B16 AIRPORT AND SURROUNDS
AIR QUALITY AND GREENHOUSE GAS EMISSIONS

CONTENTS

FIGURES

TABLES

APPENDICES (REFER SEPARATE APPENDICES DISK)

GLOSSARY, UNITS AND ACRONYMS

Units	
µg/m³	Microgram per cubic metre
t	metric tonne
Nomenclature	
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalents
NO_2	Nitrogen dioxide
N_2O	Nitrous Oxide
NO_X	Oxides of nitrogen
O_3	Ozone
PM	Particulate matter
$PM_{2.5}$ and PM_{10}	Particulate matter with an aerodynamic diameter less than 2.5 or 10 micrometres, respectively
SO_2	Sulfur dioxide
THC	Total hydrocarbons
VOC	Volatile organic compounds

16.1 INTRODUCTION

This chapter presents the results of an air quality and greenhouse gas assessment of the potential impacts associated with construction and ground based operations of the project. The assessment was conducted by Katestone Environmental Pty Ltd (Katestone).

The existing environment has been described in terms of the elements that are relevant to air quality, including the geography, land-use, climate and meteorology of the region. The existing air quality in the region has been described in terms of ambient air quality monitoring data that has been collected by the Department of Environment and Heritage Protection (DEHP). Existing emissions to air associated with industry in the area and current Sunshine Coast Airport (SCA) operations have also been used to characterise existing air quality.

The potential impacts on air quality and greenhouse gas (GHG) emissions were assessed for the construction phase of the project, the operational phase of the project and for changes in traffic associated with the project. Emissions from aircraft are considered separately in Chapter D4, Air Emissions and GHG.

16.2 METHODOLOGY AND ASSUMPTIONS

This section describes the processes that were used to characterise the existing air environment and to estimate existing and future emissions of air pollutants including GHGs. The estimation methods are described initially along with the sources of input data before the assumptions and limitations of the analysis are outlined.

16.2.1 Methodology

The impact of the project on air quality in the region depends on the existing environment including current air quality as well as emissions of air pollutants. The following sections detail the data used to describe the area surrounding the project and existing air quality, as well as the techniques for estimating emissions of air pollutants including GHGs.

16.2.1.1 Geographic features and sensitive receptors

Land-use data (Department of Agriculture, Fisheries and Forestry, 2011) was analysed to ascertain the nature of land-use within buffer distances of 3 km, 10 km and 40 km from the boundary of the project site. These areas of interest are shown in **Figure 16.2a**.

Terrain features in the region were identified by 1 km resolution Australian terrain height data from Geoscience Australia, which is supplied with the meteorological model The Air Pollution Model (TAPM), developed by CSIRO (2008).

Figure 16.2a: Buffer zones applied in land use analysis

16.2.1.2 Existing Air Quality

Data from the nearest DEHP monitoring station, located at the Mountain Creek Primary School, was analysed to provide an indication of ambient background levels of particulate matter (as PM_{10}) and nitrogen dioxide (NO_2) in the region. Background levels of air pollutants were selected as the 75th percentile of measurements recorded at the station. The conservativeness of this approach is discussed in **Section 16.4.6.3** with respect to the land-use in the area, and the classification of the Mountain Creek monitoring station.

Data from other Queensland monitoring stations have been analysed to identify typical background values for carbon monoxide (CO) and sulfur dioxide (SO_2) in the state.

Potential sources of air pollutants in the region were identified as natural sources, industry, airport operations and other more widespread activities such as traffic. Industrial operations generating air pollutants were identified through the National Pollutant Inventory (NPI) for the 2011/12 reporting period.

16.2.1.3 Local meteorology

The local meteorological conditions were described using Bureau of Meteorology (BOM) data measured at the airport (data from 1996 to 2011). The parameters wind speed and wind direction as well as temperature and humidity are summarised in **Section 16.4.5**. Parameters important to dispersion, such as mixing height and stability class, which are not measured by BOM, were extracted from the TAPM modelling.

16.2.1.4 Dispersion modelling

The potential effect of the project on local air quality was quantified using dispersion modelling. The following section summarises the different elements of the modelling including the meteorological model and the dispersion model. A detailed statement of the configurations of the models is provided in **Appendix B16:A**.

TAPM

A site-specific meteorological dataset was generated using TAPM. The TAPM model incorporates synoptic (greater than 1000 kilometres), mesoscale (several kilometres to hundreds of kilometres) and local scale atmospheric conditions. The model also incorporates detailed topography and land-use categorisation schemes to allow synoptic and regional scale meteorology to be simulated for input into diagnostic models or pollutant dispersion models.

CALMET

CALMET is an advanced non-steady-state diagnostic three-dimensional meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.327) was used to simulate meteorological conditions in the study region. The CALMET simulation was initialised with the gridded TAPM three dimensional wind field data. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. CALMET then adjusts the initial guess field for the kinematic effects of terrain, slope flows, blocking effects and 3-dimensional divergence minimisation. The geophysical data that was used in the model configuration was supplied by Geosciences Australia.

CALPUFF

The CALPUFF dispersion model utilises the three-dimensional wind fields from CALMET to simulate the dispersion of air pollutants to predict ground-level concentrations across a gridded domain. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the three-dimensional meteorological fields generated from the CALMET model by simulating the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

CALPUFF (version 6.267) was used to simulate the dispersion characteristics and emissions generated by the proposed construction activities.

16.2.1.5 Air quality emissions estimation

The following sections describe the methodology and sources of information used to estimate the emissions of air pollutants from the construction phase of the project, existing and future operations and related traffic in the local area.

Preconstruction/construction

The construction phase of the project, including the pre-construction preparation of the site, is proposed to take place over a period of approximately 4 years. The construction phase has the potential to impact on local air quality predominantly through the generation of dust by onsite activities. The dust emission rates for the activities considered were calculated using standard emission factors published by the National Pollutant Inventory (NPI) and the US EPA (AP42). The emission factors are shown in **Table 16.2a** for the activities that are expected to be the important sources of dust during the construction phase.

Table 16.2a: Construction emission factors

Activity	Emission factor TSP	PM_{10}	$PM_{2.5}$	EF unit	Source
Topsoil scraping	0.029	0.0137	0.002	kg/t topsoil	1
Scraper unloading	0.020	0.010	0.001	kg/t topsoil	1
Grading	0.615	0.218	0.046	kg/VKT	2
Materials handling (including excavator activity)	0.440	0.210	0.030	g/t material	2
Onsite haulage (unpaved)	4.786	1.364	0.136	kg/VKT	2
Bulldozing	1.798	0.341	0.189	kg/hr	2
Wind erosion of active stockpiles	8.100	4.050	0.608	kg/ha/hr	3
Wind erosion of exposed areas	0.850	0.425	0.064	t/ha/hr	1

Source:

1. *AP42 Chapter 11.9 Western Surface Coal Mining, Table 11.9-4*
2. *NPI Mining v3.1 Table 2*
3. *AP42 Chapter 11.9 Western Surface Coal Mining, Table 11.9-2*

Operations

Estimates of operational emissions have been made by the Emissions and Dispersion Modelling System (EDMS), based on aircraft activity data supplied by Airservices Australia. See Chapter D4 for a full description of EDMS. An estimation of future emissions has been made by scaling emissions according to the predicted increase in aircraft movements and passenger numbers.

The following sources of emissions associated with existing operations at the SCA have been discussed qualitatively:

- On-site diesel generators
- Engines that operate conveyors
- Movement of airport and lessee vehicles.

Traffic

Vehicle numbers were obtained for the three major intersections closest to the SCA:

- Sunshine Motorway/David Low Way
- David Low Way/Airport Drive
- Airport Drive/Kittyhawk Close.

Vehicle numbers were obtained for the existing scenario (2012) and forecast for two future (2030) scenarios – with and without development of the project. The vehicle numbers were used to estimate the Vehicle-Kilometres Travelled (VKT) and the resultant emissions of CO, NO_2 and PM from the major transport routes in the vicinity (within 3 km) of the airport, as shown in **Figure 16.2b**.

The existing fleet distribution travelling to and from the SCA was based on the Australian Bureau of Statistics (ABS), Motor Vehicle Census – 2010. Emission factors for carbon monoxide, nitrogen dioxide and particulate matter for vehicles travelling on roadways, have been based on emission factors published in "*Road tunnels: Vehicle emissions and air demand for ventilation*", by the Permanent International Association of Road Congresses (PIARC) Technical Committee on Road Tunnels Operation (C5), 2004. These emission factors account for the effect of road gradients, vehicle speeds and emission standards.

16.2.1.6 Greenhouse gas emissions estimation

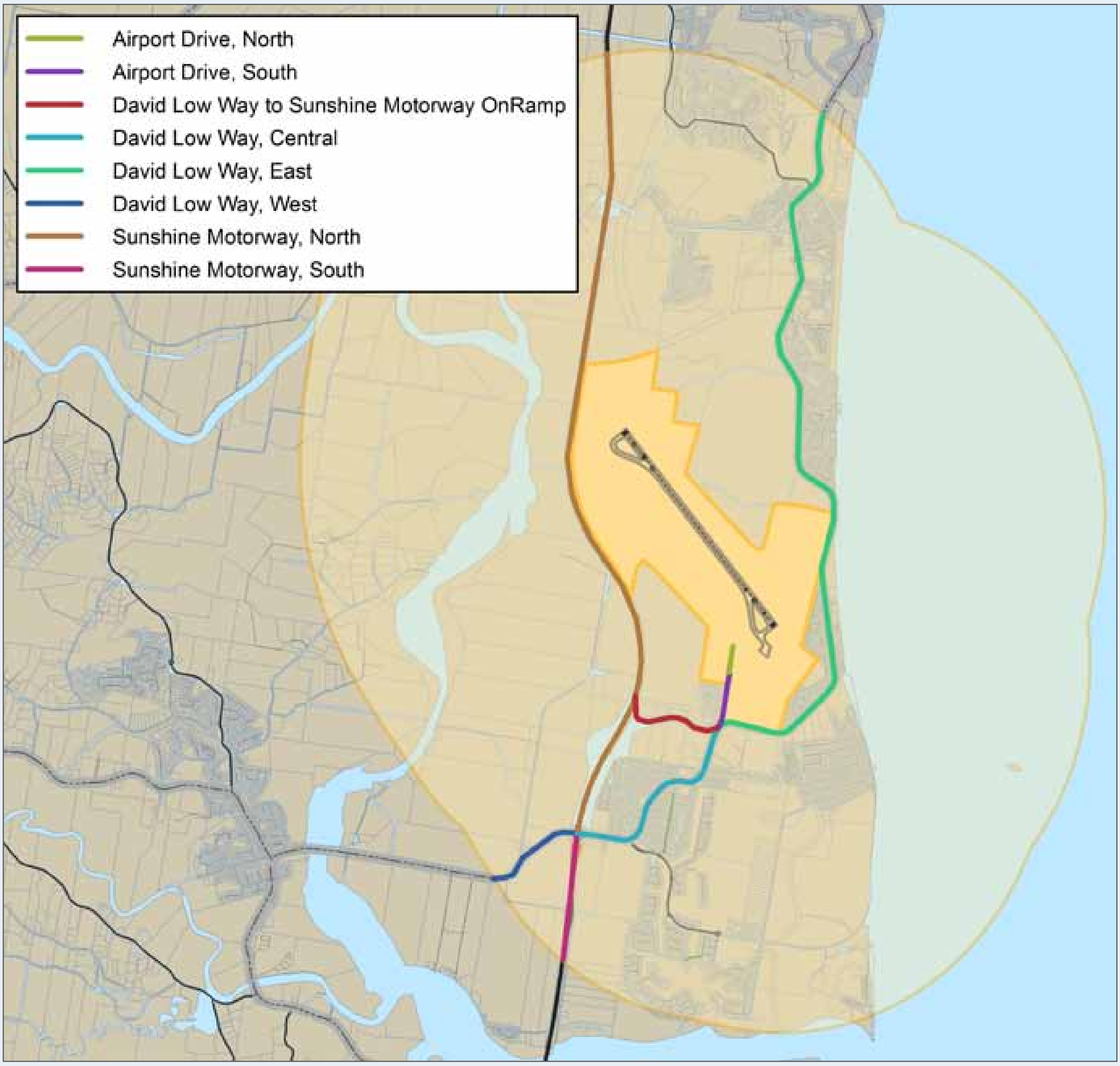
The objective of the GHG assessment component of this study was to provide an indication of the GHG emissions from the construction and operation activities associated with the project. Additionally, the potential GHG abatement measures relevant to planned activities were considered.

The assessment has considered the following categorisation scheme for GHG emissions for both construction and operation:

- Scope 1: Direct emissions (e.g. fuel for equipment, refrigeration and transport, vegetation removal, soil disturbance)
- Scope 2: Indirect emissions associated with the production of electricity, steam or heat used on site (e.g. for lighting, building power)
- Scope 3: Other upstream and downstream emissions (e.g. waste, business travel, materials purchased).

In addition to Scope 1 and 2 emissions, significant Scope 3 emission estimates were used to provide a high-level carbon footprint analysis for the project.

Figure 16.2b: Major transport routes used in emissions estimation from traffic



In terms of GHG emissions the project can be considered as a series of activities occurring in two broad stages: construction activities and ongoing operational activities. In order to estimate the potential immediate and ongoing effect of the project on GHG emissions, an indicative GHG inventory has been compiled for the following scenarios:

- Current operations (baseline)
- Future operations at reference years 2020, 2030 and 2040
- Construction.

The corresponding emission sources considered for the project are summarised in **Table 16.2b**.

GHG estimation methods

The regulatory methods for estimating GHG emissions for National Greenhouse and Energy Reporting (NGER) purposes are detailed in the NGER Determination (DIICCSRTE, 2012). The NGER technical guideline (DIICCSRTE, 2013) provides the same information contained in the NGER Determination in a more user-friendly format. In general the same methods can be applied to the assessment of GHG emissions for the purposes of an environmental impact assessment.

Table 16.2b: GHG emission sources and corresponding scopes

Phase	Activity	Emission source	Emission category	Emission Scope 1	Emission Scope 2	Emission Scope 3	Source base units
Operations (baseline and future)	**Terminal operations**	Electricity use (incl. lighting for access roads)	Purchased electricity		✓		kWh
		Tenancies – Electricity use				✓	kWh
		Air conditioning	Refrigerant leakage	✓			kg
		Waste disposal	Solid waste disposal on land			✓	tonnes
	Ground support	Fuel usage – airport vehicles	Fuel combustion (transport)	✓		✓	kL
		Fuel usage – airport generators	Fuel combustion (stationary)	✓		✓	kL
	Other	Aviation emissions	Aviation emissions			✓	tCO_2-e
		Fuel usage – third party vehicles	Fuel combustion (transport)			✓	kL
Construction	**Civil works**	Fuel usage – construction equipment	Fuel combustion (transport)	✓		✓	kL
		Fuel usage – construction vehicles		✓		✓	kL
		Fuel usage – construction staff vehicles				✓	kL
		Fuel usage – generators	Fuel combustion (stationary)	✓		✓	kL
		Electricity use	Purchased electricity		✓		kWh
		Site clearing	Vegetation loss	✓			ha
		Asphalt	Embedded emissions			✓	tonnes
		Concrete				✓	tonnes
		Aggregates				✓	tonnes
		Steel				✓	tonnes
		Material transport				✓	km

The simplest approach for estimating GHG emissions is referred to as a Method 1 estimation and is based on multiplying a quantity of an emission source by its relevant emission factor. The NGER Determination contains GHG emission factors for a range of anthropogenic activities and is updated on a regular basis, often annually to coincide with NGER assessment periods.

The basic equation underlying a Method 1 GHG estimation for each emission source is:

GHG = E x EF

Where:

GHG: Annual GHG emissions in tonnes of carbon dioxide equivalent (tCO_2-e)

E: Basic measure of emission source (e.g. annual fuel input in GJ)

EF: Emission factors for CO_2, CH_4 and N_2O (e.g. tCO_2-e /GJ)

The total annual CO_2-e emissions are the sum of the CO_2-e emissions for each of CO_2, CH_4 and N_2O.

Where there was insufficient information to use methods detailed in the NGER Determination, Katestone has used methods and emission factors detailed in the following source documents:

- Infrastructure Sustainability (IS) Materials Calculator (ISCA, 2012)
- National Greenhouse Accounts (NGA) Factors Workbook (DCCEE, 2011)
- The Full Carbon accounting Model (FullCAM) (AGO, 2005).

The emission factors used to calculate GHG emissions are presented in **Table 16.2c** and **Table 16.2d**.

Construction

Scope 3 emissions relating to embedded emissions of construction materials have been estimated using the Infrastructure Sustainability (IS) Materials Calculator. The IS Materials Calculator is a support tool for the IS rating scheme developed and administered by the Infrastructure Sustainability Council of Australia (ISCA). The IS Materials Calculator can be used to estimate the GHG emissions associated with a quantity of material.

Table 16.2c: GHG emission factors for energy and fuel use

Activity	Energy content		Emissions factors				Source
			CO_2	CH_4	N_2O	Units	
Diesel combustion – transport	38.6	GJ/kL	69.2	0.2	0.5	kg CO_2-e/GJ	Part 4, Schedule 1, NGER Determination
Diesel combustion – stationery	38.6	GJ/kL	69.2	0.1	0.2	kg CO_2-e/GJ	Part 3, Schedule 1, NGER Determination
Gasoline combustion – transport	34.2	GJ/kL	66.7	0.6	2.3	kg CO_2-e/GJ	Part 4, Schedule 1, NGER Determination
Electricity – 2011-12	3.6	MJ/kWh	0.88			kg CO_2-e/kWh	NGA Factors workbook
Electricity – 2012-13	3.6	MJ/kWh	0.86			kg CO_2-e/kWh	Part 6, Schedule 1, NGER Determination
Dredge sand	-	-	8.1			kg CO_2-e/m^3 sand	GHD, 2009

Table 16.2d: GHG emission factors for refrigerant leakage based on mass of refrigerant stored

Refrigerant	Global warming potential		Emission factor (leakage rate)		Source
			CO_2-e	Units	
R22	1700	tCO_2-e/t R22	0.09	tCO_2-e/t CO_2-e refrigerant	Part 4.5, NGER Determination
R134A	1300	tCO_2-e/t R134A	0.09	tCO_2-e/t CO_2-e refrigerant	

Traffic movements

The emissions associated with vehicle movements entering and leaving the airport have been calculated from:

- Construction workforce numbers (Project Support, 2013)
- Vehicle movement data (GHD, 2012).

The total fuel used by vehicles entering and leaving the airport was calculated using the supplied fleet distribution (GHD, 2012), and fuel breakdown and average fuel consumption taken from the Australian Bureau of Statistics (2010) (presented in **Table 16.2e** and **Table 16.2f**).

