3.3 Other regions

Of the remaining regions in Queensland, Townsville, Mackay and Rockhampton each currently have a PM_{10} monitoring station and Mount Isa has a permanent sulfur dioxide monitoring station. Cairns has historical TSP monitoring data available from recent years. Performance monitoring will be carried out in Mackay, Townsville and Mount Isa. Queensland is not formally required to monitor air quality in the Mount Isa region for Air NEPM purposes but due to the large industrial source in the region its performance against Air NEPM Standards will be reported. The other regions (Cairns, Toowoomba, Rockhampton, Maryborough-Hervey Bay and Bundaberg) will initially only be assessed by campaign monitoring for pollutants that may be of concern in the particular region.

For each of these remaining regions, with the exception of Mount Isa, when the formula in Clause 14(1) of the region is calculated, one performance monitoring station is required.

PM_{10} has been identified as a pollutant of interest in the majority of regions. Performance monitoring of PM_{10} will be carried out in Mount Isa, Mackay and Townsville. It is intended to carry out campaign monitoring of PM_{10} in the other regions within the duration of the Air NEPM, to the schedule outlined in Table 17.

For ozone the EPA intends to perform campaign monitoring of ozone in each of the smaller regions if necessary, depending on the findings of the CSIRO consultancy that is using the air pollution model (TAPM) model to provide information on ozone levels in smaller urban regions.

Campaign monitoring of nitrogen dioxide will be undertaken in the remaining regions of Queensland in conjunction with any ozone campaign monitoring.

The EPA proposes to use screening procedure F, from Table 1 of "Screening procedures" (PRC, 2000d), for carbon monoxide and lead rather than monitor the pollutants in the remaining regions, with two exceptions. Screening procedure F is reproduced below.

Acceptance limits by screening procedure for carbon monoxide, nitrogen dioxide, sulfur dioxide and lead.

Screening procedure	Acceptance limit (% of AAQ NEPM Standard)
F. In a region with no performance monitoring, comparison with a AAQ NEPM compliant region with greater population, emissions and pollution potential (*).	40%

* Pollution potential must take into account meteorology and topography.

The major source of carbon monoxide in most Queensland urban airsheds is motor vehicle emissions. The cooler temperatures in the Toowoomba region result in residents using wood combustion stoves for heating purposes. The influence of these devices on carbon monoxide levels in the region has not been evaluated as no monitoring has taken place in the region. It is intended to campaign–monitor carbon monoxide in the Toowoomba region to determine the significance of this source.

It is not expected that carbon monoxide concentrations will be significant in any other Queensland regions as these regions are warmer than Toowoomba. The current SEQ stations are peak stations and historical data is too high (64 percent of the standard) to satisfy screening criteria F. The EPA will await the outcome from campaign monitoring of carbon monoxide in the Toowoomba region from which it is expected that the requirement for carbon monoxide monitoring in the remaining regions can be screened out using screening procedure F.

The EPA will monitor sulfur dioxide in Mount Isa due to the presence of the smelters in the region.

Of the other regions, only Townsville and Rockhampton have significant sulfur dioxide sources. Townsville, the second most populated region of Queensland (110,000) and Rockhampton (58,000) are nominated for campaign monitoring of sulfur dioxide.

Motor vehicle emissions have previously been the major source of lead in most of the regions of Queensland. Monitoring in the highly populated SEQ region shows that the monitoring stations in SEQ meet the acceptance limit of screening procedure F to reduce lead monitoring in other regions. Peak lead concentrations in the SEQ region are now less than 30 percent. The phase–out of the use of leaded petrol in motor vehicles in Queensland was completed by March 2001. There are now no significant sources of lead in the remaining regions (except Mount Isa which will be dealt with separately) and therefore it is intended to only monitor lead levels in the SEQ and Mount Isa regions. The EPA proposes to monitor lead concentrations in Mount Isa due to the presence of the lead smelter in the region.

A summary on each of the remaining Queensland regions is provided below. The following table indicates the schedule for regional campaign monitoring.

Table 17 Schedule of regional campaign monitoring

Region	Year	Pollutants measured *
Townsville	2002	**SO_2,** O_3, NO_2 #
Cairns	2003	**PM_{10},** O_3, NO_2 #
Toowoomba	2002	**PM_{10}, CO,** O_3, NO_2 #
Rockhampton	2004	**PM_{10}, SO_2,**O_3, NO_2#
Maryborough - Hervey Bay	2005	PM_{10},O_3, NO_2#
Mackay	2003	O_3, NO_2#
Bundaberg	2004	PM_{10}, O_3, NO_2#
Gladstone (Targinie)	2001	**O_3**

***** Pollutants in bold will definitely be measured during regional campaign monitoring.

PM_{10}, ozone and nitrogen dioxide may be monitored in these regions depending on the results of campaign monitoring in other regions.

3.3.1 Townsville

The Townsville region is based around the Townsville-Thuringowa urban centre. With a population of 110,000, it is the second most populated region after south-east Queensland. The Townsville urban area is highly populated in comparison to adjacent areas, particularly those inland from the coast.

As shown in Figure 10, the city is located on a coastal plain surrounded by small mountain ranges, notably Mount Elliot (1234m) to the south-east, and Paluma Range to the north-east between Townsville and Ingham. The Great Dividing Range is further inland and stretches along most of the eastern Queensland coast.

