13 Air quality and noise

This chapter addresses the impact the Project may have on air quality and noise in its environs, including smoke and ash from cane-burning and emissions from the sugar mill. The issue of greenhouse gas emissions is also addressed, both in terms of land development and ongoing operations.

13.1 REGIONAL METEOROLOGY

The Bureau of Meteorology collects meteorological data at Kununurra Airport. This site is about 30 km south-west of the closest areas of the Project Area and some 80 km from the furthest areas. Data from Kununurra Airport are shown in Tables 13.1 to 13.4, and provide percentage frequency distributions for wind direction and wind speed. Additional climatic data for Kununurra covering temperature, rainfall, relative humidity and evaporation parameters are shown in Table 13.5.

Table 13.1 Wind direction frequency distribution (% at 9 a.m.) at Kununurra Airport, 1986–98

Month	Wind direction								
	N	NE	E	SE	S	SW	W	NW	Calm
January	15	8	4	15	10	17	10	11	10
February	13	8	7	13	9	21	7	11	11
March	5	8	14	25	8	12	5	8	15
April	3	10	27	42	4	2	1	2	9
May	1	3	21	56	6	3	–	2	8
June	2	3	22	59	5	1	–	1	7
July	1	3	18	61	8	2	–	1	6
August	6	7	22	44	7	3	1	2	8
September	16	13	16	26	4	3	4	7	11
October	17	17	13	18	6	4	4	14	7
November	15	14	7	17	8	9	5	14	11
December	14	11	8	17	11	16	5	10	8

Note: Rounded to the nearest 1%. The gaps in the dataset from May, June and July indicate the range occurred but with a frequency distribution less than 0.5%.

Source: Bureau of Meteorology 1998.

Table 13.2 Wind direction frequency distribution (% at 3 p.m.) at Kununurra Airport, 1986–98

Month	Wind direction								
	N	NE	E	SE	S	SW	W	NW	Calm
January	15	13	6	19	9	9	5	16	8
February	16	7	11	13	8	12	6	17	10
March	9	15	21	24	8	5	3	5	10
April	6	12	30	32	7	2	1	2	8
May	4	8	19	48	9	2	–	3	7
June	4	6	16	49	13	2	–	4	6
July	7	5	19	47	12	2	1	2	5
August	13	8	10	36	11	4	1	7	10
September	24	15	7	20	12	3	3	9	7
October	26	13	7	15	10	4	2	15	8
November	22	15	11	10	6	5	4	20	7
December	21	16	8	13	7	6	6	15	8

Note: Rounded to the nearest 1%. The gaps in the dataset for May and June indicate the range occurred but with a frequency distribution less than 0.5%.

Source: Bureau of Meteorology 1998.

Table 13.3 Wind speed frequency distribution (% at 9 a.m.) at Kununurra Airport, 1986–98

Month	Wind speed (km/h)				
	Calm	1–10	11–20	21–30	> 30
January	10	63	24	2	1
February	12	63	22	3	–
March	16	60	20	4	–
April	10	43	32	14	1
May	7	31	36	24	2
June	6	39	25	28	2
July	5	34	30	28	3
August	8	36	28	25	3
September	10	43	33	12	2
October	8	45	35	11	1
November	11	54	32	3	–
December	9	61	27	3	–

Note: Rounded to the nearest 1%. The gaps in the dataset for February, March, November and December indicate the range occurred but with a frequency distribution less than 0.5%.

Source: Bureau of Meteorology 1998.

Table 13.4 Wind speed frequency distribution (% at 3 p.m.) at Kununurra Airport, 1986–98

Month	Wind speed (km/h)				
	Calm	1–10	11–20	21–30	> 30
January	8	50	32	9	1
February	11	47	33	9	–
March	9	43	38	8	2
April	8	39	44	8	1
May	5	45	43	6	1
June	6	45	40	8	1
July	5	43	44	8	–
August	10	42	39	8	1
September	8	43	42	6	1
October	6	35	43	13	3
November	6	40	33	14	7
December	8	42	37	10	2

Note: Rounded to the nearest 1%. The gaps in the dataset for February and July indicate the range occurred but with a frequency distribution less than 0.5%.

Source: Bureau of Meteorology 1998.

