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11. Air Quality and Greenhouse Gases

11.1 Air Quality Introduction

The aim of this section is to assess the potential air quality impacts and suggest mitigation measures associated with the Hinze Dam Stage 3 project.

The project has the potential to generate air quality impacts at sensitive receivers as a result of construction and road relocation works. Construction is expected to commence in October 2007 and be completed in November 2010. The major construction activities as part of the dam construction are:

- Quarrying: removal of overburden and rock for dam wall construction, using excavators and drill and blast operations;
- Clay Excavation and Conditioning: excavation of clay using scrapers and conditioning of clay to increase the moisture content for use in dam wall construction;
- Embankment Construction: Construction of main dam embankment, the saddle dam to the east of the dam wall, and the small saddle dam to the west of the existing wall. Haul trucks will be dumping material and dozers, excavators and vibrating rollers will be used to compact and shape the wall;
- Concrete Manufacturing: Concrete batching plant capable of producing 80m^3 per hour will operate on-site. A crusher will operate near the quarry to produce aggregate for use in concrete mix;
- Haulage of Material: Most materials for dam construction will be sourced from the construction site. However, trucks will be used to transport sand, cement and reinforced steel to the project construction site;
- Vegetation Clearing: clearing of vegetation from the inundation zones around the dam, and in construction areas;
- Construction of Intake Towers;
- Site Establishment Works: including site office establishment, relocation of existing infrastructure, demolition of existing buildings; and
- Construction of Recreational Areas: Haul trucks will be dumping material while dozers and excavators will be used to shape the area.

The changes to the flood levels resulting from a 1 in 100 year ARI flood will result in the inundation of a section of the Gold Coast-Springbrook Road. It is proposed to raise this section of road, within its current alignment. The potential air quality impact of raising this road has been qualitatively assessed in **Section 11.5**.

The assessment of the air emission from the operation of the site following construction indicates that there will be no change in air emissions, with the exception of occasional vehicle emissions associated with the fish transfer system. Fish will be transported from downstream using a diesel truck. The quantities of emissions from operations are expected to be inconsequential and thus have not been assessed as part of the EIS.

11.2 Air Quality Assessment Process

To assess the air quality impacts associated with the project this EIS includes:

- review of legislative requirements and ambient air quality goals;
- description of existing air quality and dispersion meteorology within the project area;
- identification of nearest sensitive receivers;
- estimate air emissions associated with construction of the project and prediction of particulate matter concentrations and dust deposition rates at nearest sensitive receivers using dispersion modelling;
- proposal of impact mitigation measures to manage the air quality impacts from dam construction; and

- discussion of air quality impacts from road realignment with impact mitigation measures for construction.

11.3 Air Quality Guidelines

The *Environmental Protection Act 1994* provides for the management of the air environment in Queensland. Air quality guidelines are specified by the EPA in the Queensland *Environment Protection Policy (Air) 1997* (EPP(Air)).

The current goals for criteria pollutants considered relevant to the assessment of air quality impacts during construction of the project, as shown in Schedule 1 of the EPP (Air), are:

- PM_{10} maximum 24-hourly average, 150 µg/m^3;
- PM_{10} annual average, 50 µg/m^3; and
- TSP annual average, 90 µg/m^3.

The National Environment Protection Measure (NEPM) for Air Quality has released by the National Environment Protection Council (NEPC 2003). The relevant standard for PM_{10} in the NEPM is:

- PM_{10} maximum 24-hourly average, 50 µg/m^3 (with 5 allowable exceedences per year).

The application of the NEPM is intended to provide a representative measure of regional air quality, rather than a project specific target. Although the NEPM is not considered strictly applicable to construction projects it is recognised that projects should work towards achieving the NEPM goals.

The policy is designed for consideration when siting industrial developments and is not directly relevant to the assessment of construction impacts associated with the project. However, given the expected duration of the construction works and the location of residences near the construction site, it is considered appropriate to adopt these goals as part of the environmental performance criteria for the project.

Deposited dust, if present at sufficiently high levels, can reduce the amenity of an area. No formal criteria for dust deposition exist within Queensland however an informal draft guideline of 120 mg/m^2/day was introduced some years ago by the then Department of Environment and Heritage (now the EPA) applicable at nearby sensitive residential places. Dustfall monitoring has historically been undertaken as part of mining and large scale construction projects to assist with the monitoring of satisfactory performance. The EPA (2003) recommends this guideline for preparing environmental management plans for non-standard mining projects. The informal guidelines are consistent with the NSW Department of Environment and Conservation (2005) guidelines for deposited dust, which limit the maximum dust deposition rate to 4 g/m^2/month.

A dust deposition guideline of 120 mg/m^2/day is therefore considered appropriate for the construction of the project.

The air quality goals that have been used for the assessment of construction impacts of the project are presented in **Table 11-1**.

Table 11-1 Construction Air Quality Goals for the Project

Pollutant	Construction Air Quality Goals	
	Aim to achieve	Not to be exceeded
Particles as PM_{10}	50 µg/m^3 (24 hr average)	150 µg/m^3 (24 hr average)
		50 µg/m^3 (annual average)
Total Solid Particulates	-	90 µg/m^3 (annual average)
Dust deposition	-	120 mg/m^2/day

11.4 Air Quality Existing Environment

This section identifies nearest sensitive receivers, and describes the local environment, including meteorology and ambient air quality, at both the dam wall (where the dam construction site will be located) and the site of the Gold Coast-Springbrook Road construction works located to the south east of the dam.

11.4.1 Local Setting and Sensitive Receivers

Hinze Dam is located in the hinterland of the Gold Coast, approximately 8 km southwest of Nerang. Given the location of the project in a valley surrounded by mountains, the dispersive environment would be poor in calm conditions with low wind speeds. The nearest sensitive receivers to the project were identified from aerial photography and site visits to the project area. The location of the nearest sensitive receivers are identified in **Section 11.4.4** and shown on **Figure 11-2** to **Figure 11-5**.

The section of Gold Coast-Springbrook Road that will be upgraded is located 10 km southwest of Robina, at the south-eastern tip of Hinze Dam (approximately 8 km south of the current dam wall). The topography in the area is mountainous. There are a small number of residences located within 100 m of this section of road with these shown on **Figure 13-6** located within the **Section 13** of this EIS.

11.4.2 Climate and Dispersion Meteorology

Meteorological data recorded by the Bureau of Meteorology (BoM) at Hinze Dam have been reviewed to assess the existing meteorological and climatological influences in the project area. **Table 11-2** provides a summary of the temperature, humidity and rainfall data for the Hinze Dam meteorological station. Graphical presentations of the temperature, relative humidity, rainfall totals, and days are provided in **Appendix F.11.1**.