The total fuel used was then multiplied by the emission factors from the NGA Factors Workbook (DCCEE, 2011a) (**Table 16.2g**) to calculate total greenhouse gas emissions from traffic.

Carbon storage

Vegetation is a carbon sink; but the removal of vegetation results in the eventual return to the atmosphere of the carbon sequestered in the vegetation. The FullCAM software published by the Australian Government Department of Climate Change and Energy Efficiency was used to estimate a worst-case quantity of carbon released to the atmosphere as a result of vegetation clearing during the construction of the project.

The project disturbance footprint and the distribution of various vegetation types within the footprint were analysed. The FullCAM model was used to estimate the amount of carbon stored in the vegetation surrounding the airport for the baseline assessment. The assessment determined the change in stored carbon over a period of 20 years at the location of the SCA.

Waste emissions

The emissions associated with the disposal of waste have been calculated using the methods described in the Technical Guidelines for the Estimation of GHG emissions by Facilities in Australia (DCCEE, 2011). This assessment does not account for the emissions from other waste existing at the landfill. Details of the inputs to the emissions calculations are included in **Appendix B16:B**.

16.2.3 Assumptions and technical limitations

The following sections describe the assumptions that have been made in performing the air quality and GHG assessments.

16.2.3.1 Selection of a representative year

Dispersion modelling of emissions from the airport construction was conducted using TAPM, incorporating synoptic meteorological data from 2009. The methodology is consistent with that used to model aircraft operations (Chapter D4). This section describes the process used in selecting 2009 as a representative year.

Ten years of hourly averaged observational data (2002-2011) from the BOM site at the SCA were analysed. Each data set was relatively complete as shown in **Table 16.2h**. The aim was to select a single year from this period that was most representative of the climate of the project area.

Table 16.2e: Fuel breakdown used in estimation of Scope 3 GHG emissions from vehicle movements

	Percentage of each vehicle type using diesel and petrol (%)			
Fuel type	**Passenger vehicles**	**Heavy/ fixed**	**Heavy/ articulated**	**Long**
Diesel	15.9	98.6	98.6	98.6
Petrol	84.1	1.4	1.4	1.4

Table 16.2f: Average fuel consumption used in estimation of Scope 3 GHG emissions from vehicle movements

	Average fuel consumption for each vehicle type (litres/100 km)			
Fuel type	**Passenger vehicles**	**Heavy/ fixed**	**Heavy/ articulated**	**Long**
Diesel	11.4	28	56	56
Petrol	11.1	21.3	47.6	47.6

Table 16.2g: Emission factors used in estimation of Scope 3 GHG emissions from vehicle movements

		Emission factor (kg CO_2-e/GJ)		
Fuel type	**Energy content factor (GJ/kL)**	CO_2	CH_4	N_2O
Diesel	38.6	69.2	0.2	0.5
Petrol	34.2	66.7	0.6	2.3

Table 16.2h: Data capture rates for meteorological parameters collected at the SCA BOM monitoring station

Year	Data capture rate (%)
2002	98.7
2003	99.3
2004	98.6
2005	98.8
2006	99.4
2007	99.4
2008	99.2
2009	99.8
2010	99.1
2011	98.6

The hourly data for each year was compared to the complete data set (2002-2011) for the following parameters: wind speed, wind direction, temperature, relative humidity, dew point and rain since 9am. Overall, each year showed reasonably good agreement with the combined data set for all parameters.

Key parameters that influence the dispersion of air pollutants are wind speed and wind direction. The most representative year was therefore selected by focusing on the wind distribution. Given that sensitive receptors are quite evenly distributed around the airport, there are no particular wind directions that are likely to minimise or maximise potential impacts associated with the airport.

The frequency distributions of the wind speed for each year from 2002 to 2011 are presented in **Figure 16.2c**. Also shown in this graph is the frequency distribution of the wind speed over the entire 2002-2011 period. These results show all years during this period had a similar distribution of wind speeds. In particular, 2005 and 2009 show the least variation from the longer-term frequency distribution (less than 1 per cent).

Given the close agreement of 2005 and 2009 with the 10 year dataset in terms of wind speed, wind direction was analysed further to differentiate between these two years. The wind direction distribution is shown in **Figure 16.2d**. The divergence from the average wind distribution for 2005 and 2009 is plotted in **Figure 16.2e**. The two years differ most in the east-west and north-south axes; however, the difference does not exceed 2 per cent of the total distribution. Since most sensitive receptors are located close to the airport in all directions, neither year stands out as a conservative worst-case representation in terms of the potential impacts. **Figure 16.2c** shows that 2009 is representative of the overall wind speed distribution observed during the ten year period 2002 to 2011.

While wind speed and wind direction are the major influences on the dispersion of air pollutants, other meteorological parameters, such as temperature and relative humidity also play a role. A comparison between 2009 and the total ten year period for the other parameters, while not presented here, also shows good agreement. The year 2009 was chosen as most representative since the distribution of wind speed and wind direction closely represents that of the ten year period examined.

16.2.3.2 Analysis and validation of TAPM output

Meteorological parameters that are important for the dispersion of air pollutants have been extracted from the modelling system at the location of the SCA and further inland at Nambour to illustrate the variations in meteorological conditions in the region due to the airport's coastal location. **Appendix B16:C** details the validation of the meteorological modelling, which was performed using the following BOM meteorological monitoring sites:

- Sunshine Coast Airport
- Nambour (approximately 15 km west)
- Tewantin RSL Park (approximately 24 km north).

The validation shows reasonable agreement between the TAPM output and surface measurements at the SCA and Tewantin BOM meteorological monitoring sites.

16.2.3.3 Traffic Emissions

The existing fleet distribution travelling to and from the SCA was based on the Australian Bureau of Statistics (ABS), Motor Vehicle Census – 2010. This was projected from the ABS information by accounting for a take up rate of new vehicles of 3.5 per cent per annum. No account has been taken of the additional reductions in fleet emissions that could occur due to the tightening of the Australian Design Rules (ADR) after 2010. Information on fleet emissions were accounted for by estimating the gradual loss of older vehicles from the fleet that have relatively high emissions (and conform to old ADR) and the take up of new vehicles into the fleet that have lower emissions and conform to the current and more updated Euro 4 classification. The Euro 4 classification is a European emission standards set for new vehicles sold in EU member states. The Euro 1 standard was first introduced in 1992 and successive standards have been introduced with lower emissions. The ADR have been gradually updated to incorporate each new Euro category.

Emission rates from a road segment are dependent on the volume of vehicles, length of the road segment and vehicle emission factors. In estimating emissions, all roads included were assumed to be flat (i.e. a gradient of zero) and have a speed limit of 80 km/hr. Any time spent idling, at traffic lights for example, was assumed to be negligible.

Figure 16.2c: Frequency distribution of wind speeds, SCA 2002 - 2011

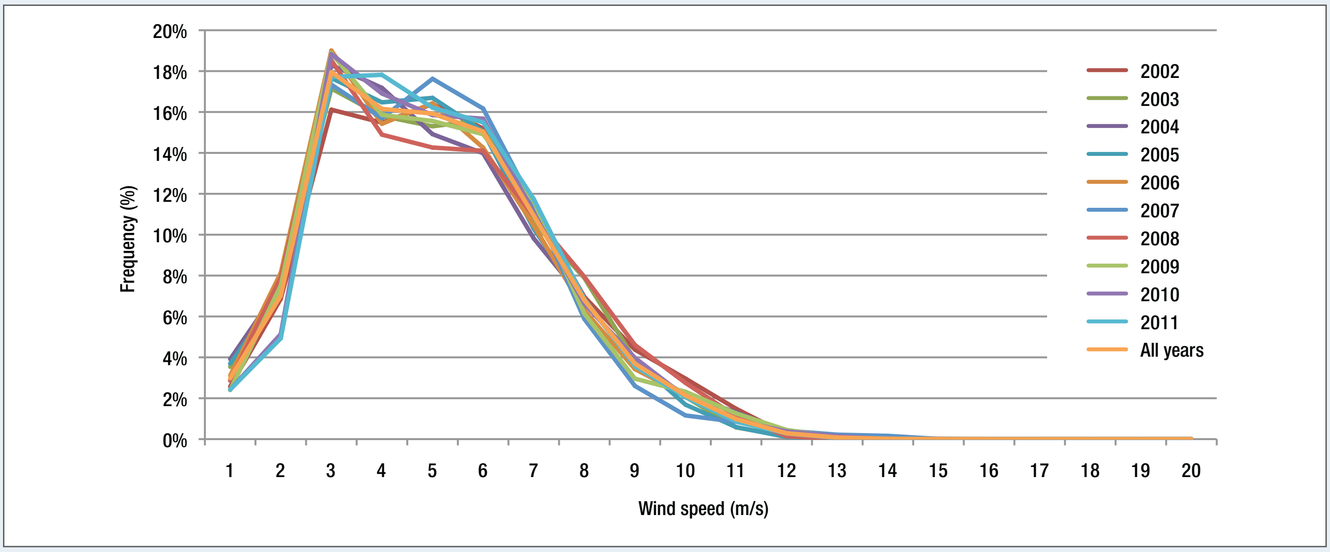


Figure 16.2d: Frequency distribution of wind directions, SCA 2002 - 2011

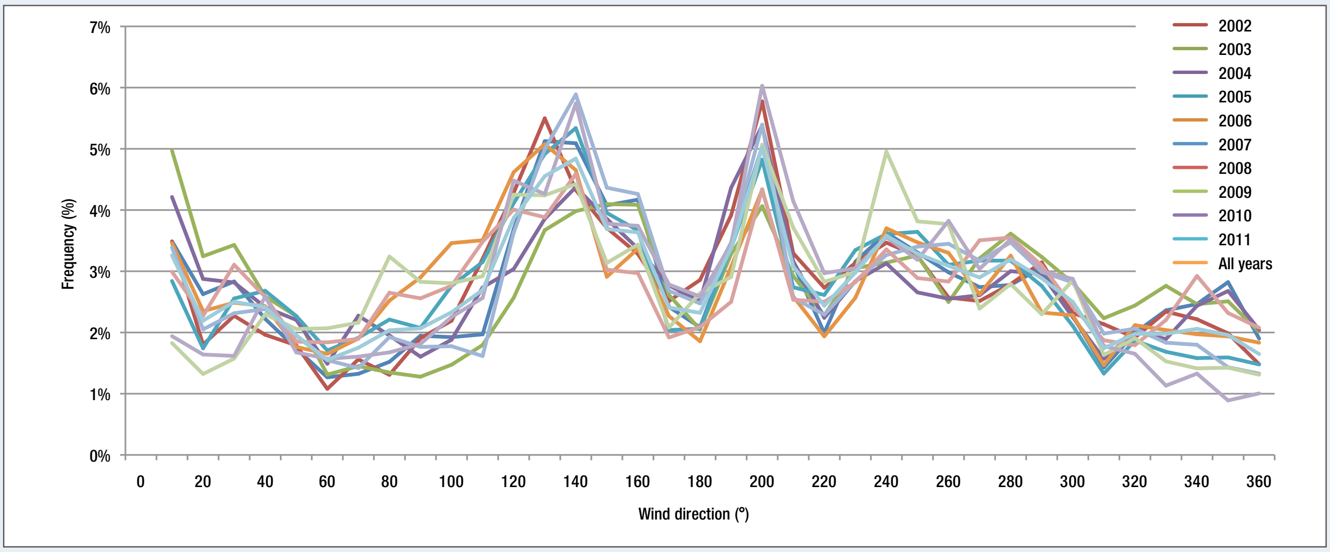
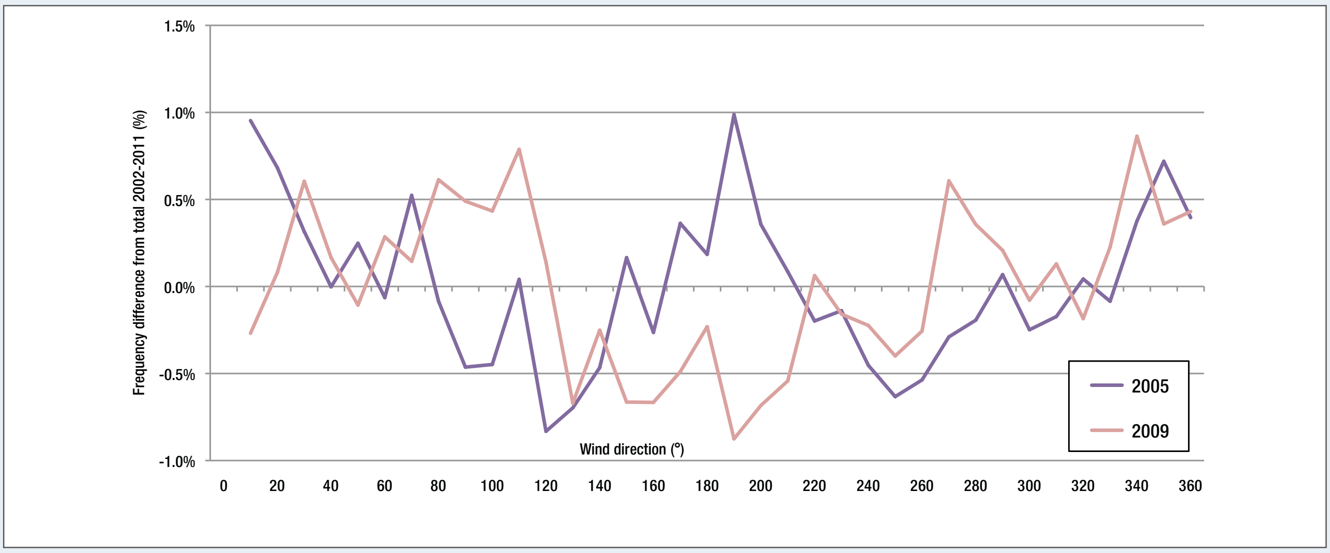


Figure 16.2e: Difference in frequency of wind direction from the mean (2002-2011) for the years 2005 and 2009



$PM_{2.5}$ emission rates were estimated from PM_{10} assuming that 70 per cent of PM_{10} is in the form of $PM_{2.5}$. This is consistent with the air quality assessment of the Brisbane North-South Bypass Tunnel (now Clem7 tunnel) (Holmes, 2004) and is based on monitoring of road tunnel emissions in Melbourne. Monitoring data from the M5 tunnel in Sydney shows a much lower $PM_{2.5}$ to PM_{10} ratio of 35 per cent and data from the Rocklea, Queensland monitoring station shows a ratio of approximately 44 per cent.

Emissions from vehicles have been considered within a 3 km radius of the SCA as traffic emissions are predominantly a local source and beyond this distance are unlikely to interact with airport sources.

The roads considered as part of the traffic assessment are relatively major transport routes. Emissions from traffic on these roads were assumed to represent the majority of traffic emissions in the area, outweighing traffic emissions from all other local roads. The roads that have not been considered have considerably lower traffic numbers and are shorter than the roads included in the assessment. Consequently, emissions from these roads have been taken to be negligible.

16.2.3.4 Greenhouse gas emissions

The assumptions used to conduct the GHG assessment include the following:

- The vehicle movements, entering and leaving the airport, have been taken from the traffic modelling (see also Chapter B14, Surface Transport). The distance that these vehicles will have travelled is unknown. The emissions were based on an average trip distance of 19.3 km, which is the average distance based on the location of the airport from major population centres on the Sunshine Coast: Caloundra, Maroochydore, Mooloolaba, Nambour and Noosa
- Scope 3 emissions have been limited to embedded emissions in primary construction materials, workforce commuting and fuel cycle emissions relating to fuel combustion and grid sourced electricity; the amount of fuel used by the baggage handlers is unknown and therefore these Scope 3 emissions have not been included in the assessment
- Construction workforce vehicle commute emissions were based on a single occupancy passenger vehicle for each worker
- Scope 3 vehicle emissions were based on total vehicle movements, which include workforce commuting, passengers and freight vehicles. The breakdown of these vehicles into workforce and passengers is unknown
- The assessment of the change in carbon stored in vegetation used the conservative assumption that any currently uncleared area is melaleuca forest
- Emissions relating to the construction of the new control tower are outside of the scope of this assessment
- During the construction phase a small amount of electricity will be used for the site office and security lighting. This electricity usage has not been estimated and it has been assumed to account for approximately 5 per cent of construction GHG emissions.

Future emissions were estimated by scaling baseline emissions with increased activity levels. The activity level indicators considered were passenger numbers and commercial flight movements taken from forecasts made by Leading Edge Aviation Planning Professionals (LEAPP, 2012), summarised in **Table 16.2i**.

Table 16.2i: Estimated commercial flight and passenger numbers for the current and future scenarios

Basis	2012	2020	2030	2040
Commercial flight	5,559	8,900	13,660	18,210
change %	-	60%	146%	228%
Passengers	620,542	1,074,602	1,567,182	2,013,912
change %	-	73%	153%	225%
AVERAGE		67%	149%	226%

There are some aspects of terminal operation that will not be directly linked to passenger numbers, such as lighting, although there are many that will be directly related to either passenger numbers, including air-conditioning, hand-dryer usage, tenancy electricity use, baggage carousel use and ground operations fuel usage. On the other hand, gate operation will depend on the number of flights rather than passenger numbers. The approach was taken to apply the average change in activity rate to all activities.

16.3 POLICY CONTEXT AND LEGISLATIVE FRAMEWORK

16.3.1 Environmental Protection (Air) Policy

The *Environmental Protection Act 1994* (EP Act) provides the framework for the management of the air environment in Queensland. The legislation applies to government, industry and individuals and provides all government departments with a mechanism to incorporate environmental factors into decision-making.

The EP Act gives the Minister of DEHP the power to create Environmental Protection Policies. *The Environmental Protection (Air) Policy* (Air EPP) was made under the EP Act and was gazetted in 1997; the Air EPP was revised in 2008 and came into force on 1 January 2009.

The objective of the Air EPP is:

> *....to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the Environmental Protection Act 1994, i.e. ecologically sustainable development.*

The environmental values to be enhanced or protected under the Air EPP are the qualities of the environment that are conducive to:

- Human health and wellbeing
- Protecting health and biodiversity of ecosystems
- Protecting the aesthetics of the environment, including the appearance of building structures and other property.

DEHP must consider the requirements of the Air EPP when it decides an application for an environmental authority or amendment of a licence. Schedule 1 of the Air EPP specifies air quality indicators and objectives for Queensland.

16.3.2 National Environment Protection measure

The National Environment Protection Council (NEPC) defines national ambient air quality standards and goals in consultation with, and with agreement from, all state governments. These were first published in 1998 in the *National Environment Protection (Ambient Air Quality) Measure* (NEPM(Air)). Compliance with the NEPM(Air) standards are assessed via ambient air quality monitoring undertaken at locations prescribed by the NEPM(Air) and that are representative of large urban populations. The goal of the NEPM(Air) is for the ambient air quality standards to be achieved at these monitoring stations within ten years of commencement, i.e. from 2008. The Air EPP adopted the NEPM(Air) standards as air quality objectives.