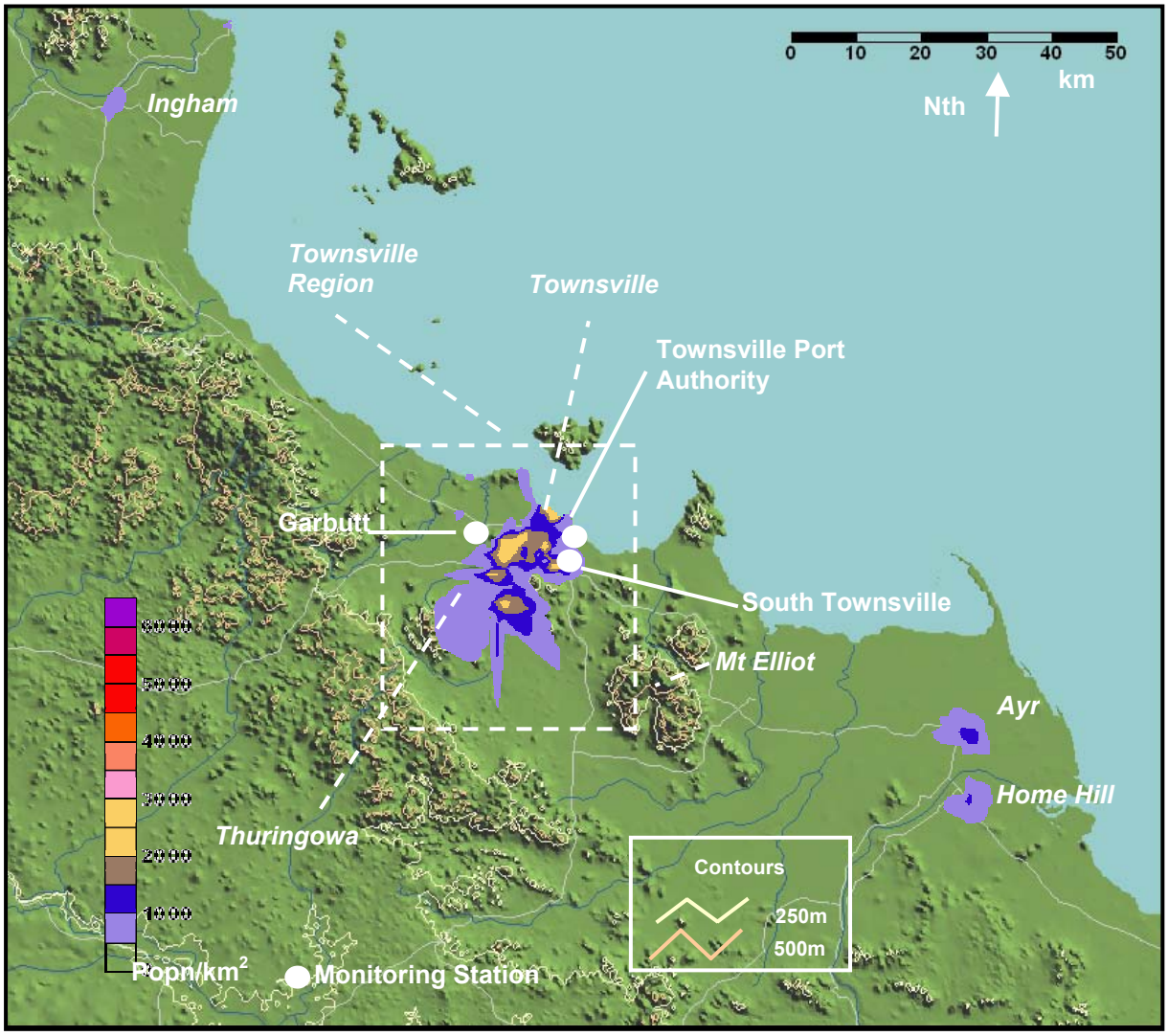

Figure 10 Townsville Region

The Port of Townsville has bulk sugar, bulk mineral and container terminals and handles the output from major industrial activities in the region, including meat processing, zinc and copper refining and nickel smelting.

Townsville's climate is humid and wet in summer, and dry and warm in winter. While day temperatures are usually lowered by a sea breeze, relative humidity during the summer months can rise to about 70 percent. Maximum temperatures in warmer months of the year average between 29-32°C. The minimum in cooler months is between 14-18°C.

The region receives about 80 percent of annual average 1153mm rainfall from December to March.

Unlike most of Queensland's tropical east coast, the coastline in the Townsville region is orientated in an east-south-east/west-north-west direction. This means that most of the prevailing winds blow almost parallel to the coastline. As a result, the rainfall is much less than in other coastal areas in the tropics.

The prevailing winds are predominantly from the south-east in the morning and tend north-east in the afternoon with the sea breeze. Strong south-easterly wind gusts are most likely to occur during November to March, coinciding with relatively high rainfall patterns, and tropical cyclone activity. An average summary of annual wind directions is displayed in Appendix D.

The locations of Townsville's three monitoring stations — at Garbutt, South Townsville and the Townsville Port — are shown in Figure 10.

The Garbutt station is located in an industrial area, the Townsville Port station is near to the loading terminals, and South Townsville is in a small residential area near the port.

High volume samplers have been used to monitor PM_{10} at the South Townsville and Garbutt stations since 1994. Monitoring also commenced at the Townsville Port in 1994, using TEOM instrumentation.

Table 18, Figure 37 and Figure 38 indicate the ambient PM_{10} concentration statistics at the Townsville monitoring stations in 2000.

Table 18 Ambient PM_{10} concentration statistics for Townsville, 2000

Monitoring location	Averaging period	Maximum ($\mu g/m^3$)	Second highest ($\mu g/m^3$)	95th Percentile ($\mu g/m^3$)
Townsville Port †	24-hour	61.2	50.1	37.7
South Townsville ‡	24-hour	51.7	38.7	31.4
Garbutt ‡	24-hour	70.2	68.9	51.6

‡ Six-day sampling site.
† Continuous monitoring site.

Under the Air NEPM formula, only one performance monitoring station is required in the Townsville region.

The current monitoring sites are not suitably located to adequately measure population exposure to pollutants in the region, so the EPA intends to establish a PM_{10} performance monitoring station in 2002. This station would be a GRUB station. Campaign monitoring will be carried out for sulfur dioxide in 2002.

The need for ozone and nitrogen dioxide monitoring in Townsville will be assessed by campaign monitoring in the region, depending on the findings of the CSIRO consultancy that is using the TAPM model to provide information on ozone levels in smaller urban regions. The need for performance monitoring or a trend station for ozone or nitrogen dioxide will be assessed once any campaign monitoring is completed. There will be no carbon monoxide or lead monitoring.

3.3.2 Cairns

The Cairns region is based around the city of Cairns, and bounded by the coast to the east and mountainous inland areas to the west.

As shown in Figure 11, the population of the region is centred on the Cairns urban centre (population 92,000). There are several towns surrounding Cairns, such as the tourist town of Port Douglas to the north and Atherton and Mareeba, agricultural centres, on the tableland to the east.