The project area has a subtropical climate, typically with warm moist summers and fine dry winters. The average maximum daytime temperatures are around 29 °C during the summer, falling to around 21 °C during the winter-time. Relative humidity is a measure of the moisture carrying capacity of the atmosphere. Relative humidity varies with the seasons as well as time of day. Mean 9 am relative humidity is generally greatest during the months of autumn and early winter, ranging from a maximum of 74% during June to 61% during September. Mean 3 pm relative humidity is generally greatest during the summer months, ranging from a maximum of 67% in February to around 50% in the months from July through to September.

Highest rainfall is generally recorded during summer months predominantly associated with storm and cyclonic events. February typically receives the highest monthly rain averages with around 190 mm/month, and at least 120 mm/month generally occurring during each of the months from November to May. During the winter and early spring months mean monthly rainfall generally drops to less than one third of the average summer monthly rainfall totals with the lowest average monthly rainfall of 42 mm occurring in August. Similarly, the average number of days upon which rain occurs decreases from between 10-13 days/month during the summer and autumn months (November to May) to around 6 rain days/month between June and September. However, it is not uncommon for no significant rainfalls to occur during the winter and early spring months in some years.

Dispersion modelling requires hourly breakdown of wind speed and direction, and other meteorological parameters such as mixing height and Pasquill-Gifford stability class. The BoM meteorological data for Hinze Dam (wind speed and direction are recorded twice daily) are not sufficient to undertake dispersion modelling purposes. TAPM version 3 was used to generate a meteorological file for Hinze Dam for 2004 to input to the AUSPLUME air dispersion model. TAPM is a three-dimensional prognostic meteorological and air pollution model which produces detailed fields of hourly estimated temperature, winds, pressure, turbulence, cloud cover and humidity at various levels in the atmosphere as well as surface solar radiation and rainfall.

Table 11-2 Climatic Summary for Hinze Dam (BoM 040584)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean daily maximum temperature (°C)	29	29	28	26	23	21	21	22	25	26	27	29	26
Mean daily minimum temperature (°C)	20	21	19	17	14	12	10	11	13	15	17	19	16
Mean 9am air temp (°C)	25	25	24	21	18	16	15	16	20	22	23	25	21
Mean 9am wet bulb temp (°C)	21	22	20	18	15	13	12	13	15	17	19	20	17
Mean 9am relative humidity (%)	69	72	72	71	73	74	70	67	61	62	63	66	68
Mean 3pm air temp (°C)	27	27	26	24	22	20	19	20	23	24	25	27	24
Mean 3pm wet bulb temp (°C)	22	22	21	19	16	15	14	14	17	18	19	21	18
Mean 3pm relative humidity (%)	63	67	65	61	58	56	50	50	50	57	60	61	58
Mean monthly rainfall (mm)	146	193	148	128	136	71	57	42	43	79	121	154	1266
Mean no. of rain days	12	13	12	10	10	6	6	6	6	9	10	11	111
Mean daily evaporation (mm)	5	5	4	4	3	2	3	3	4	5	5	6	4
Mean no. of clear days	2	3	5	5	7	9	11	11	10	6	4	5	77
Mean no. of cloudy days	9	10	7	5	6	6	4	3	4	7	9	8	78
Mean daily hours of sunshine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Windroses of the TAPM generated Hinze Dam meteorological file for 2004 are presented in **Appendix F.11.2**. The windroses indicate that:

- wind directions vary but are predominantly from the southern quadrant;
- wind speeds are fairly light, generally less than 5 m/s;
- strongest winds are from the southwest;
- during summer and spring, winds are predominantly from the north and the southeast;
- during autumn winds are from the southeast, and during winter predominantly from the southwest; and
- winds in the morning are generally light from the south and southeast, gaining in strength during the day from the northeast and southeast.

To validate the TAPM generated meteorological data, they have been compared with meteorological data collected by the BoM at Hinze Dam from 2000 to 2006 (refer to **Appendix F.11.3**). There is a strong correlation between the frequency distributions of wind speeds for the TAPM and BoM meteorological data. The frequency distribution of wind directions for TAPM and BoM meteorological data agree reasonably well together, although TAPM appears to be overpredicting winds from the northern quadrant and underpredicting winds from the eastern quadrant. Sensitive receivers are generally located to the north and northeast of the construction site, and this is unlikely to significantly affect the predicted pollutant concentrations at nearest sensitive receivers.

11.4.3 Ambient Air Quality

Emissions Sources

Existing air quality in the study area is influenced by local sources of air emissions and sources from within the broader Gold Coast airshed. The following sources contribute to air emissions within the study corridor:

- Motor vehicle emissions from major roads in the area, including the Pacific Motorway located 7 km east of the project area;
- Agricultural activity (machinery);
- Domestic sources from residential activities (eg lawn mowing); and
- Occasional bushfires and control burns.

