 PIPE SCH 40S
- * 78 — TURBINE LUBE OIL AIR/OIL PRE-SEPARATOR RETURN – 1 1/2"–3000# FF, SAE CODE 61, TP304 SCH 40S
- * 81 — GENERATOR LUBE OIL DRAIN LINE – 6" PIPE, TP304 SCH 10S
- * 104 — JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
- * 105 — JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
- * 106 — JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
- * 107 — JACKING OIL RETURN – 3/4" COMPRESSION TUBE FITTING, TP304 TUBING 0.065" WT MINIMUM
- * 124 — TURBINE LUBE OIL AIR/OIL SEPARATOR RETURN – 1/2" JIC, TP304 TUBING 0.049" WT MINIMUM
- 149 — INLET VOLUTE DRAIN – 2"–150# RF, TP304 PIPE SCH 40S
- * 161 — CO2 – 1 1/4" FNPT 3000#, CPLG, 304SS
- 183 — 8TH STAGE BLEED AIR CONNECTION – 10"–150# RF, TP304 PIPE SCH 10S
- 184 — CDP BLEED AIR CONNECTION – 6"–300# RF, TP321 PIPE SCH 10S
- 185 — INSTRUMENT AIR FOR DAMPER RESET – 1/4" FNPT, 304SS
- 187 — VBV DUCT DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
- * 193 — FIRE PROTECTION, EXTENDED DISCHARGE, CO2 INLET – 1/2" NPT 304SS
- 194 — COMBUSTOR DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
- 228 — TURBINE LUBE OIL OVERBOARD DRAIN VENT – 1"–150# RF, TP304 PIPE SCH 40S
- 229 — TURBINE LUBE OIL OVERBOARD DRAIN – 1"–150# RF, TP304 PIPE SCH 40S
- * 292 — SPRINT SYSTEM DEMINERALIZED WATER LPC INLET – 1" 150# RF, TP316 PIPE SCH40S
- 297 — GAS FUEL VENT – 1" PIPE, TP304 SCH 40S
- * 291 — SPRINT SYSTEM DEMINERALIZED WATER HPC INLET – 1" 150# RF, TP316 PIPE SCH40S
- 315 — TURBINE LUBE OIL FILTER SUPPLY – 1 1/2"–150# RF, TP304 PIPE SCH 40S
- 418 — STARTER CLUTCH SEAL TELL-TALE DRAIN – 1"–150# RF, TP304 PIPE SCH 40S

## NOTES:

1. AN ASTERISK (*) INDICATES CONNECTION HARDWARE BY GEPPLP.
2. FOR CUSTOMER CONNECTION FLANGES MAXIMUM ALLOWABLE LOADS, REFER TO DRAWING 806125.

50Hz PF

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | ADDED CUSTOMER CONNECTION 75 & 315 DETAILS | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED WITH GAS FUEL AND PF OPTION | | MR | 08/18/16 | EN |
| B | ADDED CO2 EXTENDED DISCHARGE OPTION | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ± 1/8"; ANGULAR ± 1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

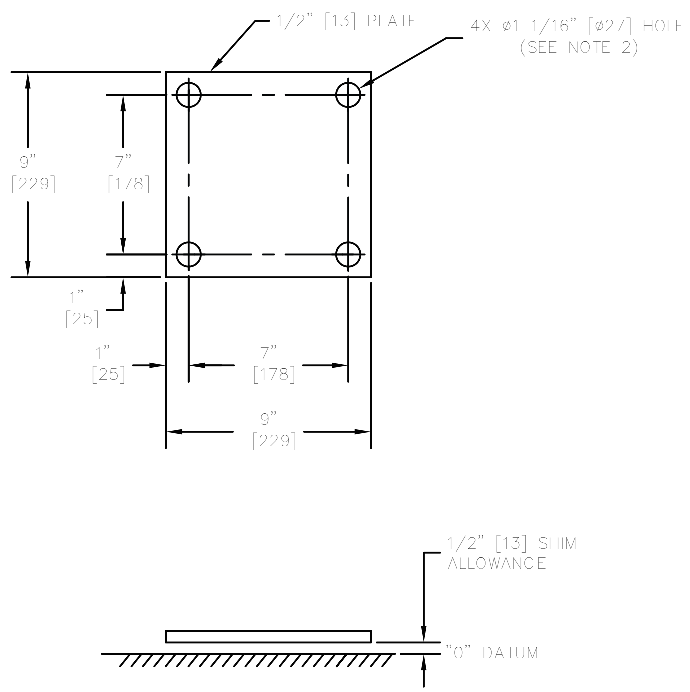
GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

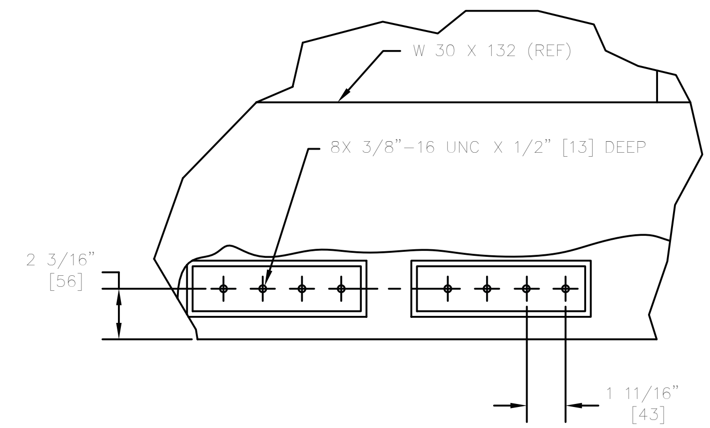
DWG NO. 7262875–504200 — REV. F

SCALE NONE — SHEET 10 OF 17

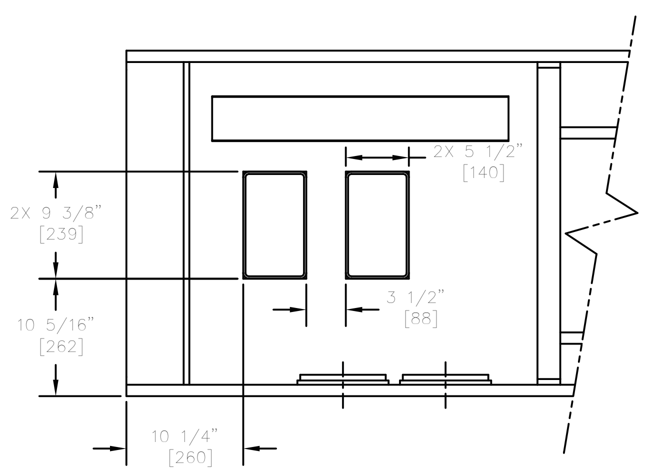
NOTES:
1. ALL ANCHORING HARDWARE TO BE SUPPLIED BY CUSTOMER.
2. BOLT HOLE TOLERANCE ± 1/8" [3], TRUE POSITION.



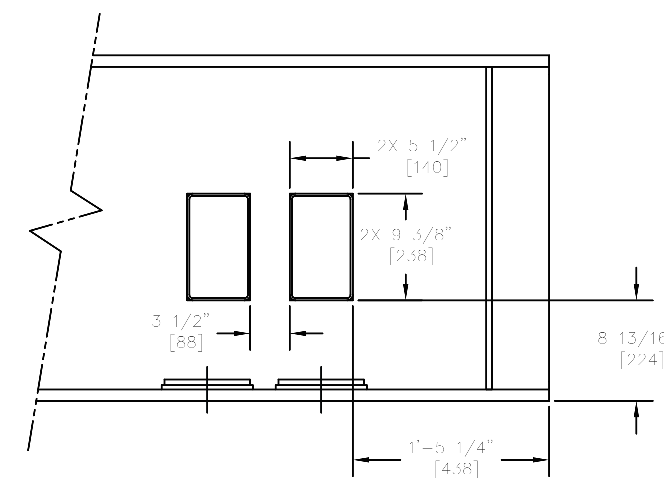

DETAIL A
ENGINE & GEARBOX REMOVAL FOOT PAD
SEE SHEET 2
(SEE NOTE 4, SHEET 1)




DETAIL B
GROUNDING LUG
SEE SHEET 3 & 4




DETAIL B
TURBINE ROXTEC ENTRANCE
SEE SHEET 3 & 4




DETAIL C
7-290 GENERATOR ROXTEC ENTRANCE
FOR 50HZ PF
SEE SHEET 3 & 4

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | RENUMBERED THIS SHEET | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010 FRACTIONAL ±1/8" ANGULAR ±1°

NEXT ASSY:

