Review of Air Dispersion Modelling and Background Monitoring Data for the Proposed Bell Bay Pulp Mill

Gunns Limited

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Executive Summary

The objective of this paper is to examine the capacity of the local airshed around the proposed Bell Bay pulp mill to accommodate the emissions from the proposed mill without breaching air quality standards, and in light of these considerations, to assess the value of baseline ambient air quality monitoring.

The draft Scope Guidelines for the integrated impact statement (IIS) requires 12 months air quality data, including peak levels of air pollutants and their duration, to be included in the IIS. Accordingly, Gunns has installed and is operating an ambient air quality monitoring station (AQMS) to provide data on existing (background) air quality in the Bell Bay region. The AQMS continuously measures SO_2, NO_X, PM_{10} and TRS (Total Reduced Sulphur), as well as meteorology.

GHD, the consultancy responsible for the air quality assessment in the IIS, is also modelling existing air quality using a state-of-the-science model. Emissions data from existing sources have been entered into the model, to provide estimates of existing (background) pollutant levels. The emission sources included in the modelling were:

- Domestic heating;
- Vehicle emissions;
- Biogenic (natural) sources; and
- Major industrial sites (Bell Bay Power Station, Comalco Aluminium Smelter, Tasmanian Electro Metallurgical Co (TEMCO) and Carter Holt Harvey Wood Panels).

Because it is possible to model background air quality, rather than being totally reliant on measurements, questions arise about the purpose and value of the monitoring data. The air quality assessment for the IIS will be based essentially on modelling, rather than monitoring, to generate estimates of background air quality. The utility of the ambient monitoring station is limited to providing data to verify the model estimates. The monitoring data are not used directly in the modelling.

Pacific Air & Environment (PAE) has used model predictions supplied by GHD, along with ambient air quality data collected by Gunns at Rowella during July and August 2005, to assess the reliability of the modelling system for estimating existing air quality. Modelling to date has included SO_2, NO_2 and PM_{10}. At the time this report was prepared, TRS modelling results were not available.

We have also used ambient monitoring data collected by the Department of Primary Industries, Water and the Environment (DIPWE) at the Ti Tree Bend ambient monitoring site during 2004 and July/August 2005 for this review.

Table ES.1 summarises the results of the model validation exercise. Based on the available data, the validation exercise indicates that the model:

- over-predicts background SO_2 and NO_2 concentrations;
- over-predicts background PM_{10} levels at 1-hour concentrations above 40 µg/m^3. It under-predicts at levels between 30 – 40 µg/m^3 and does not comply with acceptability criteria limits at less critical lower levels below 30 µg/m^3; and
- under-predicts background 24-hour average PM_{10} levels at concentrations below 30 µg/m^3 but provides improved estimates of measured levels as concentrations increase.

Table ES.1: Comparison Between Predicted (Nearest Receptor) and Measured 1-Hour Concentrations at Rowella (July and August 2005)

Pollutant	1-Hour Maximum		Comments
	Measured	Predicted	
SO_2 (ppm)	0.009	0.011	TAPM over-predicts below 0.01 ppm but is within acceptable limits at higher levels.
NO_2 (ppm)	0.015	0.021	TAPM under-predicts below 0.003 ppm but is within acceptable limits (slightly over-predicts) at higher levels.
PM_{10} (µg/m^3)	53	88 (500 m grid)	When run with a 1 km grid spacing, TAPM under-predicts and is outside acceptable limits on the 1 km grid. TAPM under-predicts below 30 µg/m^3 but is within acceptable limits above this level, and slightly over-predicts above 40 µg/m^3.

The reduced accuracy of the model in predicting ground level PM_{10} concentrations is largely due to the difficulty of including all sources of particulate emissions in the model. This is a common issue when inventorying and modelling particulates, as in any environment there are significant emissions of particulate from diffuse sources such as wind blown dust and soil erosion, pollen, agricultural activities and sea spray, all of which are difficult to quantify and characterise in models. Particulate matter from these sources, however, does not contain the types of contaminants found in combustion-related particulate matter, emitted mainly from motor vehicles and industrial processes. Combustion-related particles are known to impact on human health, and should be adequately characterised in the model.

We investigated how wind direction influences the tendency of the model to under-predict background PM_{10} concentrations. This analysis showed that higher levels of PM_{10} associated with west to northwest winds are not well simulated by the model. Stronger winds from the northwest sector appear to be associated with a significant sea salt component. A chemical analysis of grey residue accumulated on TEOM[1] filter revealed high proportions of sodium (Na) and chloride (Cl), which points to the conclusion that sea salt (NaCl) is a dominant component of the particles collected. An ongoing program of monitoring the sea salt component of particulate levels has been established by Gunns, using dedicated filters, and this will provide additional data to be used in preparing the air quality component of the IIS.

[1] A particulate monitoring instrument at the Rowella air quality monitoring station.

Preliminary modelling data are available for Rowella and Ti Tree Bend with and without the emissions from the proposed pulp mill included. These results indicate that the emissions from the proposed mill will have a minor impact on ambient concentrations of SO_2, NO_2 and PM_{10} at these locations. The changes in the peak and average pollutant concentrations are negligible. Therefore, the modelling indicates that the airshed capacity in the area will not be adversely affected by the mill emissions.

While model results for TRS are unavailable, background monitoring indicates very low (mostly zero) TRS concentrations. Hence, fugitive mill emissions can be considered to be the only significant contributor to future TRS levels in the airshed. The airshed capacity for TRS is relatively large given the very low background.

Overall, the tendency of the model to over-predict the measured pollutant concentrations at higher levels means that the modelling should provide conservative overestimates of background levels, especially at the more critical, higher concentrations. While ongoing monitoring will provide additional data to further verify this conclusion, the information available to date indicates that use of the modelled background concentrations will provide a suitably conservative (i.e. stringent) assessment of the local airshed's capacity to accommodate the proposed development.

There is no suggestion from the data provided by GHD that the airshed capacity is currently being approached or exceeded, except with respect to PM_{10} in the vicinity of Launceston, or that the mill emissions will have other than a negligible impact on the airshed capacity. Given this situation and that the monitoring data will not be needed to directly model or predict the impact of the mill on air quality, we consider that a full 12 months of monitoring would not add any significant value to the assessment of air quality, and that a shorter duration of monitoring poses no significant risk of leading to erroneous conclusions in the IIS. By the time Draft IIS is submitted, approximately 6 months' data encompassing winter, spring and summer will be available.

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1 INTRODUCTION

Gunns Limited (Gunns) contracted Pacific Air & Environment (PAE) to prepare this position paper on air quality monitoring requirements for the proposed Bell Bay Pulp Mill Integrated Impact Statement (IIS). The paper is to be submitted to the Resource Planning and Development Commission (RPDC).

The main objective of the paper is to examine the residual capacity of the local airshed[2], the impact of the proposed Mill on airshed capacity and, in light of these considerations, the value of baseline ambient air quality monitoring.

The draft Scope Guidelines for the integrated impact statement (IIS) requires 12 months air quality data, including peak levels of air pollutants and their duration, to be included in the IIS. Accordingly, Gunns has installed and is operating an ambient air quality monitoring station to provide data on existing (background) air quality in the Bell Bay region. GHD, the consultancy responsible for the air quality assessment in the IIS, is also modelling existing air quality using a state-of-the-science model. The ability to model background air quality brings into question the value of the monitoring data. This report analyses relevant data generated by both modelling and monitoring in order to address this question.

1.1 Project Background

The proposed Mill will use the Kraft process for producing pulp. The pulp will be bleached, dried and then baled into standard sizes for sale to local and export markets. The output of the mill will be in the range of 700,000 to 1,100,000 ADT pulp per annum depending on overall pulping efficiencies and mill capacity.

In the Kraft process the wood residues removed from the wood fibres are burnt in a recovery boiler to generate the mill's steam and power requirements. This process also regenerates the chemicals used in the pulping process so they can be reused. As a result, the mill only requires small quantities of make-up pulping chemicals. Included as part of the mill project is an electricity co-generation facility. With the exception of mill start-ups, the mill will be self-sufficient in electricity, and will be capable of generating excess power that can be sold on the national electricity market.