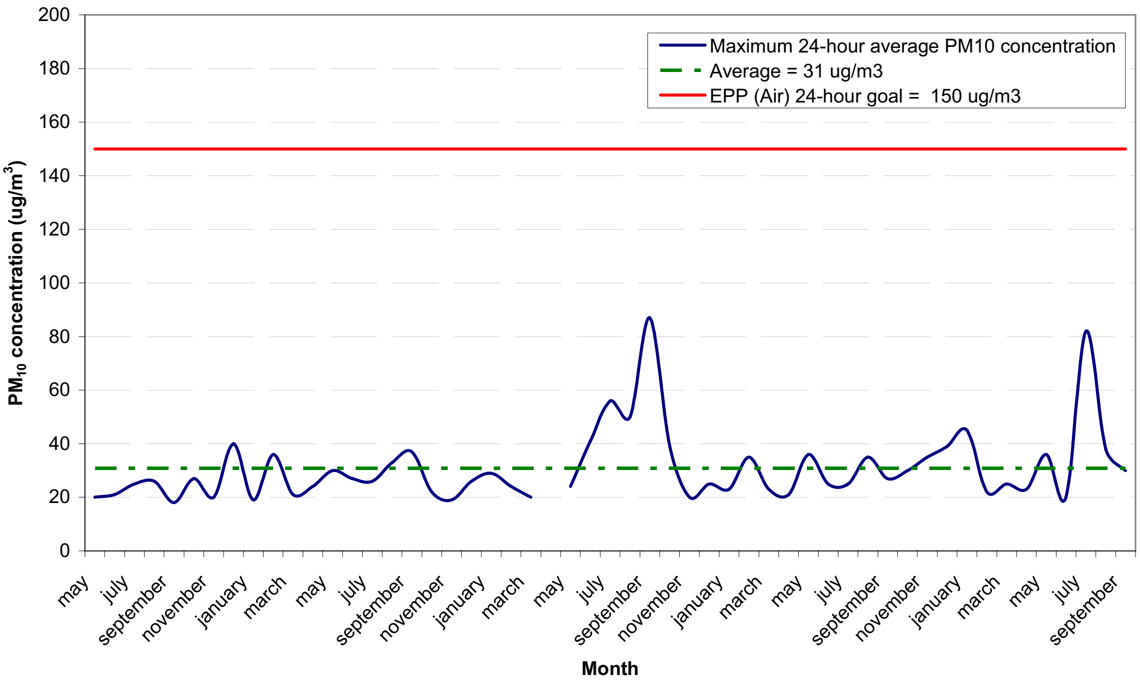
Ambient Air Quality Monitoring

The closest EPA air quality monitoring site is located at Helensvale, approximately 15 km to the north-northeast of the site. Helensvale PM_{10} concentrations from May 1998 through to October 2002 are presented in **Figure 11-1**. Inspection of these data shows that maximum 24-hour average concentrations are significantly less than the air quality goal of 150 µg/m^3 in the EPP(Air). The average of these 24-hour maxima is 31 µg/m^3.

The annual average background PM_{10} for the Helensvale site is 15.8 µg/m^3, significantly less than the air quality goal of 50 µg/m^3 in the EPP(Air). The annual average background TSP concentration has been assumed to be double the average annual PM_{10} concentration at 32 µg/m^3. This is also significantly less than the air quality goal of 90 µg/m^3 in the EPP(Air).

Although generally representative of the Gold Coast airshed, the EPA monitoring station at Helensvale is located relatively close to the Pacific Motorway. The influence of vehicle emissions would be considered more significant at this location in comparison with the project area. Therefore, the expected PM_{10} concentrations would be lower at the project area and Helensvale data can be considered conservative background concentrations.

- **Figure 11-1 Maximum 24-Hour Average PM_{10} Concentrations (Helensvale)**



Source: EPA

11.5 Potential Impacts – Construction Dust

11.5.1 Air Emissions Sources and Assessment of Likely Impact

The construction phase of the project is expected to occur for three years, commencing in October 2007. The majority of construction works are expected to occur over a five day working week, with work occurring on one Saturday per four weeks. Construction hours will generally be a 10 hour day operating between 6 am and 6 pm, with work conducted at night to work on machinery within the workshop building. The different construction activities and potential sources of air emissions are presented in **Table 11-3**.

The most significant air emissions from construction activities are expected to be particulate matter resulting from excavation activities, blasting and wheel-generated dust from haul roads. There will also be small emissions of carbon monoxide (CO), oxides of nitrogen (NO_X), sulphur dioxide (SO_2), and PM_{10} from exhaust emissions from construction equipment and haul trucks. These emissions are not expected to be significant for this study due to their low levels.

Some vegetation that is required to be removed from the site may need to be burned. Burning of cleared vegetation will generate CO, NO_X, PM_{10} and odour. These events will be undertaken in consultation with the Queensland Rural Fire Service and Queensland Parks and Wildlife Service. Given the mountainous terrain and poor dispersive environment, burning large quantities of cleared vegetation has the potential to generate air quality impacts at sensitive receivers located around the dam. Wherever possible, burning cleared vegetation should be avoided. The prevailing meteorological conditions and ambient air quality should be considered before undertaking any burn event to minimise potential air quality impacts from this activity.

The construction of the intake towers, site office establishment and relocation of powerlines will all generate small quantities of fugitive dust. However, these are not expected to be significant in comparison with major excavation and haulage activities and have not been considered in the air quality assessment.

This air quality assessment has therefore focused on the impact of TSP, PM_{10} and dust deposition generated during construction of the project on nearby sensitive receivers.

11.5.2 Emissions Estimation

The main dust generating activities are identified in **Table 11-3**, and the dust emissions from the main sources estimated. The construction information which has been used as the basis for calculations is presented in **Table 11-4**. Emissions were estimated using emission factors in the Emission Estimation Technique Manual for Mining version 2.3 (NPI 2001). The emission factors used to estimate dust emissions from site are presented in **Table 11-5**.

Table 11-3 Construction Activities and Air Emissions Sources

Construction Activity	Air Emissions sources
Quarrying	Fugitive dust from: ■ Excavation of rock and overburden (3 excavators); ■ Blasting (approx one 5000 m^3 blast per day); ■ Drilling holes for blasts (2 Drills); ■ Clearing trees and topsoil with dozer; and ■ Wind blown dust from exposed areas. Diesel emissions from construction equipment.
Clay Excavation and Conditioning	Fugitive dust from: ■ Clearing trees and excavating clay (3 scrapers); ■ Conditioning clay by laying it out in a thin layer, adding water and blade mixed with a grader (3 graders); and ■ Wind blown dust from exposed areas. Diesel emissions from construction equipment.
Dam Construction	Fugitive dust from: ■ Clear trees and excavate toe of dam (3 scrapers); ■ Haul trucks will be dumping material for dam construction; ■ Dozers, excavators and vibrating rollers will be used to compact and shape the wall (2 dozers, 3 excavators); and ■ Wind blown dust from exposed areas. Diesel emissions from construction equipment.
Construction of Recreation Area	Fugitive dust from: ■ Haul trucks will be dumping material for construction recreational area; ■ Dozers, and excavators will be used to shape the area; and ■ Wind blown dust from exposed areas.
Crusher	Fugitive dust from primary and secondary crushing of rock
Concrete Batch Plant	Fugitive dust from: ■ Mixing materials for concrete manufacture ■ Wind blown dust from stockpiles of sand and aggregate
Haulage of Material	Fugitive dust from wheel-generated dust by vehicles travelling on unsealed roads (20 haul trucks) Diesel emissions from haul trucks and water trucks
Spillway and Fishway Construction	Fugitive dust from: ■ Drilling as part of spillway construction; ■ Haul trucks will be dumping material for dam construction;
Vegetation Clearing	Fugitive dust from clearing trees from inundation zone Combustion products from burning of cleared timber
Site Office Establishment and Site Establishment Works	Small quantities of fugitive dust from construction activities
Intake Tower Upgrade	Small quantities of fugitive dust from construction activities