16.3.3 Relevant ambient air quality objectives for the project

The air quality objectives specified in Schedule 1 of the Air EPP and the NEPM(Air), as presented in **Table 16.3a**, are relevant for the air quality assessment of the project. The Air EPP does not specify an air quality objective for dust deposition rates. While not enforceable by legislation, the DEHP recommends a dust deposition impact assessment criteria from the NSW Office of Environment and Heritage (OEH), Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (Department of Environment and Climate [DEC], 2005). This list represents the most significant pollutants associated with construction and operations of the project. Other pollutants may be emitted by airport activities in trace amounts.

16.3.4 GHG emissions – Australian policy and regulation

16.3.4.1 GHG emission scopes

The process for accounting for greenhouse gas emissions involves dividing emissions among three 'scopes' to assign responsibility for emissions and manage potential double-counting. The Australian Government Clean Energy Regulator defines two emission categories for calculating greenhouse gas emissions in legislation. These are as follows:

- Direct emissions (Scope 1), in relation to a facility, means the release of GHG into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility
- Indirect emissions (Scope 2), in relation to a facility, means the release of GHG into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by a facility but that do not form part of the facility.

A third emission category is defined under the Greenhouse Gas Protocol (WBCSD, 2009) for calculating greenhouse gas emissions that are a consequence of the activities of a facility but occur from sources owned or controlled by another organisation. This category is termed Scope 3 emissions and covers sources such as:

- Aircraft emissions
- Employee business travel
- Transportation of products, materials and waste
- Outsourced activities, contract manufacturing and franchises
- Emissions from waste that are released in locations owned or controlled by another company
- Emissions from the use and end-of-life phases of products and services produced by the reporting facility
- Employees commuting to and from work
- Production of imported materials.

The following policy commitments and reporting thresholds refer to Scope 1 and 2 emissions only.

16.3.4.2 Australian international commitments

The following discussion of Australia's global commitments to respond to climate change is derived from information published by the Commonwealth Department of Environment (DoE) on its website (DoE, 2013).

The United Nations Framework Convention on Climate Change (UNFCCC) provides the basis for global action 'to protect the climate system for present and future generations'. Australia ratified the Convention in 1992. The Convention entered into force in 1994 after a requisite 50 countries had ratified it. There are now 193 Parties to the UNFCCC including almost all of the members of the United Nations.

Parties to the Convention have agreed to work towards stabilising 'greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.

Table 16.3a: Relevant ambient air quality indicators, objectives and guidelines used in Queensland

Indicator	Averaging period	Objective	Source	Environmental value
Particulate matter (as $PM_{2.5}$)[a]	24-hour	25 µg/m³	Air EPP	Health and wellbeing
	Annual	8 µg/m³	Air EPP	
Particulate matter (as PM_{10})[b,c]	24-hour	50 µg/m³	Air EPP	Health and wellbeing
Particulate matter (as TSP)	Annual	90 µg/m³	Air EPP	Health and wellbeing
Dust deposition rate (total insoluble solids)	Monthly	120 mg/m²/day	DEHP recommended	Amenity
	Annual	130 mg/m²/day	OEH[d]	Amenity
Nitrogen dioxide (NO_2)	1-hour	250 µg/m³	Air EPP	Health and wellbeing
	Annual	62 µg/m³		
	Annual	33 µg/m³		Health and biodiversity of ecosystems
Sulfur dioxide (SO_2)	1-hour	570 µg/m³	Air EPP	Health and wellbeing
	24-hour	230 µg/m³		
	Annual	57 µg/m³		
	Annual	32 µg/m³		Protecting agriculture
	Annual	22 µg/m³		Health and biodiversity for ecosystems (for forests and natural vegetation)
Carbon monoxide (CO)	8-hour	11 mg/m³	Air EPP	Health and wellbeing

Note:

a $PM_{2.5}$ are particles that have aerodynamic diameters that are less than 2.5 µm

b PM_{10} are particles that have aerodynamic diameters that are less than 10 µm

c Five exceedences allowed per year

d Office of Environment and Heritage (OEH), Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC, 2005)

Under the convention, Australia is committed to:

- Submitting a national inventory of emissions and removals of GHGs
- Implementing national programs to mitigate climate change and adapt to its impacts
- Conducting research related to the climate system and promoting relevant technologies
- Raising public awareness about climate change
- Submitting comprehensive National Communications (i.e. reports).

The Kyoto Protocol is an international agreement created under the UNFCCC in Kyoto, Japan in 1997. Australia's ratification of the protocol came into effect on 11 March 2008. The protocol aims to reduce the collective greenhouse gas emissions of developed country parties by at least five per cent below 1990 levels during 2008 to 2012 – referred to as the first commitment period. Australia has a target for emissions of 108 per cent of estimated emissions for 1990 or 591.5 Mt CO_2-e.

At the United Nations climate change negotiations in Durban, South Africa in 2011, Parties to the Kyoto Protocol decided to establish a second commitment period from 1 January 2013. On 9 November 2012, the Australian Government announced its intention to join a second commitment period under the Kyoto Protocol, conditional on a number of factors to be negotiated at the Doha Conference of the Parties in late 2012. All countries that are party to the UNFCCC are negotiating a new global agreement that is intended to have legally binding commitments for all major emitters. This agreement is due for finalisation by 2015 and come into effect in 2020 (Combet, 2012).

The Australian Government has a constitutional power to ensure that Australia meets its international commitments, including those made under the UNFCCC. For the purposes of this discussion, it is assumed that Sunshine Coast Council (SCC) will operate the airport. There are several related national policies, statutes and regulations that may be of importance to the construction and operation of the airport, including:

- The *National Greenhouse and Energy Reporting (NGER) Act 2007* and regulations
- The *Clean Energy Act 2011*.

This legislation is enforced by Australian Government agencies and penalties apply for non-compliance.

16.3.4.3 National Greenhouse and Energy Reporting

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) established a national framework for corporations to report GHG emissions and energy consumption. Registration and reporting is mandatory for corporations that have energy production, energy use or GHG emissions that exceed specified thresholds. The current NGER thresholds for facilities are 25kt CO_2-e GHG emissions or 100TJ of energy produced or used. The thresholds for corporations are 50kt CO_2-e or 200TJ.

The SCC must report greenhouse and energy data annually to the Australian Government under the *National Greenhouse and Energy Reporting Act 2007* and regulations. In 2011/12 SCC estimated its GHG emission as 177,230 tonnes, consisting predominantly of emission from landfill and wastewater treatment. Current reporting obligations require that GHG emissions relating to airport operations be captured as a component of SCC's corporate emissions estimation.

The NGER Act is administered by the Clean Energy Regulator and the scheme is also the basis for the *Clean Energy Act 2011* and associated carbon pricing mechanism.

Corporations are required to register under the NGER Act for the first year in which a threshold is triggered. A corporation remains registered until an application for deregistration is approved. Once registered, corporations are required to report by 31 October following the reporting year, and must submit an NGER Report for every year that it remains registered (CER, 2012a).

16.3.4.4 Clean Energy Act (carbon pricing mechanism)

The *Clean Energy Act 2011* has established a carbon emissions trading system for Australia including a fixed price period, a 'collar' period (with ceiling and floor prices) and full emissions trading from 1 July 2015, where the market will determine prices (with some restrictions). The NGER Scheme is the basis for the *Clean Energy Act 2011*.

Generally, if a facility meets or exceeds the threshold of covered emissions of 25 ktCO_2-e in a financial year, the entity responsible for the facility will be liable under the carbon pricing mechanism. The assessment is made on a facility basis; facilities with covered emissions of less than 25 ktCO_2-e in a financial year do not have a liability under the carbon pricing mechanism. Where a facility has Scope 1 emissions of 25 ktCO_2-e these emissions are considered 'covered emissions' and would constitute a liability under the carbon pricing mechanism. There are some exceptions to what constitutes a covered emission including fuels where an excise has been applied and natural gas where the supplier is liable for the embodied emissions unless the liability is transferred to the end user.

Following the September 2013 election, the repeal of the *Clean Energy Act 2011* and associated legislation is currently under consideration. The 2013/14 reporting period is planned to be the final period that a carbon price will be applied to 'covered emissions' under the *Clean Energy Act 2011*. It has been proposed that if an agreement cannot be reached by this time that any ongoing payments from 'liable entities' will be refunded once the Act has been repealed. 'Direct Action' is the government's planned approach to reducing carbon emissions to meet Australia's commitments under the second period of the Kyoto Protocol.

SCC is currently liable for the carbon pricing mechanism under the *Clean Energy Act 2011*, but this obligation arises from landfills it operates ('facilities' under the legislation) and emissions from aircraft movements are unrelated.

16.3.4.5 Summary of reporting obligations

A summary of the program reporting obligations is provided in **Table 16.3b**.

Table 16.3b: Summary of reporting thresholds

Program	GHG (t CO_2-e)	Energy Use (TJ)
NGER Facility	25,000	100
NGER Corporation	50,000	200
Clean Energy Act	25,000	100

16.4 EXISTING CONDITIONS

This section describes the current air quality in the Sunshine Coast Region as well as the estimated emissions from the current airport operations.

16.4.1 Geographic features and sensitive receptors

This section describes the area surrounding the SCA, in terms of the elements that will have an effect on the local meteorology, such as current land use and terrain; and the identified sensitive receptor areas.

16.4.2 Land-use

The breakdown of land-use surrounding the SCA is presented in **Table 16.4a**. Of particular note in terms of proximity to sensitive receptors is that nearly 12 per cent of the area within 3 km of the project site is classified as residential. The proximity of the site to the coastline results in almost a quarter of the area within 3 km of the site boundary being ocean, and almost half of the area within 40 km. Another major land-use is cropping, which also accounts for a quarter of the area within 3 km of the boundary.

16.4.3 Terrain

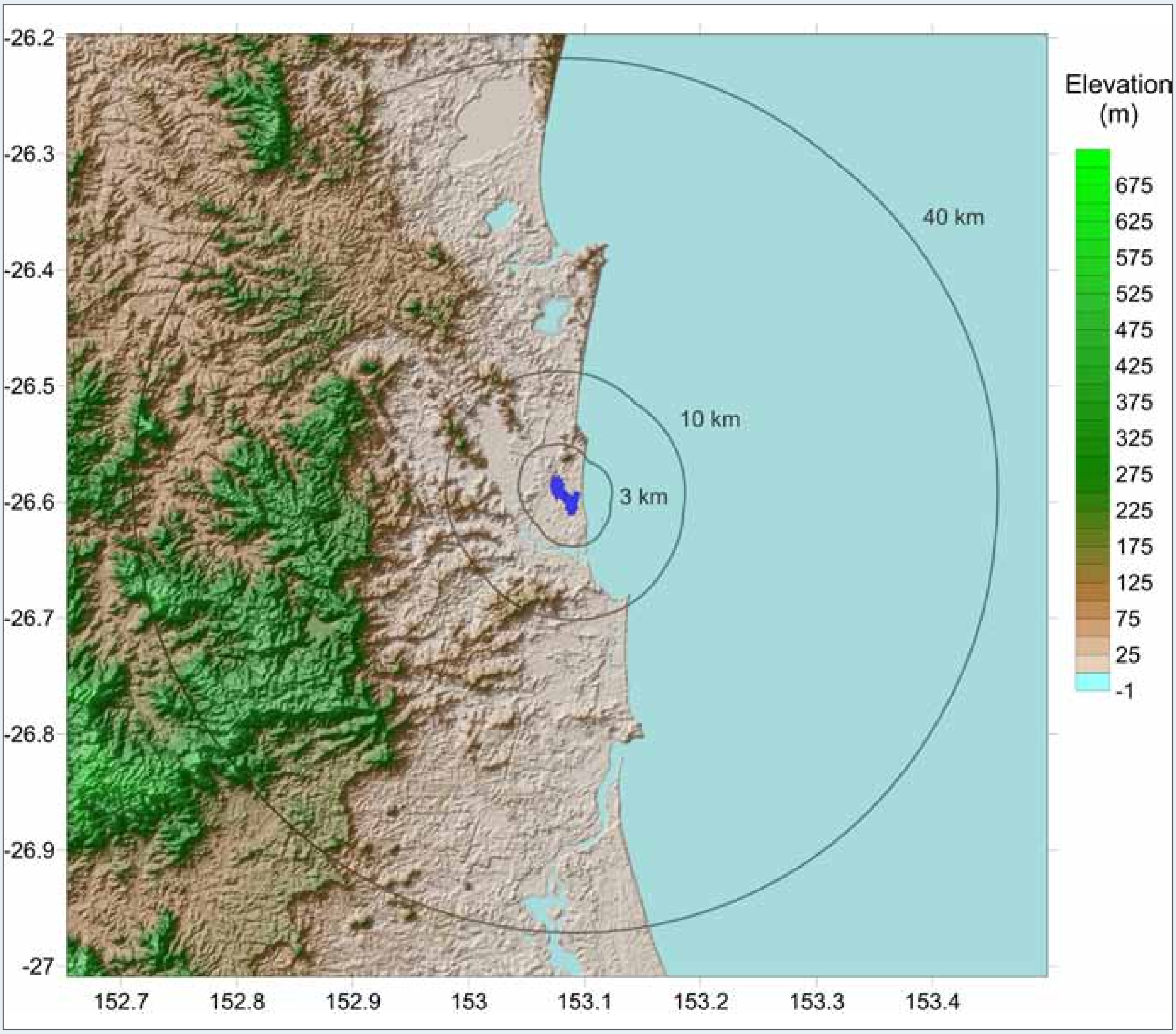
The coastal site of the SCA is generally flat and has low elevation, i.e. less than 10 m. The Pacific Ocean to the east is at its closest at 100 m from the site. A notable terrain feature is Mount Coolum, which rises to an elevation of around 200 m approximately 2 km north of the Project site's northern boundary.

A shaded relief map showing the terrain in the wider region of the SCA is presented in **Figure 16.4a**. Within 10 km of the coast, terrain in the region for the most part has an elevation below 25 m, however further from the coast and within 40 km of the airport site elevation rises to around 600 m. In the sector bounded by the west-northwest and south-west directions there are areas of elevated terrain approximately 15 km from the site. The terrain closer to the site (within 10 km) is shown in **Figure 16.4b**. From **Figure 16.4b** it may be seen that apart from Mount Coolum, the closest elevated terrain is approximately 5 to 7 km from the site boundary in the north-west, west, and south-southwest directions.

Table 16.4a: Land-use surrounding the project site

	3 km buffer zone		10 km buffer zone		40 km buffer zone	
Land-use description	**ha**	**%**	**ha**	**%**	**ha**	**%**
Cropping	1479	24.8	7,427	17.9	13,306	2.5
Nature conservation	638	10.7	2,484	6.0	38,607	7.1
Residential	696	11.7	6,124	14.7	41,393	7.6
Services	344	5.8	772	1.9	3,060	0.6
Grazing natural vegetation	0	0	1,612	3.9	66,100	12.2
Intensive animal production	0	0	43	0.1	16,981	3.1
Plantation forestry	0	0	153	0.4	21,029	3.9
River	117	2.0	493	1.2	2,154	0.4
Lake	0	0	0	0	5,794	1.1
Ocean	1738	29.1	16,780	40.4	253,195	46.7
Production forestry	0	0	0	0	11,109	2.0
Other minimal use	859	14.4	4,655	11.2	55,300	10.2
All other land uses	94	1.6	996	2.4	14,387	2.7
TOTAL	5963	100	41,538	100	542,417	100

Figure 16.4a: Terrain in the Sunshine Coast region



16.4.4 Sensitive receptors

Areas containing residential dwellings, community facilities and other accommodation facilities are sensitive to air quality impacts. Vegetated areas, whether forest, cultivated agricultural land, or uncultivated regions, are also sensitive to air quality impacts. These areas have been identified from land-use data published by Geoscience Australia.

Figure 16.4c illustrates the locations of different types of sensitive receptors in the study area. The built up areas indicate where most residential, community and accommodation facilities are located, and in these areas air quality criteria relevant to human health and well-being apply. Those areas marked as cultivated, native vegetation, recreation areas and parks and reserves are also sensitive, and in these regions air quality criteria for the health and biodiversity of ecosystems apply. **Figure 16.4c** shows that most of the study area is sensitive to air quality impacts.

Figure 16.4d illustrates these sensitive receptor regions in the immediate vicinity of the SCA. The sensitive receptors that may potentially be affected during the construction phase of the project are the residences directly to the east of the existing north-south runway.