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT
MAIN UNIT – RH

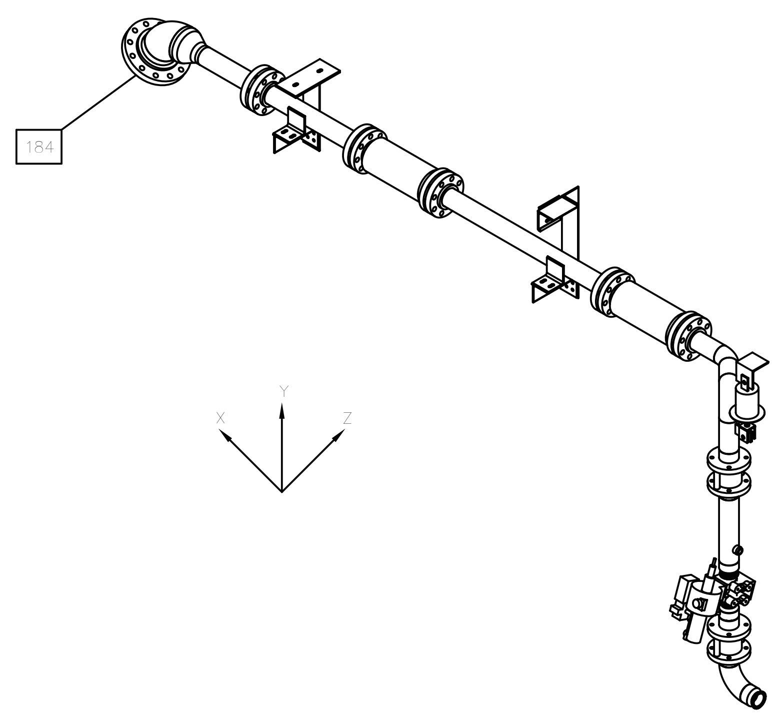
DWG NO. 7262875-504200 REV. F

SCALE 3" = 1'-0" SHEET 11 OF 17

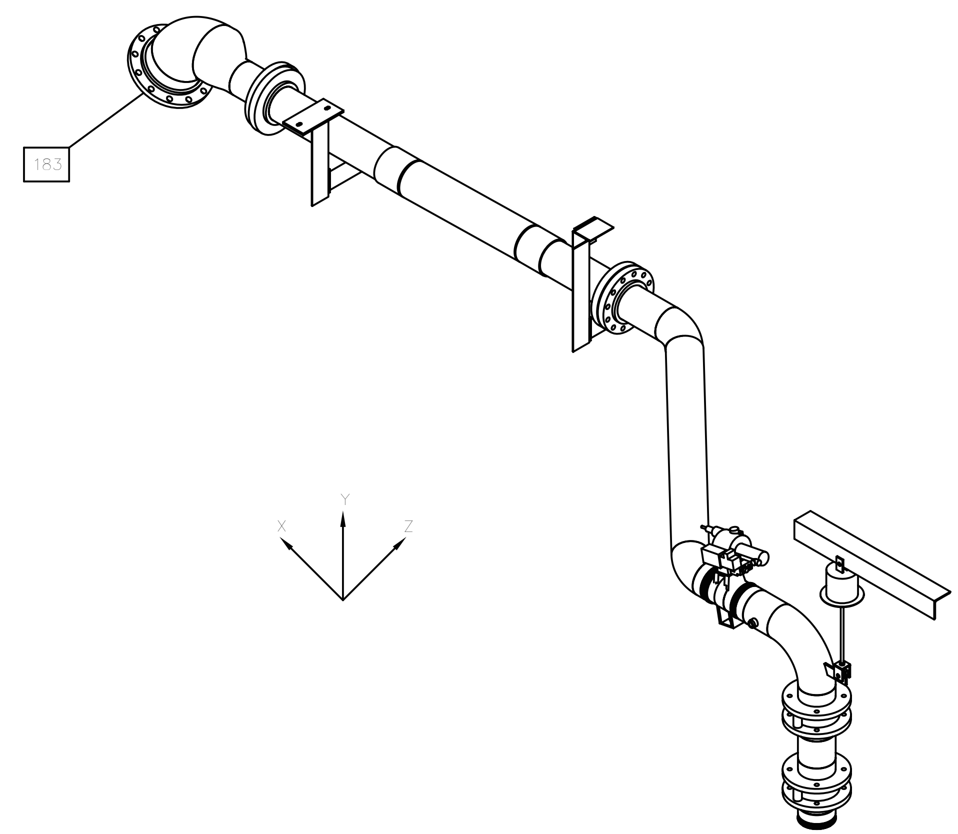
## LOADS ON CUSTOMER CONNECTIONS

| | LOAD CASE | FORCE-X lbs | FORCE-Y lbs | FORCE-Z lbs | MOMENT-X ft-lbs | MOMENT-Y ft-lbs | MOMENT-Z ft-lbs |
|---|---|---|---|---|---|---|---|
| CDP | OPERATING LOAD | 1314 | -273 | -16 | 70 | -43 | -915 |
| | SEISMIX X-0.5g | 115 | 1 | -1 | 0 | -1 | -67 |
| | SEISMIX Z-0.5g | 0 | 0 | 59 | 9 | 10 | -2 |
| 8TH STAGE | OPERATING LOAD | 4596 | -340 | -8 | 130 | -37 | -1629 |
| | SEISMIX X-0.5g | 114 | -9 | -31 | 12 | -51 | -34 |
| | SEISMIX Z-0.5g | 0 | 0 | 123 | -53 | 138 | 1 |

NOTES:
1. THESE ARE FORCES EXERTED AT CUSTOMER CONNECTIONS BY AERO PIPING. CUSTOMER NEEDS TO CONSIDER THESE FORCES IN THEIR DESIGN. THESE ARE NOT THE ALLOWABLE LOADS AT GE FLANGES.
2. OPERATING LOAD IS RESULT OF TEMPERATURE, PRESSURE AND WEIGHT OF THE SYSTEM.
3. FY OPERATING LOAD IS THE WEIGHT OF THE SYSTEM EXERTED ON THE CUSTOMER CONNECTION.
4. CUSTOMER SHOULD INCLUDE THE VERTICAL SEISMIC LOAD EFFECT EV = +/-0.2 SDS D = +/-0.24 D IN CONNECTION DESIGN PER ASCE 7-10 SECTION 12.4.




CDP BLEED




8TH STAGE BLEED

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | ADDED THIS SHEET | | MR | 08/18/16 | EN |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES: DECIMALS .XX ± .03, .XXX ± .010; FRACTIONAL ±1/8"; ANGULAR ±1°

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO. 7262875–504200 | REV. F

SCALE 3/4" = 1'-0" | SHEET 12 OF 17

## NOTES:

1. INTERIOR OF THE TURBINE ROOM IS CONSIDERED ZONE 2, ATEX CATEGORY 3 PER IEC 60079-10 AND NEC 505 WHEN VENTILATION FANS ARE NOT OPERATING. WHEN FANS ARE OPERATING, AREA IS CONSIDERED UNCLASSIFIED.
2. INSIDE GENERATOR ENCLOSURE, CONSIDERED NON-HAZARDOUS AREA.
3. DIMENSIONS AND VALUES IN [ ] ARE U.S. CUSTOMARY UNITS. SI UNITS ARE GIVEN FOR REFERENCE ONLY. EQUIPMENT SHALL BE DESIGNED AND MANUFACTURED USING U.S. CUSTOMARY UNITS.
4. AREA OUTSIDE OF TURBINE ENCLOSURE CAN BECOME UNCLASSIFIED WHEN GAS FUEL SUPPLY PIPE INTERFACE IS SEAL WELDED. EXCLUSIVE OF THE TURBINE FAN AND VBV EXHAUST PATHS
5. CUSTOMER DRAWING NUMBERS CONSIST OF: (ORDER NUMBER)-(STANDARD DRAWING NUMBER), AND ARE REFERENCED AS X-(STANDARD DRAWING NUMBER), WHERE X = ORDER NUMBER.
6. IT IS THE CUSTOMERS SCOPE OF RESPONSIBILITY TO ROUTE GAS VENT LINES TO A SAFE AREA.
7. REFERENCE GENERAL ARRANGEMENT FOR EQUIPMENT LAYOUT.
8. LOCATION OF WOBBE METER/ GAS CHROMATOGRAPH SHALL BE AS FAR AS POSSIBLE FROM FILTER HOUSE TO AVOID INGRESS OF GAS TO THE ENGINE AIR INLET FLOW PATH.