Table 11-4 Construction Information Used for Emissions Estimates

Parameter	Parameter	Value
Material quantities	Rock for toe wall	1 400 000 m^3
	Rock for saddle dam	400 000 m^3
	Overburden for toe wall	200 000 m^3
	Overburden for saddle dam	100 000 m^3
	Overburden for recreational area	300 000 m^3
	Quantity of clay	150 000 m^3
Haul distances (return)	Quarry to Toe	3 km
	Quarry to Saddle Dam	7 km
	Quarry to Recreation Area	1.5 km
	Clay from borrow pit	2 km
Blasting	Area	540 m^2
	Depth	10 m
	Blasting frequency	1 blast per day
	Average holes drilled per blast	50
Other	Grading speed	5 km/hr
	Exposed area	18 ha
	Concrete batching plant	80 m^3/hr
	Crusher	1000 t/d

Table 11-5 Summary of Dust Emission Factors

Construction Activity	TSP Emission Factors	PM_{10} Emission Factors	Dust Control
Excavation of rock	0.0025 kg/t	0.0012 kg/t	-
Excavation of overburden	0.0118 kg/t	0.0056 kg/t	-
Scraper	1.644 kg/VKT	0.529 kg/VKT	-
Grader	0.19 kg/VKT	0.085 kg/VKT	-
Dozer	8.368 kg/hr	2.038 kg/hr	-
Wind erosion	4.0 x 10^{-6} g/m^2/sec	2.0 x 10^{-6} g/m^2/sec	50% control with water sprays
Blasting	60.1 kg/blast	31.3 kg/blast	-
Drilling	0.177 kg/hole	0.31 kg/t	70% control with water sprays
Crushing	0.2 kg/t	0.02 kg/t	-
Concrete Batching	0.0087 kg/t	0.0024 kg/t	ESP on hopper outlet[1]
Wheel Generated Dust			75% control with water sprays
■ CAT777	1.13 kg/VKT	0.27 kg/VKT	
■ CAT773	0.89 kg/VKT	0.23 kg/VKT	

1 ESP – electrostatic precipitator

11.5.3 Modelling Methodology

The AUSPLUME version 6.0 dispersion model has been used to predict ground level concentrations of PM_{10} and TSP, and dust deposition amounts, within a 3.6 km x 4 km receptor grid surrounding the site. The grid receptor spacing is 100 metres. Particle concentrations and dust deposition amounts have also been predicted for nine discrete receptors to predict air quality impacts at residences close to the construction site. The TAPM generated meteorological data file described previously was used (refer **Section 11.4.2**). Impacts at sensitive receivers, including residences, are compared to the goals for ambient air quality shown in **Table 11-1**.

The AUSPLUME dispersion modelling options assumed as part of this air quality assessment include:

- regulatory default model options for dispersion;

- Irwin rural wind profile exponents;
- average roughness length of 1.2 m;
- terrain file for the receptor grid was generated from the contour data;
- emissions were modelled as 12 volume sources across the project construction site;
- emissions were conservatively assumed to be emitted every hour of every day between 6 am and 6 pm, apart from blasting emissions which occurred for one hour each day;
- dust deposition modelling run used a variable emissions file with construction activities occurring from Monday to Saturday;
- annual average dust deposition rates were divided by number of 365 to determine average daily dust deposition rates;
- wind blown dust was assumed to be a source of emissions 24 hours per day;
- dry depletion options in AUSPLUME with particle size distribution information based on estimated TSP and PM10 emissions; and
- particle size for TSP and PM10 is 20 µm and 8 µm respectively.

11.5.4 Modelling Results

This section outlines the predicted concentrations of particulate matter and dust deposition rates from the construction of the project for the indicative scenario outlines in **Table 11-4** and **Table 11-5**. The predicted increase in concentrations as a result of project construction and the cumulative impact (including background concentration) is presented in the following sections. Contour plots presented below indicate the increase in particulate matter concentrations and dust deposition rates from construction.

PM_{10} Concentrations (24 Hour Average)

The maximum predicted 24 hour PM_{10} concentrations at nearest sensitive receivers during construction of the project are presented in **Table 11-6**. The cumulative concentrations (including an assumed background of 31 µg/m^3) are also presented in **Table 11-6**. All concentrations at sensitive receivers are below the ambient air quality goal of 150 µg/m^3 in the EPP(Air). Contour plots of maximum PM_{10} concentrations (24 hour average) during construction are presented in **Figure 11-2**.

The predicted concentrations Residences #2 and #5 represent a substantial increase above ambient levels. The main contributions to dust levels at these locations are dust generated from haul roads which are a high priority for dust management for the project. The predicted results suggest that there may be potential dust impacts at receivers located close to the project construction area.

- **Table 11-6 Predicted PM_{10} Concentrations (24 hour average)**

Location	Description	PM_{10} Concentration (µg/m^3)	
		Predicted Increase	Including Background
1	Residence #1	57	88
2	Residence #2	84	115
3	Residence #3	51	82
4	Residence #4	60	91
5	Residence #5	93	124
6	Residence #6	53	84
7	Residence #7	52	83
8	Residence #8	37	68
9	Residence #9	45	76