Figure 16.4b: Terrain close to the SCA

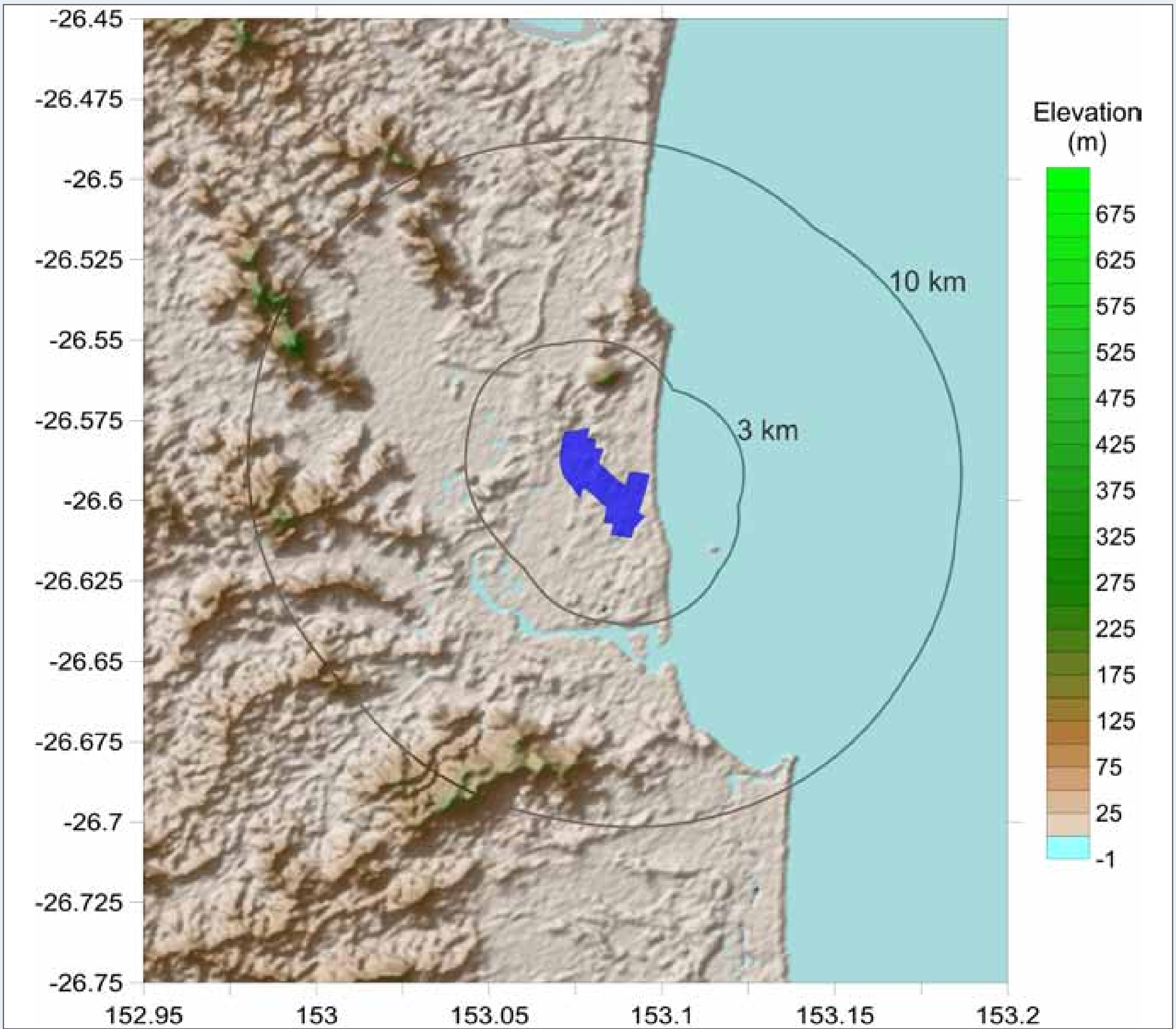


Figure 16.4c: Sensitive receptor regions around the SCA Project site

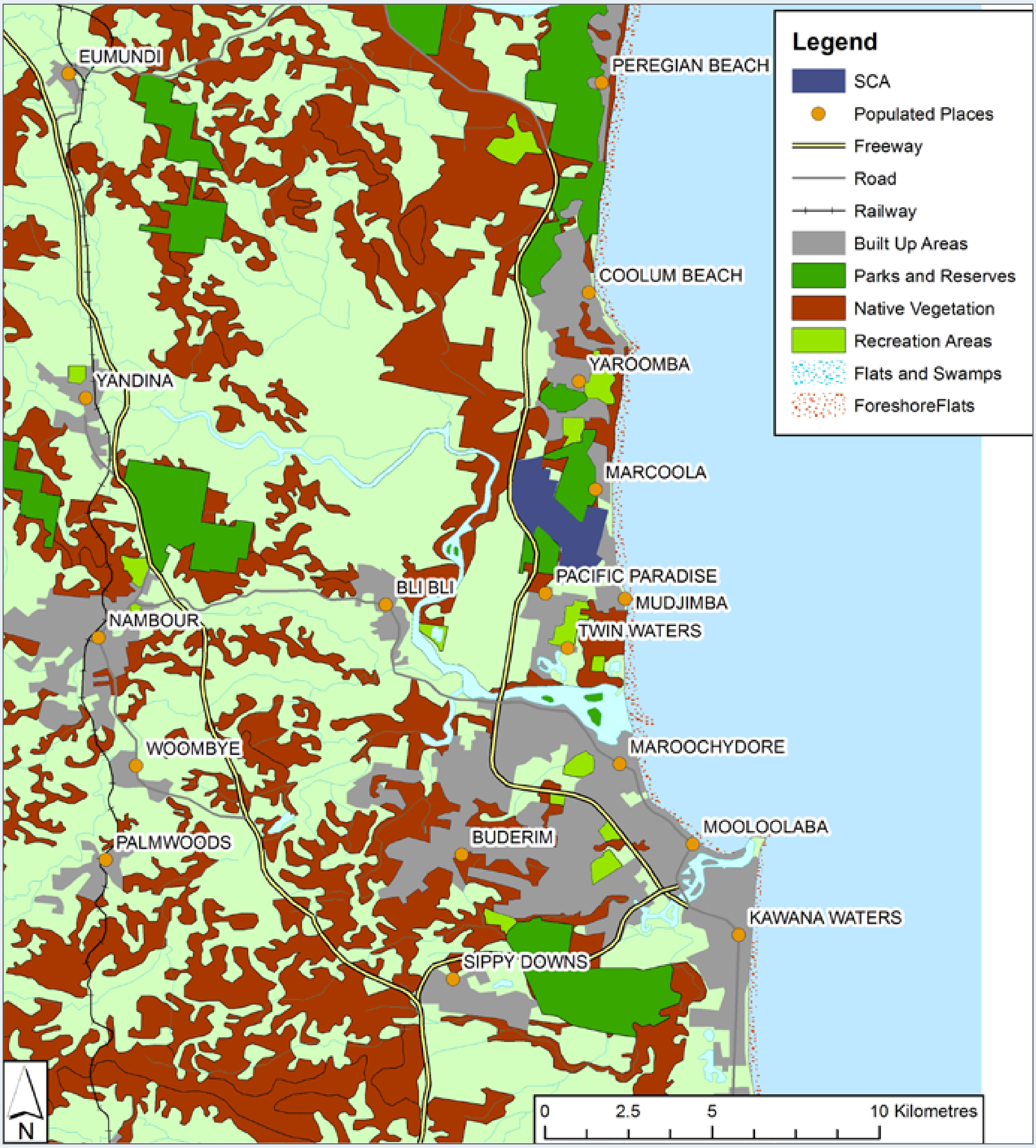


Figure 16.4d: Aerial imagery of the SCA Project site (Google Earth, 2013). Residences directly to the east of the north-south runway are most likely to be impacted during the construction phase of the project by dust emissions

16.4.5 Meteorology

Local meteorology plays a strong role in the dispersion of pollutants and the potential for subsequent impacts on surrounding areas. This section describes the local meteorology in terms of measurements made by BOM and modelled parameters produced by TAPM.

16.4.5.1 Wind speed and wind direction

Wind speed and wind direction are important parameters for the transport and dispersion of air pollutants. The winds in the vicinity of the SCA are strongly influenced by sea and land breezes as a result of the coastal location. The annual, diurnal and seasonal frequency distributions of the winds measured by BOM at the location of the SCA between 1996 and 2011 are presented in **Figure 16.4e** to **Figure 16.4g**. These show that both the wind speed and wind direction vary significantly according to time of day and season.

Figure 16.4g shows that south-easterly winds are predominant throughout summer and autumn, with a more even distribution of winds occurring in winter and spring. The diurnal wind distribution in **Figure 16.4f** demonstrates the sea and land breezes, which are more intense during the warmer summer and autumn months. The sea breeze is caused by solar heating of the coastal land surface during the day, which results in a warming of the air over the land and winds that blow inland as this warm air rises (the predominant south-westerlies that occur during the afternoon). The cooling of the land overnight results in winds blowing out towards the sea as the warmer air over the ocean rises. The sea breeze is responsible for the strongest winds that occur at the SCA, which are afternoon south-easterlies.

Figure 16.4e: Wind rose of hourly winds measured by BOM at SCA between 1996 and 2011

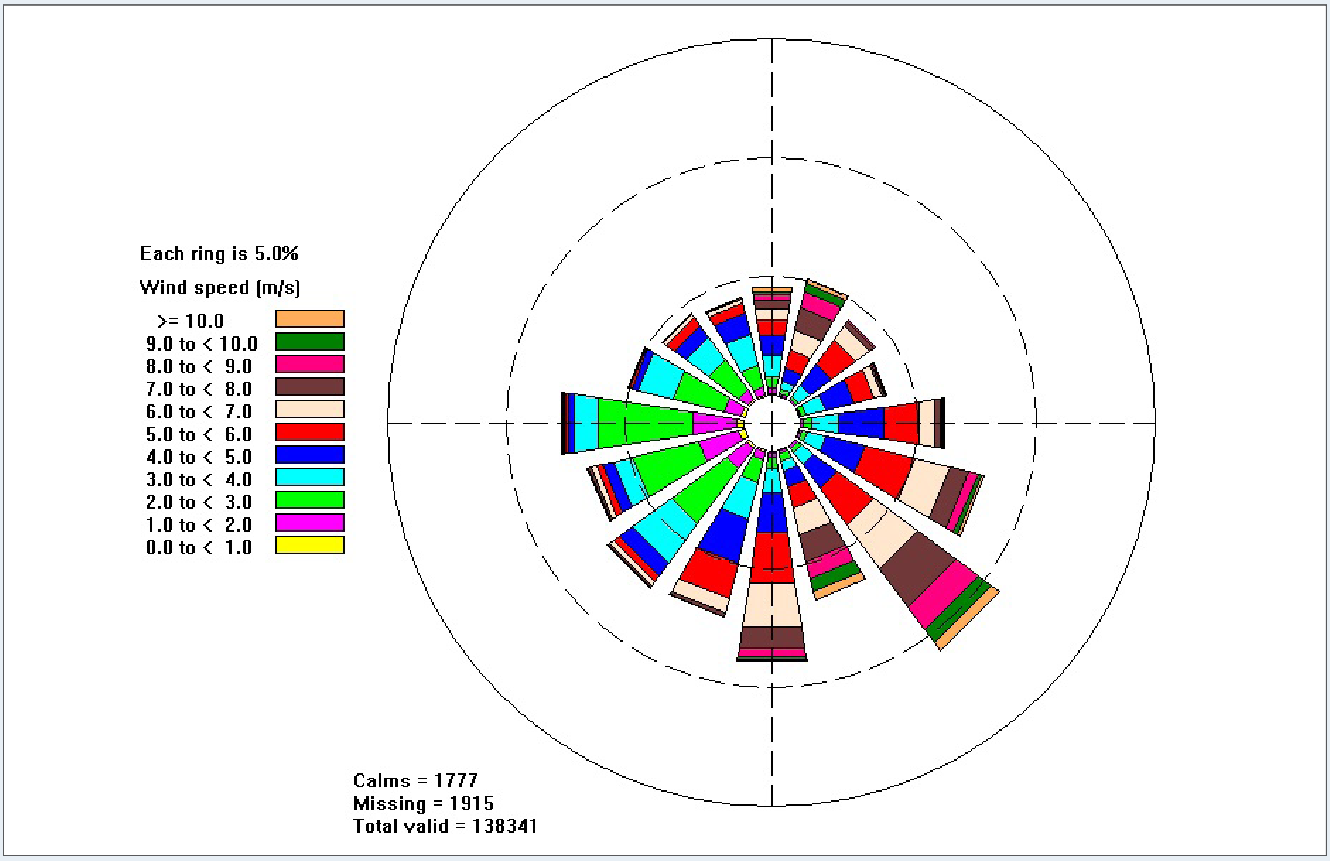


Figure 16.4f: Diurnal wind rose of winds measured by BOM at SCA between 1996 and 2011

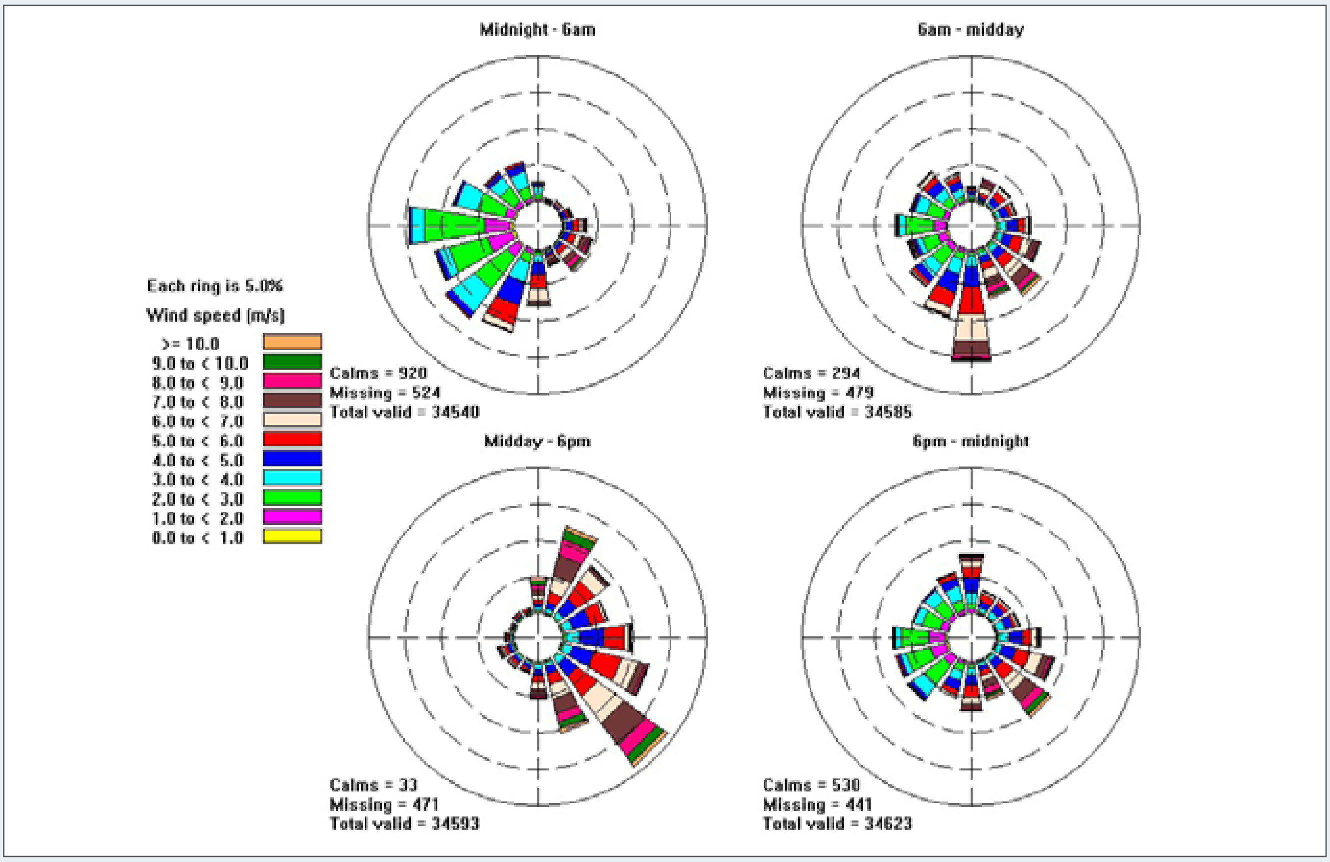
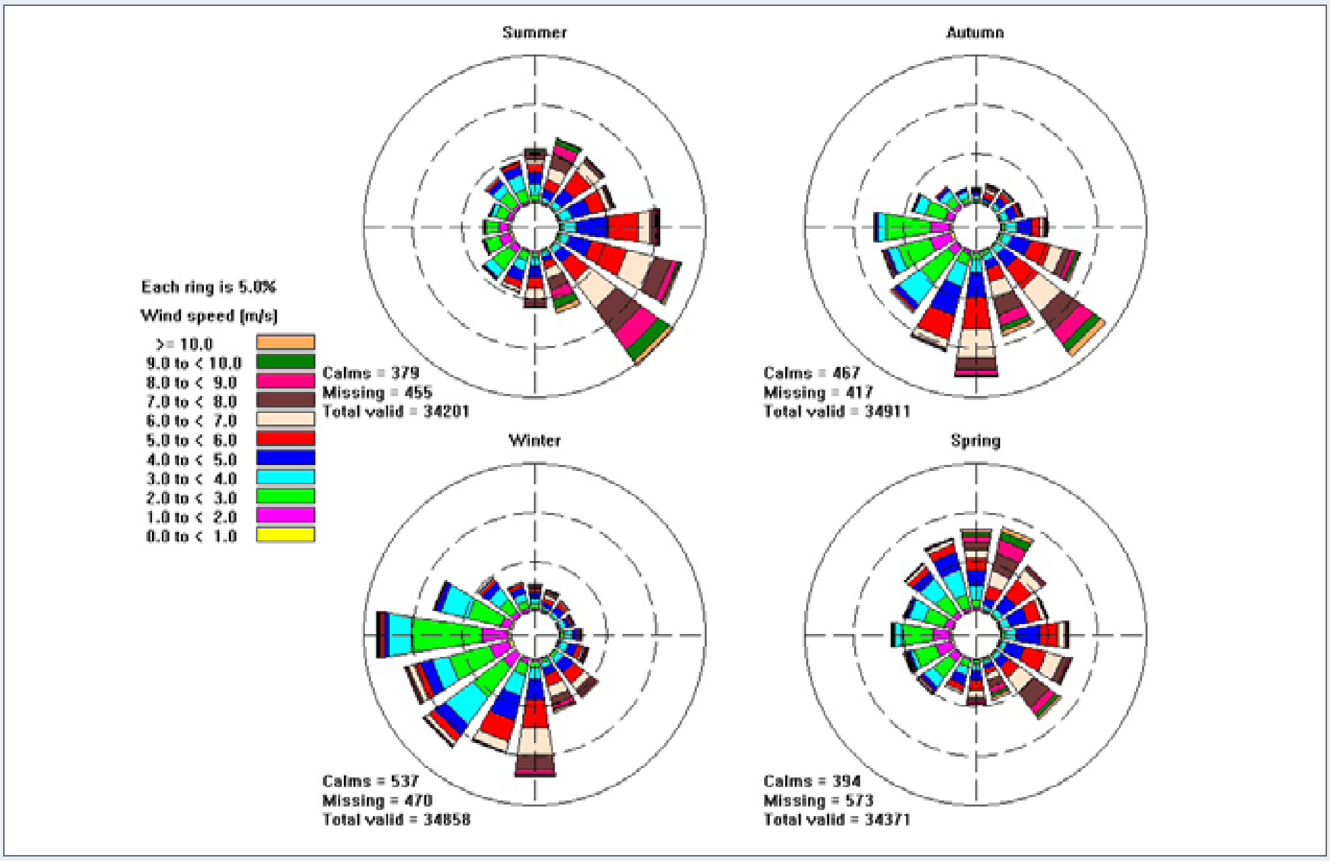


Figure 16.4g: Seasonal wind rose of winds measured by BOM at SCA between 1996 and 2011



During winter the strongest winds are also south-easterlies; however, there is an even distribution of wind directions during the afternoon, and winds are mostly from the westerly quadrants in the evening (6pm to midnight) and overnight (midnight to 6am). During spring, the predominant wind directions range from north-northwesterly to north-northeasterly and the strongest winds occur from the predominant wind directions throughout the day.

The average wind speed at the SCA is 4.6 m/s. **Table 16.4b** shows that the highest frequency of winds stronger than 6 m/s occurs during summer and, throughout all seasons, the highest percentage of winds stronger than 6 m/s occur during the afternoon.