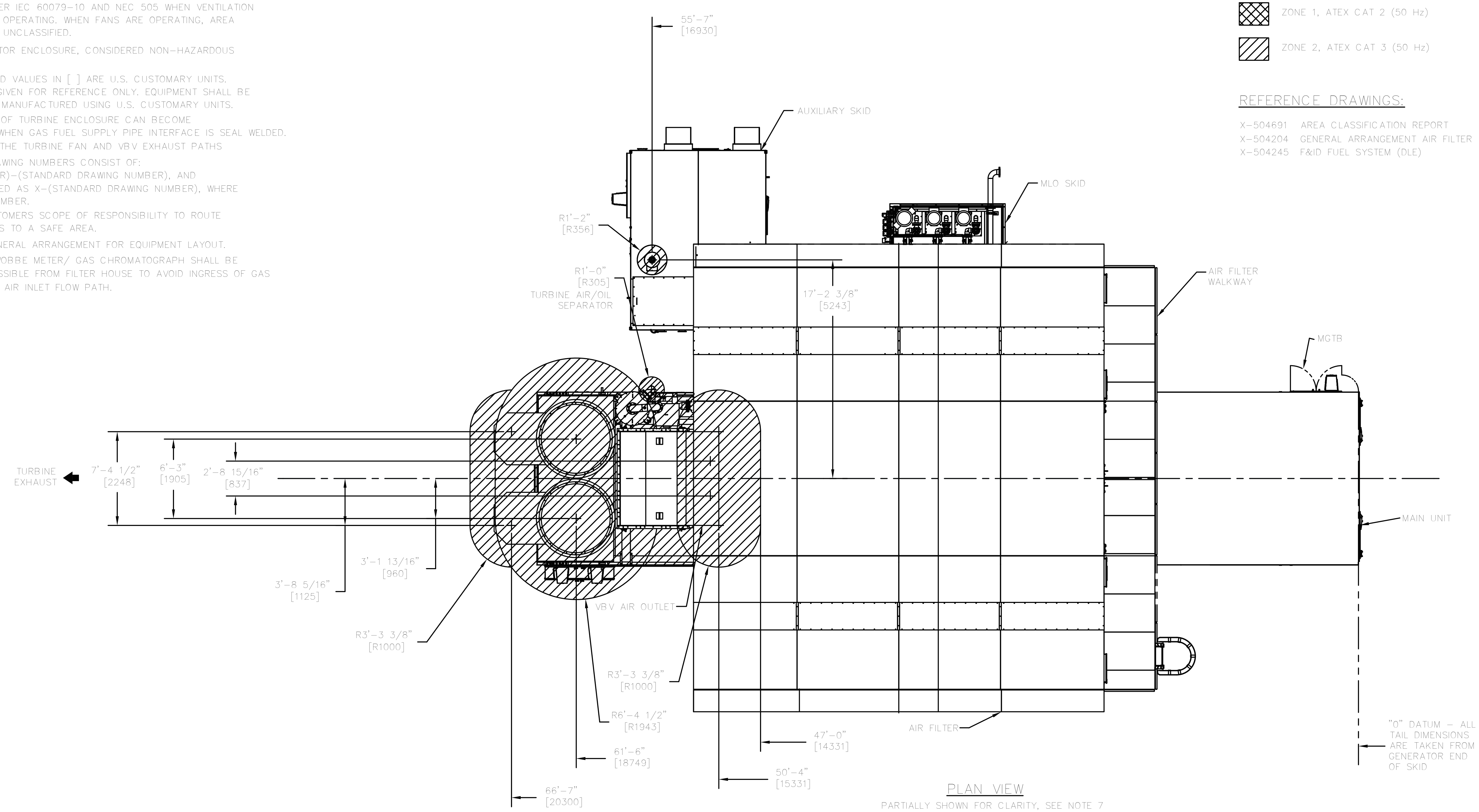
## LEGEND:

ZONE 1, ATEX CAT 2 (50 Hz)

ZONE 2, ATEX CAT 3 (50 Hz)

## REFERENCE DRAWINGS:

X-504691 AREA CLASSIFICATION REPORT
X-504204 GENERAL ARRANGEMENT AIR FILTER
X-504245 F&ID FUEL SYSTEM (DLE)




PLAN VIEW

PARTIALLY SHOWN FOR CLARITY, SEE NOTE 7

AREA CLASSIFICATION

RESERVED



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED WITH AUXILIARY SKID ENCLOSED | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DO NOT SCALE DRAWING

TOLERANCES
DECIMALS .XX ± .03 .XXX ± .010
FRACTIONAL ±1/8"
ANGULAR ±1°

NEXT ASSY:

UNIT TYPE: LM6000®

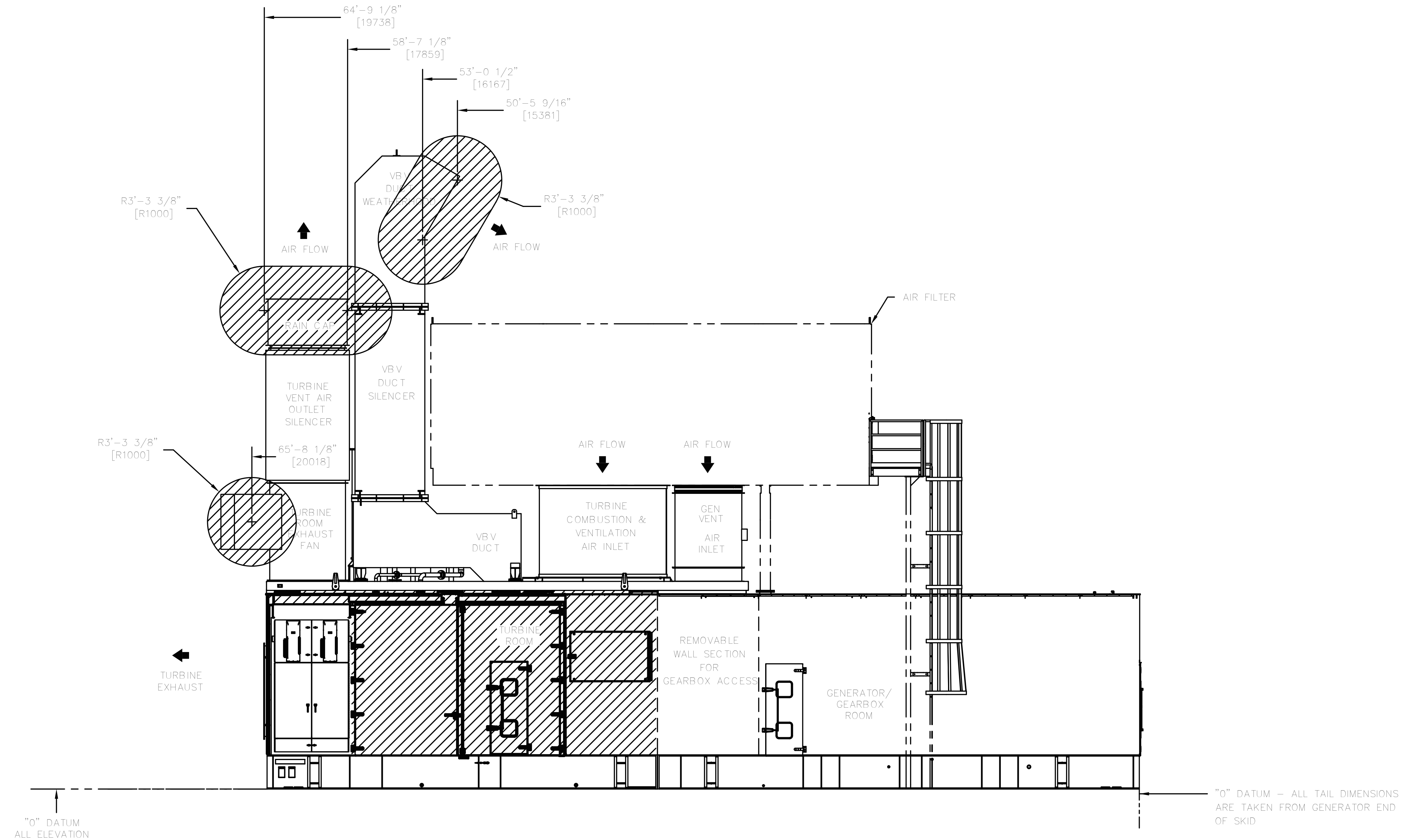
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT MAIN UNIT - RH

DWG NO. 7262875-504200 REV. F

SCALE 1/4" = 1'-0" SHEET 13 OF 17




LEFT SIDE ELEVATION

PARTIALLY SHOWN FOR CLARITY, SEE NOTE 7

AREA CLASSIFICATION



| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | RENUMBERED THIS SHEET | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

REVISIONS

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

| TOLERANCES | | |
|---|---|---|
| DECIMALS | FRACTIONAL | ANGULAR |
| .XX ± .03<br>.XXX ± .010 | ±1/8" | ±1° |

NEXT ASSY.