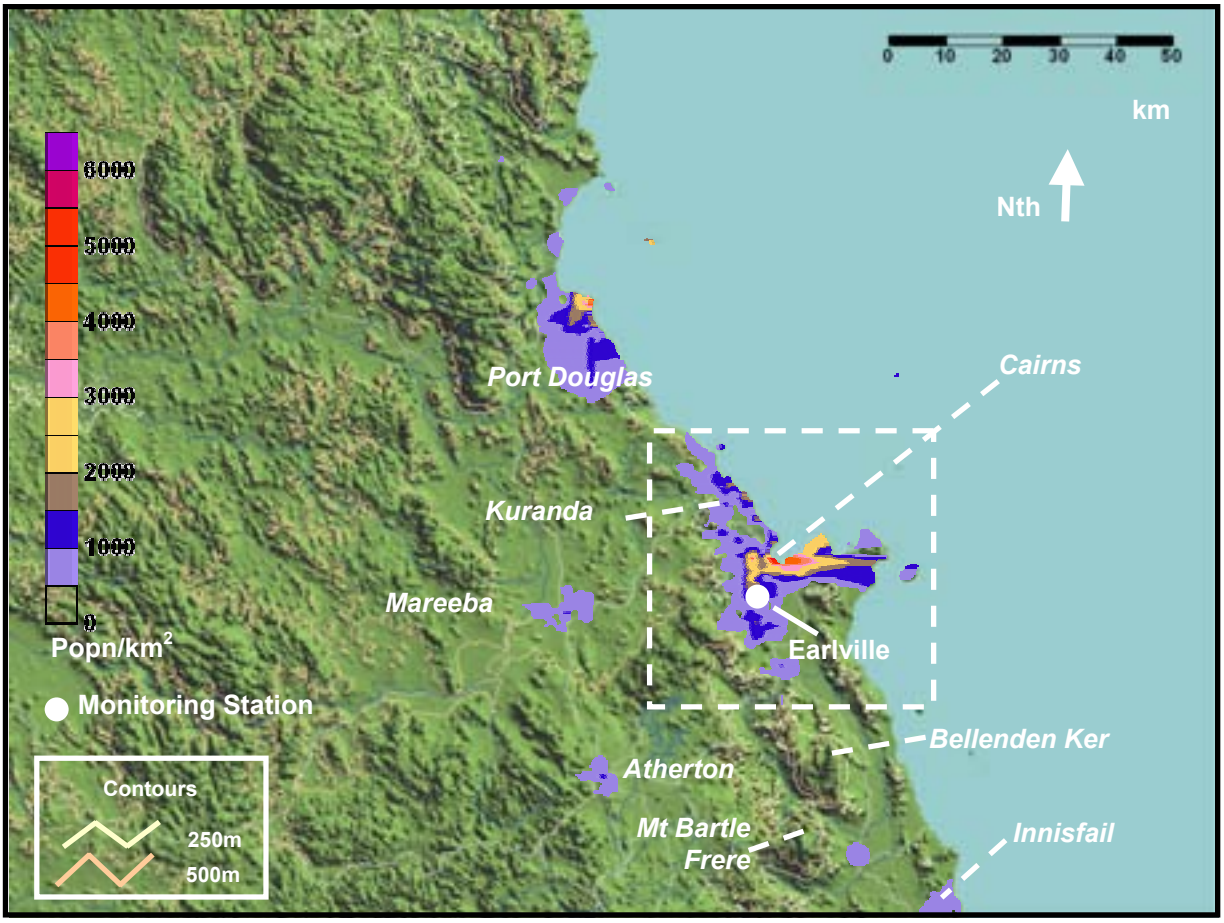

Figure 11 Cairns Region

The region is characterised by extensive cane fields along the coastal plains, surrounded by mountains and valleys covered with tropical rainforests. Queensland's highest peaks, Mt Bartle Frere (1622m) and Bellenden Ker (1593m) are south of the region. The Great Dividing Range separates the coastal Cairns region from the Atherton Tableland which is cooler and drier than Cairns throughout the year.

The region's economy is based on tourism and agricultural production, particularly sugar cane. Sugar milling is the main industry facility type in the Cairns region.

North Queensland is estimated to green cane harvest (no burning of the crop) around 90 percent of the harvest to reduce particle emissions (pers com Canegrowers, 2000) in this tourist region.

The climate is tropical - with oppressively humid, rainy summers and warm, sunny winters. During summer, most of the rain falls at night and the winds blow mainly from the east. Temperatures along the coast sit at around 30°C continuously, dropping briefly to the mid-20s in the early morning. Heavy showers continue through to March, the wettest month of the year, as the humidity and temperatures lower.

In winter, the movement of ocean winds result in breezes along the coast blowing predominantly from the south or south-east. In summer, the afternoon sea breezes blow south-east to north-east. Every one or two years, a tropical cyclone will bring strong winds and driving rain during the cyclone season (December to April). Even when there is no direct threat from cyclones striking the region, the influence of cyclonic weather in the Coral Sea often causes strong south-easterly winds on the coast during the season. A summary of wind direction in the region is displayed in Appendix D.

Emissions of particles have been monitored in recent years at the region's only monitoring station at Earlville. Total suspended particulate matter (TSP) was monitored at Earlville from 1995 and 1998. The TSP levels measured at the station were around half of the TSP levels monitored at the Fortitude Valley monitoring station in inner Brisbane, as shown in Figure 39 (EPA, 2001a).

One factor contributing to the low TSP levels measured at the Earlville site would be the high rainfall experienced in the region which acts to reduce the particulate matter suspended in the air (EPA, 2001a).

In accordance with Clause 14(1), one performance monitoring station is required in the Cairns region. No additional performance monitoring stations are needed for this region with respect to the influence of local characteristics.

Campaign monitoring for PM_{10} will be performed in the Cairns region. The need for ozone and nitrogen dioxide monitoring will be assessed before campaign monitoring proceeds in the region. No carbon monoxide, sulfur dioxide or lead monitoring will take place as indicated earlier. Also, the establishment of a performance monitoring or trend station will be assessed once campaign monitoring has taken place.

3.3.3 Toowoomba

The Toowoomba region is well inland, centred upon the city of Toowoomba and surrounded by small towns such as Dalby, Oakey and Gatton (see Figure 12).

Toowoomba (population 83,000) is situated on top of the Great Dividing Range, about 700 metres above sea level. To the west of Toowoomba are flat open plains – the Darling Downs – and to the east is the coastal plain.

The region's industries include food processing plants and agriculture. A power station is located just outside the Toowoomba region.

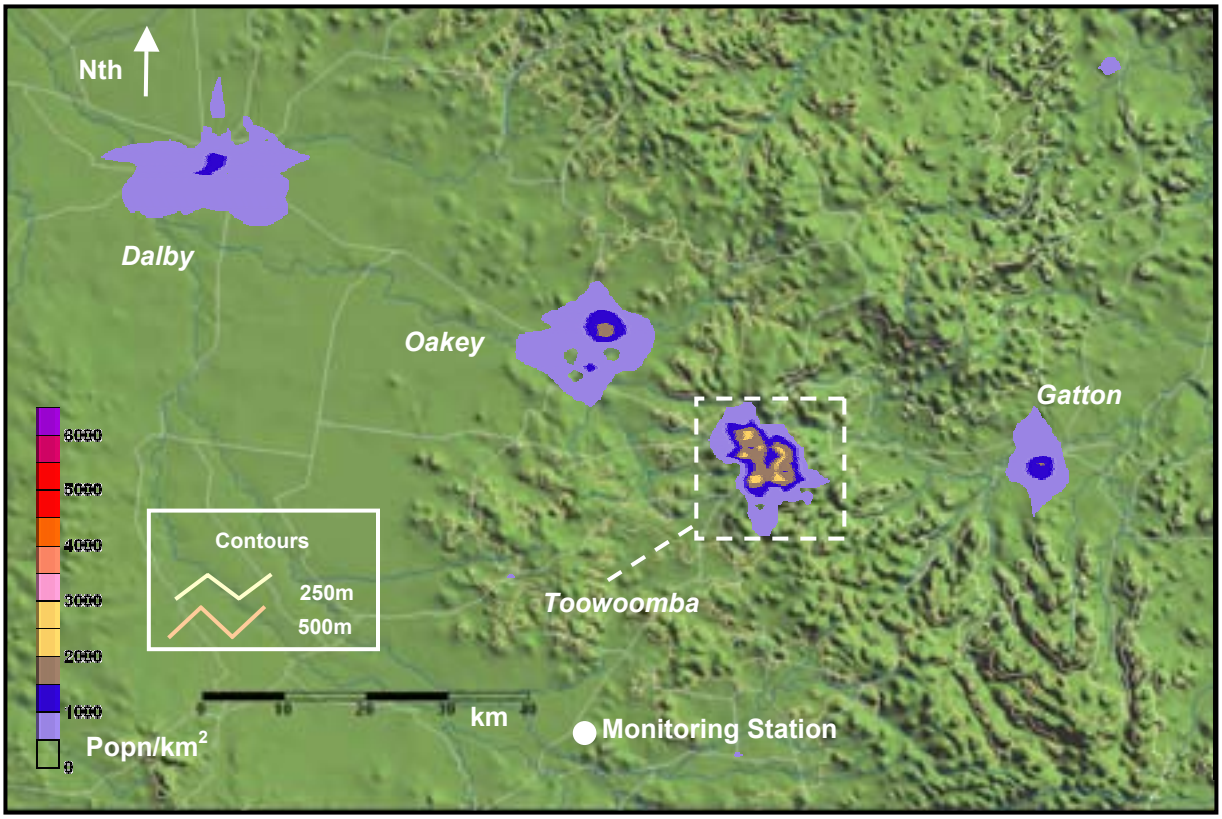

Figure 12 Toowoomba region

Because of its elevation, Toowoomba's weather is made up of mostly mild, somewhat moist summers and frosty, dry winters. Maximum summer temperatures are in the mid to high twenties, just reaching 30°C in lower areas to the east (below about 500m). In winter, the maximum temperatures are generally in the mid teens. It is possible for daily maximum temperatures to not reach double figures when associated with strong winds from the south-west. Overnight minimum temperatures can be as low as 1-5°C during winter and can drop below freezing in areas surrounding Toowoomba.