The bleaching process will be Elemental Chlorine Free (ECF). The bleaching chemicals being considered include (but are not limited to) oxygen, ozone, chlorine dioxide, enzymes and hydrogen peroxide.

Key emissions to air from the proposed development include particulate matter, sulphur dioxide, oxides of nitrogen, and reduced sulphur compounds.

Existing sources of these air pollutants in the region, which contribute to background concentrations, include domestic heating, vehicle emissions, biogenic (natural) sources and the following industrial facilities:

- Bell Bay Power Station;

2 The ability of the local airshed to assimilate increased industrial emissions without compromising compliance with air quality standards.

- Comalco Smelter;
- Temco (manganese alloys);
- Pine Panels; and
- Ekka Granules (metal processing).

1.2 Purpose of the Background Monitoring Station

The draft Scope Guidelines for the IIS requires 12 months air quality data, including peak levels of air pollutants and their duration, to be included in the IIS. Accordingly, Gunns has installed and is operating an ambient air quality monitoring station to provide data on existing (background) air quality in the Bell Bay region. A site near Rowella was chosen, based on the findings of two GHD reports: *Dispersion Modelling to assist in Siting of an Ambient Air Quality Monitoring Station in Tamar Valley Air Shed – Paper for DIPWE* (June 2005) and *Siting of Ambient Air Quality Station in Tamar Valley – Addendum Report* (June 2005).

The air quality assessment for the IIS will be based essentially on modelling, rather than monitoring, to generate estimates of existing or background air quality. Existing emission sources[3] are included in the model, so the model estimates should be inherently robust, provided that the emissions estimates are sound and meteorological processes that disperse emissions are also well represented in the model.

The modelling process, explained in more detail in Section 4, generates its own meteorological data. The TAPM model[4], which GHD is using for the study, is a highly sophisticated model akin to weather forecasting models: in other words, it generates detailed three-dimensional meteorological data from a global database using detailed equations that describe atmospheric behaviour, instead of requiring data from an on-site weather station.

One of the main problems in air quality assessment is that site-specific weather data suitable for dispersion modelling are often unavailable. Hence, particularly for sensitive projects, it has been important to measure the necessary meteorological parameters for a suitable period[5] so that site-specific data can be used. Importantly, one of the major advantages of TAPM is its ability to by-pass this need for meteorological monitoring. It is, however, important to ensure that the model generates reasonable estimates. This can be done by assimilating data from regional weather stations into the model and comparing model predictions to measured data (see Section 4).

Given that TAPM generates the required meteorology for the dispersion modelling and also generates estimates of background air quality, the utility of the ambient monitoring station is limited to providing data to simply verify the model estimates. The monitoring data are not used directly in the modelling. An important question is how much data from the monitoring station are necessary to provide adequate verification.

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[3] All significant sources of SO_2 and NO_X are readily identified, as are industrial sources of PM_{10}. Some unquantified natural sources of PM_{10} are also significant, as discussed in Section 7.1.3.

[4] The Air Pollution Model (TAPM) was developed by CSIRO originally in 1999 and has been upgraded progressively since.

[5] Typically one year.

Should the proposed pulp mill be approved and built, then the continued operation of the monitoring station would provide data on any measurable increases in ground level pollutant concentrations compared to current levels.

2 SCOPE OF WORK AND METHODOLOGY

This report has been prepared in consultation with GHD Pty Ltd (GHD), the consultancy undertaking the air dispersion modelling for the proposed pulp mill. Model predictions supplied by GHD have been analysed by PAE, along with ambient air quality data collected by Gunns at Rowella during July and August 2005, to assess the reliability of the modelling system in predicting existing ambient air pollutant concentrations at this location. Ambient monitoring data collected by the Department of Primary Industries, Water and the Environment (DIPWE) at the Ti Tree Bend ambient monitoring site during 2004 and July/August 2005 have also been analysed as part of this review.

The modelling performed by GHD entailed modelling of emissions from existing background sources, including all existing industrial emissions for which data are available, to provide estimates of existing pollutant levels. The pollutants modelled and analysed in this review were:

- sulphur dioxide (SO_2),
- nitrogen dioxide (NO_2), and
- particulate matter less than 10 µm in diameter (PM_{10}).

Total reduced sulphur (TRS) is measured by the AQMS and is to be included in the IIS assessment. To date, model results for TRS are unavailable and hence there is no detailed analysis of TRS in this report.

The emission sources included in the modelling were:

- Domestic heating;
- Vehicle emissions;
- Biogenic (natural) sources; and
- Major industrial sites (Bell Bay Power Station, Comalco Aluminium Smelter, Tasmanian Electro Metallurgical Co (TEMCO) and Carter Holt Harvey Wood Panels).

The emission data used in the modelling have not been provided to PAE due to confidentiality restrictions, hence no assessment of the relative significance of each of these emission sources has been made. A summary of the annual emission loads of NO_X, SO_2 and PM_{10} reported to the National Pollutant Inventory by the industrial facilities currently located in Bell Bay is provided in Table 2.1. These data indicate that the Comalco site is a significant emitter of SO_2, while the Bell Bay Power Station is a significant emitter of NO_X. Both CHH Wood Panels and TEMCO are significant emitters of PM_{10}.

Table 2.1: Pollutant Emission Loads Reported to NPI for 2003/4 by Existing Local Industries

Site	Annual Emissions (kg/year)		
	SO_2	NO_X	PM_{10}
Bell Bay Power Station	6,500	1,700,000	26,000
Comalco Aluminium	3,300,000	23,000	69,000
TEMCO	3,400	78,000	220,000
Carter Holt Harvey Wood Panels	1,600	290,000	150,000

3 ROWELLA MONITORING STATION

Figure 3.1 shows the location of the Rowella monitoring station relative to the proposed pulp mill site and existing industrial facilities in the region. Figure 3.2 is a photograph of the station. A description of the monitoring equipment installed at the monitoring station is provided in Appendix A.

The station provides continuous measurements of ambient SO_2, NO_2 and PM_{10} concentrations as well as meteorological parameters such as temperature, wind speed and wind direction, relative humidity and solar radiation. The station also measures ambient concentrations of Total Reduced Sulphur (TRS) compounds but TRS data were not included in this analysis given the absence of any significant existing sources in the area.

ECOTECH, the supplier of the monitoring equipment, is contracted to service and manage data acquisition, carry out daily downloads of data and verification, perform monthly site visits and provide quarterly reporting to NATA requirements.

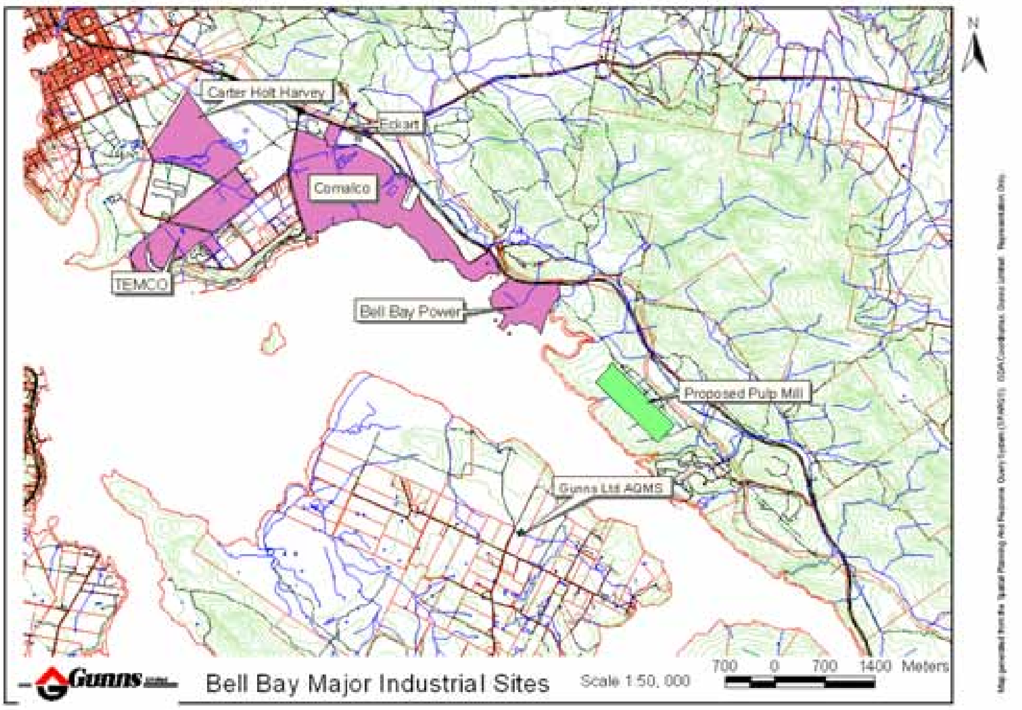

Figure 3.1: Location of the Monitoring Station Relative to the Mill Site and Existing Industry