UNIT TYPE: LM6000®

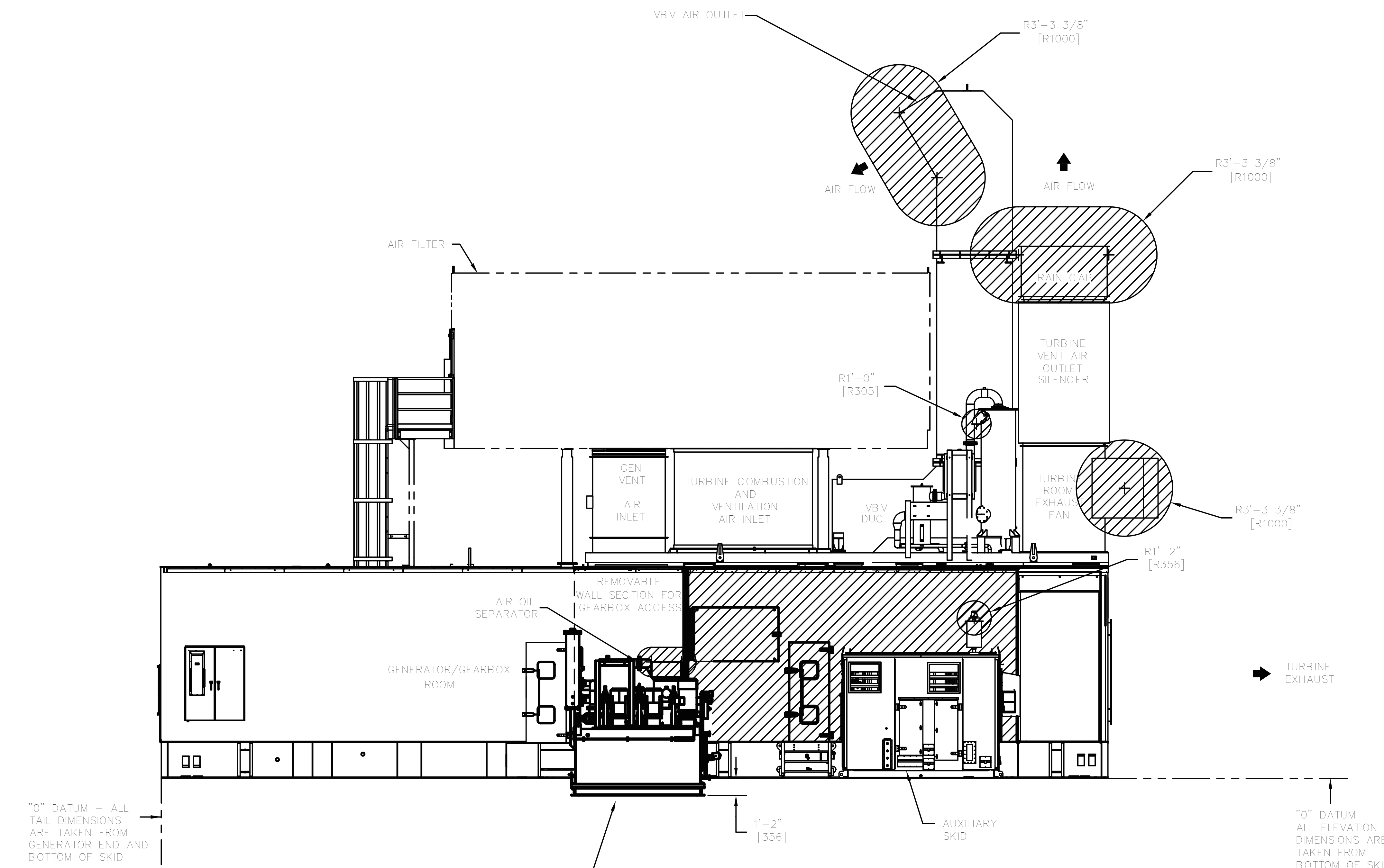
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. 7262875–504200 | REV. F

SCALE 1/4" = 1'–0" | SHEET 14 OF 17




RIGHT SIDE ELEVATION

AREA CLASSIFICATION

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT
MAIN UNIT - RH

DWG NO. 7262875-504200 — REV. F

SCALE 1/4" = 1'-0" — SHEET 15 OF 17

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

| DECIMALS | FRACTIONAL | ANGULAR |
|---|---|---|
| .XX ± .03<br>.XXX ± .010 | ±1/8" | ±1° |

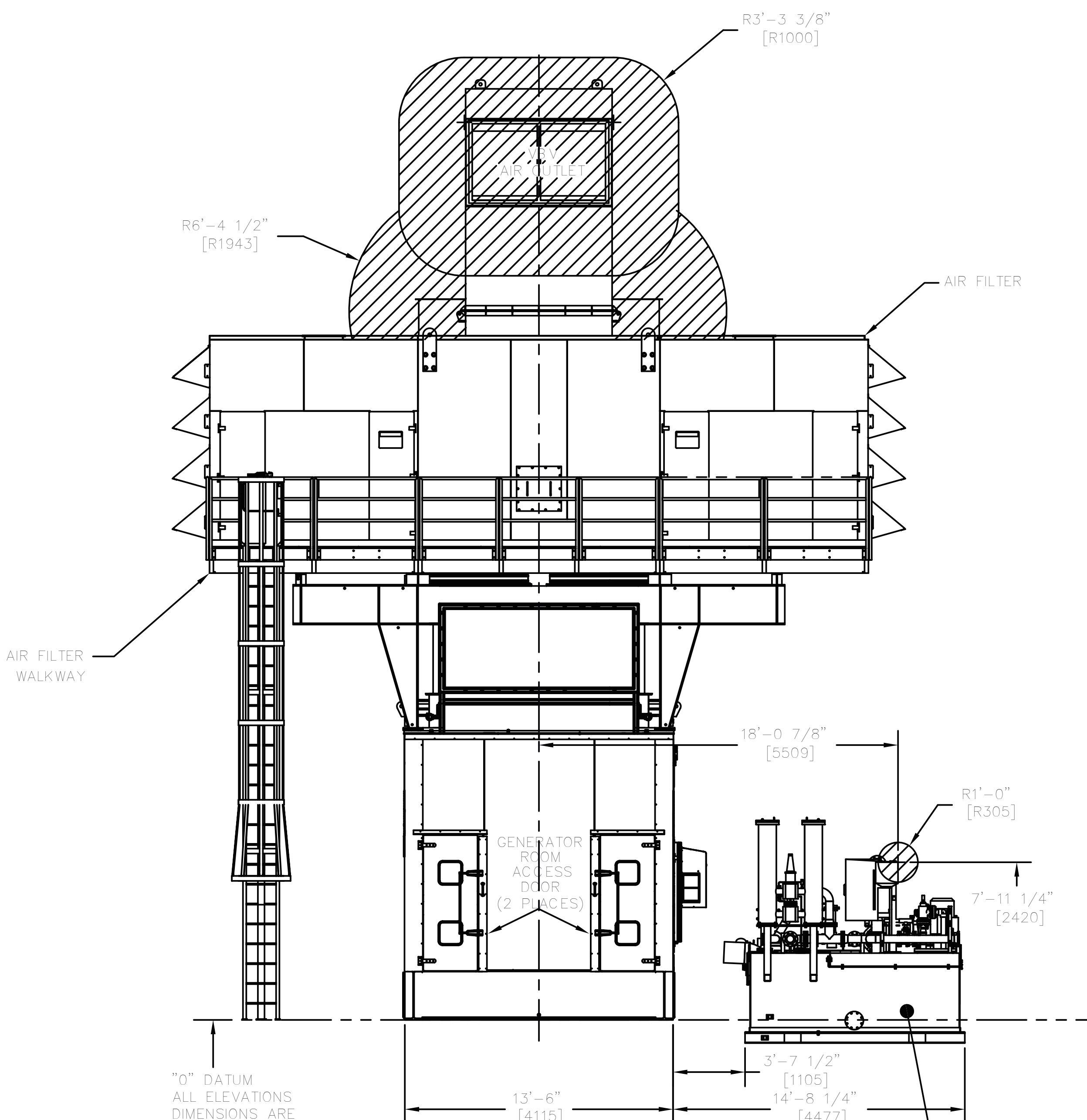
NEXT ASSY.