16.4.5.2 Temperature and humidity

The average daily minimum and maximum temperatures at the SCA are presented in **Figure 16.4h**. This shows a seasonal temperature profile typical of the sub-tropical Queensland climate, with cooler winter months of June to August and warmer summer months of December to January.

The average maximum daily temperature at the SCA is 28.0°C recorded during the summer season. The average minimum daily temperature at the monitoring station is 9.6°C, recorded during winter.

The seasonal availability of moisture is another important factor that influences the climate, by affecting the transfer of heat in the atmosphere and the occurrence of rain. Relative humidity is one of several measures used to describe the amount of moisture in the atmosphere, and is the ratio of the actual amount of moisture in the atmosphere to the maximum amount that could be held, at a given temperature.

Relative humidity has been analysed from measurements collected at SCA. The data show that the relative humidity is highest overnight, and drops during the day due to the drying effect of the sun as the day progresses. The monthly average daily maximum and minimum relative humidity is presented in **Figure 16.4i**.

Table 16.4b: Summary of wind speeds at the SCA measured by BOM

	Wind speed frequency (%)			
Period	**<2 m/s**	**2 – 4 m/s**	**4 – 6 m/s**	**>6 m/s**
Spring				
Midnight to 6am	4.8	12.7	5.0	2.5
6am to Midday	2.0	7.7	8.7	6.7
Midday to 6pm	0.2	1.9	10.0	12.9
6pm to Midnight	2.8	9.3	8.1	4.7
Summer				
Midnight to 6am	4.6	10.1	6.0	4.3
6am to Midday	1.9	6.1	9.2	7.8
Midday to 6pm	0.2	1.3	9.9	13.7
6pm to Midnight	1.5	6.4	9.2	7.9
Autumn				
Midnight to 6am	4.1	11.6	5.6	3.7
6am to Midday	2.3	8.3	8.0	6.4
Midday to 6pm	0.4	4.3	10.2	10.0
6pm to Midnight	3.7	9.5	6.1	5.6
Winter				
Midnight to 6am	3.8	14.7	4.4	2.0
6am to Midday	2.9	10.3	6.9	4.9
Midday to 6pm	0.9	6.4	10.5	7.2
6pm to Midnight	5.3	12.9	4.8	2.1
Season totals				
Spring	9.8	31.6	31.8	26.8
Summer	8.2	23.9	34.2	33.6
Autumn	10.6	33.7	29.9	25.8
Winter	12.8	44.3	26.6	16.3
Annual	10.4	33.4	30.6	25.6

Figure 16.4h: Average daily maximum and minimum temperatures at SCA between 1996 and 2011 (BOM)

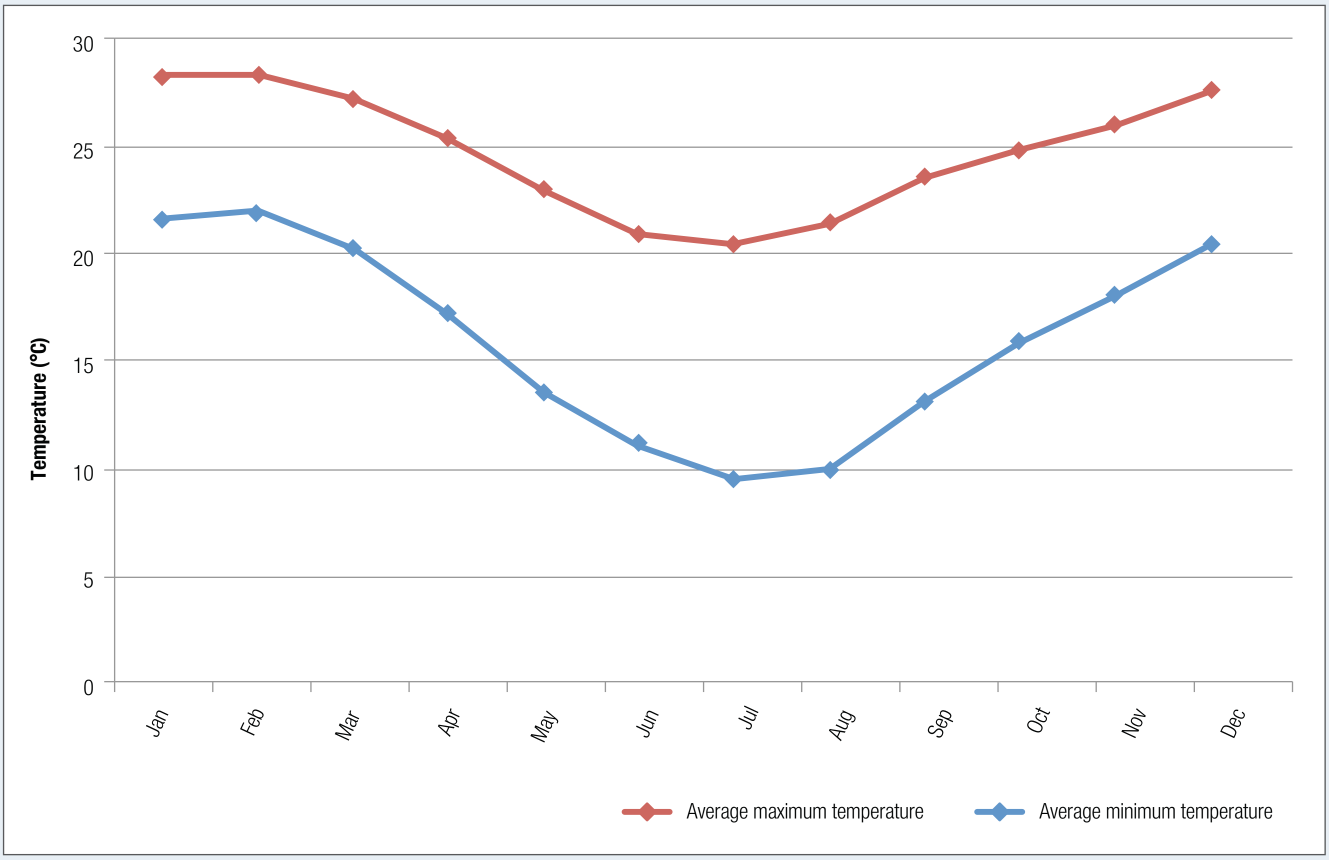
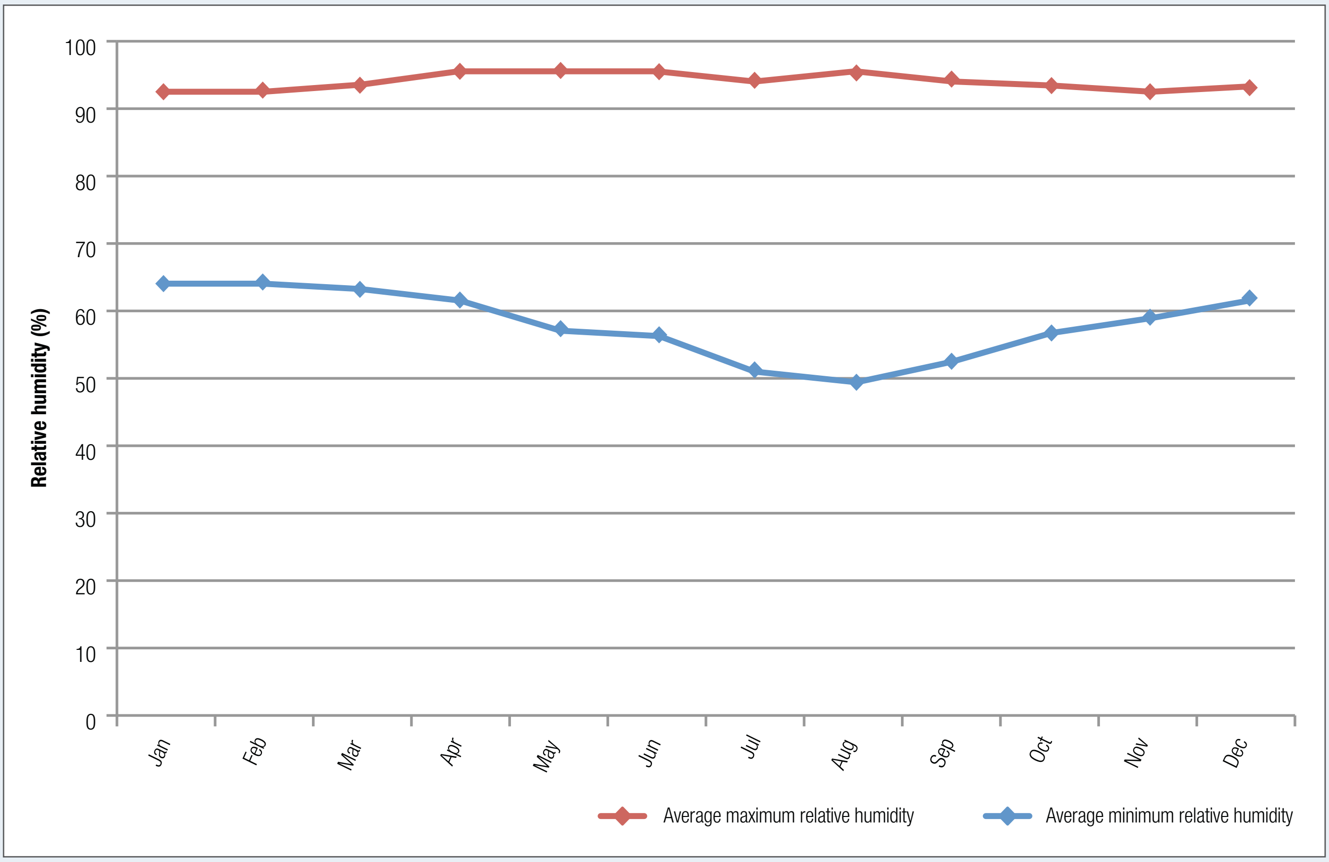


Figure 16.4i: Average daily maximum and minimum relative humidity at SCA between 1996 and 2011 (BOM)



16.4.5.3 Dispersion meteorology

The prognostic model TAPM was used to develop a three-dimensional wind field used in dispersion modelling. Stability class and mixing height are important parameters for dispersion that are not measured by BOM. These parameters are discussed below.

Atmospheric stability

Stability classification is a measure of the stability of the atmosphere and can be determined from wind measurements and other atmospheric observations. Stability classes range from A Class, which represents very unstable atmospheric conditions that may typically occur on a sunny day, to F Class stability which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Classes A to C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the night, the atmospheric conditions are generally stable (Classes E and F).

Table 16.4c shows the distribution of stability classes at the SCA. There is a relatively high proportion of class C and D, or slightly unstable and neutral conditions. This is typical of a coastal location, where solar heating of the ground surface and subsequent cooling lead to strong convective air movements and reasonably strong wind speeds during the day and night.

Mixing height

The mixing height refers to the height above ground within which particulates or other pollutants released at or near ground can mix with ambient air. During stable atmospheric conditions (F class stability), the mixing height is often quite low and particulate dispersion is limited to within this layer. During the day, solar radiation heats the air at the ground level and causes the mixing height to rise. The air above the mixing height during the day is generally cooler. The growth of the mixing height is dependent on how well the air can mix with the cooler upper level air and therefore depends on meteorological factors such as the intensity of solar radiation and wind speed. During strong wind speed conditions the air will be well mixed, resulting in a high mixing height.

Mixing height information at a representative site has been extracted from TAPM and is presented in **Figure 16.4j**. The mixing height tends to develop around 8am, peaks around early afternoon (1pm) before decreasing between 2pm and 6pm.

16.4.6 Existing Air Quality

This section describes the potential sources of pollution in the area, including existing industry and diffuse sources such as traffic. The overall air quality as determined by DEHP monitoring is also discussed.

Figure 16.4j: Diurnal profile of mixing height generated by TAPM

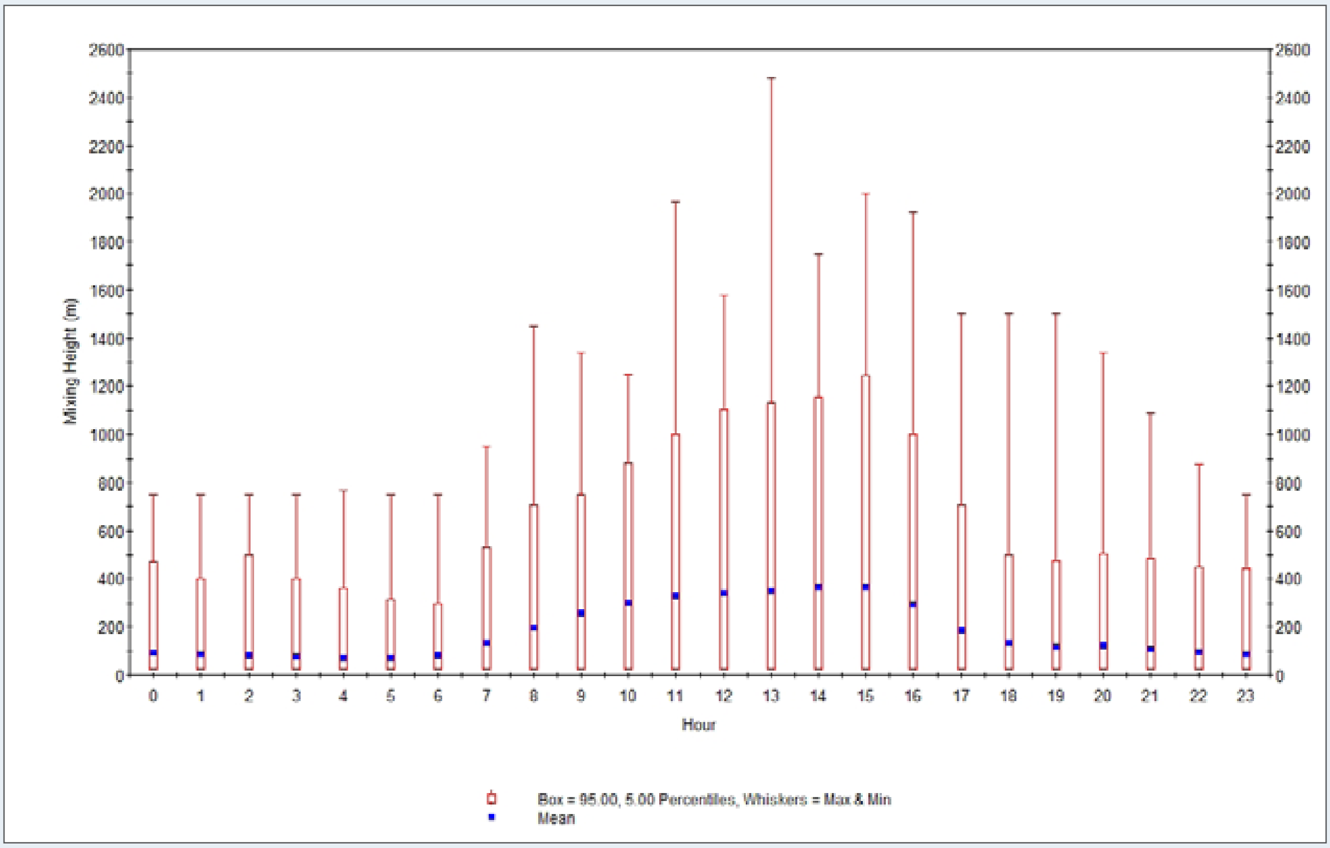


Table 16.4c: Percentage frequency distribution for atmospheric stability under the Pasquill-Gifford stability classification scheme

Pasquill-Gifford Stability Class	Classification	Frequency (%)
A	Extremely unstable	0.1
B	Unstable	6.1
C	Slightly unstable	18.4
D	Neutral	55.5
E	Slightly stable	7.9
F	Stable	11.9

16.4.6.1 Existing industry

In addition to the airport and associated infrastructure, the following industries operate in the region (taken as being located within a 40 km radius of the airport):

- Water supply and treatment
- Sewerage treatment
- Confectionery manufacturing
- Sawmilling
- Poultry farming
- Animal feed manufacturing
- Asphalt manufacture
- Quarrying

These industries emit a variety of pollutants, including particulate matter, oxides of nitrogen (NO_X), sulfur dioxide (SO_2) and carbon monoxide (CO). The emissions of selected pollutants from NPI reporting facilities in the region are shown in **Table 16.4d**. Most of these facilities are at least 10 km from the SCA, but will contribute to the ambient background concentrations in the region. The significant NPI reporting facilities located close to the airport include the Buderim Landfill and a quarry operated by Boral (operations ceased in 2012).

The dust emissions in the region are primarily due to quarrying, and quarries are also the most significant sources of NO_X. Emissions reported to the NPI of most pollutants have either reduced or remained steady over the last five years.

16.4.6.2 Other sources of air pollutants in the region

There are additional sources of air pollutants in the region, many of which are not easily quantifiable. For example, dust storms and bushfires can have a significant influence on the concentrations of particular matter in the region from time to time (BOM, citing Middleton, 1984). This is demonstrated in the monitoring data collected at Mountain Creek, where dust storms in 2003, 2005 and 2009 resulted in concentrations of PM_{10} that exceeded the Air EPP objective (**Table 16.4d**).

The SCA is located in a region of Australia that is expected to have less than one dust storm per year on average (BOM, citing Middleton, 1984).

In the wider region, minor industrial activities, commercial and domestic activities such as fuel burning and agricultural burning also contribute pollutants to the airshed and are not included in NPI reporting. Traffic movements, including road vehicles, railway and boating traffic, in the area that are not associated with airport operations are also not typically quantified. There would also be biogenic emissions from vegetation in the area. The coastal location of the airport means that salt spray will be a source of particulates in the atmosphere.

Although there are many sources that are not easily quantified, ambient monitoring data in the region reflects the cumulative contribution of all sources of air pollutants in the region.

16.4.6.3 Ambient air quality monitoring at Mountain Creek

There is one DEHP operated ambient air quality monitoring station that is indicative of air quality in the vicinity of the SCA. It is located at Mountain Creek Primary School, approximately 10 km south, and 2 km further inland than the SCA.

The area in the immediate vicinity of the monitoring station is noticeably more developed in terms of residential settlement than the area immediately surrounding the SCA. The Mountain Creek monitoring station was installed to measure achievement against the goals specified in the NEPM(Air), and is characterised as a Generally Representative Upper Bound (GRUB) station, meaning that it is indicative of pollutant concentrations in the upper range of levels occurring in populated areas in the region. Concentrations recorded at this monitor may therefore be slightly higher than those expected in the area surrounding the SCA.