Figure 3.2: View of the Rowella Monitoring Station

4 ATMOSPHERIC DISPERSION MODELLING

Plume dispersion modelling has undergone significant refinement in recent years. Steady-state[6] Gaussian plume air dispersion models such as AUSPLUME and the USEPA's ISC3, which formed the basis of air dispersion assessment for many years, are now being replaced by a generation of complex three-dimensional models, such as TAPM[7], developed by CSIRO, and CALPUFF, which is endorsed by the US EPA. These new models are able to simulate atmospheric processes ignored by the steady-state Gaussian models, but which are known to significantly affect plume dispersion in many situations.

The steady-state Gaussian plume models adopt a relatively simple methodology. They assume that for each hour all meteorological conditions, most notably wind speed and direction, are fixed for that hour. They also assume that meteorological conditions do not vary from location to location across the modelling domain[8]. During any particular hour under consideration, the plume from the source is assumed to travel in the direction of the wind instantaneously to the edge of the model domain, and spread at a rate determined by the current meteorological conditions. In the next modelled hour, the model assumes that the plume instantly changes direction to align itself with the new wind direction and the plume from the previous hour ceases to exist. In other words, all information pertaining to the previous hour of modelling is discarded. Spatial and temporal variations in meteorology, and hence plume behaviour, can be very poorly represented with such an approach.

The non-steady-state TAPM and CALMET/CALPUFF models substantially overcome the basic limitations of Gaussian plume models. The modelling for the IIS is being undertaken by GHD using the TAPM model. The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided elsewhere, (Hurley, 2002a, 2002b; Hurley et al., 2002a, 2002b; Hibberd et al., 2003; Luhar & Hurley, 2003).

TAPM solves the fundamental fluid dynamics and scalar transport equations to predict both meteorology and pollutant concentrations. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain-induced flows, against a background of larger scale meteorology provided by synoptic analyses. Data collected from meteorological stations located within the modelling domain (study area) can also be input into the model to provide improved estimates of local weather patterns in the vicinity of the stations. This has been done by GHD where such data is available and is considered to be of appropriate quality.

It should be noted, however, that all atmospheric dispersion models are mathematical simulations of reality and are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations. Models are reasonably reliable for estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. Predicted concentrations that occur at a specific time and site are poorly correlated with observed concentrations and are much less reliable (US EPA, 2003).

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[6] Explained in the next paragraph

[7] TAPM is 'The Air Pollution Model'

[8] The region included in the model

5 METEOROLOGICAL DATA

5.1 Long-Term Climatic Conditions

5.1.1 Temperature, Rainfall and Humidity

Long term climate data collected on the coast at Low Head, approximately 9 km northwest of the proposed development site, and at Ti Tree Bend in Launceston are summarised in Table 5.1.

Temperatures at Low Head range from an average daily maximum of 20.9°C in February to an average daily minimum of 5.9°C in July. Further inland at Ti Tree Bend, the temperature variation is more marked, ranging from an average daily maximum of 24.4°C in February to an average daily minimum of 2.1°C in July (Table 5.1).

Annual average rainfall in the region is around 680 mm, with May to August producing the highest monthly totals on average (Table 5.1). July and August tend to have the highest number of rainy days.

Maximum relative humidity levels occur during June and July, with averages of 87% and 91% recorded at Low Head and Ti Tree Bend respectively at 9am, and averages of 77% and 69% recorded at 3pm (Table 5.1). Relative humidity levels drop to their lowest during the summer months with averages of 73% and 66% recorded at Low Head and Ti Tree Bend respectively at 9am, and averages of 68% and 48% recorded at 3pm.

5.1.2 Surface Winds

Wind speed frequency plots for 2004, prepared from the meteorological data compiled by GHD using TAPM, are presented in Figure 5.1 for Rowella and Ti Tree Bend. This plot shows a higher frequency of very low (<1 m/s) and high (>5 m/s) wind speeds at Rowella.

The general features of winds affecting plume dispersion are also illustrated in the wind rose diagrams for Rowella and Ti Tree Bend (Figure 5.2 and Figure 5.3). The wind roses summarise the wind statistics at 10 m height at these two locations for 2004, as predicted by TAPM. The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points – N, NNE, NE, etc. The bar at the top of each wind rose diagram represents winds blowing from the north (i.e., northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds.

The major features of the annual wind roses are as follows:

- At Rowella, the predominant wind direction changes from southeast during the morning to the northwest during the afternoon and evening;
- Stronger winds are predominantly from the northwest quadrant and are most frequent during the afternoon and early evening;
- At Ti Tree bend, northwesterly winds remain predominant during all hours, with southerly and southeasterly winds only occurring with significant frequency during the morning hours.

Table 5.1: Climate Statistics for Low Head (1877 - 2001) and Ti Tree Bend (1980 – 2004)

	Mean Daily Minimum Temperature (°C)		Mean Daily Maximum Temperature (°C)		Lowest Minimum Temperature (°C)		Highest Maximum Temperature (°C)		Mean 9am Relative Humidity (%)		Mean 3pm Relative Humidity (%)		Mean Rainfall (mm)		Mean Number of Rain Days (>0.1mm)	
	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend	Low Head	Ti Tree Bend
January	12.9	12.0	20.3	24.0	4.4	2.5	29.5	35.4	73	70	68	49	37.2	51.8	7.6	8.2
February	13.3	11.9	20.9	24.4	4.4	3.4	29.5	34.4	75	74	68	48	35.0	28.9	6.6	6.1
March	12.2	9.9	19.7	22.3	1.1	0.5	28.0	32.3	78	76	69	48	43.3	34.7	8.7	6.6
April	10.3	7.4	17.2	18.8	1.7	-1.5	25.6	27.7	81	81	71	56	54.7	53.5	10.8	9.0
May	8.3	5.1	14.7	15.7	-0.6	-3.0	23.2	22.0	86	89	75	65	67.1	67.9	13.0	10.7
June	6.6	2.8	12.6	13.0	-1.2	-4.9	24.4	18.2	87	91	76	69	76.7	67.3	14.4	12.2
July	5.9	2.1	11.9	12.5	-2.8	-5.2	17.4	17.6	87	91	77	69	81.0	79.4	16.6	14.4
August	6.3	3.6	12.5	13.7	-1.1	-3.5	18.0	19.6	86	87	76	64	70.9	83.0	15.9	14.8
September	7.5	5.1	13.6	15.5	-0.6	-2.4	22.0	24.8	83	78	76	59	59.5	66.4	14.3	13.9
October	8.7	6.9	15.0	17.9	0.0	-0.6	23.2	28.7	79	73	75	54	58.7	55.7	12.7	12.1
November	10.1	8.7	16.9	20.2	2.9	-2.0	26.5	30.7	76	69	72	52	47.1	49.3	10.4	9.7
December	11.7	10.5	18.7	22.4	5.0	2.0	27.5	33.8	74	66	69	49	46.0	45.5	9.4	8.0
Annual	9.5	7.2	16.2	18.4	-2.8	-5.2	29.5	35.4	80	79	73	57	677.2	683.3	140.5	125.6
No. years	*106.9*	*20.9*	*106.8*	*20.9*	*106.0*	*20.9*	*106.0*	*20.9*	*105.2*	*21.0*	*973*	*21.0*	*119.8*	*23.6*	*105.8*	*23.5*