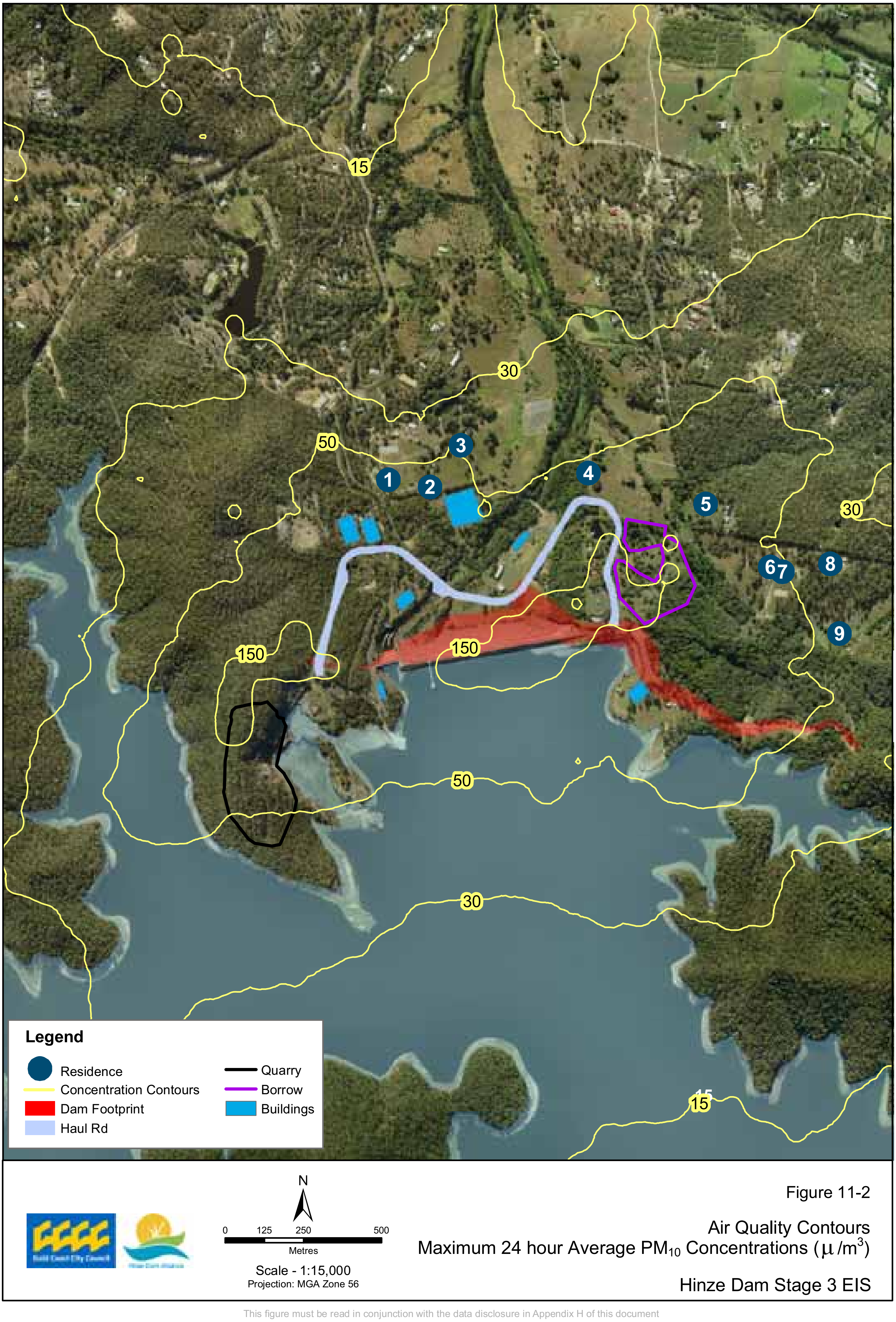


Figure 11-2

Air Quality Contours
Maximum 24 hour Average PM_{10} Concentrations (μ/m^3)

Hinze Dam Stage 3 EIS

PM_{10} Concentrations (Annual Average)

The annual average PM_{10} concentrations at nearest sensitive receivers during construction are presented in **Table 11-7**. The cumulative concentrations (including a background of 15.8 µg/m^3) are also presented in **Table 11-7**. All concentrations at sensitive receivers are well below the ambient air quality goal of 50 µg/m^3 in the EPP(Air). Contour plots of PM_{10} concentrations (annual average) during construction are presented in **Figure 11-3**.

▪ **Table 11-7 Predicted PM_{10} Concentrations (24 hour average)**

Location	Description	PM_{10} Concentration (µg/m^3)	
		Predicted Increase	Including Background
1	Residence #1	7	23
2	Residence #2	6	22
3	Residence #3	5	20
4	Residence #4	6	22
5	Residence #5	4	20
6	Residence #6	4	20
7	Residence #7	4	19
8	Residence #8	2	18
9	Residence #9	3	19

TSP Concentrations (Annual Average)

The average annual TSP concentrations at nearest sensitive receivers during construction are presented in **Table 11-8**. The cumulative concentrations (including a background of 32 µg/m^3) are also presented in **Table 11-8**. All concentrations at sensitive receivers are below the ambient air quality goal of 90 µg/m^3 in the EPP(Air). Contour plots of TSP concentrations (annual average) during construction are presented in **Figure 11-4**.

▪ **Table 11-8 Predicted TSP Concentrations (Annual Average)**

Location	Description	TSP Concentration (µg/m^3)	
		Predicted Increase	Including Background
1	Residence #1	12	44
2	Residence #2	10	42
3	Residence #3	8	40
4	Residence #4	10	42
5	Residence #5	7	39
6	Residence #6	6	38
7	Residence #7	5	37
8	Residence #8	4	36
9	Residence #9	4	36

Figure 11-3

Air Quality Contours
Average Annual PM_{10} Concentrations (μ/m^3)