Table 13.5 Additional climatic data for Kununurra

Month	Mean maximum temperature (°C)	Mean minimum temperature (°C)	Rainfall (mm)	Relative humidity (%)	Evaporation (mm)
January	36.0	24.4	190.5	65.0	230
February	35.0	24.2	201.9	68.5	176
March	35.5	23.4	114.8	60.6	195
April	35.1	20.7	44.1	44.3	217
May	32.7	17.9	12.0	36.2	212
June	30.5	15.3	3.2	35.7	203
July	30.5	14.1	6.5	31.9	209
August	32.9	15.5	0.6	32.5	241
September	35.8	19.0	3.6	34.2	294
October	38.0	22.8	23.3	39.0	330
November	38.9	24.5	63.7	47.7	287
December	37.8	24.8	123.8	55.8	275
Total	**–**	**–**	**788.0**	**–**	**2,869**

Source: Department of Resources Development 1996.

The wind data indicate a predominant daily east to south-east wind pattern between March and September. From September to February the easterly pattern declines and there is a greater influence of winds from the northern sector.

Morning (9 a.m.) wind speeds from April to October have an overall stronger pattern than at other times during the year. The afternoon (3 p.m.) data indicate a more uniform pattern throughout the year and have approximately equal percentage frequency distributions between 1–10 km/h and 11–20 km/h. In the late part of the dry season (late October to early November) afternoon storms with strong northerly winds are a common occurrence.

It is likely that the Project Area has a similar meteorological pattern to that of Kununurra although there are potential microclimate variations due to several prominent topographical features, such as the Pincombe and Weaber ranges, that exist nearby.

13.2 DUST

Ambient levels of dust in the Project Area are likely to be highly seasonal, with low levels during the wet season, increasing during the dry season as the cover of native vegetation becomes substantially less and wind strength increases. Movements of vehicles on unsealed roads and stock movements would be localised sources of dust.

It is inevitable that dust would be generated during construction, predominantly from the earthworks associated with construction of farm blocks, service roads, irrigation channels and drains. Land-clearing and land-levelling in particular have the potential to generate dust due to the movement of vehicles on unsealed areas. The quantity of dust generated would depend to a minor extent on the moisture content of the ground surface during construction; however, all land development would be undertaken during the dry season as it would not be practicable to perform significant construction work on the clay soils of the Project Area during the wet season.

The bulk of the development work would be on the Weaber, Keep and Knox Plains, and the impact of dust on local residents from these construction activities would be mitigated by the remoteness of the Project Area. The M2 Channel, however, would be constructed adjacent to the existing M1 Channel from the Diversion Dam to the Project Area. The nearest permanent residences to construction activities associated with the proposed M2 Channel would be those on the outskirts of Kununurra, some 300 m away. These residences are located south of the M2 Channel alignment and, therefore, would be predominantly upwind of the construction activity.

The main issue associated with dust would be the protection of workers from excessive levels. Earth-moving contracts would be structured to require air-conditioned cabins on earth-moving equipment and monitoring of dust levels associated with development activities.

A dust monitoring programme would be established as part of the EMP and administered throughout the construction and operational phases of the Project, using dust deposit gauges that comply with *AS 3580.10.1—1991*. Periodic dust monitoring would also be undertaken using portable monitors.

13.3 SMOKE AND ASH

13.3.1 Cane-burning

The burning of sugar cane in preparation for harvesting is an integral part of farming operations for the majority of cane-growers worldwide. Sugar cane grows vigourously in the Ord region, and the burning of cane facilitates efficient harvesting. Burning also has a number of beneficial effects on cane-farming operations: these include reducing the amount of trash (unwanted leaf material) delivered to the sugar mill and reducing the levels of pests in the cane fields. Cane fires are fast and hot and create a strong updraught.

Typically, a cane fire lasts for about five minutes as only sufficient sugarcane for the next day's harvest is burnt and the fallout of ash particles may last for a further fifteen minutes, depending upon local meteorological conditions. The updraught created by the fires ensures that there is little smoke at ground level. Furthermore, having regular fires within the Project Area would not be a new occurrence. It is understood fire stick farming practices have been used in Northern Australia by Aboriginal people for many years (Langton 1998).