Source: www.bom.gov.au, 2005

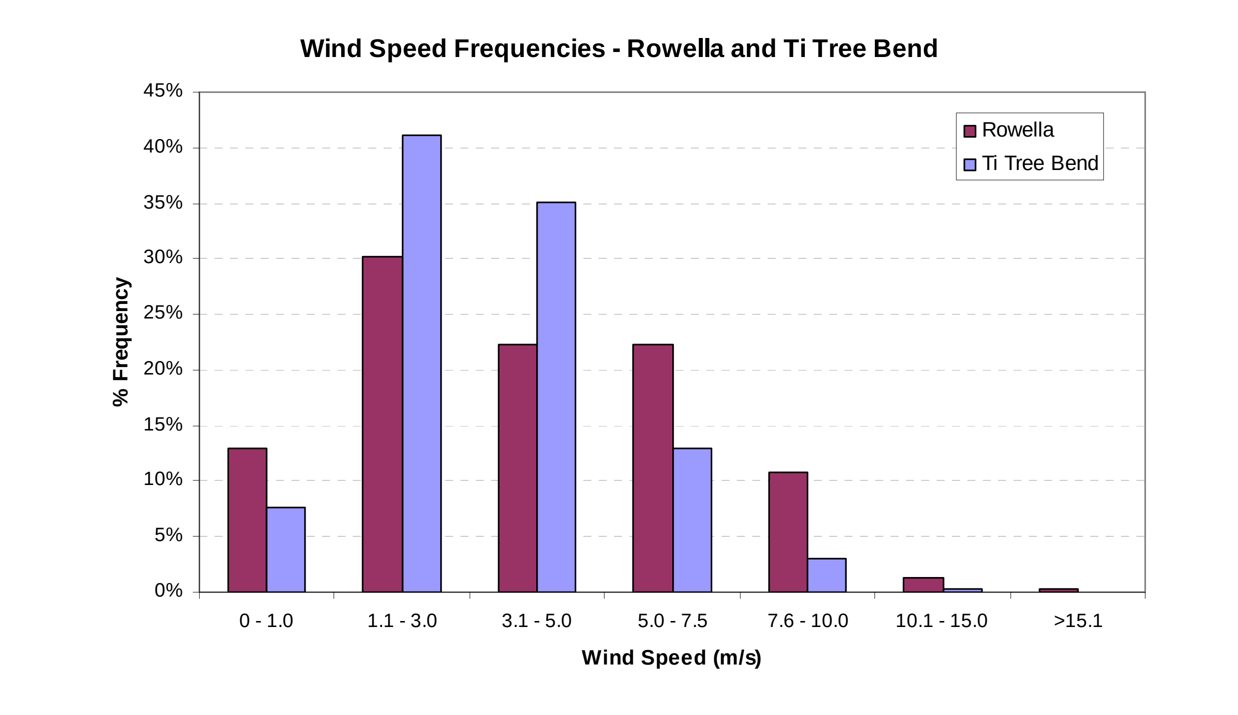


Figure 5.1: Wind Speed Frequencies at Rowella and Ti Tree Bend (TAPM, 2004)

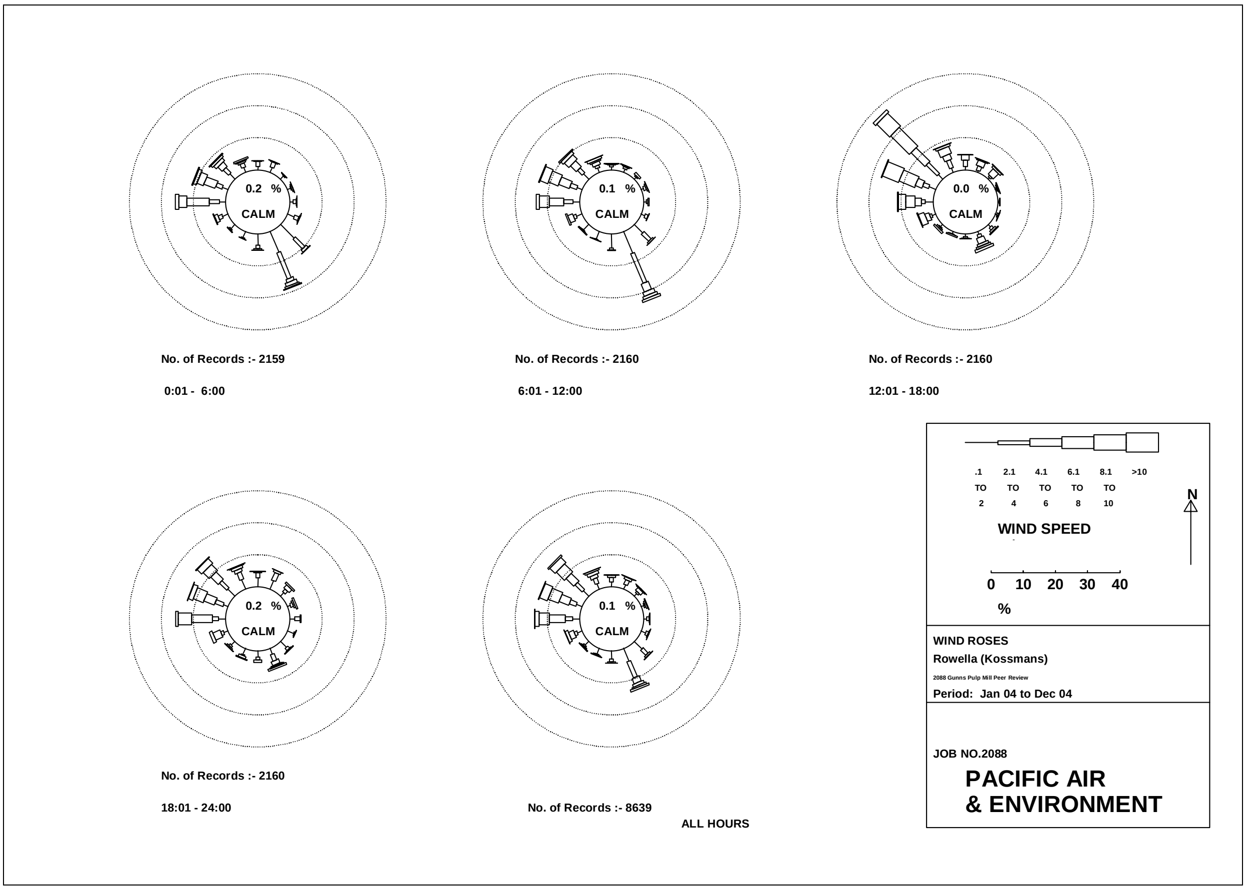


Figure 5.2: Wind Roses for Rowella (TAPM, 2004)