UNIT TYPE: LM6000®

| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED VIEW OF AUXILIARY SKID AND MLO SKID | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

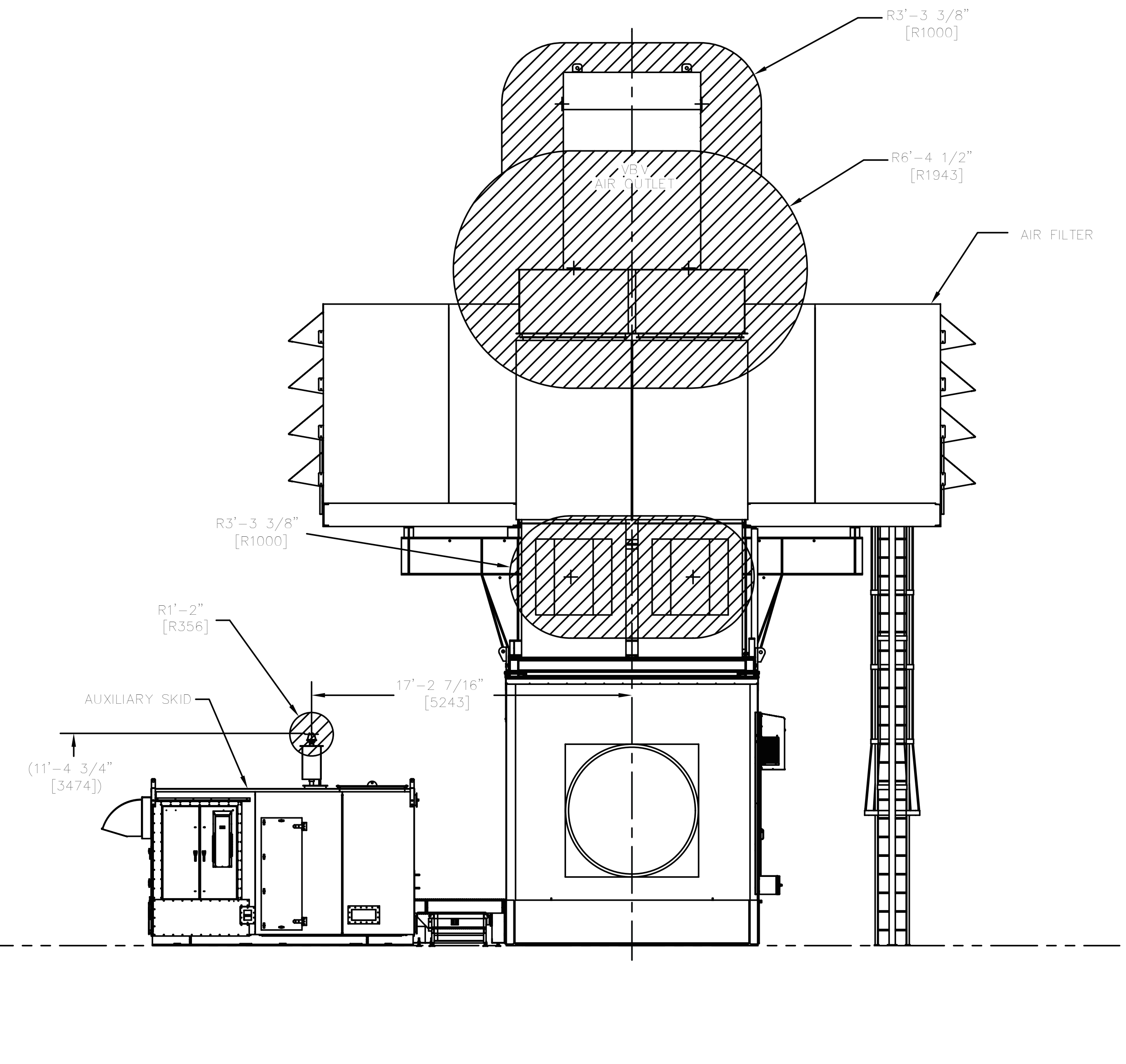
REVISIONS

RESERVED




GENERATOR END VIEW

SOME SKIDS & INTERCONNECT PLATFORM NOT SHOWN FOR CLARITY




EXHAUST END VIEW

SOME SKIDS NOT SHOWN FOR CLARITY

MAIN UNIT 50Hz



RESERVED

REVISIONS

| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED MLO WITH FIN FAN COOLER | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

| TOLERANCES | | |
|---|---|---|
| DECIMALS | FRACTIONAL | ANGULAR |
| .XX ± .03<br>.XXX ± .010 | ±1/8" | ±1° |

NEXT ASSY.

UNIT TYPE: LM6000®

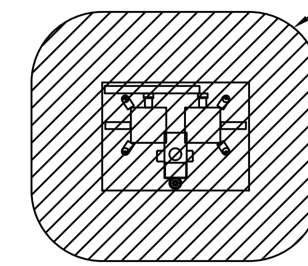
ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

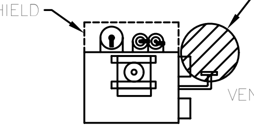
TITLE: GENERAL ARRANGEMENT MAIN UNIT – RH

DWG NO.: 7262875–504200 REV.: F

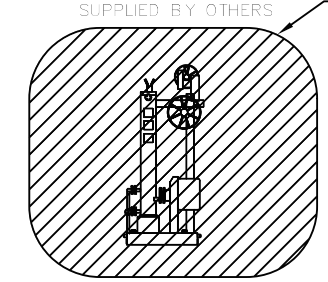
SCALE 1/4" = 1'–0" SHEET 16 OF 17




GAS FUEL FILTER SKID
REFERENCE ONLY




GAS CHROMATOGRAPH SYSTEM
REFERENCE ONLY




GAS FUEL FILTER SKID
REFERENCE ONLY


GAS CHROMATOGRAPH SYSTEM
REFERENCE ONLY

GAS FUEL FILTER SKID
50 Hz

GAS CHROMATOGRAPH
50 Hz

RESERVED



REVISIONS

| REV | DESCRIPTION | ECO | DRAWN | DATE | DESIGN |
|---|---|---|---|---|---|
| F | UPDATED COPYRIGHT | | MR | 02/16/17 | EN |
| E | NO CHANGES THIS SHEET | | MR | 12/14/16 | EN |
| D | NO CHANGES THIS SHEET | | MR | 11/04/16 | EN |
| C | UPDATED WITH GAS CHROMATOGRAPH & GAS FILTER | | MR | 08/18/16 | EN |
| B | UPDATED COPYRIGHT | | SK | 05/17/16 | ZJ |
| A | ORIGINAL ISSUE | | SK | 10/28/15 | ZJ |

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
DO NOT SCALE DRAWING

TOLERANCES

| DECIMALS | FRACTIONAL | ANGULAR |
|---|---|---|
| .XX ± .03 | ±1/8" | ±1° |
| .XXX ± .010 | | |

NEXT ASSY.

UNIT TYPE: LM6000®

ADDL INFO: GE CLASS II (INTERNAL)

GE P&W DISTRIBUTED POWER

TITLE: GENERAL ARRANGEMENT
MAIN UNIT – RH

DWG NO. 7262875-504200

REV. F

SCALE 1/4" = 1'-0"

**PERFORMANCE CENTRAL REPORT**

Version 1.2.10 Built: 2017-07-17 22:35 UTC

| | | | |
|---|---|---|---|
| Performance By: | Not Found | **Date:** | 20/07/2017 |
| Project: | Not Found | **Time:** | 00:48:28 |