Table 16.4d: NPI reported emissions to air for 2011/12 from facilities within a 40 km radius of the SCA (kg/year)

Industry Type	Facility Name	CO	NO_2	SO_2	PM_{10}	$PM_{2.5}$	Distance from airport (km)
Production of hot-mix asphalt	Bli Bli	2,305	1,563	133	27,072	6,119	11
Quarrying; sand and gravel production; extraction of rock, crushing, screening	Bli Bli quarry	8,197	16,436	10	43,298	1,186	11
	Sunrock quarry	10,164	21,380	13	31,408	1,506	38
	Hanson Glasshouse Mtns quarry	6,881	12,888	1,299	19,253	918	38
	Boral quarries, Coolum	3,502	9,864	6	25,259	862	10
	Boral quarries, Moy Pocket	27,618	39,375	40	42,699	4,720	36
Landfill and municipal waste	Buderim landfill	680	523	113	224	213	9
	Coolum landfill	42	-	-	-	-	9
	Eumundi landfill	3	-	-	-	-	19
	Kenilworth landfill	1	-	-	-	-	37
	Nambour landfill	232	-	-	-	-	11
	Woombye landfill	12	-	-	-	-	14
	Caloundra landfill	248	-	-	-	-	21
Food Processing, Confectionary and Processed Ginger Products	Ginger factory	410	2,392	189	130	70	14
Sawmilling	Peachester Sawmilling Company Pty Ltd	2,448	894	102	1,944	1,644	34
Protein rendering	Sunland Proteins	4,491	9,881	27,307	11,857	4,132	26
Maximum from a single facility (kg/year)		27,618	39,375	27,307	43,298	6,119	
Total reported emissions (kg/year)		67,235	115,195	29,213	203,143	21,370	

Table 16.4e presents a summary of the PM_{10} concentrations measured at Mountain Creek, as well as the number of recorded exceedances and the circumstances leading to them. **Table 16.4f** presents a summary of NO_2 and PM_{10} concentrations measured at Mountain Creek, including the 75th percentile value, which is a good indication of typical ambient background concentrations. The data show that measured concentrations of nitrogen dioxide in the region are consistently below the standards specified in the NEPM(Air).

Occasional exceedances of the PM_{10} air quality criteria have occurred; however, the limit of five allowable exceedances per year was only exceeded in 2009. Five of these recorded exceedances coincided with major dust storms that affected much of eastern Australia and most of Queensland during late September, and an additional two occurred during the passage of wind-blown dust transported by a weather front.

This analysis of ambient air quality monitoring at Mountain Creek shows that the air quality objectives are rarely exceeded except during regional events such as dust storms that are associated with elevated levels of particulate matter. Inference from this data suggests that concentrations of dust and NO_2 in the region around the SCA will generally be low; however, exceedances of the Air EPP objectives for particulate matter will occur on occasion due to natural events.

16.4.6.4 Other ambient air quality monitoring

The Woolloongabba monitoring station is currently the only Queensland monitoring station that monitors CO. Woolloongabba is classified as a peak station and is located in the inner city of Brisbane. Therefore, it is expected that levels of CO measured at Woolloongabba would be above those on the Sunshine Coast. Data from the Woolloongabba monitoring station is summarised in **Table 16.4g**.

Sulfur dioxide (SO_2) is monitored at Flinders View and Springwood in South East Queensland. Flinders View is a GRUB station, while Springwood is classified as a population average station. Data from the Flinders View station is summarised in **Table 16.4h**. Data from the Springwood station is summarised in **Table 16.4i**.

Analysis of the monitoring data indicates that neither SO_2 nor CO is of concern at the monitoring locations. It is unlikely that concentrations of these pollutants would be higher in the area surrounding SCA.

Table 16.4e: Concentrations of 24-hour average PM_{10} measured at the DEHP Mountain Creek ambient air quality monitoring station

Year	Maximum concentration (µg/m³)	6th highest concentration (µg/m³)	Number of exceedances	Circumstances during periods of exceedance
2003	69	35.8	1	Dust storms
2004	66.6	35	1	Construction works nearby
2005	62.9	30.1	2	Dust storms
2006	39.8	28.9	0	-
2007	41.9	31.9	0	-
2008	56.3	36	1	Wind-blown dust
2009	863.8	69	8	Major dust storms
2010	33.7	23.9	0	-
2011	49.5	28.4	0	-
Air quality objective:		50 µg/m³		

Table 16.4f: Concentrations of NO_2 and PM_{10} measured at the DEHP Mountain Creek ambient air quality monitoring station

	NO_2 concentration (µg/m³)			PM_{10} (µg/m³)	
Year	**Maximum 1-hour average**	**75th percentile 1-hour average**	**Annual average**	**6th highest**	**75th percentile 24-hour average**
2003	62.0	32.0	9.4	35.8	18.2
2004	77.1	37.6	9.4	35.0	17.7
2005	60.2	30.1	9.4	30.1	17.1
2006	65.8	30.1	9.4	28.9	17.1
2007	63.9	28.2	7.5	31.9	17.3
2008	56.4	30.1	7.5	36.0	17.9
2009	56.4	28.2	7.5	69.0	19.2
2010	54.5	30.1	9.4	23.9	15.4
2011	60.2	Not reported	7.5	28.4	15.7
Air quality objective	250	-	62, 33	50	-

Table 16.4g: Concentrations of 8-hour average CO measured at the DEHP Woolloongabba ambient air quality monitoring station

Year	Maximum concentration (µg/m³)	Number of exceedances
2003	6,180	0
2004	5,379	0
2005	4,578	0
2006	4,578	0
2007	1,259	0
2008	3,319	0
2009	2,747	0
2010	3,090	0
2011	2,174	0
Air quality objective:	11,000	

Table 16.4h: Concentrations of SO_2 measured at the DEHP Flinders View ambient air quality monitoring station

	SO_2 (µg/m^3)		
Year	**Maximum 1-hour average**	**Maximum 24-hour average**	**Annual average**
2003	120.5	15.7	2.6
2004	165.1	18.3	2.6
2005	89.1	15.7	2.6
2006	104.8	18.3	2.6
2007	68.1	15.7	2.6
2008	110.0	15.7	2.6
2009	120.5	18.3	2.6
2010	89.1	21.0	2.6
2011	73.4	13.1	2.6
Air quality objective	570	230	57 (Human health) 32 (Biodiversity) 22 (Agriculture)

Table note: Concentrations converted from ppm to µg/m^3 at 25°C

Table 16.4i: Concentrations of SO_2 measured at the DEHP Springwood ambient air quality monitoring station

	SO_2 (µg/m^3)		
Year	**Maximum 1-hour average**	**Maximum 24-hour average**	**Annual average**
2003	60.3	10.5	2.6
2004	44.5	10.5	2.6
2005	39.3	7.9	2.6
2006	49.8	5.2	0.0
2007	31.4	7.9	2.6
2008	28.8	5.2	0.0
2009	36.7	10.5	2.6
2010	28.8	7.9	2.6
2011	28.8	13.1	2.6
Air quality objective	570	230	57 (Human health) 32 (Biodiversity) 22 (Agriculture)

Table note: Concentrations converted from ppm to µg/m^3 at 25°C

16.4.7 Existing air quality emissions

Airport operations have the potential to affect local and regional air quality through emissions of pollutants by onsite ground activities and an increase in vehicle traffic in the area associated with increased airport activity.

16.4.7.1 Emissions due to existing airport operations

Table 16.4j summarises the estimated emissions to air from existing airport activities. In comparison with other industrial activities that report to the NPI, the existing SCA operations contribute relatively small amounts of NO_X, SO_X and PM_{10}.

The on-site diesel generator, conveyor engines, and the movement of airport and lessee vehicles (in addition to ground support equipment) are likely to generate CO, NO_X, PM and VOCs. The refuelling of aircraft is likely to emit VOCs through fugitive release of vapours from the fuel. However, the quantities of pollutants generated by these activities are likely to be negligible in comparison to the emissions quantified and listed in **Table 16.4j**.

16.4.7.2 Traffic

Emission rates estimated for traffic on each of the major road sections within 3 km of SCA are summarised in **Table 16.4k** based on the existing (2012) traffic data. The Sunshine Motorway is the major transport route in the area of SCA and dominates the emissions of air pollutants although the majority of vehicles on the motorway are not likely to be travelling to or from the airport. Traffic associated with the airport travels on Airport Drive, which contributes a small proportion to overall traffic emissions in the area. When compared to the industrial emissions from the region, as presented in **Table 16.4d**, it can be seen that emissions from traffic in the vicinity of the airport is a relatively major source of CO, but emissions of NO_X and PM_{10} are comparable to emissions from a single medium to large sized industrial operation.

Table 16.4j: Estimated emissions to air from existing operations at the SCA

	Emissions due to existing activities (kg/year)			
Activity	**CO**	**NO_X**	**SO_X**	**PM_{10}**
Auxiliary power units	318	966	107	73
Ground support equipment	25,998	3,182	66	113
TOTAL	26,316	4,148	173	185

Table 16.4k: Estimated emission rates for major road segments within 3 km of the SCA (kg/year)

			Emissions (kg/year)		
Road segment	**Length[a] (km)**	**Vehicles/ day**	**CO**	**NO_X**	**PM_{10}**
Airport Drive, North	0.3	3,797	155	57	14
Airport Drive, South	0.6	6,556	558	274	56
David Low Way to Sunshine Motorway	1.1	13,416	2,227	857	202
David Low Way, Central	2.1	10,682	3,477	1,213	305
David Low Way, East	7.5	15,280	15,845	5,284	1,372
David Low Way, West	1.0	10,421	1,642	629	149
Sunshine Motorway, North	8.1	33,007	41,485	15,619	3,739
Sunshine Motorway, South	1.3	41,498	8,104	2,921	720
TOTAL			73,492	26,854	6,556

Table note:

a Length refers to the length of road segment within 3 km of the airport boundary

16.4.8 Existing GHG emissions

The activity data that has been used for GHG emission estimation relating to the baseline reference period is summarised in **Table 16.4l**.

The annual GHG emissions associated with baseline operational activities are summarised in **Table 16.4m**.

An analysis of the baseline Scope 1 and 2 GHG emissions shows that:

- The existing Scope 1 and 2 emissions for the project do not trigger NGER thresholds at a facility level; however, emissions associated with the airport would need to be considered at a corporate level based on SCC's existing reporting obligations under NGER
- The emissions associated with Scope 2 are significantly larger than Scope 1 emissions
- The baseline emissions for Scope 1 and 2 total 1,771 t CO_2-e. The total greenhouse gas emissions are approximately 0.00032 per cent of Australia's estimated 546.3 Mt of domestic emissions in 2011 (DCCEE, 2011b).

An analysis of the baseline Scope 3 greenhouse gas emissions shows that:

- A significant amount of greenhouse gas emissions occur due to Scope 3 emissions, particularly the emissions associated with aircraft
- The total baseline emissions for Scope 3 total 75.2 kt CO_2-e. The total greenhouse gas emissions are approximately 0.014 per cent of Australia's estimated domestic emissions in 2011.

Table 16.4l: Baseline GHG emission sources

Activity	Emission source	Usage	Units
Terminal operations	Electricity use (incl lighting for access roads)	1,866,107	kWh
	Tenancies – Electricity use	796,182	kWh
	Air conditioning – refrigerant use	703.5	kg
	Waste disposal	2,059.2	tonnes
Ground support	Fuel usage – airport vehicles	4,377	L
	Fuel usage – airport generators	3,500	L
Other	Fuel usage – third party vehicles	1,343,975	L

Table 16.4m: Baseline GHG annual emissions summary

		Annual GHG emissions (tCO_2-e/y)		
Activity	**Emission source**	**Scope 1**	**Scope 2**	**Scope 3**
Terminal operations	Electricity use (incl lighting for access roads)		1,642	224
	Tenancies – Electricity use			797
	Air conditioning – refrigerant leakage	108		
	Waste disposal			6,336
Ground support	Fuel usage – airport vehicles	12		1
	Fuel usage – airport generators	9		1
Other	Fuel usage – third party vehicles			7,147
	Aircraft emissions			60,660
TOTAL		129	1,642	75,166
TOTAL – Scope 1 and 2		1,771		

16.5 DESCRIPTION OF SIGNIFICANCE CRITERIA

16.5.1 Air quality

Table 16.5a presents the significance criteria used in this chapter to assess the potential impacts of emissions to air associated with the project. A level of significance (negligible to very high) was assigned to each air pollutant assessed based on a calculated Air Quality Index (AQI) score. The AQI was calculated using the following equation:

AQI = pollutant concentration / pollutant standard x 100

The AQI calculation is used by the DEHP to interpret current air quality levels across Queensland. Using the AQI calculation, DEHP determines the current state of each air quality monitoring station, ranging from very good (low AQI) to hazardous (high AQI).

For each air pollutant assessed, an AQI score was calculated and a level of significance assigned based on the relevant AQI range presented in Table . The significance of an impact would be assigned the designation of "High" where the AQI was predicted to be "Very poor – hazardous" at a local scale, but not at a regional scale. If the AQI was predicted to be "Very poor – hazardous" across an entire region, the impact significance designation would be "Very High".

The air quality significance criteria are based on predicted ground level concentrations of pollutants. Where the change in estimated emissions is minor or the total estimated emission rate is low, the impact significance has been assumed to be minor or negligible, with no requirement to predict the spatial distribution of ground level concentrations.

16.5.2 Greenhouse gas

GHG emissions leading to climate change is a global issue. The potential for GHG emissions to have a direct impact on the project lies in the costs associated with emissions, either directly (carbon price) or indirectly (monitoring or reporting costs). Reporting and pricing thresholds are indicators of the relative importance of emission levels, and these have been used in the development of significance criteria, as shown in **Table 16.5b**.

Table 16.5a: Impact significance criteria: construction emissions

Impact significance/ consequence	Air Quality Index (AQI) Score	Equivalent DEHP AQI rating	Impact scale
Very High	150 +	Very poor - hazardous	Regional
High	150 +	Very poor - hazardous	Local
Moderate	100 – 149	Poor	Local
Minor	67 – 99	Fair	Local
Negligible	0 – 66	Good/very good	Local

Table 16.5b: Impact significance criteria: GHG

Impact significance/ consequence	Description of significance
Very High	A major increase in GHG emissions compared to existing emissions and a significant estimated financial liability. Scope 1 and 2 emissions form a significant proportion of Australia's total emissions (> 0.1 per cent)
High	A major increase in GHG emissions compared to existing emissions. An estimated financial liability. Scope 1 and 2 emissions form a non-negligible proportion of Australia's total emissions (> 0.01 per cent)
Moderate	An increase in GHG emissions compared to existing emissions. The potential for some financial liability, requirement to monitor emissions.
Minor	Some increase in GHG emissions compared to existing emissions. No change in reporting obligations and no financial liability for GHG emissions.
Negligible	No change or a decrease in GHG emissions compared to existing emissions. No obligation to report and no financial liability for GHG emissions.

16.6 ASSESSMENT OF POTENTIAL IMPACTS AND MITIGATION MEASURES

This section describes the potential impacts that the construction and operation of the project may have on the surrounding air quality and emissions of GHGs from the SCA. The assessment considers airport operations excluding aviation activities, which are covered separately (see Chapter D4). Mitigation measures are discussed that would minimise these impacts where necessary.

16.6.1 Pre-construction/construction

The preparation of the site (pre-construction) and subsequent construction of the new runway and associated terminal upgrade has been planned to take place over a period of approximately four years (January 2016 – January 2020).

16.6.1.1 Air quality

The most important impact on air quality due to the project construction is expected to be in the form of dust from the site. The construction process has been divided into four work packages, corresponding to civil works, dredging and sand placement, runway and taxiway pavements, and terminal upgrade. The dust generating activities associated with each package are as follows:

- Package 1 – Civil works
  - Clearing of land by excavator and bulldozer
  - Scraping of topsoil
  - Grading
  - Materials handling by bobcat, backhoe
  - Truck haulage of materials and equipment
  - Wind erosion of exposed areas
- Package 2 – Dredging and sand placement
  - Scraping of topsoil
  - Placement of sand by excavator and bulldozer
  - Grading and compacting of sand
  - Materials handling by front end loader
  - Truck haulage of materials and equipment
  - Wind erosion of exposed areas
- Package 3 – Runway and taxiway construction
  - Mixing (pugmill)
  - Asphalt plant
  - Truck haulage of materials and equipment
- Package 4 –Terminal upgrade
  - Truck haulage of materials and equipment.

While Package 2 has similar activities to Package 1, the former will involve significant quantities of wet dredged material and therefore dust emissions will be lower on a relative basis. Package 1 is expected to have the highest potential for dust emissions due primarily to the following factors:

- Higher rate of bulldozing and land clearing
- Movement of haul trucks
- Wind erosion of exposed (cleared) area, prior to the seeding applied in Package 2.

Impacts

To assess the potential impacts of dust generated during Package 1, a scenario was developed to represent typical activities that may occur during the package. Although the activities and activity rates will be variable throughout the construction process, the scenario presented below and summarised in **Table 16.6a** is representative of the activities that will occur on average throughout Package 1 without the application of proactive and reactive mitigation measures. Whilst, the location of activities will vary throughout the construction process, no activities will occur within areas of *Allocasuarina emuina* (Mount Emu She-oak), see Chapter B5, Terrestrial Flora.

The scenario has been based on the following activities:

- Two bulldozers operating for 11 hours per day
- Removal and transfer of 160,000 t of topsoil over a 65 day period (47 working days), averaging to 3,404 tonnes per working day
- Two graders operating for 11 hours per day at an average speed of 8 km/hr
- Excavation, loading and unloading of material, other than topsoil, assumed to be occurring at the same rate as topsoil transfer (3,404 tonnes per day)
- 170 vehicle movements per day, equivalent to 3,404 tonnes of topsoil and 3,404 tonnes of other material being moved by 40 t trucks. The average onsite distance for a movement is 3 km, including the return trip
- Wind erosion of the topsoil stockpiles, general stockpiles (non-topsoil material) and cleared areas.

The scenario described above was modelled using CALPUFF to assess the potential impacts on the surrounding areas. **Figure 16.6a** shows the predicted 6th highest 24-hour average PM_{10} concentrations due to the Package 1 construction scenario, considered in isolation, while Figure presents the same scenario including a background of 19.2 µg/m^3. Predicted concentrations in **Figure 16.6b** are coloured according to the significance criteria. The figures show that elevated concentrations are predicted to occur immediately offsite, to the west of the SCA boundary. When background concentrations are accounted for, there is the potential for moderate impacts, extending up to 2 km from the SCA boundary, primarily in regions of low population density.