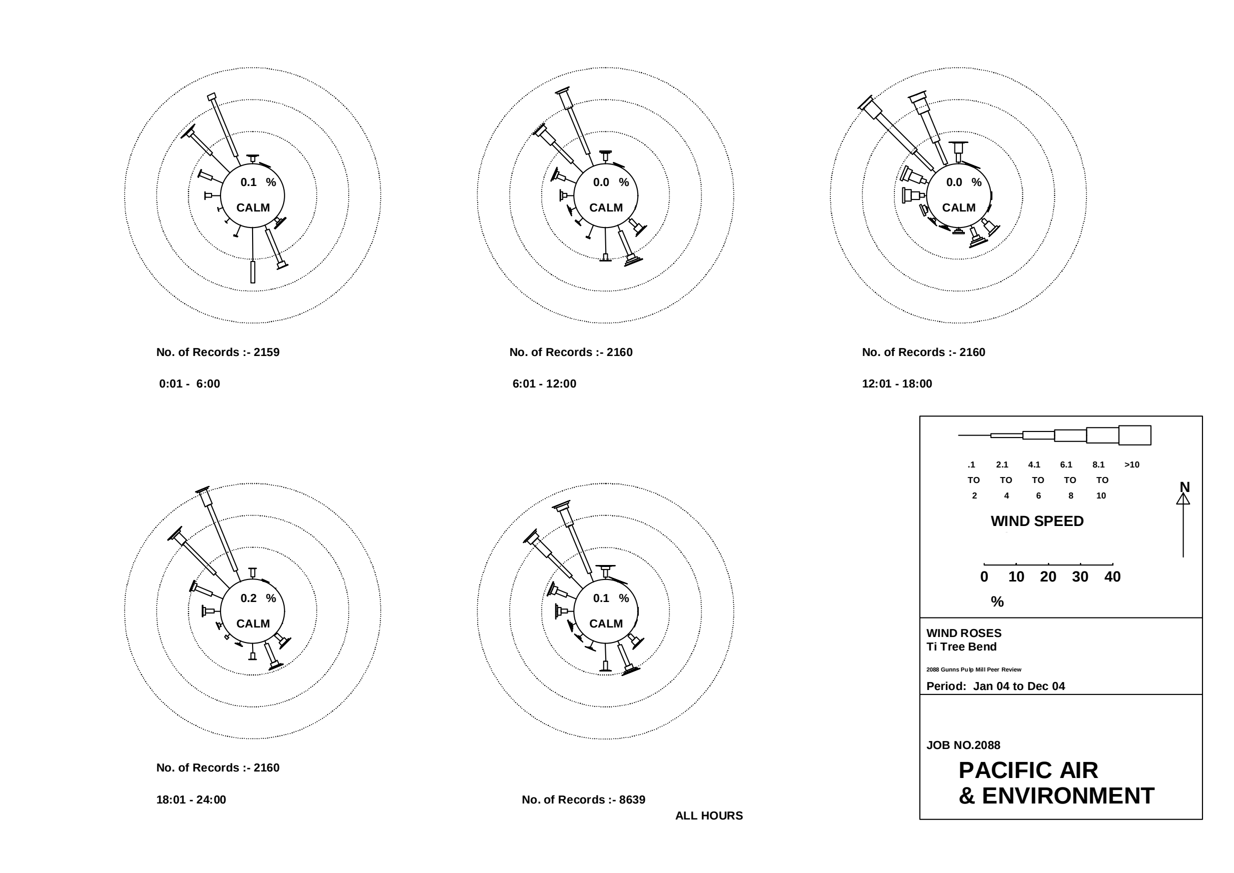


Figure 5.3: Wind Roses for Ti Tree Bend (TAPM, 2004)

5.1.3 Mixing Heights

Mixing height is defined as the height above ground of a temperature inversion or statically stable layer of air capping the atmospheric boundary layer. It is often associated with, or measured by, a sharp increase of temperature with height (inversion), a sharp decrease of water vapour, a sharp decrease in turbulence intensity and a sharp decrease in pollutant concentration[9]. Mixing height is variable in space and time, and typically increases during fair-weather daytime over land from tens to hundreds of metres around sunrise up to 1–4 km in the mid-afternoon, depending on the location, season and day-to-day weather conditions.

Two different types of temperature inversion frequently develop and may lead to air pollution episodes. These are:

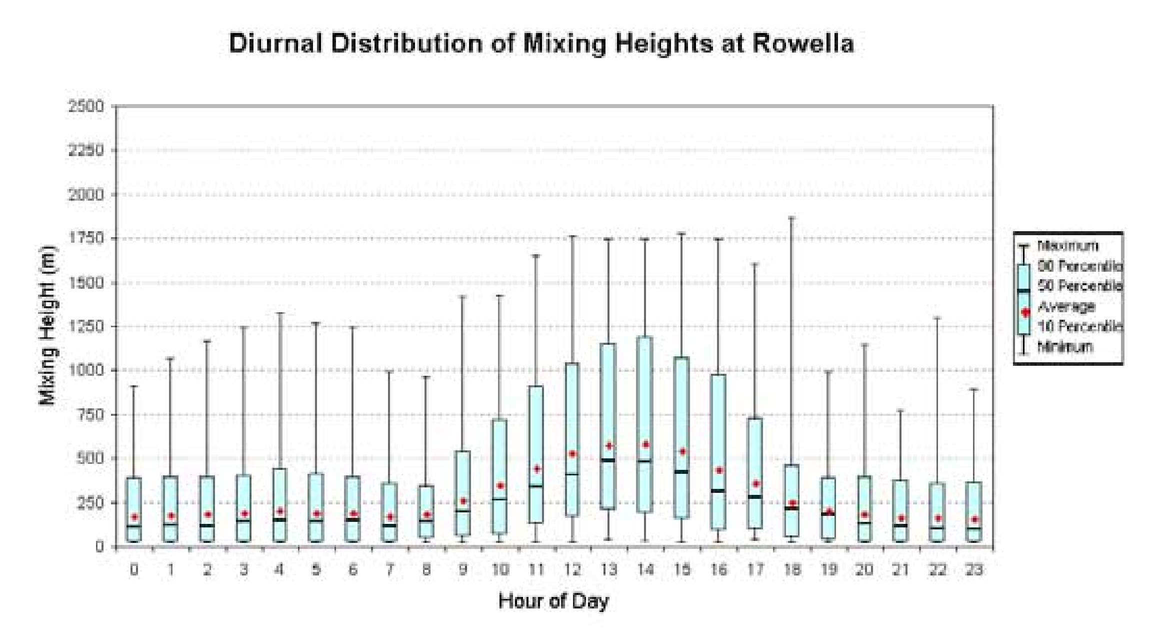
- radiation or surface inversions that form overnight through rapid cooling of the ground and surface air layers; and

- subsidence inversions that form at various heights above the ground due to subsiding air associated with the anticyclone.

[9] Provided that pollutants have been emitted into the boundary layer beneath the mixing height.

Radiation inversions are usually short-lived and rarely persist beyond mid-morning. Subsidence inversions may persist for several days while the associated anticyclone is in the vicinity. Short periods of severe air pollution can occur with radiation inversions but sustained, broad-scale pollution events result from subsidence inversions.

The frequency of mixing heights in the 2004 meteorological dataset developed by GHD at Rowella is shown in Figure 5.4 and Figure 5.5. Mixing heights are marginally lower during the night and early morning hours (<200 m), increasing after sunrise to an average maximum of 570 m (90%^{ile} of 1,190 m) by mid-afternoon.



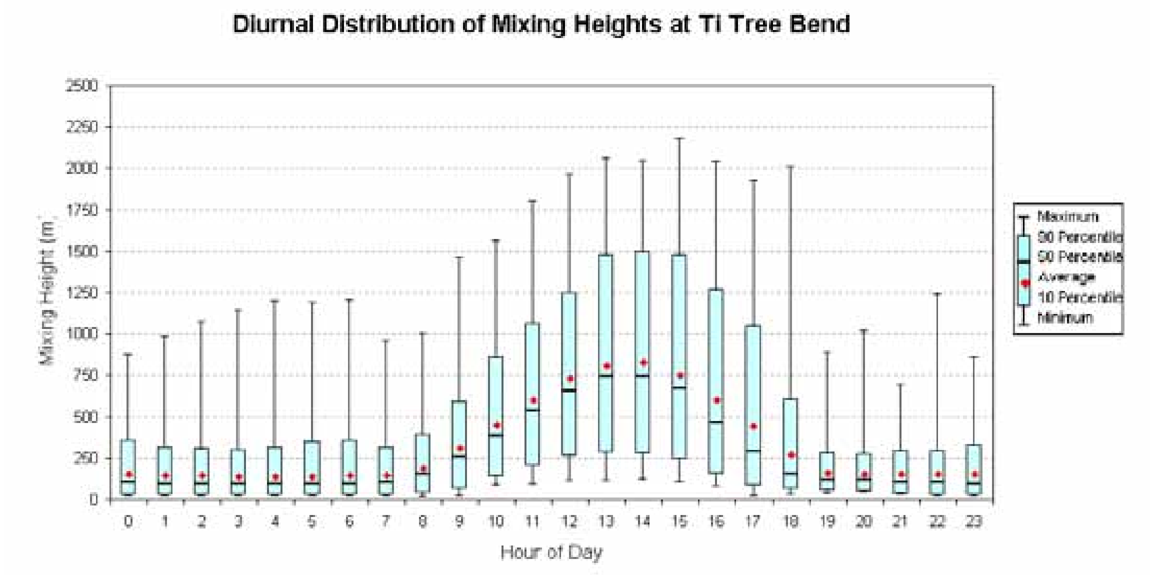


Figure 5.4: Diurnal Distribution of Mixing Heights at Rowella and Ti Tree Bend (TAPM, 2004)