**Estimated Engine Performance NOT FOR GUARANTEE: USE FOR STUDY ONLY**

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Engine: | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 |
| Model: | PF-SPRINT-25 | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-: | PF-SPRINT-25 |
| Options: | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Generator | BDAX 7-290ER: | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290ERJT |
| Frequency,Hz | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Voltage,kV | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| PF | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| **Case** | **100** | **101** | **102** | **103** | **104** | **105** | **106** | **107** | **108** | **109** | **110** | **111** | **112** | **113** | **114** | **115** | **116** | **117** | **118** |
| **Ambient Conditions** | | | | | | | | | | | | | | | | | | | |
| Dry Bulb Temp., °C | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Wet Bulb Temp., °C | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 |
| Relative Humidity, % | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Elevation a.s.l., m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barometric Press., kPa | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 |
| **Pressure Losses** | | | | | | | | | | | | | | | | | | | |
| Inlet Press. Loss, mmH2O | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 |
| Exh. Press. Loss, mmH2O | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 |
| Volute Loss, mmH2O | 112.73 | 110.88 | 109.53 | 107.08 | 102.33 | 91.53 | 86.01 | 76.62 | 70.8 | 71.56 | 71.98 | 72.02 | 72.08 | 72.11 | 72.15 | 72.2 | 72.22 | 72.1 | 72.13 |
| **GTG Load, %** | **100** | **95** | **90** | **85** | **80** | **75** | **70** | **65** | **60** | **55** | **50** | **45** | **40** | **35** | **30** | **25** | **20** | **15** | **10** |
| **Gen. Output, Gross, kW** | **47733** | **45346** | **42960** | **40573** | **38186** | **35800** | **33413** | **31026** | **28640** | **26253** | **23866** | **21480** | **19093** | **16706** | **14320** | **11933** | **9547** | **7160** | **4773** |
| **HR, kJ/(kW*h)** | **8738** | **8791** | **8943** | **9157** | **9346** | **9249** | **9431** | **9616** | **9871** | **10249** | **10757** | **11509** | **12425** | **13427** | **14437** | **15922** | **18069** | **20641** | **28262** |
| Comp. Inlet Temp., °C | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| **Fuel Flow** | | | | | | | | | | | | | | | | | | | |
| Fuel Number | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 | 801-577 |
| Fuel Name | Fuel with sulfur | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfu | Fuel with sulfur |
| Fuel LHV, kJ/kg | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 | 44173 |
| Heat Input, MW | 115.9 | 110.7 | 106.7 | 103.2 | 99.1 | 92 | 87.5 | 82.9 | 78.5 | 74.7 | 71.3 | 68.7 | 65.9 | 62.3 | 57.4 | 52.8 | 47.9 | 41.1 | 37.5 |
| Fuel Flow, kg/h | 9441.7 | 9024.5 | 8697.4 | 8410.4 | 8079.4 | 7496.1 | 7133.8 | 6753.9 | 6400.1 | 6091.4 | 5812.2 | 5596.6 | 5370.3 | 5078.3 | 4680.2 | 4301.2 | 3905 | 3345.7 | 3053.9 |
| Vol. Fuel Flow, Nm3/hr | 11214.7 | 10719.1 | 10330.6 | 9989.7 | 9596.6 | 8903.7 | 8473.4 | 8022.1 | 7602 | 7235.3 | 6903.6 | 6647.6 | 6378.8 | 6031.9 | 5559.1 | 5109 | 4638.3 | 3973.9 | 3627.4 |
| Fuel Temp., °C | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 |
| **NOx Control** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** | **DLE** |
| **Sprint Location** | **LPC** | **LPC** | **LPC** | **LPC** | **LPC** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** | **OFF** |
| Sprint Water Flow, kg/h | 4220.7 | 4220.7 | 4220.7 | 4220.7 | 4220.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sprint Water Temp., °C | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 | 15.6 |
| **Exhaust Parameters** | | | | | | | | | | | | | | | | | | | |
| Exhaust Temp., °C | 457.07 | 443.54 | 436.7 | 442.66 | 449.38 | 452.05 | 463.26 | 473.01 | 482.07 | 490.59 | 495.76 | 490.74 | 494.24 | 495.33 | 486.55 | 482.6 | 475.22 | 445.6 | 448.25 |
| Exhaust Flow, kg/s | 132.3 | 131.1 | 129.9 | 125.2 | 119.4 | 116.8 | 108.8 | 101.9 | 95.8 | 90.7 | 87.4 | 88.2 | 86.7 | 84 | 80.5 | 76.3 | 72.3 | 67.2 | 63.9 |
| Energy (Ref 0R), kW | 103154 | 100080 | 98128 | 95457 | 91960 | 89431 | 84768 | 80503 | 76719 | 73524 | 71362 | 71389 | 70500 | 68358 | 64617 | 60897 | 56984 | 50697 | 48322 |
| Energy (Ref T2), kW | 63593 | 60913 | 58881 | 57311 | 55590 | 54108 | 51856 | 49700 | 47753 | 46104 | 44502 | 43028 | 41753 | 40017 | 37573 | 35361 | 32901 | 29224 | 27266 |
| Exhaust stack exit temperature estimate | 395 | 381.47 | 374.63 | 380.59 | 387.31 | 389.98 | 401.19 | 410.94 | 420 | 428.52 | 433.69 | 428.67 | 432.17 | 433.26 | 424.48 | 420.53 | 413.15 | 383.53 | 386.18 |
| **Emissions (ESTIMATED, NOT FOR GUARANTEE)** | | | | | | | | | | | | | | | | | | | |
| NOx, Ref % O2, mg/Nm3 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 |
| CO, Ref % O2, mg/Nm3 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 |

| | |
|---|---|
| **Aero Energy Fuel Number** | 801-577 |
| Fuel Bound N, %Mass | 0 |
| Sulfur Content, %Mass | 0.1 |
| Hydrogen, % | 0 |
| Methane, % | 84.5 |
| Ethane, % | 5.58 |
| Ethylene, % | 0 |
| Propane, % | 2.05 |
| Propylene, % | 0 |
| Butane, % | 0.78 |
| Butylene, % | 0 |
| Butadiene, % | 0 |
| Pentane, % | 0.18 |
| Cyclopentane, % | 0 |
| Hexane, % | 0.17 |
| Heptane, % | 0 |
| CarbonMonoxide, % | 0 |
| Carbon Dioxide, % | 0.67 |
| Nitrogen, % | 5.93 |
| Water Vapor, % | 0 |
| Oxygen, % | 0.04 |
| HydrogenSulfide, % | 0.1 |
| Ammonia, % | 0 |
| LHV, kJ/kg | 44173 |
| HHV, kJ/kg | 48886 |
| NOx Scalar | 0.994 |
| Specific Gravity | 0.6515 |
| MWI, (kJ/Nm3)/SQRT(K) | 0.957 |
| LHV, kJ/Nm3 | 37393 |
| HHV, kJ/Nm3 | 41267 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exhaust Parameters** | | | | | | | | | | | | | | | | | | | |
| Sp. Heat, kJ/(kg*°K) | 1.142 | 1.137 | 1.135 | 1.137 | 1.14 | 1.128 | 1.133 | 1.135 | 1.138 | 1.141 | 1.144 | 1.146 | 1.15 | 1.151 | 1.146 | 1.144 | 1.14 | 1.126 | 1.129 |
| Exh Mol Wght, kg/kmol | 28.341 | 28.352 | 28.355 | 28.349 | 28.343 | 28.526 | 28.519 | 28.516 | 28.513 | 28.511 | 28.509 | 28.504 | 28.5 | 28.502 | 28.515 | 28.525 | 28.539 | 28.575 | 28.575 |
| Exh. Flow, ACFM | 583975.9 | 567649.7 | 557288.5 | 541852.1 | 521589 | 508546.8 | 481360.2 | 456637.6 | 434744.6 | 416263.2 | 403980.8 | 404928.2 | 400074.4 | 388105.8 | 367370.6 | 346493.9 | 324626.7 | 289762.5 | 276357.4 |
| Exh. Flow, SCFM | 234291.5 | 232041.9 | 229999 | 221766.3 | 211489.6 | 205440.3 | 191497.8 | 179289.8 | 168646 | 159676.1 | 153921.9 | 155295.7 | 152735.7 | 147955.5 | 141669.1 | 134317.9 | 127081.3 | 118108.9 | 112230.8 |
| **Generator Information** | | | | | | | | | | | | | | | | | | | |
| Gen. Capacity, kW | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 |
| LPC Inlet Flow Wet, kg/s | 130.156 | 129.086 | 128.292 | 126.842 | 123.998 | 117.282 | 113.684 | 107.302 | 103.138 | 103.685 | 103.981 | 103.996 | 104.036 | 104.05 | 104.074 | 104.106 | 104.122 | 104.035 | 104.046 |
| LPC Inlet Flow Dry, kg/s | 129.327 | 128.264 | 127.475 | 126.034 | 123.208 | 116.535 | 112.96 | 106.619 | 102.482 | 103.025 | 103.318 | 103.334 | 103.373 | 103.387 | 103.412 | 103.443 | 103.459 | 103.372 | 103.383 |