If the cane was not burnt prior to harvesting much of the trash would be left on the farm. Harvesting of cane which has not been burnt beforehand is known as green cane harvesting. Rapid removal of the trash, to facilitate irrigation of the ratoon crop or replanting of sugarcane, would be required.

A number of issues have arisen with respect to cane-burning when it occurs near populated areas, and in some locations increasing pressure from Government and the public has seen restrictions developed on burning practices. In other areas burning has been eliminated and green-cane harvesting techniques developed. In 1997 it was estimated that over 60% of Queensland cane-growers used green-cane harvesting techniques. However, in the Burdekin district of Queensland, which has similar cane yields and irrigation systems to ORIA Stage 1, less than 5% of the crop in 1997 was harvested using green-cane techniques. A summary of the positive and negative aspects associated with cane-burning is presented in Table 13.6.

Table 13.6 Summary of positive and negative aspects associated with cane-burning

Positive aspects	Negative aspects
Reduces the amount of trash delivered to the mill. Controls vermin.	Generates smoke and cane ash fallout ('black snow'), which is a general nuisance in populated areas, particularly affecting laundry on washing lines and swimming pools.
Reduces cane trash within furrows that can obstruct flood irrigation.	Reduces soil cover and increases risk of erosion during heavy rainfall events.
Leads to rapid incorporation of some of the nutrients within cane ash into the soil.	Results in loss of organic matter and some trace elements to the atmosphere.
If managed properly, it can reduce the risk of uncontrolled fires spreading through large areas and potentially adversely affecting the crop, operations and safety.	If not managed properly, it provides an opportunity for fire to spread to surrounding bushland areas or cane paddocks at times when burning is not required or desirable.

Existing growers in ORIA Stage One have adopted cane-burning prior to harvest, and this practice occurs throughout the period between April and September. Occasional complaints associated with smoke and cane ash fallout have been lodged with local government regulatory agencies. Changing production practices to green-cane harvesting in ORIA Stage One has been investigated in the past and not adopted. The main reason for green-cane harvesting not being adopted is concern that the additional trash generated during harvesting would interfere with flood irrigation of the cane fields. For this reason cane-burning is considered the preferred method of cane-harvesting for the Project at this time.

Another reason for the adoption of cane-burning as the preferred method of cane-harvesting is that the remoteness of the Project Area, some 30–80 km north-east of Kununurra, would effectively eliminate land-use conflicts associated with the practice. In addition, meteorological data (Tables 13.1 and 13.2) indicate wind directions for the Kununurra region are predominantly south-east and east for the greater period of the year, particularly during the period of April to October when the sugarcane would be harvested. Consequently, smoke and cane ash would be dispersed away from population areas for most of the harvesting period.

Despite there being a low potential for nuisance issues associated with cane-burning, green-cane harvesting techniques would be investigated as part of the Project's ongoing research programmes into cane cultivation in the ORIA. This research would also assess any other environmental benefits of green-cane harvesting, such as reductions in greenhouse gas emissions. The issue of greenhouse gas emissions is discussed in Section 13.5.

13.3.2 Land-clearing impacts and their management

Some smoke and ash may be generated from burning wood and other vegetation during the construction phase of the Project. The impact of this activity is anticipated to be minimal and temporary as the burning would be carried out over a relatively short period. The isolation of the Project Area and the relatively sparse coverage of vegetation on the black-soil plains also reduce the significance of this issue. Furthermore, burning practices would be managed to occur at to times when prevailing winds would direct smoke and ash away from any residential areas.

13.4 EMISSIONS FROM THE SUGAR MILL

The sugar mill would primarily be powered by burning bagasse in a boiler, with stand-by power being supplied either from local generating capacity or from the Western Power grid. Emissions to the atmosphere would occur from the following sources at the sugar mill:

- the boiler chimney;
- the cooling towers and steam safety valves;
- intermittent use of a diesel generator.

Boiler chimney

Approximately 200 t/a of bagasse would be consumed in the sugar mill boilers to produce the steam for process purposes and to generate power. Two fuels would be used in the boiler: bagasse during normal operations, and fuel-oil at start-up. The boiler would usually operate continuously during the crop harvesting season.

The gas volume discharged by the chimney would be 420 m^3/s at 45°C and it would have a density of 0.83 kg/m^3. Prior to discharge, the gases would be passed through a scrubber to reduce particulate levels to fewer than 0.12 g/Nm^3, a level which is well within the current national guideline value of 0.25 g/Nm^3 for control of air pollutant emissions from new stationary sources (Australian Environment Council and National Health and Medical Research Council 1986).