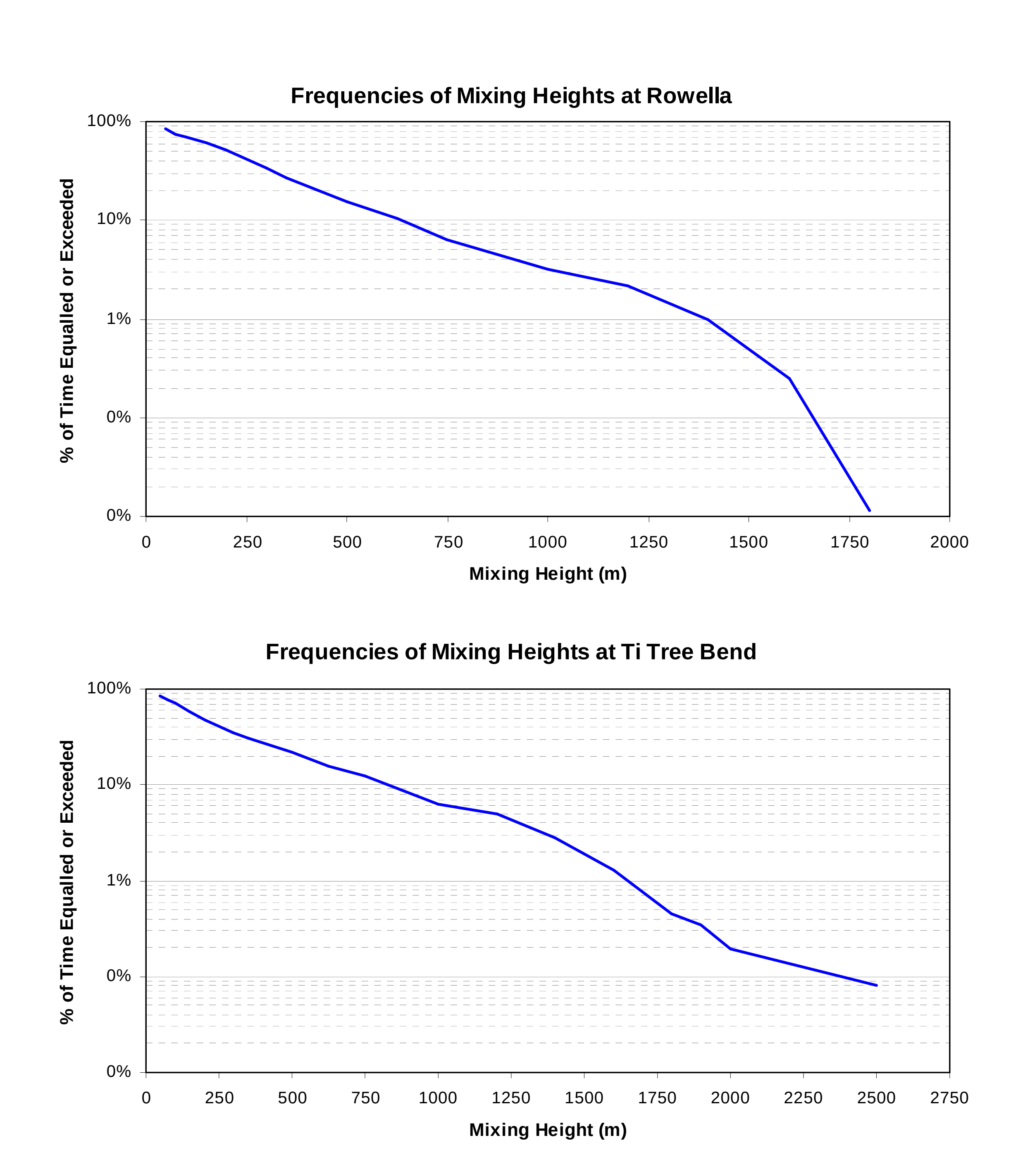


Figure 5.5: Frequencies of Mixing Heights at Rowella and Ti Tree Bend (TAPM, 2004)

5.2 July and August 2005

Windroses compiled from data recorded by the Rowella monitoring station during July and August 2005 are presented in Figure 5.6, while windroses compiled from the TAPM modelling file for the same period are presented in Figure 5.7. Comparisons of wind speed frequencies and ambient temperatures in the two datasets are provided in Figure 5.8 and Figure 5.9 respectively. The monitoring data from Rowella was assimilated into the TAPM run, so as would be expected, these plots show good agreement between the measured values and those estimated by TAPM for modelling purposes. While meteorological data were also available from Comalco for the modelling period, these data were not assimilated into the TAPM run as there were some missing data due to down-time in the anemometer.

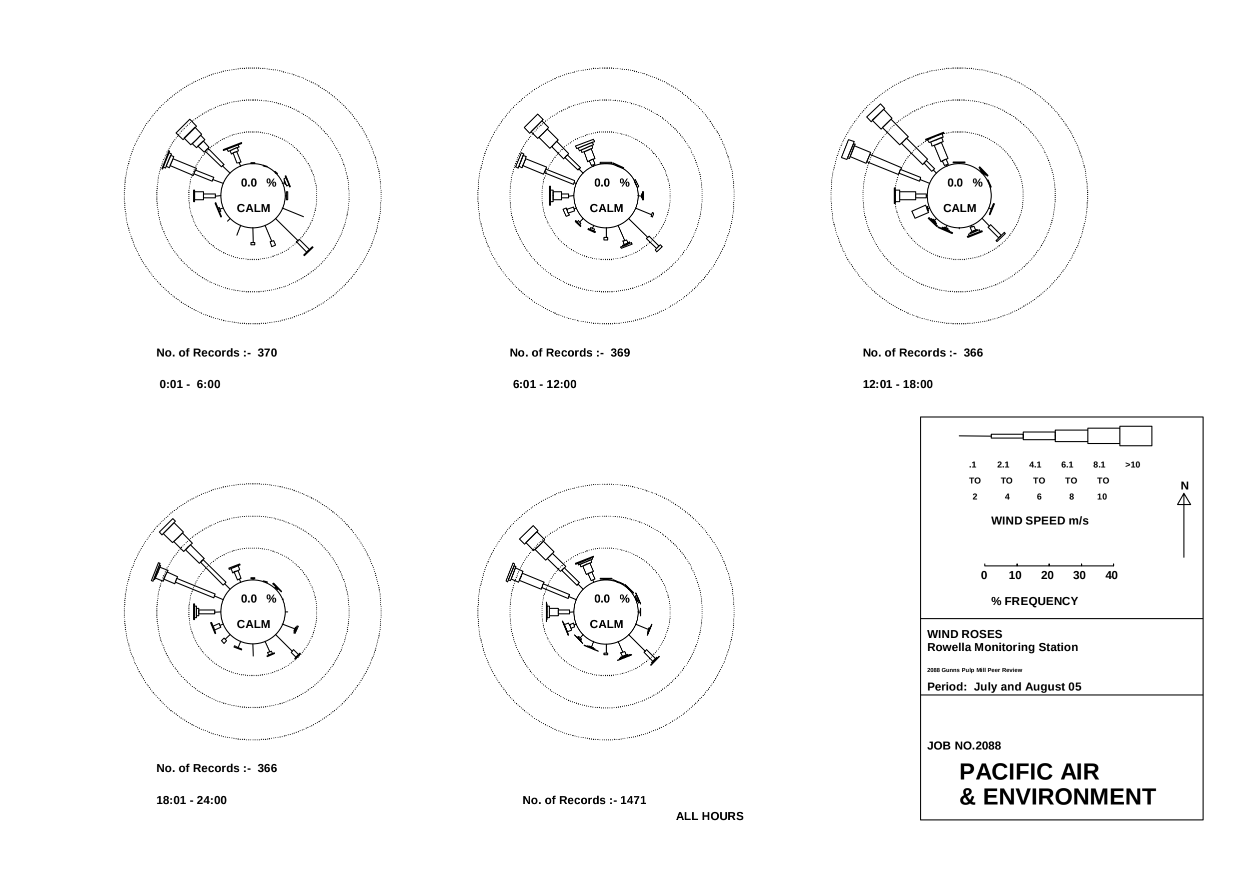


Figure 5.6: Wind Roses for Rowella (Monitoring Station Data, July and August 2005)