| | |
|---|---|
| **Generator** | |
| Generator Name | BDAX 7-290ERJT |
| Coolant | Air |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Run Control Level 1** | | | | | | | | | | | | | | | | | | | |
| Target Power | Shaft Horse Powe | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load |
| Target Part Load, % | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 | 20 | 15 | 10 |
| Sprint ON/OFF | On | On | On | On | On | On | On | On | On | On | On | On | On | On | On | On | On | On | On |
| **NOx Control** | | | | | | | | | | | | | | | | | | | |
| **NOx Target** | | | | | | | | | | | | | | | | | | | |
| **NOx Level, mg/Nm3** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** | **51** |
| **Emissions (Estimated, NOT for Guarantee)** | | | | | | | | | | | | | | | | | | | |
| NOx, Ref % O2, mg/Nm3 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 | 51.2 |
| NOx (NO2), kg/h | 12.38 | 11.8 | 11.69 | 11.27 | 10.75 | 10.09 | 9.4 | 9.17 | 8.62 | 8.16 | 7.87 | 8.25 | 8.12 | 7.86 | 7.24 | 6.6 | 5.98 | 4.84 | 4.6 |
| CO2, kg/h | 23855.61 | 22809.45 | 22231.93 | 21680.04 | 20824.82 | 19345.27 | 18405.99 | 17423.92 | 16509.85 | 15712.7 | 15268.03 | 15611.9 | 15533.4 | 14965.72 | 13798.74 | 12685.52 | 11522.29 | 9507.65 | 9024.45 |
| SOx (SO2), kg/h | 31.91 | 30.67 | 29.93 | 29.31 | 27.94 | 26.06 | 24.68 | 23.47 | 22.07 | 21.22 | 20.46 | 20.95 | 20.92 | 19.96 | 18.54 | 17.04 | 15.35 | 12.83 | 12.19 |

**PERFORMANCE CENTRAL REPORT**

Version 1.2.10 Built: 2017-07-17 22:35 UTC

| | | | |
|---|---|---|---|
| Performance By: | Not Found | **Date:** | 20/07/2017 |
| Project: | Not Found | **Time:** | 00:56:09 |

**Estimated Engine Performance NOT FOR GUARANTEE: USE FOR STUDY ONLY**

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Engine: | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 | LM6000 |
| Model: | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF | PF |
| Options: | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Generator | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290 | BDAX 7-290ERJT |
| Frequency,Hz | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Voltage,kV | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| PF | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| **Case** | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 |
| **Ambient Conditions** | | | | | | | | | | | | | | | | | | | |
| Dry Bulb Temp., °C | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Wet Bulb Temp., °C | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 | 10.82 |
| Relative Humidity, % | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Elevation a.s.l., m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Barometric Press., kPa | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 | 101.325 |
| **Pressure Losses** | | | | | | | | | | | | | | | | | | | |
| Inlet Press. Loss, mmH2O | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 | 101.6 |
| Exh. Press. Loss, mmH2O | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 | 152.4 |
| Volute Loss, mmH2O | 99.62 | 95.2 | 89.97 | 86.18 | 81.34 | 73.34 | 70.87 | 71.65 | 72.21 | 72.37 | 72.35 | 72.4 | 72.37 | 72.41 | 72.44 | 72.47 | 72.36 | 72.35 | 71.99 |
| **GTG Load, %** | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 | 20 | 15 | 10 |
| **Gen. Output, Gross, kW** | 40726 | 38689 | 36653 | 34617 | 32581 | 30544 | 28508 | 26472 | 24435 | 22399 | 20363 | 18327 | 16290 | 14254 | 12218 | 10181 | 8145 | 6109 | 4073 |
| **HR, kJ/(kW*h)** | 8904 | 8999 | 9132 | 9299 | 9483 | 9656 | 9913 | 10244 | 10625 | 11220 | 11997 | 12904 | 13678 | 14263 | 15825 | 17522 | 19192 | 23947 | 30587 |
| Comp. Inlet Temp., °C | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| **Fuel Flow** | | | | | | | | | | | | | | | | | | | |
| Fuel Number | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 |
| Fuel Name | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 | Diesel #2 |
| Fuel LHV, kJ/kg | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 | 42798 |
| Heat Input, MW | 100.7 | 96.7 | 93 | 89.4 | 85.8 | 81.9 | 78.5 | 75.3 | 72.1 | 69.8 | 67.9 | 65.7 | 61.9 | 56.5 | 53.7 | 49.6 | 43.4 | 40.6 | 34.6 |
| Fuel Flow, kg/h | 8472.7 | 8135 | 7820.7 | 7521.3 | 7219.1 | 6891 | 6603 | 6336.1 | 6066.3 | 5871.9 | 5707.8 | 5525.7 | 5206.2 | 4750.3 | 4517.6 | 4168.4 | 3652.5 | 3418.1 | 2910.6 |
| Vol. Fuel Flow, Nm3/hr | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Fuel Temp., °C | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| **NOx Control** | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE | DLE |
| **Exhaust Parameters** | | | | | | | | | | | | | | | | | | | |
| Exhaust Temp., °C | 461.07 | 456.86 | 456.44 | 455.71 | 466.12 | 475.42 | 484.05 | 492.38 | 501.48 | 502.08 | 498.86 | 507.52 | 501.53 | 486.52 | 490.56 | 484.57 | 457.13 | 460.83 | 468.06 |
| Exhaust Flow, kg/s | 123.1 | 120.3 | 117 | 114 | 107.6 | 101.6 | 96.5 | 92 | 87.5 | 86.9 | 87.9 | 85.9 | 83.5 | 79.2 | 76.8 | 73.3 | 68.9 | 66.5 | 55.6 |
| Energy (Ref 0R), kW | 94636 | 91877 | 89238 | 86854 | 83238 | 79665 | 76642 | 73921 | 71210 | 70776 | 71249 | 70435 | 67835 | 62963 | 61436 | 58112 | 52466 | 50873 | 42944 |
| Energy (Ref T2), kW | 58593 | 56663 | 55012 | 52984 | 51116 | 49344 | 47838 | 46472 | 45108 | 43886 | 42899 | 41935 | 40000 | 37348 | 35977 | 33879 | 30604 | 29074 | 26470 |
| Stack exit exhaust temp | 399 | 394.79 | 394.37 | 393.64 | 404.05 | 413.35 | 421.98 | 430.31 | 439.41 | 440.01 | 436.79 | 445.45 | 439.46 | 424.45 | 428.49 | 422.5 | 395.06 | 398.76 | 405.99 |
| **Emissions (ESTIMATED, NOT FOR GUARANTEE)** | | | | | | | | | | | | | | | | | | | |
| NOx, Ref % O2, mg/Nm3 | 174.3 | 174.2 | 174.2 | 174.2 | 174.2 | 174.2 | 174.2 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.2 | 174.2 | 174.2 | 174.1 |
| CO, Ref % O2, mg/Nm3 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.2 | 31.1 |
| **Exhaust Parameters** | | | | | | | | | | | | | | | | | | | |
| Sp. Heat, kJ/(kg*°K) | 1.121 | 1.119 | 1.119 | 1.119 | 1.122 | 1.125 | 1.128 | 1.13 | 1.133 | 1.136 | 1.14 | 1.143 | 1.141 | 1.135 | 1.137 | 1.134 | 1.122 | 1.125 | 1.117 |
| Exh Mol Wght, kg/kmol | 28.889 | 28.888 | 28.888 | 28.888 | 28.889 | 28.889 | 28.889 | 28.89 | 28.89 | 28.89 | 28.891 | 28.892 | 28.891 | 28.889 | 28.889 | 28.888 | 28.884 | 28.884 | 28.881 |
| Exh. Flow, ACFM | 536219.4 | 520968.6 | 506132 | 492757.3 | 471619 | 450876 | 433328.6 | 417547.1 | 401822 | 399536 | 402612.1 | 397725.6 | 383482 | 356718.6 | 348042.7 | 329581.9 | 298671.6 | 289626.2 | 244284.1 |
| Exh. Flow, SCFM | 213960.1 | 209072.1 | 203234.7 | 198062.7 | 186896.2 | 176456.7 | 167656.3 | 159792.8 | 151968.9 | 150988 | 152784.9 | 149255.2 | 145023.8 | 137566.8 | 133511.9 | 127430 | 119817.2 | 115602.9 | 96553.4 |
| **Generator Information** | | | | | | | | | | | | | | | | | | | |
| Gen. Capacity, kW | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 | 50812.8 |
| LPC Inlet Flow Wet, kg/s | 122.168 | 119.425 | 116.103 | 113.626 | 110.395 | 104.827 | 103.041 | 103.606 | 104.014 | 104.126 | 104.115 | 104.147 | 104.127 | 104.157 | 104.178 | 104.197 | 104.124 | 104.112 | 103.856 |
| LPC Inlet Flow Dry, kg/s | 121.39 | 118.665 | 115.364 | 112.902 | 109.692 | 104.159 | 102.385 | 102.946 | 103.351 | 103.463 | 103.452 | 103.484 | 103.464 | 103.493 | 103.515 | 103.533 | 103.461 | 103.449 | 103.195 |
| **Generator** | | | | | | | | | | | | | | | | | | | |
| Generator Name | BDAX 7-290EF | | | | | | | | | | | | | | | | | | |
| Coolant | Air | | | | | | | | | | | | | | | | | | |
| **Run Control Level 1** | | | | | | | | | | | | | | | | | | | |
| Target Power | Shaft Horse P | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load | % Load |
| Target Part Load, % | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 | 20 | 15 | 10 |
| GTG Load, % | 100 | 95 | 90 | 85 | 80 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 40 | 35 | 30 | 25 | 20.0001 | 15 | 10 |
| **Gen. Output, Gross, kW** | 40726 | 38689 | 36653 | 34617 | 32581 | 30544 | 28508 | 26472 | 24435 | 22399 | 20363 | 18327 | 16290 | 14254 | 12218 | 10181 | 8145 | 6109 | 4073 |
| **HR, kJ/(kW*h)** | 8904 | 8999 | 9132 | 9299 | 9483 | 9656 | 9913 | 10244 | 10625 | 11220 | 11997 | 12904 | 13678 | 14263 | 15825 | 17522 | 19192 | 23947 | 30587 |
| **Emissions (Estimated, NOT for Guarantee)** | | | | | | | | | | | | | | | | | | | |
| NOx, Ref % O2, mg/Nm3 | 174.3 | 174.2 | 174.2 | 174.2 | 174.2 | 174.2 | 174.2 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.3 | 174.2 | 174.2 | 174.2 | 174.1 |
| NOx (NO2), kg/h | 37.68 | 35.95 | 34.53 | 33.65 | 32.53 | 31.08 | 29.87 | 28.47 | 27.39 | 27.53 | 28.49 | 28.45 | 26.74 | 23.94 | 23.24 | 21.38 | 18.12 | 17.48 | 13 |
| CO2, kg/h | 27125.2 | 26047.99 | 25043.74 | 24435.58 | 23573.55 | 22500.58 | 21558.22 | 20685.67 | 19803.68 | 19990.34 | 20578.17 | 20444.04 | 19410.1 | 17284.49 | 16850.9 | 15552.79 | 13131.67 | 12765.67 | 9524.92 |
| SOx (SO2), kg/h | 16.84 | 16.46 | 15.58 | 15.18 | 14.72 | 13.89 | 13.55 | 12.91 | 12.28 | 12.51 | 12.98 | 12.68 | 12.02 | 10.83 | 10.51 | 9.77 | 8.19 | 7.9 | 6 |