Light to moderate moist south-east to easterly winds from the coast dominate in the Toowoomba region. Fog and cloud cover are common, and there are often thunderstorms in summer, lessening as the cooler weather approaches, bringing stronger winds.

Rainfall reaches its peak during summer, with January being the wettest month. Toowoomba's highest annual rainfalls, of around 950mm, are recorded on the eastern slopes of the range.

During autumn, the humidity and rainfall lessen, and average maximum temperatures decline to a range of 17-21°C by May. Nightly temperatures can drop to 6-9°C in the valleys around Toowoomba and high on the range. Easterly and south-easterly winds

begin to give way to the westerly and south-westerly winds generated from the northward movement of the high pressure belt from the south. These dry westerly winds dominate during winter to early spring. Annual average wind directions in the region are displayed in Appendix D.

Spring is a transition period for the region. The westerly winds begin to wane in September and October as the high pressure belt returns to the south. Maximum temperatures undergo a rapid increase to reach 23-27°C in November and minima are recorded in the low to mid teens. Frosts may still occur at high altitudes in October and November. When thunderstorms occur during late spring and early summer, they are occasionally accompanied by hail, most frequently in higher areas.

Due to the region's location, topography and cool climate, some residents use combustion stoves and wood heaters to heat their homes. As a result of this domestic fuel use and industry emissions, PM_{10} and carbon monoxide have been identified as pollutants of interest. No monitoring has previously occurred in the region.

In accordance with Clause 14(1), one performance monitoring station is required in the Toowoomba region. No additional performance monitoring is needed for this region with respect to the influence of local characteristics.

Campaign monitoring will be performed in the Toowoomba region for PM_{10} and carbon monoxide. The need for ozone and nitrogen dioxide monitoring will be assessed before campaign monitoring proceeds in the region. No lead or sulfur dioxide monitoring will take place. The establishment of a performance monitoring or trend station will be assessed once campaign monitoring has taken place.

3.3.4 Rockhampton

The Rockhampton region is centred around the city of Rockhampton, an urban centre which is located on the banks of the Fitzroy River, 26 kilometres from the coast in the centre of flat coastal plains, largely surrounded by mountain ranges. The region is shown in Figure 13.

Most of the regional population of 58,000 is concentrated in the city of Rockhampton. The region's economy incorporates food and chemical processing facilities in industrial areas of Rockhampton itself. A power station (1400MW) and other fuel-burning activities occur in the areas surrounding Rockhampton.

Summers in the region are warm and humid while winters are mild and dry. Maximum summer temperatures in the region average 31-32°C and can exceed 35°C. At times, overnight temperatures may only fall to 21-22°C in summer, around the same temperature as winter maximum temperatures in June. Minimum winter temperatures are 9-11°C, although they can drop below 2°C on clear, dry nights.

Rockhampton's wind patterns are dominated by the south-east trade winds and their more easterly afternoon variants during March and April. From May to June particularly, mornings are calmer, then south-easterly winds become more frequent again in August. From September to November, the winds turn to north-west and north-east winds as a result of the influence of air movements to the south. After December these northerly winds drop away and the south-easterlies become the predominant wind direction until March.

Very strong winds only tend to affect the Rockhampton region when cyclones or thunderstorms are present. Appendix D includes a summary of annual average wind directions in the region.

The region has a single monitoring station established in December 1997 at Parkhurst, 8km from Rockhampton near the Parkhurst industrial estate. A HiVol sampler is used at six day intervals to measure PM_{10} levels at the site. The EPA intends to replace all existing high volume samplers with TEOM instruments so that continuous 24-hour monitoring data can be reported.