Bagasse firing would be maintained as a complete combustion process with excess oxygen at all times; therefore, only insignificant levels of carbon monoxide would be generated.

Fuel-oil use would be necessary only during boiler start-up conditions, and about 20 t/h would be consumed. The fuel-oil would typically contain 0.7% sulphur, and the emissions from the chimney during the use of fuel-oil are expected to contain 300 ppm of sulphur dioxide, 200 ppm of oxides of nitrogen and fewer than 200 mg/Nm^3 of carbon monoxide.

Cooling towers and steam safety valves

Water vapour would be given off continuously by cooling towers and occasionally by steam safety valves.

The steam would be discharged at temperatures ranging from 120°C to 400°C.

13.5 GREENHOUSE GAS EMISSIONS

13.5.1 Background

The Commonwealth Government, through the Greenhouse Office and Greenhouse Challenge Co-operative Agreements, provides encouragement for the reduction of greenhouse gas emissions by industry. Further strategy initiatives, such as emission offsets against known greenhouse sinks and emissions trading, are evolving from the recent international greenhouse conference at Kyoto in 1997. These initiatives are still in their formative development stages nationally and internationally.

At Kyoto, Australia was successful in gaining acceptance for differentiated commitments to climate change targets. The agreement that was reached will allow Australia to have an 8% rise in emissions above 1990 levels by 2008–12. The Protocol from the Kyoto conference also allows all the main greenhouse gases from all sectors to be included. This means that rising emissions from energy use can be offset, to some extent, by a fall in emissions from changed land uses.

The Kyoto Protocol was opened for signature by Parties to the Conference in mid-March 1998. However, ratification and the subsequent entry into force of the Protocol's conditions are expected to take at least several years.

Perhaps the most important implication of the Kyoto Protocol for Governments at all levels and the community is that, within a few years, and for the first time in history, Australia is likely to be subject to a legally binding target that may impact directly on domestic economic activity—a target that Australians should assume is going to be enforced (Barrett 1998).

Australia's efforts to address the greenhouse issue effectively commenced in 1992 with the National Greenhouse Response Strategy. This was adopted by Australian Governments as the framework for policies covering all sources and sinks of greenhouse gases across all sectors of the economy. Since then, measures with major greenhouse-gas-reducing potential have been implemented across most sectors of the economy. They include energy market reforms, a number of initiatives aimed at increasing the efficiency of energy use by industry and domestic consumers, and large-scale tree planting and revegetation programmes (Barrett 1998).

The Commonwealth Government published another strategy dealing with greenhouse gas issues, the National Greenhouse Strategy, in 1998 after it was endorsed by the Council of Australian Governments. It had previously been released as a discussion paper.

Objectives of the National Greenhouse Strategy include improving the cost-effectiveness, competitiveness and availability of energy technologies that abate greenhouse emissions, and increasing energy use efficiency and the adoption of 'greenhouse-friendly' behaviour, practices, technologies and fuels. In the vegetation and forest management sector, proposed strategies include reducing land-clearing and encouraging the increased capacity to sequester greenhouse gases through forest planting; and in the agricultural sector, the strategies include reducing fuel use and improving a range of farm management practices.

The EPA has also developed a greenhouse gas emission policy for new projects requiring environmental impact assessment. This policy requires proponents to indicate their projects' greenhouse gas emissions inventory and to implement measures to minimise their project's impact on the environment.

The sugar industry as practised in Australia and internationally has both greenhouse gas sources and carbon sinks. A summary of potential sources and sinks for the Project is presented in Table 13.7. In addition, the Project has the potential to displace or reduce existing greenhouse gas sources (e.g through removal of cattle from the Project Area).

Table 13.7 Potential sources of greenhouse gases and carbon sinks for the Project

Potential sources of greenhouse gases	Potential carbon sinks
Burning of vegetation during construction.	Reduced burning of the Project conservation area by adoption of improved fire management techniques.
Sugarcane and soils release carbon dioxide and nitrous oxide.	Uptake of carbon dioxide by sugarcane.
Burning of sugarcane prior to harvest produces carbon dioxide, nitrous oxide and methane.	Increase in organic content of soils.
Fuel usage at the sugar mill (burning of bagasse) and farm machinery.	Carbon contained in products (raw sugar and molasses) stored.
Fuel usage during transport.	