Hinze Dam Stage 3 EIS

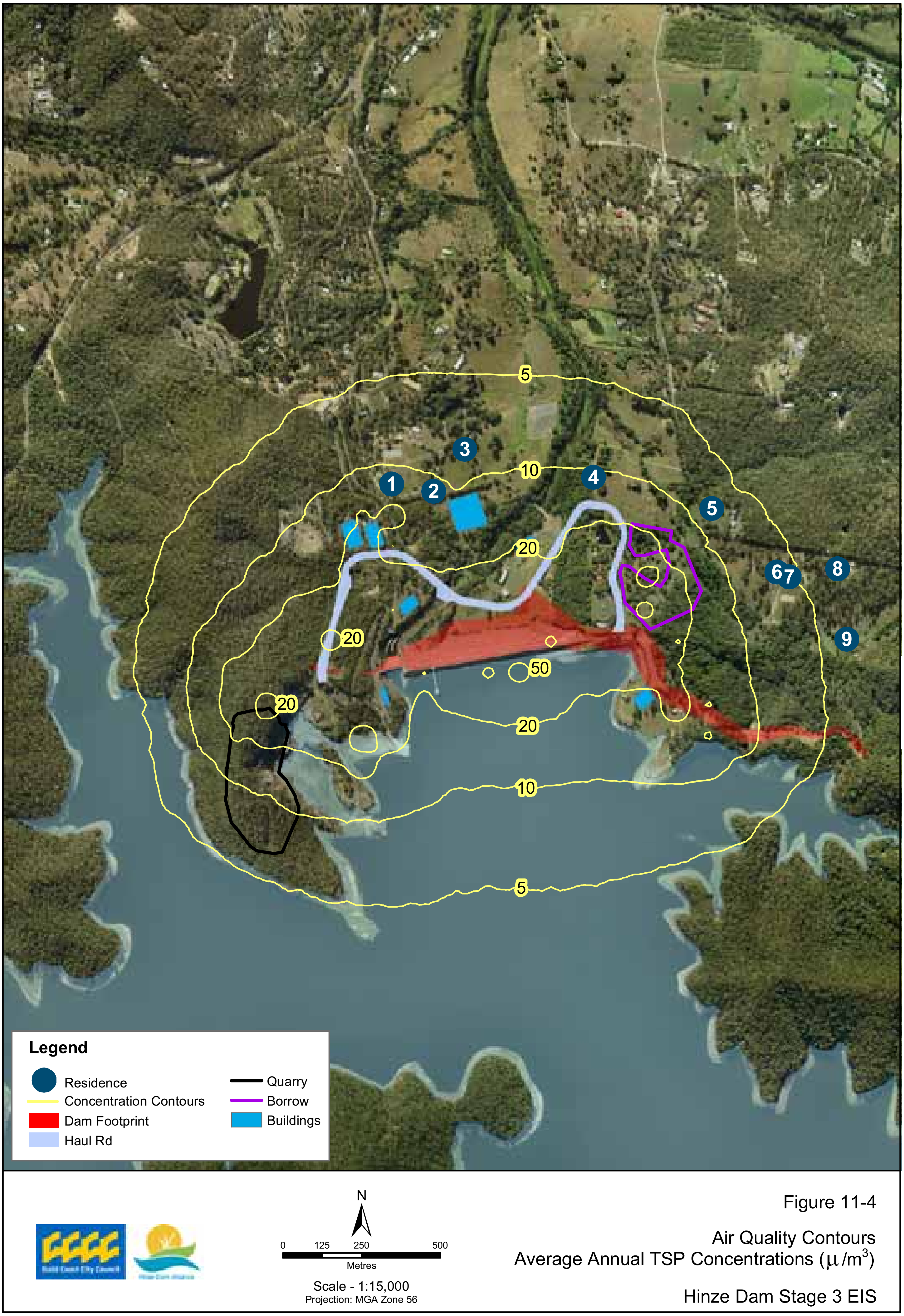


Figure 11-4

Air Quality Contours
Average Annual TSP Concentrations (μ/m³)

Hinze Dam Stage 3 EIS

Dust Deposition

The average dust deposition rates nearest sensitive receivers during construction are presented in **Table 11-9**. Dust deposition rates at nearest sensitive receivers are predicted to be less than the guideline of 120 mg/m^2/day. The modelling is considered conservative and the dust deposition guideline of 120 mg/m^2/day is unlikely to be exceeded using 5 day per week construction program. Contour plots of average dust deposition rates during construction are presented in **Figure 11-5**.

- **Table 11-9 Predicted Average Dust Deposition Rates**

Location	Description	Dust Deposition Rate (mg/m^2/day)
1	Residence #1	108
2	Residence #2	86
3	Residence #3	59
4	Residence #4	81
5	Residence #5	34
6	Residence #6	28
7	Residence #7	25
8	Residence #8	15
9	Residence #9	17

Discussion

All mathematical models of airborne pollutant dispersion are simplifications of reality. Ausplume is a Gaussian plume model that is accepted by the EPA for the majority of regulatory applications.

The following factors should be considered when interpreting dust emission assessment:

- the construction scenario assessed is a snapshot of typical activities that could be expected to occur at the site during a high level of activity;
- actual emission rates may differ from the estimates in **Table 11-5**;
- emission factors are generally long-term averages, whereas actual emissions will vary on a short-term time scale;
- estimated dust emission rates are based on an assumption that dust emission controls have been utilised on many of the dust emitting processes as outlined in **Table 11-5**; and
- dispersion models are based on a number of assumptions about regional homogeneity of winds and surface conditions.

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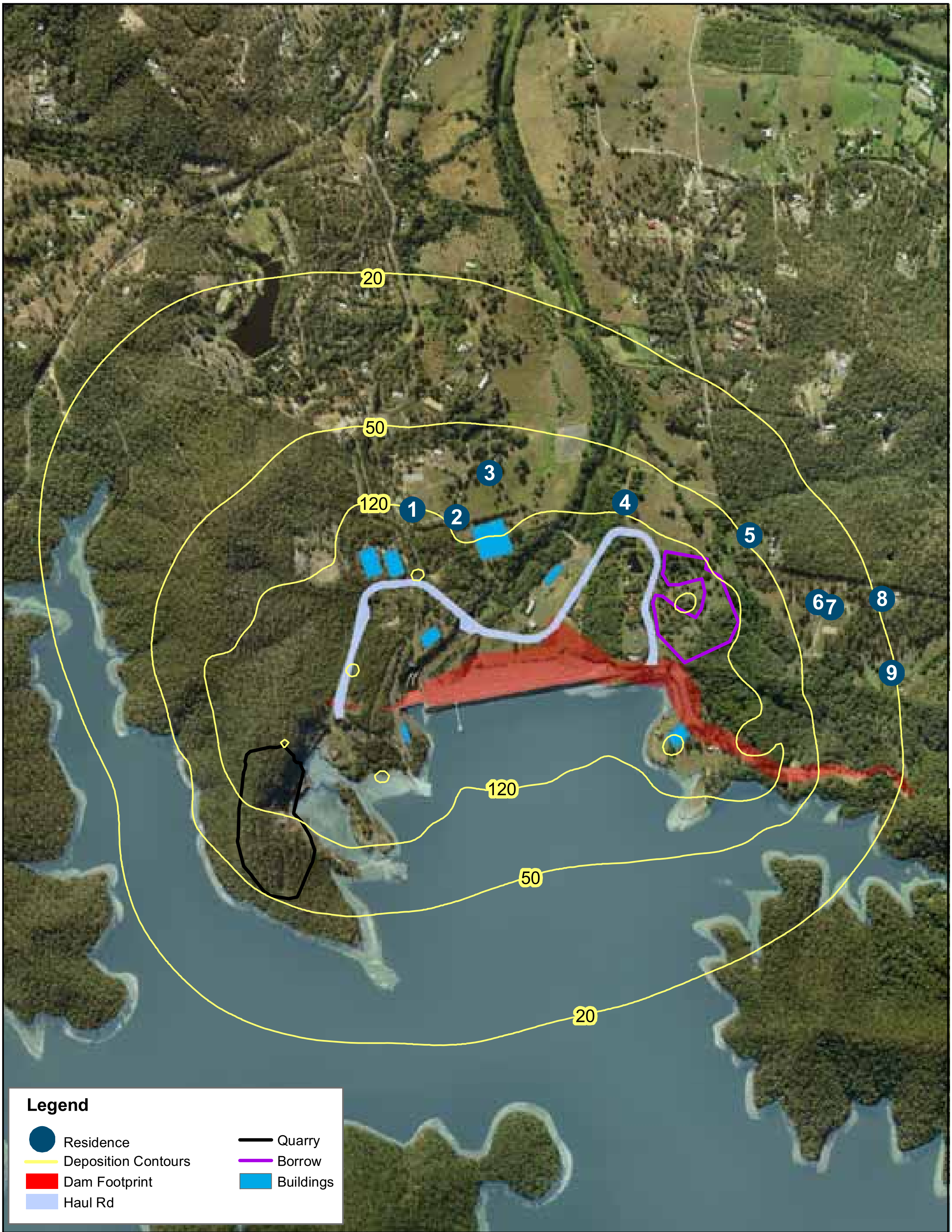