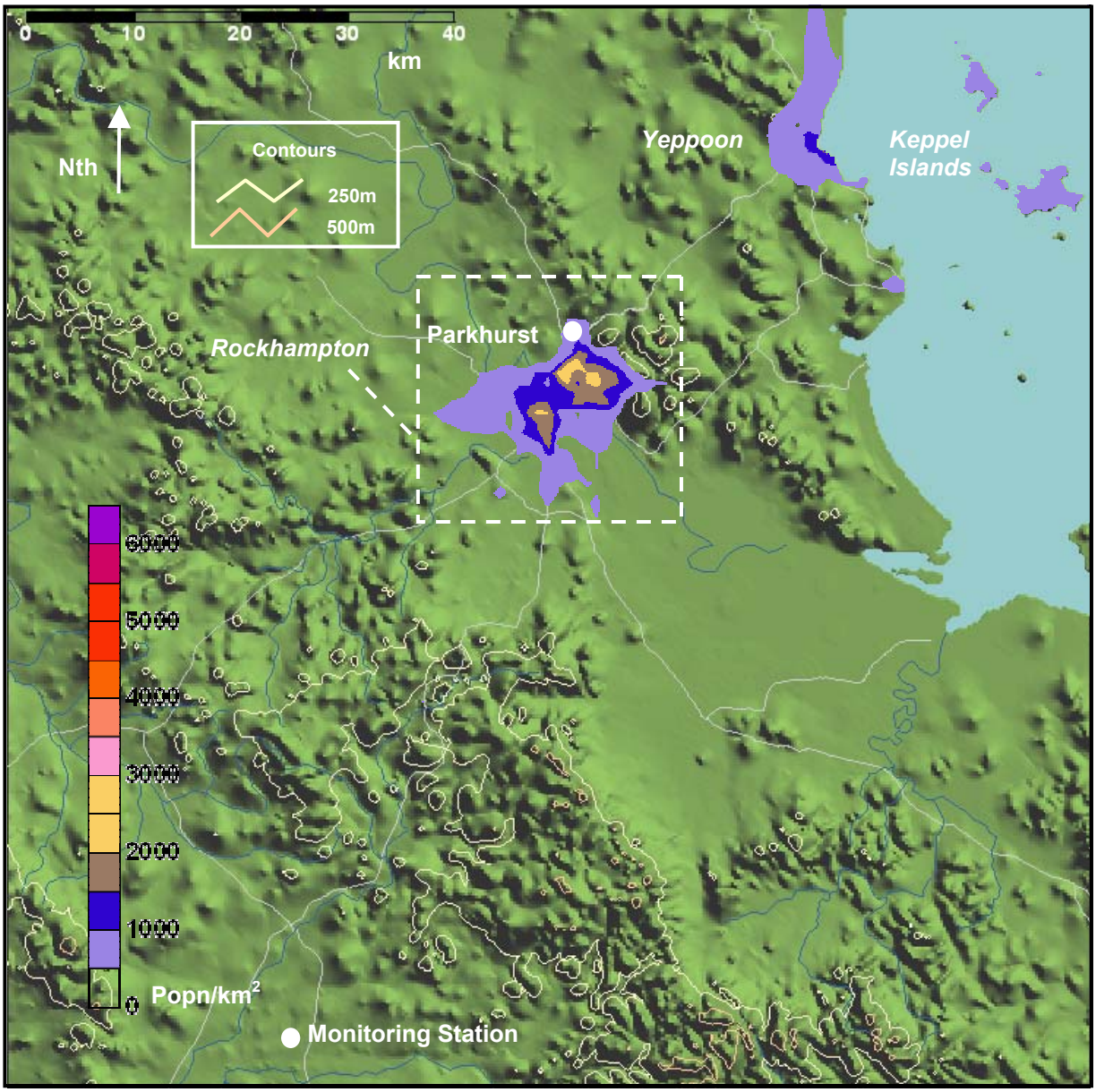

Figure 13 Rockhampton region

Table 19, Figure 40 and Figure 41 provide statistics on the PM_{10} concentrations measured in the Rockhampton region in recent years. On three days in 1998, the Parkhurst station exceeded the Standard, as shown in Figure 40.

Table 19 Ambient PM_{10} concentration statistics for Parkhurst, Rockhampton, 1998-2000 ‡

Monitoring location	Averaging period	Maximum (µg/m^3)	Second highest (µg/m^3)	95th Percentile (µg/m^3)
2000	24-hour	41.4	30.1	27.6
1999	24-hour	33.8	29.4	29.4
1998	24-hour	73.9	65.9	54.3

‡ six-day sampling site

In accordance with Clause 14(1), one performance monitoring station is required in the Rockhampton region.

Campaign monitoring will be performed in the Rockhampton region for PM_{10} and SO_2 pollutants. Because the Parkhurst station is located near an industrial estate, it is not suitably sited for Air NEPM requirements to obtain the upper bound concentrations to which the population would be exposed.

The need for ozone and nitrogen dioxide monitoring will be assessed before campaign monitoring proceeds in the region. No lead or carbon monoxide monitoring will be carried out. The establishment of a performance monitoring or trend station will be assessed once campaign monitoring has taken place.

3.3.5 Maryborough-Hervey Bay

The Maryborough-Hervey Bay region is composed of two sub-regions — Maryborough and Hervey Bay. Figure 14 shows the region (and also the Bundaberg region to the north).

The Maryborough–Hervey Bay region encompasses the Maryborough and Hervey Bay urban centres and takes in the coastline and part of Fraser Island. Maryborough is located on the Mary River, about 30 kilometres south of Hervey Bay.

The region has a total population, based on the two urban centres, of about 53,300. Figure 14 indicates the spread of the population, showing Maryborough and Hervey Bay to have higher population densities than other inland towns. The only other town near the region with a population density over 500 persons/km^2 is Childers, with a population of only 2600.

The region is relatively flat, with areas of higher elevation further inland, building up to the Great Dividing Range to the west.

Neither of the sub-regions has significant industrial activity, although there are some saw mills and sugar mills. The economy is based on agriculture, tourism and retail trade. Much of the sugar cane harvesting in the region is done by green cane harvesting methods, reducing potential particle emission sources from agricultural burning.

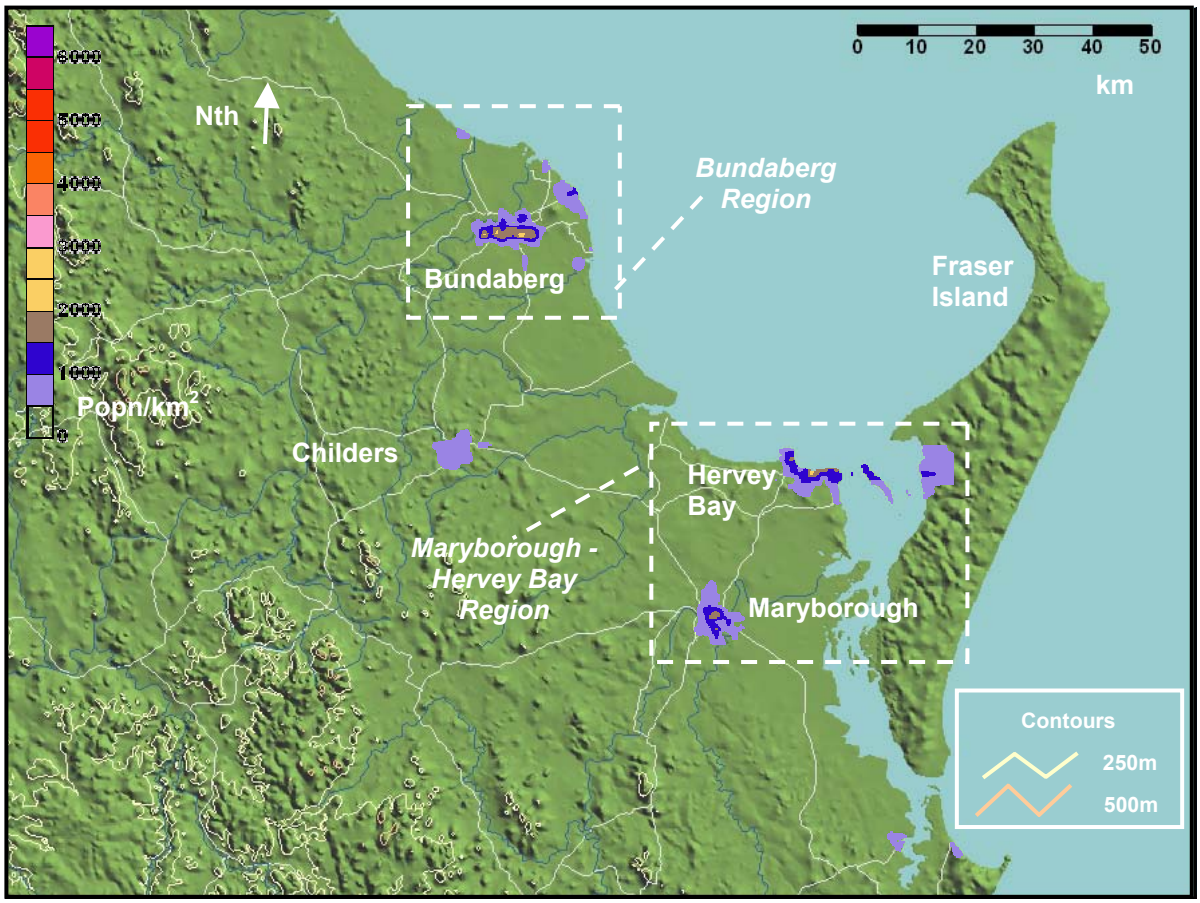

Figure 14 Maryborough–Hervey Bay Region and Bundaberg Region

Summers are warm, humid and partly cloudy while winters are mild, dry and mostly sunny. During summer and early autumn, the region comes under the influence of the south-easterly trade winds when the high pressure belt is well to the south. Over late autumn and winter, these winds become mixed with south and south-westerly winds as the high pressure belt moves north and winds from further south penetrate the region.

Maximum summer temperatures in the region average around 30-31°C with overnight temperatures around 20-21°C. Temperatures decrease from March and winter maximums in June are around 22°C. Minimum temperatures average 10°C and clear. Dry nights can cause temperatures below 2°C during July and August. Frosts occur about five times a year at Maryborough.