Table 16.6a: Typical 24-hour Package 1 construction scenario

Activity	Production rate	Controls: Description	Controls: % efficiency	Emission rate (g/s): TSP	Emission rate (g/s): PM_{10}	Emission rate (g/s): $PM_{2.5}$
Operating hours activities (7am – 6pm)						
Topsoil scraping	3,404 t/day	Watering	50%	1.25	0.59	0.09
Topsoil transfer		none	0%	1.72	0.81	0.12
Grading	2 graders, 11 hrs/day	none	0%	2.74	0.97	0.21
Excavating	3,404 t/day	none	0%	0.04	0.02	0.003
Truck loading		none	0%	0.04	0.02	0.003
Truck unloading to stockpile		none	0%	0.04	0.02	0.003
Haulage	511 VKT/day	Watering	50%	30.86	8.80	0.88
Bulldozing on stockpiles	1 dozer, 11 hrs/day	none	0%	0.50	0.09	0.05
Bulldozing clearing area	1 dozer, 11 hrs/day	none	0%	0.50	0.09	0.05
All hours						
Wind erosion of topsoil stockpile	2.4 ha	none	0%	5.14	2.57	0.39
Wind erosion of general stockpiles	4.1 ha	none	0%	4.19	2.09	0.31
Wind erosion of cleared area	153 ha	none	0%	4.12	2.06	0.31

The results of dispersion modelling without the application of proactive and reactive mitigation measures show that:

- The most important emission sources are stockpile wind erosion and truck haul
- Dust emissions will be transported towards the west, due to the predominant easterly winds
- PM10 was found to be the air pollutant of most importance due to construction activities. Predicted concentrations of TSP, PM2.5 and dust deposition rates due to construction activities with the inclusion of background were well below their respective objectives.
- With the addition of a background of 19.2 μg/m³ (the highest recorded 75th percentile from Mountain Creek), the results show that there is the potential for PM_{10} concentration to be close to or exceed the criteria at the residential areas to the east of the site
- Particulate matter from the Package 1 construction scenario is predicted to be limited to localised impacts and is predicted to fall below 20 per cent of the criteria within approximately 4 km of the site boundary.

Table 16.6b summarises the outcomes of the air quality impact assessment in terms of the risk rating associated with construction emissions. The table shows that the predicted risks associated with construction operations without the application of proactive and reactive mitigation measures is medium.

Mitigation

The results presented in the previous section showed that there exists the potential for elevated dust levels at the closest sensitive receptors due to construction activity. This section describes potential mitigation measures to manage potential impacts.

Active stockpiles were determined to be the most significant contributor of dust. The modelling did not assume any controls in place on the active stockpiles.

Table 16.6b: Impact assessment table: construction air quality

Primary impacting processes	Initial assessment with mitigation inherent in the preliminary design in place: Mitigation inherent in the design	Significance of impact	Likelihood of impact	Risk rating
Pollutant concentrations related to human health impacts	• Watering of haul roads • Daytime operations	Moderate	Likely	Medium
Pollutant concentrations related to amenity		Minor	Possible	Low

Figure 16.6a: Predicted 6th highest 24-hour average ground level concentrations of PM_{10} due to the Package 1 construction scenario considered in isolation

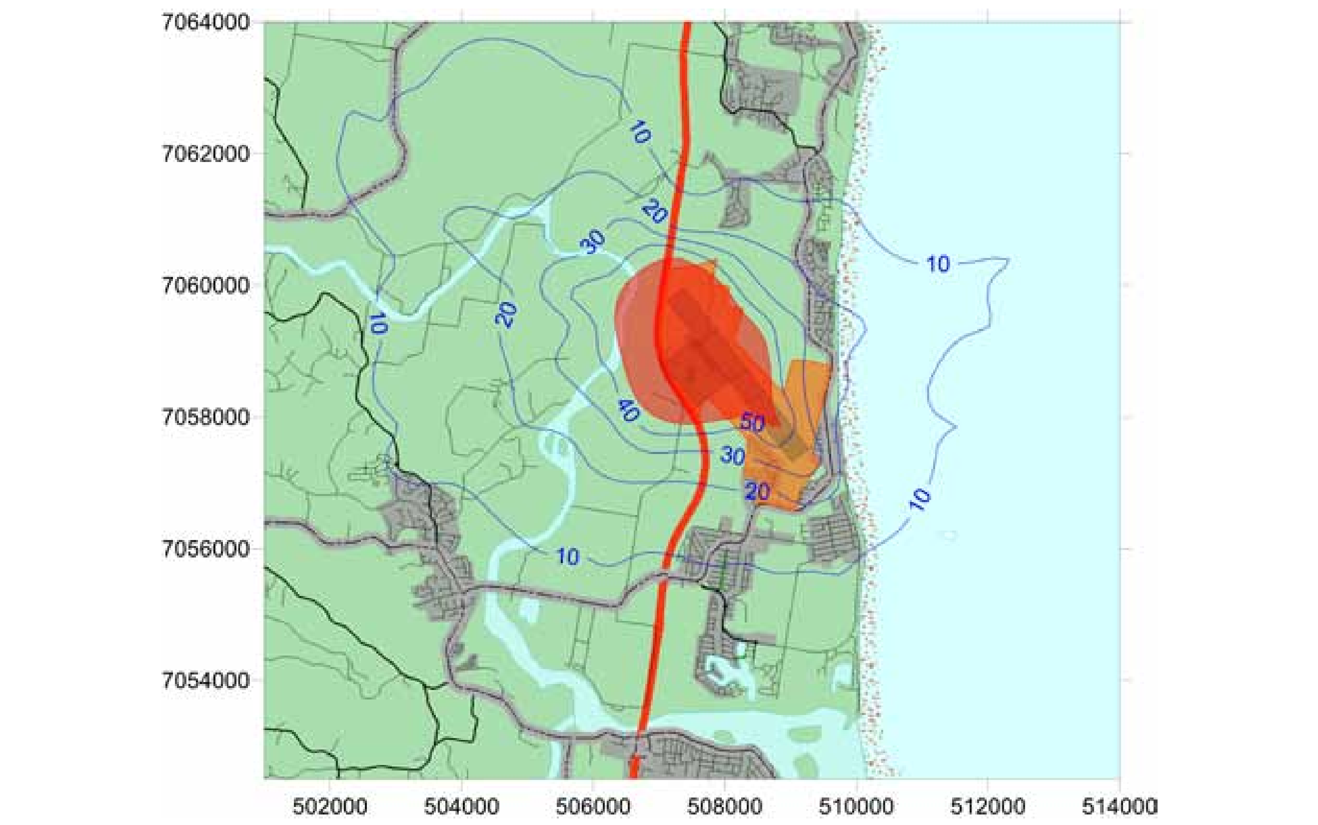
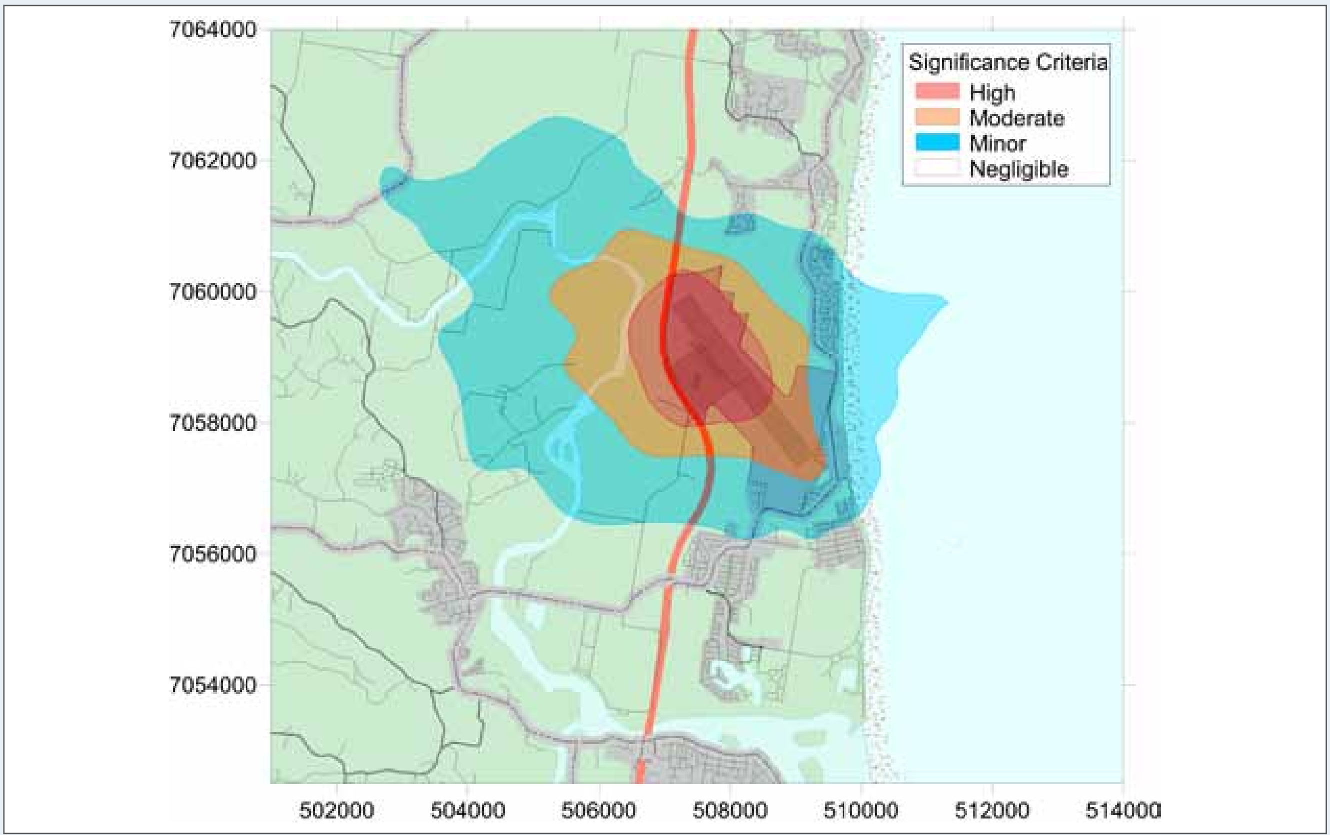


Figure 16.6b: Predicted significance criteria of 6th highest 24-hour average of PM_{10} due to the Package 1 construction scenario including background



The following mitigation measures could be put in place to minimise emissions from stockpiles and reduce the potential impacts from moderate to minor:

- Watering
- Minimising surface area
- Shielding/enclosure.

The modelling indicated that the residential areas to the east of the runway are the sensitive receptors most likely to be affected by dust emissions. Effective management of activities is therefore most important during the periods of activity in the areas closest to these receptors. Management of activities could include the following measures that would reduce the likelihood of impacts from likely to unlikely:

- Taking into account meteorological factors by applying additional watering during periods of very strong winds
- Where possible, ensuring work hours are within daylight hours, avoiding working during early morning/ evening calm conditions when the dispersive capacity of the atmosphere is poor, particularly when activity is in close proximity to residences.
- Minimising exposed areas.

Table 16.6c summarises the outcomes of the air quality impact assessment in terms of the risk rating associated with construction emissions, taking into account the proposed mitigation measures. The table shows that the predicted residual risks associated with construction operations is low.

16.6.1.2 CHG

Table 16.6d provides a summary of the expected emission sources and quantities over the construction period and **Table 16.6e** provides a summary of the significant material planned for use during the construction phase of the project.

Impacts

The estimated GHG emissions associated with the construction period are summarised in **Table 16.6f**. The table indicates that Scope 1 and 2 emissions will be well below the NGER reporting threshold of 25 kt. The construction phase will therefore not affect the SCA reporting obligations and construction GHG emissions represent a minor impact.

GHG emissions embedded in materials are summarised in **Table 16.6g**. Additionally **Figure 16.6c** and **Figure 16.6d** provide a breakdown of the embedded GHG emissions associated with primary construction materials.

Approximately 70 per cent of embedded emissions relate to aggregate and dredged sand.

Table 16.6c: Impact assessment table: construction air quality

Primary impacting processes	Assessment, including proposed additional mitigation measures in place			
	Additional mitigation measures	Significance of impact	Likelihood of impact	Risk rating
Pollutant concentrations related to human health impacts	• Stockpile watering • Stockpile surface minimisation and, partial enclosure • Additional watering during high winds • Avoiding activities near residences during stable conditions	Minor	Unlikely	Low
Pollutant concentrations related to amenity		Minor	Unlikely	Low

Table 16.6d: Construction GHG emission sources (Scope 1 and 2)

Emission source	Usage	Units
Fuel usage – construction equipment		L
Fuel usage – construction vehicles	250,000	L
Fuel usage – generators		L
Fuel usage – booster pump	200,000	L
Fuel usage – workforce vehicles	6,290	L
Total fuel usage	456,290	L

Table 16.6e: Construction GHG embedded emission sources (Scope 3)

Material category	Material type	Quantity (tonnes)	Transport mode	Transport distance (km)
Asphalt	Hot mix	45,018	Rigid truck	20[2]
Concrete	40 MPa	5,856	Rigid truck	110[8]
Aggregate	Topsoil[1]	112,110	Rigid truck	5
	Clay[1]	77,020	Rigid truck	5
	Fine crushed rock	332,683	Articulated truck	50[4]
	Gravel	36,178	Articulated truck	5[3]
Dredged fill	Sand fill	1,907,784	Dredge vessel located in Moreton Bay	
Steel	Galvanised pipe and tube	120	Rigid truck	110[8]
	Chain mesh	34	Rigid truck	110[8]
Pond liner[5]	HDPE	1,067	Rigid truck	200[6]
Piping	Reinforced concrete	191	Rigid truck	150[7]

1 *Approximated as sand for the purposes of calculating embedded emissions*
2 *Material sourced from Sunshine Coast estimated to be within 20 km proximity*
3 *Locally sourced*
4 *Fine crushed rock is sourced from Moy Pocket quarry*
5 *HDPE material used for pond lining has been estimated under the category of piping*
6 *HDPE pond lining supplied out of the Gold Coast*
7 *Reinforced concrete piping is sourced from Ipswich*
8 *Steel sourced from Brisbane*

Table 16.6f: Construction GHG emissions summary

Emission source	Scope 1	Scope 2	Scope 3
Fuel usage – construction equipment	671	-	-
Fuel usage – construction vehicles			
Fuel usage – generators			
Fuel usage – dredge booster pump	537	-	-
Fuel usage – workforce vehicles	-	-	17
Electricity use	-	60	-
Materials – Embedded emissions	-	-	32,397
TOTAL	1,207	60	32,414

Table 16.6g: Construction GHG embedded emissions summary, tCO_2-e (Scope 3)

Material	Embedded emissions ($t\ CO_2$-e)	Transport emissions ($t\ CO_2$-e)	TOTAL ($t\ CO_2$-e)
Asphalt	2,729	230	2,959
Concrete	1,091	164	1,256
Aggregate	6,811	4,885	11,695
Dredged fill	10,397	537	10,933
Steel	338	4	342
Piping	5,149	62	5,211
TOTAL	26,515	5,881	32,397

Figure 16.6c: Construction material embedded emissions

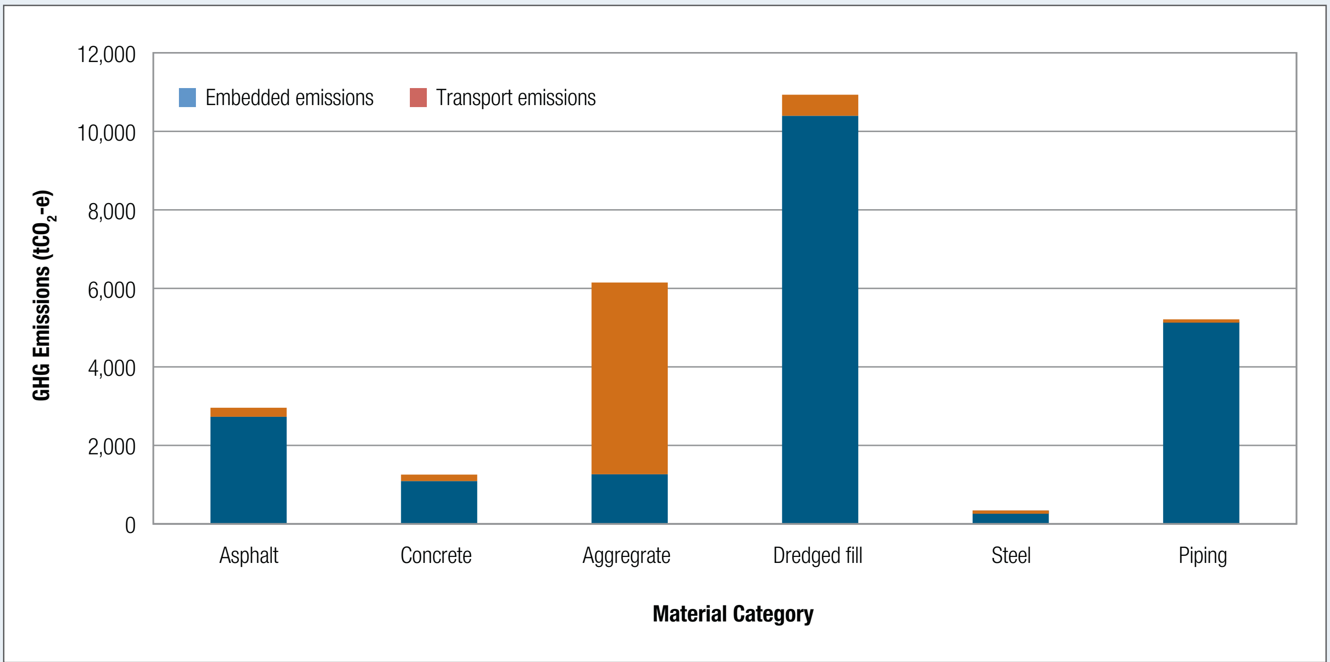
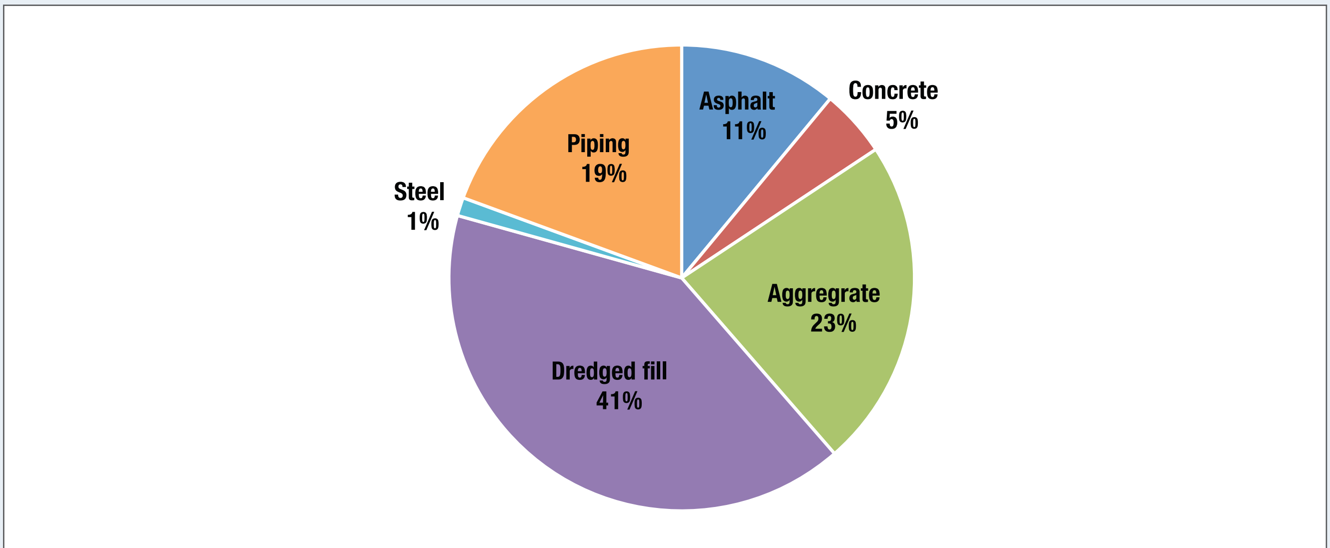


Figure 16.6d: Construction materials embedded emissions by type



Change in land-use

The vegetation in the area of disturbance is summarised in **Table 16.6h**. In areas that are not agricultural or cleared, melaleuca forest of various types is the dominant vegetation type. All such areas were classified in FullCAM as "melaleuca forest and woodland". The following may be noted:

- The area classified as melaleuca forest and woodland was equal to approximately one third (33 per cent) of the estimated area of disturbance
- The grouping of all vegetation under the "Melaleuca Forest and Woodland" species in FullCAM is conservative because other prevalent vegetation types (e.g. regrowth open heath) tend to be smaller in height and mass and so are likely to store less carbon.