13.5.2 Effects of initial development

Project development would entail removal of approximately 36,000 ha of the existing vegetation cover of grass and sparse trees and replacement of much of that area with agricultural farmland. The principal crop would be sugarcane, a perennial grass that would be grown on most of the farm area. The amount of carbon stored in the Project Area in both the existing and developed scenarios would vary seasonally. The comparison of the two scenarios shown in Table 13.8 is therefore made on the basis of the minimum carbon stored at any time, which corresponds to the end of the dry season for both scenarios. The comparison ignores carbon stored in vegetation that would not be cleared and carbon stored in the soil. These factors are assumed not to change significantly over the short construction period planned for the Project.

Table 13.8 shows that the minimum carbon stored would increase following project development, from about 19,500 t currently to about 670,000 t at full development. Most of this increase is from the growth of sugarcane (including roots, trash and tops) during the dry season following progressive harvesting of the crop, and the estimate includes the effects of burning prior to harvest. It also includes the carbon content in the raw sugar and molasses that would be in storage at the end of the dry season.

Table 13.8 Minimum total carbon stored in the Project Area for the existing and development scenarios *

Existing scenario**		Development scenario⊥	
Sink	Stored carbon (t)	Sink	Stored carbon (t)
Trees	1,500	Cane roots	180,000
Grasses and litter	18,000	Cane	210,000
		Cane trash	58,000
		Cane tops	124,000
		Sugar storage	79,000
		Molasses storage	19,000
Total	**19,500**		**670,000**

* *Does not include carbon stored in soils and in vegetation in areas that would not be cleared.*

** *Assumes full grass cover.*

⊥ *Assumes 50% of independent farms planted to sugarcane with balance to annual crops.*

Project development would be beneficial in reducing the level of carbon dioxide (a greenhouse gas) in the atmosphere by sequestering it in ongoing carbon storage. This reduction, although not significant on a global scale, would be consistent with Australia's commitments under the Kyoto Protocol (Section 13.5.1).

The calculations supporting the data in Table 13.8 require a number of assumptions to be made. These assumptions, and their supporting references where applicable, are described below.

The total amount of carbon stored in the existing scenario was calculated based on the data and methods used in Howden et al. (1994) and assumed the percentage of carbon contained in dry plant matter to be 45% (Chapman et al. 1992). A figure of 1,000 kg/ha was used for the dry mass of existing grasses and litter, typical of the vegetation in the Project Area, from a study of a similar environment in north Queensland (Howden et al. 1994). Roots were assumed to be 15% additional to this. None of the Project Area was assumed to be burnt for the existing scenario, although fires are quite common in the region throughout the dry season. The carbon contained in livestock was considered too small to include in calculations.

For the development scenario the total quantities of carbon stored in the roots, cane, cane trash and cane tops were calculated as follows: 61% cane, 9% cane tops, 17% cane trash and 13% roots (Chapman et al. 1992). The carbon stored in the roots was assumed to be unaffected by burning and harvesting. Cane trash was assumed to grow in proportion to the cane, with both starting from the value zero at the time of harvest and growing uniformly throughout the year. The carbon stored in the cane tops was assumed to be a full year's growth, as cane tops would be discarded to the cane field during harvest.

13.5.3 Effects of ongoing operations

The previous section examined the implications of the Project on the level of stored carbon by comparing the scenario immediately after full development with the existing situation. This section examines the relative contributions of various greenhouse gas sources and carbon sinks during ongoing operations.

The results of calculations into the estimated greenhouse gas balance for the project operations, summarised in Table 13.9, show that development of the Project would result in a net reduction in greenhouse gas emissions from the Project Area each year. It is estimated that the magnitude of this reduction would be approximately 160,000 t/a of carbon dioxide equivalent carbon.