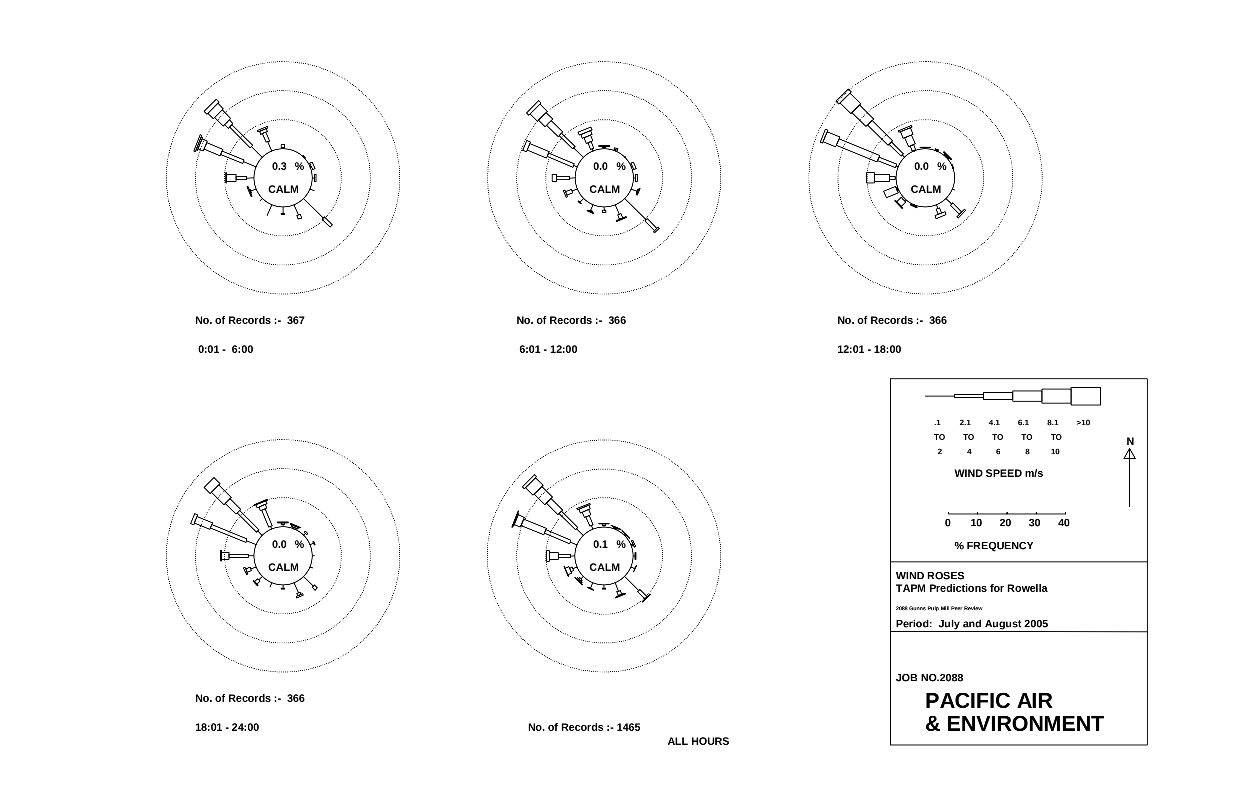


Figure 5.7: Wind Roses for Rowella (TAPM Data, July and August 2005)

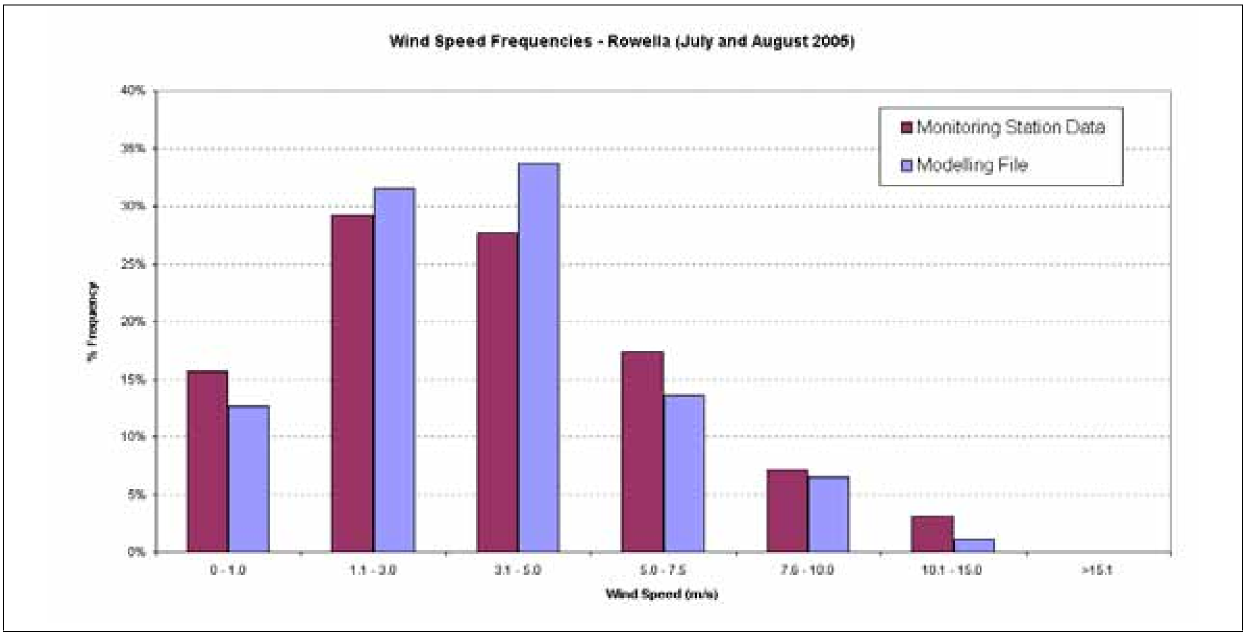


Figure 5.8: Wind Frequency Data for Rowella (Monitoring and TAPM Data, July & August 2005)

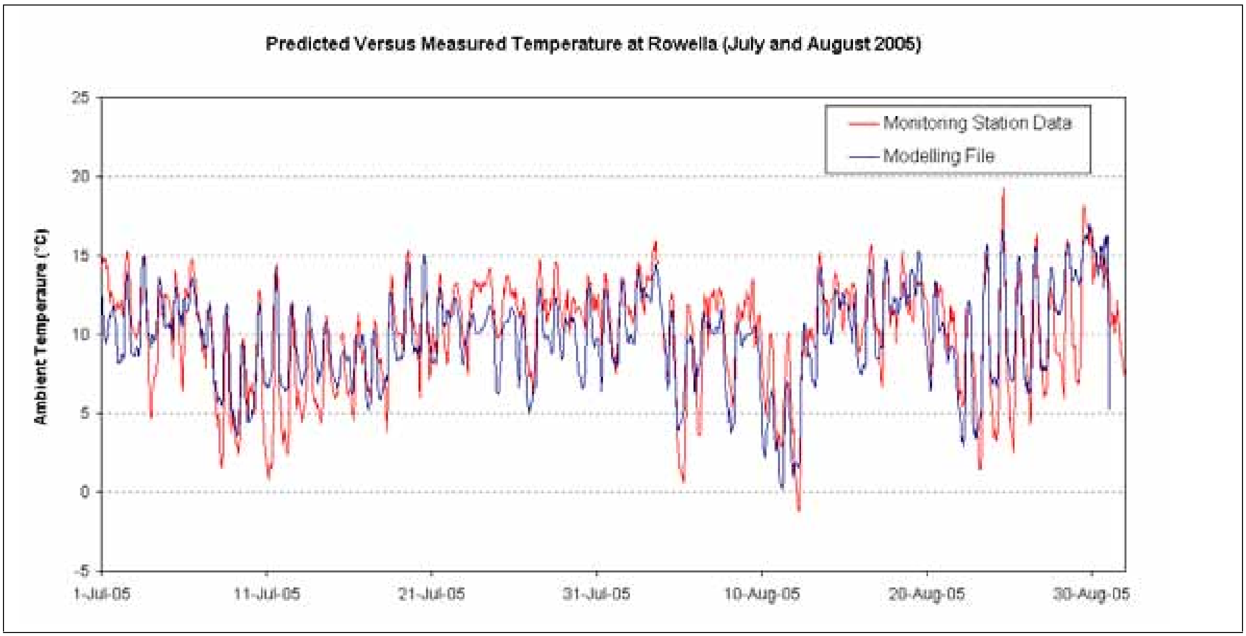


Figure 5.9: Temperature Data for Rowella (Monitoring and TAPM Data, July and August 2005)

6 AMBIENT MONITORING DATA

6.1 Rowella

The SO_2, NO_2 and PM_{10} concentrations measured at Rowella during July and August 2005 are presented graphically in detail in Appendix B. Measurements of TRS are not shown, but the available data indicates very low background levels, with zero concentrations frequently recorded.