December to March is the wettest period, when 50-55 percent of the annual rainfall occurs. The dry season is from July to September when only 10 percent of the annual rainfall is recorded. Annual average rainfall varies at stations around Maryborough from 1023m to 1274mm.

During March, the morning winds are generally from the south or south-east. When the cooler season begins in April, south-westerly winds become more noticeable. The southerly component of the winds dominates during May. In June to July, the south-easterly winds are at their lowest frequency for the year and westerly winds dominate. In September, the wind profile shifts back to south-east and south-west. The south and

south-westerly winds peter out during October when north-westerlies and north-easterlies become the most common types of winds. South-east and easterly winds also occur during October and the pattern of north-west to north-east to south-east winds continues during November through to December when the south-easterly winds become most frequent.

Afternoon winds are stronger than morning winds and are dominated by south-easterlies. Afternoon winds move from east to south-easterly during April to east to south-westerlies during May. June and July see a continuation of the trend away from east and south-easterlies to south, south-west and westerly winds. From August, the wind direction changes to be more south-easterly, with some northerly and easterly components. From September to December, the winds tend to be either south-easterly or more commonly northerly. January sees a decline in northerly and north-easterly winds and an increase in south-easterly winds which remain dominant until March. Cyclones create winds from the south-east or north-east as they past up the coast. Appendix D includes a summary of the wind directions in the region.

No air quality monitoring has previously been undertaken in the Maryborough-Hervey Bay region of Queensland, and currently there are no monitoring stations. In accordance with Clause 14(1), one performance monitoring station is required in the region. No additional monitoring stations are required with respect to the influence of local characteristics.

Campaign monitoring of PM_{10} will be performed in the Maryborough sub-region which should provide more significant concentrations from the surrounding emission sources than Hervey Bay. Campaign monitoring in the Maryborough sub-region will therefore represent the upper bound of PM_{10} concentrations in the region.

The need for ozone and nitrogen dioxide monitoring will be assessed before campaign monitoring proceeds. The results of the CSIRO consultancy that is using the TAPM model to provide information on ozone levels in smaller urban regions and any campaign monitoring in the Mackay region will be used to determine if ozone and nitrogen dioxide monitoring is necessary in the Maryborough-Hervey Bay region. No lead, sulfur dioxide or carbon monoxide monitoring will take place. The establishment of a performance monitoring or trend station will be assessed after any campaign monitoring is completed.

3.3.6 Mackay

The Mackay region is based around the Mackay urban centre (popn 45,000). Other towns in the region are Sarina to the south, Mirani to the west and the tourist resorts on the Whitsunday Islands to the north. Figure 15 shows the region and the surrounding areas.

The hinterland is studded with splinters of the Great Dividing Range, the highest peak being Mt Dalrymple (1277m) to the west of Mackay, and Mt Blackwood (639m) to the north.

The economy is dominated by sugar growing and sugar milling. Therefore, particles (PM_{10}) are a pollutant of interest in the region due to the burning of cane in the harvesting season.

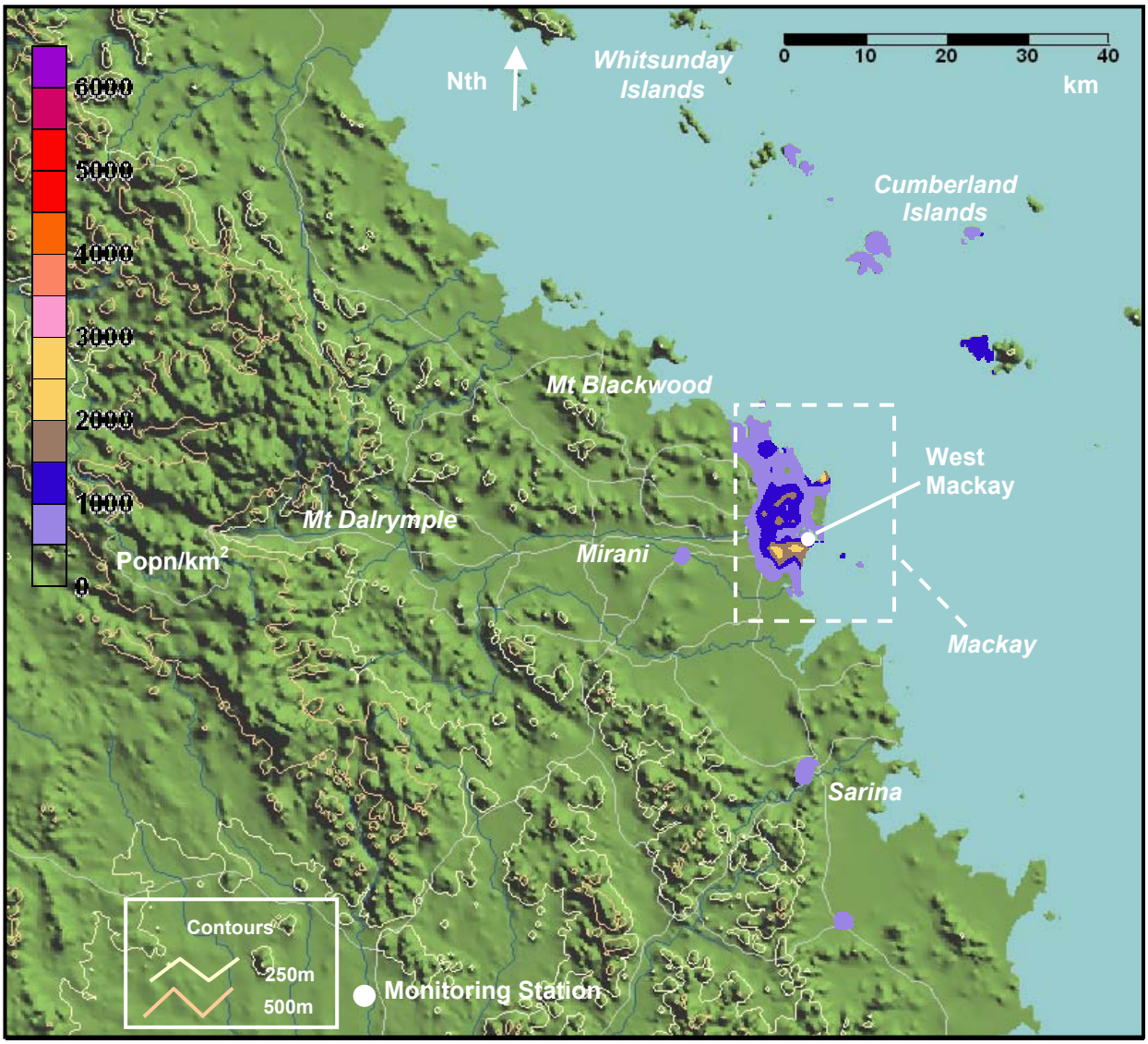

Figure 15 Mackay region

Summers are generally hot and rainy, with high levels of humidity in late summer to early autumn. Prevailing winds from the sea blow from the east/south-east, creating afternoon sea breezes. These winds carry moisture bringing regular brief showers. Occasional cyclones can bring days of rain, followed by days of high humidity. Thunderstorms are common on the ranges to the west.

Maximum summer temperatures on the coast are around the low 30s, with early morning temperatures in the mid 20s. As summer ends, temperatures lower to the mid to high 20s and the south-east trade winds continue to bring heavy showers to the coast.