Table 13.9 Estimated greenhouse gas balance during project operations

		Greenhouse gases as carbon dioxide equivalent carbon* (t/a)			
Source/sink	Description	Carbon dioxide	Nitrous oxide	Methane	Total
Farmland	Destocking (removal of cattle)**			–300	–300
	Biological processes in crop and soil	128,800	40,800		169,600
	Crop burning	173,200	102,200	6,600	282,000
	Crop growth	–1,193,400			–1,193,400
	Assimilation of organic carbon in soils	–32,000			–32,000
Sugar mill	Bagasse and fuel oil	603,700			603,700
Machinery	On-farm (cultivation)	2,400			2,400
	Harvest	2,500			2,500
	Cane transport	1,000			1,000
	Sugar and molasses transport	1,600			1,600
Total		**–312,200**	**143,000**	**6,300**	**–162,900**

* *Using global warming potential of carbon dioxide = 1; nitrous oxide = 310; methane = 21.*

** *Shown as methane but actually a mixture of all gases, with global warming potential used by the data source for this item of carbon dioxide = 1; nitrous oxide = 270; methane = 11.*

Note: Negative values indicate sinks.

It should be noted that Table 13.9 excludes greenhouse gas emissions that would arise from consumption of the raw sugar and molasses products and the fuel required to transport the products to markets, principally in Asia, from Wyndham. The assumption made is that the Project would only displace demand for the products that would be satisfied by other producers if the Project did not proceed. Hence the carbon contained in the products, approximately 236,000 t/a, nor the greenhouse gas emissions of their transport were considered in the greenhouse gas balance for the Project.

Greenhouse gas emissions from shipping and transport would also occur with respect to alternative sources of supply should the Project not proceed. However, in the case of shipping and transport, the Project would in all likelihood displace existing sugar suppliers that have greater shipping distances to the intended markets. It is estimated that a net reduction of up to approximately 40,000 t/a may result from shipping of the products due to development of the Project. This would be on the basis that future demand would be satisfied in proportion to current exports to Asia from existing producers.

The greenhouse gas emissions from the existing pastoral activities were calculated using the values reported in Howden et al. (1994), who studied a similar scenario in northern Queensland. Greenhouse gas emissions and assimilation from sugarcane production were calculated from the values provided in Weier (1998), utilising mean values from the Australian sugar industry wherever a range of values was quoted.

The calculations also assume that the level of organic carbon in the surface 150 mm of soil would increase under irrigated cultivation of sugarcane from the current level of about 0.4% (Table 4.2) to a level of 1.5% over a period of twenty years. A level of 1.5% organic carbon is the minimum level preferred for optimal crop growth (Table 4.3) and it would therefore be the target level for farm managers.

13.6 NOISE

The Project Area is currently characterised by a general absence of development and low ambient noise levels typical of isolated rural areas. The dominant sources of noise would include rustling of vegetation and insects. Periodic sources of noise would be associated with the low-intensity rural operations and consist of vehicle movements (e.g. cars, helicopters, motorcycles) and animal noises (e.g. cattle lowing). Closer to Kununurra, ambient noise levels are higher, particularly in proximity to major roads, and centres of commercial and industrial activity.

Noise would be generated during construction from large earth-moving machinery associated with earthworks, land-clearing and levelling. Noise would also be generated at construction sites (e.g. at the sugar mill) and from vehicle movements. The main noise-generating activity of the Project would occur at distances of 30–80 km from Kununurra and, under these circumstances, would have negligible effect on existing residences.

Construction works associated with development of the M2 Channel may at times be within 300 m of existing residences. The following management measures would be adopted to mitigate adverse impacts on these residences:

- construction activities would be restricted to daylight hours for all activities within 500 m of an existing residence;
- all occupiers of residences within 1 km of construction activities would be advised of the nature and duration of the activities planned, and well in advance of construction commencing;
- all construction equipment would be fitted with appropriate silencing equipment and operated in a manner such that the construction activities comply with the Environmental Protection (Noise) Regulations (as amended) published by the EPA in October 1997.

Noise would be generated from operational activities associated with the farms and the sugar mill in the Project Area. However, negligable impact on existing residences is foreseen due to the relative remoteness of the Project Area from built up areas.

Transport of the products (raw sugar and molasses) from the sugar mill to Wyndham would occur on a twenty-four hour basis during the dry season. Approximately forty-five vehicle movements per day are anticipated. The only transport route available at present skirts the township of Kununurra and through Wyndham. All trucks used for product transport would be fitted with mufflers such that noise levels conform to noise abatement regulations.