N
0 125 250 500
Metres
Scale - 1:15,000
Projection: MGA Zone 56

Figure 11-5

Air Quality Contours
Average Daily Dust Deposition (mg/m^2/day)

Hinze Dam Stage 3 EIS

11.5.5 Mitigation Measures – Construction Dust

The following sections outline construction mitigation measures which will be implemented to minimise the potential for nuisance dust impacts during the project. The dust control strategies provided in the points below have been included within the Environmental Management Plan (EMP):

- haul roads will be watered regularly using truck water carts to reduce emissions of wheel generated dust. The recommended watering rate is more than two litres/m^2/hour, with particular focus on haul roads located near residents to the north and northeast of the construction site. Recycled water will be used preferentially for dust suppression purposes;
- the size of cleared areas will be minimised to limit exposed areas available for dust emissions by wind erosion;
- surface excavation works and blasting activities will incorporate consideration of prevailing meteorological conditions wind speed and direction, with works potentially ceasing if high winds are blowing in the direction towards sensitive receivers. This is particularly important when dust emissions are close to residences;
- limit speeds of haul trucks to control wheel-generated dust from haul roads, if visual inspection indicates that significant quantities of dust are being generated and transported off-site;
- regular monitoring of PM_{10} and dust deposition levels at nearest sensitive places will provide a basis for compliance with appropriate criteria;
- newly established stockpiles in the construction site will be seeded and stabilised as soon as practical. Water sprays may also be used on stockpiles and could be activated during dry and windy conditions;
- hydromulch and hydroseed will be applied to batters adjacent to haul roads to stabilise these areas and minimise wind-blown dust;
- retention of existing vegetation, where practical, between construction activities and sensitive receivers will reduce particulate concentrations and dust deposition rates at receivers;
- construction of an enclosure around the crushing area will be undertaken if dust impacts from crushing operations become problematic;
- electrostatic precipitation on the hopper vent for the concrete batching plant to minimise particulate emissions;
- re-use or mulch cleared vegetation, wherever practical. Burning of cleared vegetation would only be undertaken if other options are not feasible;
- the prevailing meteorological conditions will be considered before undertaking any burn event to minimise potential air quality impacts from this activity. These events would be undertaken in consultation with the Queensland Rural Fire Service and Queensland Parks and Wildlife Service;
- trucks transporting material to or from and the construction site on public roads will cover their loads to prevent wind-blown dust during transport; and
- sealed access roads to the worksite sheds will be kept relatively dust free by regular sweeping and washing if needed. At certain times of the year, natural rainfall should keep this surface washed.

The most effective way of avoiding nuisance from construction activities is to have in place a system that addresses the following:

- effective monitoring of impacts and proactive response to complaints;
- effective communications with the local community on issues associated with the construction activities;
- a clearly identified point of contact should the community have comments or complaints;
- a well defined process to ensure that any issues are dealt with promptly and to a satisfactory level; and
- a well defined system of recording any incidents or complaints.

11.6 Potential Impacts – Gold Coast-Springbrook Road Upgrade

The upgrading of the Gold Coast- Springbrook Road has the potential to generate air quality impacts during operation and construction. This section of the report provides a qualitative assessment of these impacts at nearest sensitive receivers.

11.6.1 Construction

The main sources of dust generation during upgrading of the Gold Coast-Springbrook Road are likely to include:

- vegetation clearing;
- handling and transport of material for construction;
- wheel generated dust from vehicles travelling along unpaved surfaces;
- wind erosion from exposed surfaces; and
- short term odour during laying of bitumen.

In order to minimise the potential for off-site air emissions the following air quality management strategies will be adopted during construction:

- minimise areas to be disturbed;
- cover trucks transporting fill to prevent wind blown dust during transport;
- regular watering of unsealed trafficked areas and exposed areas; and
- avoid, wherever possible, works such as vegetation removal and widespread excavation etc. during strong winds and dry periods.

11.6.2 Operation

Vehicle emissions, such as CO, NO_X, PM_{10} and SO_2, have the potential to generate air quality impacts at locations close to the roadside. As a result of the potential inundation of the Gold Coast-Springbrook Road , a 700 m section of road will be raised by up to 3 m, within the existing road corridor. This vertical realignment has been investigated for its potential to increase pollutant concentrations at the nearest sensitive receivers.

This road upgrading is not expected to significantly decrease the effective distance between vehicle emissions and sensitive receivers because the upgrade will occur within the existing alignment. The road upgrade is also not expected to affect traffic numbers on the road which are currently less than 1000 vehicles per day. Roadside monitoring data collected by the EPA (2001) on busy roads (greater than 10 000 vehicles per day) in Brisbane did not show exceedances of the ambient air quality goals in the EPP(Air). Therefore, air quality impacts at sensitive receivers are unlikely as a result of the road upgrade.

11.7 Greenhouse Assessment

11.7.1 Introduction

Increasing concentrations of greenhouse gases in the atmosphere have the potential to cause climate change. The Queensland Government developed the Queensland Greenhouse Strategy (EPA 2004) in response to the potential social, economic and environmental implications of climate change.

The key objectives of the Queensland Greenhouse Strategy are to:

- foster increased knowledge and understanding of greenhouse issues and climate change impacts;
- reduce greenhouse gas emissions; and
- lay the foundation for adaptation to climate change.

AGO (2005) have calculated that in 2002 Queensland emitted 145.1 Mt CO_2-e (almost 27 % of Australia's total greenhouse gas emissions). Queensland's emissions consisted of 44.1 Mt CO_2-e from electricity generation, 16.8 Mt CO_2-e from the transport sources, and 4.4 Mt CO_2-e from industrial processes.