February and March are the wettest months of the year as the ocean remains warm enough to sustain cyclones and continues to bring rain to the region before the dry season in winter.

Winter is the driest and coolest season in Mackay. The ocean winds shift north resulting in winds blowing predominantly from the south and south-east. In winter, the weather is

warm and sunny, with low rainfall and mild overnight temperatures. As summer returns, maximum temperatures rise again to the low 30s but the humidity and rainfall remain low until the onset of the thunderstorm season.

The region lies in the belt of the trade winds for most of the year, with prevailing south-east to north-east winds in summer and south to south-east winds in winter. Gale force winds normally only occur during tropical cyclones which hit the region about once every two years. Tropical cyclones off shore in the Coral Sea can influence the weather because they generate strong south-easterly winds along the coast. Afternoon sea breezes usually reinforce the prevailing wind. Appendix D includes an annual summary of the region's wind directions.

The region has one monitoring station, in a commercial/residential area at West Mackay, established in late 1997. Table 20 shows the concentrations of PM_{10} measured at the West Mackay station.

Table 20 Ambient PM_{10} concentration statistics for Mackay, 1998-2000 †

Year	Averaging period	Maximum ($\mu g/m^3$)	Second highest ($\mu g/m^3$)	95th Percentile ($\mu g/m^3$)
2000	24-hour	51.6	51.2	35.0
1999	24-hour	50.4	45.4	27.7
1998	24-hour	28.9	28.7	22.3

† continuous monitoring site

The station was established to monitor particles from areas of the region where the sugar cane crops are burnt before harvesting. It is nominated as a performance monitoring station as it is representative of the upper bound of PM_{10} concentrations in the region.

Figure 22, Figure 42 and Figure 43 show that the station has exceeded the Standard once in 1999 and twice in 2000. Sugar cane burning in the region causes elevated levels of particles which results in reduced visibility at the site between June and November, as shown in Figure 42. Figure 22 illustrates the variation in 24-hour PM_{10} concentrations at all continuously monitored stations in Queensland.

In accordance with Clause 14(1), one performance monitoring station is required in the region. No additional performance monitoring is needed for this region with respect to the influence of local characteristics.

The need for ozone and nitrogen dioxide monitoring will be assessed before campaign monitoring proceeds in the region, based on the findings of the CSIRO consultancy that is using the TAPM model to provide information on ozone levels in smaller urban regions. No lead, sulfur dioxide or carbon monoxide monitoring will take place. The establishment of a performance monitoring or trend station will be assessed once campaign monitoring has taken place.

3.3.7 Bundaberg

The Bundaberg region is centred on the city of Bundaberg (popn 41,000) and includes several small towns along the coastline. As shown on Figure 14, the city lies on the Burnett River, about 15 kilometres inland from the coast.

Like the Maryborough-Hervey Bay region to the south, Bundaberg is on a relatively flat coastal plain, with mountains to the west.

The most significant industrial activities are brick manufacturing as well as sugar milling, sugar refining, and processing of the output from the extensive sugar cane fields in the region. It is necessary for some of the cane in the region to be burnt before harvesting, therefore the level of particle emissions in the region are of interest.

Summers are warm, humid and partly cloudy while winters are mild, dry and mostly sunny. Winds in the region are overwhelmingly onshore, in particular from the north-east and south-east.

Summer temperatures reach maximums averaging 29-30°C, and fall to 22-23°C overnight. Temperatures decrease quickly from late March with average maximums in June down to 22°C and minimums at 11°C. Temperatures begin to warm again from September onwards.

About 55 percent of the annual rainfall occurs from December to March. Then it is particularly dry from July to September. Average annual rainfall totals vary from 987mm to 1168mm.

As with other coastal regions, the most common wind direction in Bundaberg is from the south-east. Morning wind speeds are fairly consistent throughout the year - at around 19km/h. In February, winds come from between the east-south-east and south-south-east. The winds shift more southerly during March. South-westerly winds are present during July and there is a marked increase of calm weather. Then the wind direction begins to shift back to the south-east and east in August. From September to February, wind directions vary significantly. East to south-easterly winds dominate but others occur, even northerlies. In January, south-easterly winds become more frequent, and east to south-easterlies again dominate.

Afternoon sea breezes tend to be stronger than morning winds, except between May and August when winds are generally lighter. March and April winds are east to south-east and are joined by south-westerly winds in May until June. There is no dominant afternoon wind direction in July. Winds shift towards the north to east-south-east in August and continue to blow from these directions from September to December with northerly winds being the most common. The afternoon wind regime changes in January and there is a marked decrease in northerly winds and a corresponding increase in south-easterly winds continuing throughout February and leading to east and south-easterly winds in March and April.

Strong wind gusts, mainly as south-easterly or north-easterly, can result from tropical cyclones out to sea from November to April. Also, southerly, south-westerly or westerly winds can be caused by severe thunderstorms usually from October to February.

No air quality monitoring has been performed in the Bundaberg region to date. One performance monitoring station is required in the region, but no additional stations are needed due to the influence of local characteristics.

The decision on whether to perform campaign monitoring of PM_{10} in the Bundaberg region will depend on results of PM_{10} monitoring in the adjacent Maryborough-Hervey region – which has slightly more population and pollution sources.

If campaign monitoring in Maryborough-Hervey Bay region shows pollutant concentrations below acceptance limits outlined in the PRC's *Screening procedures* (PRC, 2000d), it is unlikely that campaign monitoring will be performed in Bundaberg region.

The need for ozone and nitrogen dioxide monitoring in Bundaberg will be assessed before any campaign monitoring proceeds, based on the findings of the CSIRO consultancy that is using the TAPM model to provide information on ozone levels in smaller urban regions and any monitoring performed in the larger Mackay or Maryborough-Hervey Bay regions. No lead, sulfur dioxide or carbon monoxide monitoring will take place in Bundaberg.

The need for a performance monitoring or trend station will be assessed if campaign monitoring takes place.

3.3.8 Mount Isa

The Mount Isa region is centred on the Mount Isa urban centre (popn 21,300), including the township of Mount Isa.

As the population of Mount Isa is below the 25,000 population threshold of Clause 14(1), no formal monitoring is required in the region for Air NEPM purposes. However, because of the large industrial facilities located there, the EPA considers that air quality monitoring should be performed, and results reported against Air NEPM Standards.

As shown in Figure 16, Mount Isa is located in the flat inland area of north-west Queensland. It is 350 kilometres south of the Gulf of Carpentaria. The population density data indicates that almost all residents live in the township. Very few people live in the surrounding areas.

The major emission sources in the region are the copper and lead smelters, located on the western edge of the town. As a result, sulfur dioxide, lead and particles are the major pollutant emissions of interest in the region.

The climate of the region is tropical continental with a marked wet season during summer, with about 75 percent of the annual rainfall falling from December to March.

The hot summers can occasionally be humid while winter days are sunny and mild. Early mornings can be quite cool, and minimums below zero have been recorded. Winds are predominantly south-east with occasional incursions of north-east and north-west winds in summer as the monsoon trough moves south.

Maximum summer temperatures average 34-37°C, with minimums at 23°C (an average of 60 days from November to January have temperatures above 35°C). Daytime winter temperatures are around 25-27°C, with minimums around 11-14°C. As the region is so far inland, the average humidity is quite low throughout the year, ranging from 30-40 percent in summer and 20-25 percent in winter and spring.