Table 16.6h: Vegetation within the estimated area of disturbance

Vegetation type	Area (ha)
Grouped under "Pasture" in FullCAM	
Agricultural	88.3
Cleared	81.5
PASTURE TOTAL	169.8
Grouped under "Melaleuca Forest and Woodland" in FullCAM	
Casuarina open forest	0.2
Closed heath	2.7
Eucalypt regrowth	2.5
Melaleuca low open forest	6.6
Melaleuca open forest	29.4
Melaleuca wetland	1.9
Melaleuca/slash pine regrowth	12.7
Open heath	3.1
Open heath with Melaleuca thickening	8.1
Regrowth open heath	11.7
Regrowth wet heath	3.8
Melaleuca Forest and Woodland total	82.6
GRAND TOTAL	252.3

The land classified as pasture made a negligible contribution to the stored carbon. The conservative FullCAM model prediction for the mass of carbon stored in trees in the area of disturbance was approximately 12 kt. This corresponds to approximately 42 kt of CO_2-e, with a maximum annual emission of 9 kt CO_2-e.

Mitigation

Potential mitigation options for Scope 1 and 2 emissions include the following:

- Emissions can be optimised through scheduling and organisation of activities to minimise fuel consumption of site vehicles
- Where biodiesel is readily available it can be substituted for regular diesel
- Proportions of biodiesel used should be in line equipment/vehicle manufacturer recommendations
- Fuel storage can be located to minimise travel distance associated with refuelling. Multiple or mobile refuelling facilities should be considered where appropriate.

Potential mitigation options for Scope 3 emissions include the following:

- Throughout the construction phases consideration can be given to minimising quantities of construction materials required to meet specifications
- The use of materials with lower emissions intensity should also be considered
- At the time of construction material sources closer to the construction site should also be investigated for suitability
- The use of crushed recycled concrete can also be considered as a substitute for aggregate for roads, drainage infrastructure and other non-airfield pavement purposes, where available in sufficient quantities.

16.6.2 Operations

This section describes the assessment of the operations of the airport, with the exception of aviation activities. Airport operations include activities within the terminal, ground support vehicles, fuel storage on site and the traffic associated with the airport.

16.6.2.1 Air quality

Airport operations have the potential to affect local and regional air quality through emissions of pollutants by onsite ground support vehicles and an increase in vehicle traffic in the area associated with increased airport activity.

Impacts

Ground support vehicles

Table 16.6i shows the predicted emissions from auxiliary power units and ground support units operating at the SCA in 2040. The table shows the following:

- Emissions of NO_X, SO_X and PM_{10} remain minor compared to industrial sources in the area (**Table 16.4d**)
- CO emissions are dominated by ground support equipment. The SCA is predicted to be a significant source in the area, with emissions similar to industrial sources in the area and local traffic. However, CO is not currently an air quality issue, and is not predicted to become one.

Traffic

Emission rates estimated for traffic on each of the major roads within 3 km of the SCA are summarised in **Table 16.6j** and **Table 16.6k** based on the 2030 traffic data, without the project and with the project, respectively. The estimated emissions of NO_X are shown in **Figure 16.6e**, indexed to the existing (2012) scenario.

The figure shows that without the project, traffic growth in the general area is expected to lead to an increase in local emissions by a factor of about 1.4 by 2030, although the airport specific traffic is forecast to grow by much less. The 2030 forecast with the inclusion of the project is estimated to lead to a marginally higher growth in emissions compared to the base case. On Airport Drive, the growth is significantly higher; however, as shown in **Table 16.6k**, the total emissions from these segments are very low.

Table 16.6i: Estimated emissions to air from forecast 2040 operations at SCA

	Emissions due to forecast 2040 activities (kg/year)			
Activity	**CO**	**NO_X**	**SO_X**	**PM_{10}**
Auxiliary power units	1,042	3,165	351	238
Ground support equipment	70,449	7,957	179	261
TOTAL	71,490	11,122	529	499

Table 16.6j: Estimated emission rates for major road segments within 3 km of SCA (kg/year) for 2030 without the Project

			Emissions (kg/year)		
Road Segment	**Length[a] (km)**	**Vehicles/ day**	**CO**	**NO_X**	**PM_{10}**
Airport Drive, North	0.3	4,791	196	68	17
Airport Drive, South	0.6	7,326	626	278	60
David Low Way to Sunshine Motorway	1.1	18,155	3,020	1,092	269
David Low Way, Central	2.1	15,251	4,966	1,707	434
David Low Way, East	7.5	22,294	21,998	7,257	1,898
David Low Way, West	1.0	15,353	2,419	918	219
Sunshine Motorway, North	8.1	47,142	59,251	22,310	5,340
Sunshine Motorway, South	1.3	59,268	11,574	4,171	1,028
TOTAL			104,050	37,801	9,264

Table note:

a Length refers to the length of road segment within 3 km of the airport boundary

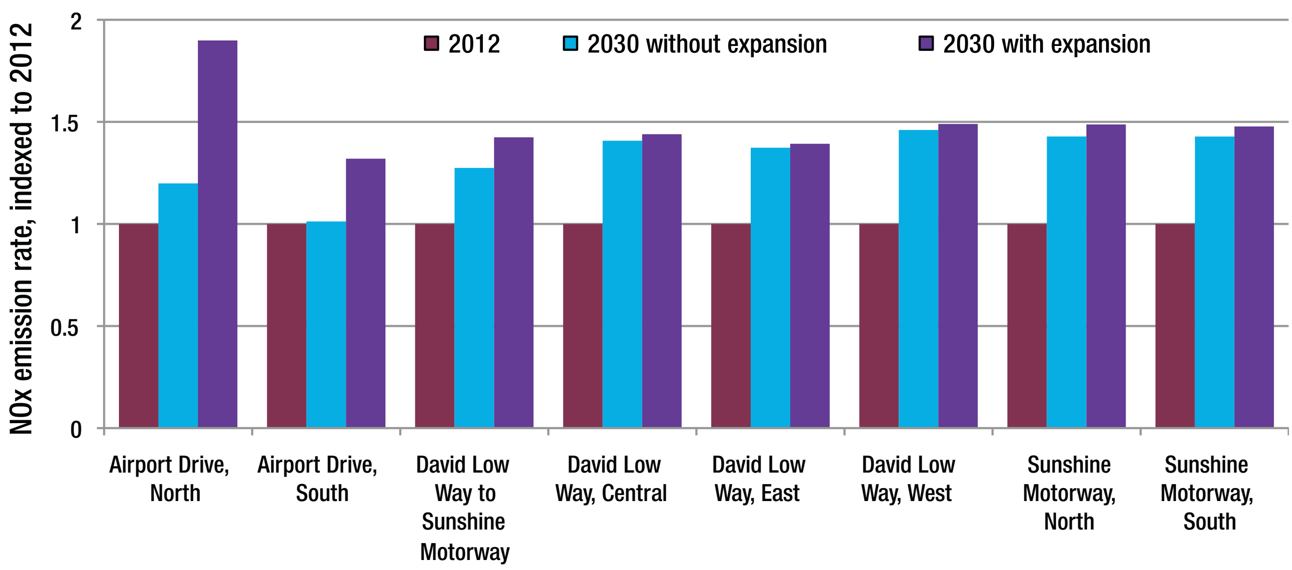
Table 16.6k: Estimated emission rates for major road segments within 3 km of SCA (kg/year) for 2030 with the Project

			Emissions (kg/year)		
Road Segment	**Length[a] (km)**	**Vehicles/ day**	**CO**	**NO_X**	**PM_{10}**
Airport Drive, North	0.3	8,266	339	108	29
Airport Drive, South	0.6	10,827	929	362	85
David Low Way to Sunshine Motorway	1.1	20,920	3,484	1,221	306
David Low Way, Central	2.1	15,672	5,104	1,746	445
David Low Way, East	7.5	22,715	22,367	7,360	1,928
David Low Way, West	1.0	15,774	2,486	937	224
Sunshine Motorway, North	8.1	49,766	62,578	23,232	5,613
Sunshine Motorway, South	1.3	61,894	12,090	4,315	1,070
TOTAL			109,377	39,280	9,701

Table note:

a Length refers to the length of road segment within 3 km of the airport boundary

Figure 16.6e: Estimated change in NO_x emissions from major road segments near the SCA, based on forecasts for traffic with and without the project



16.6.2.2 GHG

A summary of future emissions sources is presented in **Table 16.6l**.

Impacts

It is expected that flight movements and associated passenger numbers will increase over time. As a result, the highest annual emission rate of GHG has been estimated to occur in 2040 (**Table 16.6n**). Scope 1 and 2 emissions in 2040 are more than three times the 2011/12 baseline period, whereas Scope 3 emissions were predicted to increase by more than six times (**Table 16.6n**). The more significant increase in Scope 3 emissions is a direct result of the increased aircraft emissions relating to commercial flights (domestic and international).

The results show that Scope 1 and 2 emissions remain well below the 25 kt reporting threshold for a single facility; therefore the impact of GHG is predicted to be minor.

An impact assessment summary table is shown in **Table 16.6o**.

Mitigation

The management of energy consumption and greenhouse gas emissions is already an integral part of the environmental management at the SCA; this has been evidenced by the voluntary involvement of the airport in the ecoBiz program and the ACI Airport Carbon Accreditation scheme. Potential measures to further minimise the emissions of GHG from airport operations include:

- Energy use in the new section of the terminal can be optimised through the design of the extension including appropriate building materials and the choice of energy efficient options for lighting, air-conditioning and other equipment/devices
- The new section of the terminal should be integrated into the existing Building Management System to ensure that energy associated with lighting and air-conditioning is optimised
- Continued engagement with the ACI Airport Carbon Accreditation scheme
- Mitigation opportunities relating to aviation emission are detailed in Chapter D4.

Table 16.6l: GHG emissions sources by year

Activity	Emission source	Units	Usage 2012	Usage 2020	Usage 2030	Usage 2040
Terminal operations	Electricity use (incl lighting for access roads)	kWh	1,866,108	3,109,609	4,649,203	6,084,610
	Tenancies – Electricity use	kWh	796,812	1,327,777	1,985,170	2,598,076
	Air conditioning – refrigerant use	kg	704	1172	1753	2294
	Waste disposal	tonnes	2,059	3,431	5,130	6,714
Ground support	Fuel usage – airport vehicles	L	4,377	7,294	10,905	14,272
	Fuel usage – airport generators	L	3,500	5,832	8,720	11,412
Other	Fuel usage – third party vehicles	L	2,687,950	4,479,096	6,696,734	8,764,299

Table 16.6m: Future operations GHG emissions summary, Scope 1 and 2

		2011/12 (Baseline)		2020		2030		2040	
		Scope		Scope		Scope		Scope	
Activity	**Emission source**	1	2	1	2	1	2	1	2
Terminal operations	Electricity use (incl lighting for access roads)		1,642		2,674		3,998		5,233
	Air conditioning – refrigerant leakage	108		179		268		351	
Ground support	Fuel usage – airport vehicles	12		20		29		39	
	Fuel usage – airport generators	9		16		23		31	
TOTAL		129	1,642	214	2,674	321	3,998	420	5,233
TOTAL – Scope 1 and 2		1,771		2,889		4,319		5,652	

Table 16.6n: Future operations GHG emissions summary, Scope 3

Activity	Emission source	2011/12 (Baseline)	2020	2030	2040
Terminal operations	Electricity use (incl lighting for access roads)	224	373	558	730
	Tenancies – Electricity use	797	1,328	1,985	2,598
	Waste disposal	6,336	10,559	15,786	20,660
Ground support	Fuel life cycle – airport vehicles	1	1	2	3
	Fuel life cycle – airport generators	1	1	2	2
Other	Fuel usage – third party vehicles	7,147	11,909	17,806	23,303
	Aircraft emissions	60,660	153,750	358,140	420,960
TOTAL		75,166	177,922	394,279	468,257

Table 16.6o: Impact assessment table

		Initial assessment with mitigation inherent in the Preliminary Design in place				Residual Assessment with additional mitigation in place (i.e. those actions recommended as part of the impact assessment phase)			
Primary impacting processes Mitigation inherent in the design		Significance of impact	Likelihood of impact	Risk rating	Additional mitigation measures proposed	Significance of impact	Likelihood of impact	Residual Risk rating	
Construction	Pollutant concentrations related to human health impacts		Moderate	Likely	Medium	• Stockpile watering • Stockpile surface minimisation and partial enclosure	Minor - Moderate	Unlikely	Low
	Pollutant concentrations related to amenity	• Watering of haul roads • Daytime operations	Minor	Possible	Low	• Additional watering during high winds • Avoiding activities near residences during stable conditions (e.g. light winds)	Minor	Unlikely	Low
	GHG emissions		Minor	Possible	Low		Minor	Possible	Low
Operations	Pollutant concentrations related to human health impacts, biodiversity of ecosystems and amenity		Minor	Possible	Low		Minor	Possible	Low
	GHG emissions		Minor	Possible	Low		Minor	Possible	Low

16.7 CONCLUSION

This chapter presented the results of an air quality and greenhouse gas assessment of the potential impacts associated with construction and ground based operations of the project.

The existing environment was described in terms of the elements that are relevant to air quality, including the geography, land-use, climate and meteorology of the region. The existing air quality in the region was described in terms of ambient air quality monitoring data that has been collected by the Department of Environment and Heritage Protection (DEHP). Existing emissions to air associated with industry in the area and current SCA operations were also been used to characterise existing air quality.

The potential impacts on air quality and greenhouse gas (GHG) emissions were assessed for the construction phase of the project, the operational phase of the project and for changes in traffic associated with the project. Emissions from aircraft are considered separately in Chapter D4, Air Emissions and GHG.

This analysis of ambient air quality monitoring at Mountain Creek shows that the air quality objectives are rarely exceeded except during regional events such as dust storms that are associated with elevated levels of particulate matter. Inference from this data suggests that concentrations of dust and NO_2 in the region around the SCA will generally be low; however, exceedances of the Environmental Protection (Air) Policy (Air EPP) objectives for particulate matter will occur on occasion due to natural events.

The assessment of the project has estimated the potential impacts associated with the construction, presented in **Table 16.7a**.

The assessment of the project has estimated the potential impacts associated with the operations to be low in terms of both air quality and GHG emissions, presented in **Table 16.7b**.

Table 16.7a: Summary of construction impacts

Parameter	Potential impact	Main mitigation strategies	Residual impacts
Pollutant concentrations related to human health impacts	Medium – High	• Stockpile watering • Stockpile surface minimisation and, partial enclosure • Additional watering during high winds • Avoiding activities near residences during stable conditions	Low
Pollutant concentrations related to amenity	Low		Low
Pollutant concentrations related to biodiversity	Low		Low
GHG emissions	Low		Low

Table 16.7b: Summary of operational impacts

Parameter	Potential impact	Main mitigation strategies	Residual impacts
Pollutant concentrations related to human health impacts, amenity and biodiversity	Low	None required	Low
GHG emissions	Low		Low

16.7 REFERENCES

Australian Greenhouse Office (AGO), 2005. The FullCAM Carbon Accounting Model (Version 3.0) User Manual, March 2005. Department of the Environment and Heritage

CSIRO, 2008. The Air Pollution Model (TAPM) Version 4.0.2, http://www.cmar.csiro.au/research/tapm/

Department of Agriculture, Fisheries and Forestry, 2011. Land Use in Queensland dataset, showing land use in 1999, accessed August 2012. http://www.daff.gov.au/abares/

Department of Climate Change and Energy Efficiency (DCCEE), 2011. National Greenhouse Accounts (NGA) Factors, Department of Climate Change and Energy Efficiency, July 2011. Energy Efficiency Opportunities Act 2006 (Australian Government)

DIICCSRTE, 2012. National Greenhouse and Energy Reporting Determination. Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education.

DIICCSRTE, 2013. National greenhouse and energy reporting system measurement. Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia, July 2013. Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education.

Holmes Air Sciences (2004), "Draft Air Quality Impact Assessment: Brisbane North-South Bypass Tunnel", prepared for Sinclair Knight Merz/Connell Wagner Joint Venture on behalf of Brisbane City Council.

Infrastructure Sustainability Council of Australia (ISCA), 2012. IS Materials Calculator. http://www.isca.org.au/is/download-is-rating-tool

Leading Edge Aviation Planning Professionals (LEAPP), 2012. Long-term forecasts of aviation activity at Sunshine Coast Airport for 2013-2050, Draft Report, Unpublished.

Middleton, N.J., 1984. Dust-storms in Australia: frequency, distribution and seasonality, p 46

NPI, 2012. Emission Estimation Technique Manual for Mining, v3.1, Jan 2012. Department of Sustainability, Environment, Water, Population and Communities

PIARC – World Road Association 2004, Road tunnels: Vehicle emissions and air demand for ventilation, PIARC Technical Committee on Road Tunnels Operation C5.

USEPA, 1998. Volume 1: Stationary Point and Area Sources: Chapter 11.9 Western Coal Mining, AP42, Fifth Edition

World Business Council for Sustainable Development, 2009. Greenhouse Gas Protocol.

This page has been left blank intentionally