11.7.2 Methodology

A greenhouse gas inventory has been prepared for the construction of the project, to provide an indication of the relative benefits and impacts of the project. The AGO Factors and Methods Workbook (AGO 2006) was used in the preparation of this greenhouse gas inventory. The relevant emission factors are summarised in **Table 11-10**.

The greenhouse gas emissions from land clearing have not been estimated as part of the EIS. These emissions are not expected to be significant as the project will have to provide offsets for most of these areas. Therefore the net greenhouse emissions are not expected to be significant.

The potential change in greenhouse gas emissions during operation of Hinze Dam Stage 2 and Stage 3 has been investigated based on electricity use as outlined.

■ **Table 11-10 Greenhouse Gas Emission Factors**

Source	Emission Factor	Units
Electricity end use (QLD)	1.046	t CO_2-e/MWh
Automotive diesel	2.7	t CO_2-e /kL
Explosives (Heavy ANFO)	0.178	t CO_2-e /t explosive

Source: AGO, 2006

Note: t CO_2-e = tonnes of CO_2 equivalents

11.7.3 Construction

Diesel and electricity consumption estimates during the three years of construction of the dam wall are in **Table 11-11**. The estimates relate to typical diesel consumption rates in the construction vehicle fleet, electricity consumption from site services, and explosives used in quarry operations over an approximate 3 year construction period.

The corresponding greenhouse gas emission estimates during construction of the project are included in **Table 11-11**. The construction of the project is estimated to result in approximately 0.022 Mt CO_2-e of greenhouse gases, or 0.007 Mt CO_2-e on an annual basis. These emissions represent a small fraction of Queensland's annual greenhouse gas emissions.

■ **Table 11-11 Greenhouse Gas Emissions During Construction Period**

Stage	Value	Units	GHG Emissions (t CO_2-e)
Diesel	7800	kL	21 060
Electricity	900	MWh	941
Explosives (heavy ANFO)	1238	t	220
TOTAL			**22 222**

Construction Greenhouse Management Measures

In order to minimise greenhouse gas emissions as part of the construction works, a variety of mitigation and management measures are available, including:

- designing a construction works program to source most construction materials from within or close to the project area to reduce fuel use from transporting materials;

- maintaining construction equipment and haul trucks in good working order so fuel efficiency of equipment is maximised;
- using appropriately sized equipment for construction activities; and
- minimising waste from construction.

These management measures have been considered in the design of the project and will be undertaken during the construction phase of the project.

11.7.4 Operation

Currently water is transferred from the lower intake of Hinze Dam to Molendinar water treatment plant and from the upper intake plant to Mudgeeraba water treatment plant. The dam will continue to be operated in this manner after the completion of the raising of the dam wall. In addition to the water supply process of Hinze Dam, the operation of the dam will also include the management of a fish transfer system. The fish transfer system is not expected to use significant quantities of fuel, due to nature of the transfer requirements as detailed in **Section 3**, and these greenhouse gas emissions have therefore not been estimated.

The energy consumption to pump water from the dam to the water treatment plants will vary according to volumetric flow of water and the height of water in the dam. The volume of water being pumped will vary throughout the day and also during the year. The yield (annual average volume of water being drawn from the dam) is expected to increase from 209 ML/day to 225 ML/day after raising the dam wall. The storage level of water within the dam is also expected to increase after raising the dam wall. The 75th percentile exceedance levels were selected as a conservative measure of water height, with the 75th percentile exceedance levels expected to increase from 74 m to 85 m. The change in water level will reduce the energy consumption compared to the operation of the existing dam by increasing the amount of water that can be transferred by gravity flows and reducing the static head. Estimates of greenhouse gas emissions are presented in **Table 11-12**.

- **Table 11-12 Estimate of Greenhouse Gas Emissions During Site Operation**

Heading	Hinze Dam Stage 2	Hinze Dam Stage 3
Yield	209 ML/day	225 ML/day
Storage level (75% exceedance probability)	74 m	85 m
Energy consumption	12.0 MWhr/yr	10.8 MWhr/yr
Greenhouse Gas Emissions	12 560 t CO_2-e/yr	11 350 t CO_2-e/yr

The assumptions used in preparing these estimates were:

- static head and dynamic head were determined to transfer water from each of the intake towers;
- pumping efficiency assumed to be 90% and other losses assumed to be 20%;
- pumping requirements for water transferred from the upper intake to Mudgeeraba water treatment plant required pumping was 100%; and
- pumping requirements of water transferred from the lower intake to Molendinar water treatment plant assumed to be 60% for Hinze Dam Stage 2 and 55% for Hinze Dam Stage 3.

The estimates of greenhouse gas emissions **Table 11-12** indicate that there is a small reduction (1100 t CO_2-e) after the raising of the dam wall and the overall greenhouse gas emissions from the operation of the project represent a small fraction of Queensland's annual greenhouse gas emissions (less than 0.005%).

Operation Greenhouse Management Measures

The following management measures are proposed for the operation of the project to minimise greenhouse gas emissions:

- use of gravity flows to transfer water from the dam to water treatment plants, wherever practical; and
- the operator of the project (Gold Coast City Council) is a member of Greenhouse Challenge Plus.

11.8 Summary and Conclusions

This section has assessed the air quality impacts of the Hinze Dam Stage 3 project. AUSPLUME was used to predict PM_{10} and TSP concentrations and dust deposition rates at sensitive receivers near the construction area. The predicted PM_{10} and TSP concentrations were well below ambient air quality goals in EPP(Air). The predicted results suggest that there may be potential dust nuisance impacts at receivers located close to the project construction area. However, it is considered highly unlikely that this project will result in exceedances of the guidelines because of the conservative methodology employed in the assessment.

The construction of the project will result in 0.022 Mt CO_2-e of greenhouse gas emissions over an approximate three year period (or 0.007 Mt CO_2-e per annum). The construction program has been designed to maximise energy efficiency and minimise greenhouse gas emissions from the works. This has been done primarily by sourcing almost all material for construction operation from the project site. The greenhouse gas emissions are not expected to change significantly from current emissions during operation of the project. Greenhouse gas emissions from construction and operation of the project represent a small fraction of Queensland's greenhouse gas emissions.

Climate change risk assessment has determined that the project has limited vulnerability to climate change. Climate change has the potential to reduce the potential yield from the project but this can be offset through water demand management, if required. The vulnerability to flooding resulting from an increase in rainfall intensity will be reduced after raising the dam wall. In this context, the project aligns with the Queensland Greenhouse Strategy (EPA 2004) by laying the foundation for climate change adaptation.