The average annual rainfall is 453mm. January is the wettest month – with an average of 102mm. In winter and early spring, the monthly average can be less than 10mm.

North-easterly winds are frequent in summer, while south-easterlies are more prevalent for the remainder of the year. During winter and spring, the winds turn more south-east to southerly as the high pressure systems well to the south move to their most northerly latitudes. While wind speeds tend to be 11-20 km/hr throughout the year, strong wind gusts have been recorded, usually associated with thunderstorms. Appendix D includes a summary of annual wind directions in the region.

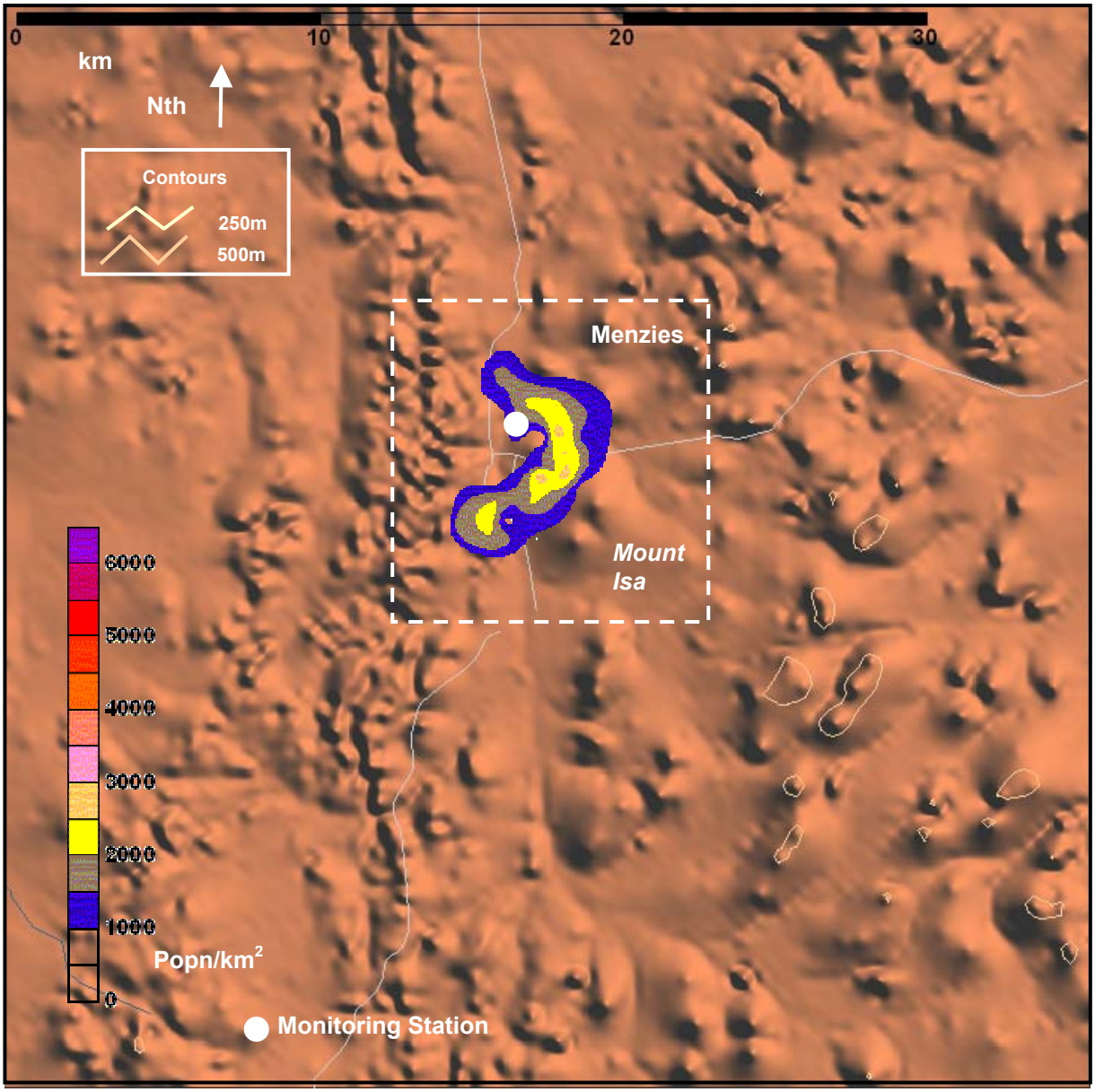

Figure 16 Mount Isa region

Mount Isa's industries are to the west of town, so the dominant south-easterlies tend to carry pollutants away from residential areas.

The region has a monitoring site at Menzies, 1km north of Mount Isa's centre and 3km from the lead smelter stack. The EPA has been monitoring sulfur dioxide there since 1979.

Also, the smelter operator, Mount Isa Mines Limited, monitors sulfur dioxide levels at a network of ten stations in and around the town. These form part of a control system to manage the smelter operations so that the ambient concentrations of sulfur dioxide in Mount Isa are maintained below the limits set in the *Mount Isa Mines Agreement Act 1985.* The company also monitors PM_{10} and lead levels at five sites in the region.

Because of the significant industrial activity in the region, the EPA proposes to monitor the performance of sulfur dioxide, lead and PM_{10} concentrations and report this monitoring against the standards in the Air NEPM.

No carbon monoxide, ozone or nitrogen dioxide monitoring is intended for the region.

3.3.8.1 PM_{10}

Results of Mount Isa Mines' PM_{10} monitoring at five sites (using high volume samplers) have ranged well above the Air NEPM Standard. As a result, PM_{10} performance monitoring will be conducted at the EPA's Menzies monitoring station.

3.3.8.2 Sulfur dioxide

As shown in Table 21, exceedences of the sulfur dioxide Air NEPM one-hour Standard have been recorded at the Menzies station on or around seven to 31 days each year during recent years. Regional trends showing that one-hour and 24-hour Standards have been exceeded in past years are displayed in Figure 45 and Figure 47. However, annual averages are within the Air NEPM Standard, as shown in Figure 48.

Table 21 Sulfur dioxide concentrations and exceedences at Menzies, Mount Isa, 1996-2000

Maximum concentration (ppm)			95th percentile of 1-hour daily maximum (ppm)	No of days 1-hour>0.20ppm				
annual	24 hour	1 hour		1996	1997	1998	1999	2000
0.006	0.078	0.693	0.209	16	7	16	17	31

In a new industrial initiative at Mt Isa, Western Mining Corporation has established a sulfuric acid plant which will utilise most of the sulfur dioxide now being discharged into the atmosphere. This should result in an overall lowering of sulfur dioxide levels in the area.

Because of the accumulated historical data available from the Menzies station, the station is nominated as the performance monitoring site and a trend station for sulfur dioxide monitoring for the region.

3.3.8.3 Lead

The EPA has undertaken no lead monitoring at Mount Isa. However, Mount Isa Mines Limited operates five sites using high volume samplers for measuring PM_{10} lead concentrations. Because of the influence of lead emissions from the town's lead smelter, the EPA proposes to begin performance monitoring for lead, using monitoring instruments (TSP high-volume air sampler), co-located with the sulfur dioxide and PM_{10} instruments at the Menzies monitoring station.