**Fuel Composition, Mass %**

| | |
|---|---|
| Fuel Bound N, %Mass | 0 |
| **Sulfur Content, %Mass** | **0.1** |
| Hydrogen, % | N/A |
| Methane, % | N/A |
| Ethane, % | N/A |
| Ethylene, % | N/A |
| Propane, % | N/A |
| Propylene, % | N/A |
| Butane, % | N/A |
| Butylene, % | N/A |
| Butadiene, % | N/A |
| Pentane, % | N/A |
| Cyclopentane, % | N/A |
| Hexane, % | N/A |
| Heptane, % | N/A |
| CarbonMonoxide, % | N/A |
| Carbon Dioxide, % | N/A |
| Nitrogen, % | N/A |
| Water Vapor, % | N/A |
| Oxygen, % | N/A |
| HydrogenSulfide, % | N/A |
| Ammonia, % | N/A |

# APPENDIX G

## Practitioner Capability Statement

As presented in Appendix 1 of Environment Protection Authority (2016) Ambient Air Quality Assessment, the following Capability Statement is respectfully offered.

**Table G-1 Practitioner capability statement**

| Section | Requirements | Reeves Plains Power Station Project |
|---|---|---|
| Cover page | Project title | Reeves Plains Power Station Project |
| | Proponent details | Arcadis Australia Pacific Pty Ltd., on behalf of Alinta Energy (Reeves Plains) Pty Ltd |
| | Location of the premises | Reeves Plains, South Australia |
| Primary consulting organisation | Name of the practitioner/s | Gary Graham, Director, Northstar Air Quality<br>Martin Doyle, Director, Northstar Air Quality<br>Marie-Laure Nguyen, AQ Engineer, Northstar Air Quality |
| | Company name | Northstar Air Quality Pty Ltd |
| | ACN | 609 741 728 |
| | Responsible person | Gary Graham |
| | Qualifications of relevant staff | Gary Graham, BSc(hons), MSc<br>Martin Doyle, BSc(hons), PhD<br>Marie-Laure Nguyen, M.Physics |
| | Experience and practitioner affiliation<br>Accreditation (NATA or equivalent) | Gary Graham, 24 years, CSci, CEnv, CAQP (CASANZ)<br>Martin Doyle, 18 years, AAirQual (CASANZ)<br>Marie-Laure Nguyen, 11 years |
| | Is the accreditation specific to methods | Not applicable |
| Subcontractors | (a) Monitoring practitioners | None required or used |
| | (b) Analytical laboratories | None required or used |
| | (c) Modelling practitioners | Northstar Air Quality Pty Ltd (details as stated above) |
| Methods used | List of monitoring or analytical method(s) being used for which practitioners have accreditation, or dispersion models for which the practitioners have demonstrated experience | No monitoring or analytical methods were required. The assessment uses the TAPM and AERMOD dispersion models |

To further assist with demonstrating that appropriate methods and practices have been adopted, the following key requirements have been addressed:

**Table G-2 Air quality impact assessment requirements**

| Reference | Requirement | Response |
|---|---|---|
| Section 1.3 Reports and submissions | The EPA has a continuing commitment to assess submissions as soon as possible, so this document sets out how best to present information in a Project. This includes methods, protocols, comparisons against relevant criteria, quality processes that should be used and the range of supporting information needed for reports. It is important that reports are based on these principles and signed off by qualified and experienced senior practitioners. | Reference should be made to the practitioner capability statement |
| Section 2 Risk-based air quality assessment | To demonstrate that no adverse effects will occur at ground level due to emissions from a proposed or existing facility, owners/operators or proponents of facilities should initially use appropriate conservative models to predict the maximum ground level concentrations (GLCs) of pollutants. | The methodology used for modelling is presented in **Section 4.2**. The modelling contains a high degree of conservatism, as outlined in **Section 4.2** and discussed throughout the AQIA. |
| | Owners/operators or proponents are required to demonstrate that these maximum concentrations are less than the GLCs of pollutants specified in Schedule 2 or odour criteria in Schedule 3 of the Air EPP at sensitive receptor(s). The GLCs are levels of specific pollutants or odours, below which environmental risk can be considered to be acceptable. | Reference should be made to **Section 6.2** which demonstrates that the predicted concentrations are below the GLCs specified in the Air EPP. |
| | GLCs adopted under the Air EPP may be based on public health or amenity or may relate to other environmental values, where applicable. | The pollutants assessed during construction and operation are discussed in **Section 2.3**. The criteria adopted are presented in **Section 1.3** |
| | It is expected that existing ambient background concentrations of pollutants are also included into the assessment process, so that total concentrations of specific pollutants are less than their respective GLC. Where applicable, these background concentrations can be based on data from the nearest EPA monitoring station, modelled background levels, baseline monitoring performed for the project or advice from the EPA given on a case-by-case basis. | The assumptions used to assess the contribution of background air quality is discussed in **Section 3.3**. The results presented in **Section 6.2** account for the contribution of background air quality. |
| Section 3 Modelling | The first step in undertaking air quality modelling is to clearly define the objectives and expected outcomes. This can be done by addressing questions such as: | |

| Reference | Requirement | Response |
|---|---|---|
| | • What is the reason for the air quality modelling? | Reference should be made to **Section 1.2** |
| | • What questions need to be answered by modelling work? | Reference should be made to **Section 1.2** |
| | • What pollutants or environmental indicators need to be modelled in order to provide the information required? | Reference should be made to **Section 2.3** |
| | • What data and information are already available and how can these help? | Reference should be made to **Section 4.2** |
| | • What considerations need to be made about background concentrations of pollutants? | Reference should be made to **Section 3.3** |
| | • What type of pollutant source/s need to be modelled? | Reference should be made to **Section 4.2** |
| | • What are the geographical features near the pollutant source/s? | Reference should be made to **Section 3.1** |
| | • How is the modelled data best utilised and reported to describe the issues under investigation? | Reference should be made to **Section 6.2**, and **Section 7** |