Key statistics for the monitoring data, compared against the standards set in the *National Environment Protection Measure (Ambient Air Quality)*, are presented in Table 6.1. As shown in the table, the pollutant levels measured during this two-month period were generally low. The highest recorded 1-hour NO_2 concentration was only 13% of the NEPM standard, while the maximum 1-hour SO_2 concentration was less than 5% of the standard and the 24-hour SO_2 concentration was less than 2% of the standard. The maximum 24-hour PM_{10} concentration recorded was 29 µg/m^3, which is 58% of the NEPM standard.

Table 6.1: Monitoring Data Statistics for Rowella (July and August 2005)

Statistic	SO_2 (ppm)		NO_2 (ppm)	PM_{10} (µg/m^3)	
	1-Hour	24-Hour	1-Hour	1-Hour	24-Hour
Maximum	0.009	0.0013	0.015	53.1	28.9
90th Percentile	0.001	0.0005	0.006	21.9	18.1
70th Percentile	0.001	0.0005	0.004	15.5	14.6
Average	0.001	0.0005	0.003	12.8	12.9
NEPM Standard	**0.20**	**0.08**	**0.12**	**-**	**50**
RPDC Standard	**0.07**	**-**	**0.08**	**-**	**-**

The 1-hour average SO_2, NO_2 and PM_{10} concentrations (uncorrected) measured at Rowella during July and August 2005 are plotted against wind direction in Figure 6.1. These plots show the dominant northwesterly and southeasterly winds recorded during this period, as discussed in Section 5.2. The SO_2 plot also shows a strong correlation between higher SO_2 levels and winds blowing from the northwest. These higher concentrations are associated with emissions from the existing industrial facilities located north-northwest of the monitoring station.

Figure 6.2 also presents plots of the measured SO_2, NO_2 and PM_{10} concentrations plotted against wind direction, but only includes those hours when wind speeds were greater than 8 m/s, i.e., relatively strong winds It is evident from these plots that almost all occurrences of higher windspeed are from the northwest sector, representing onshore flows from Bass Strait. The SO_2 and NO_2 plots show a narrow signal from industry, which has lower concentrations than the signal associated with all wind speeds (Figure 6.1), as would be expected[10]. There are also many near-zero values.

However for PM_{10}, most of the high values remain at higher windspeed and there is a baseline in the data of around 12-20 µg/m^3, which is likely to represent the sea salt component from wind-generated aerosol over Bass Strait. This baseline increases as the windspeed cut-off value is increased, which is consistent with the source being generated by wind effects.

[10] As a simple generalisation, downwind concentrations from industrial sources are lower with increasing windspeed, and vice versa.

Figure 6.1: 1-Hour NO_2, SO_2 and PM_{10} versus Wind Direction - Rowella: All Windspeeds (July and August 2005)

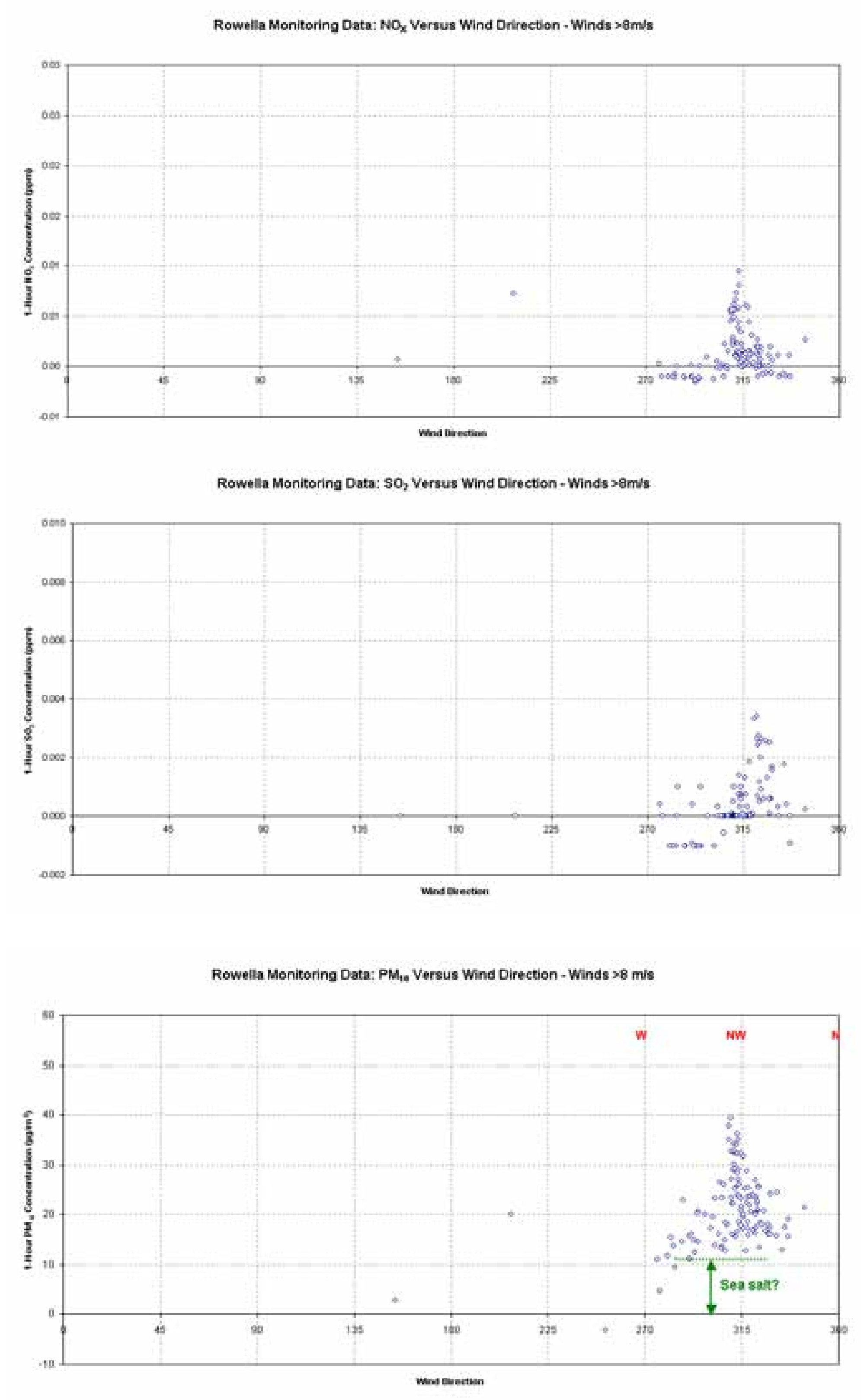


Figure 6.2: 1-Hour NO_2, SO_2 and PM_{10} versus Wind Direction – Rowella: Windspeeds Greater than 8 m/s (July and August 2005)

Figure 6.3 presents the PM_{10} concentrations measured at Rowella during July and August 2005, plotted against the concurrently measured SO_2 concentrations. This plot does not show a strong relationship between the two pollutants, indicating that while the SO_2 concentrations will be mainly associated with nearby industrial sources, there are other non-industrial sources that are acting as significant contributors to ambient PM_{10} levels. Sea salt is a primary contender.

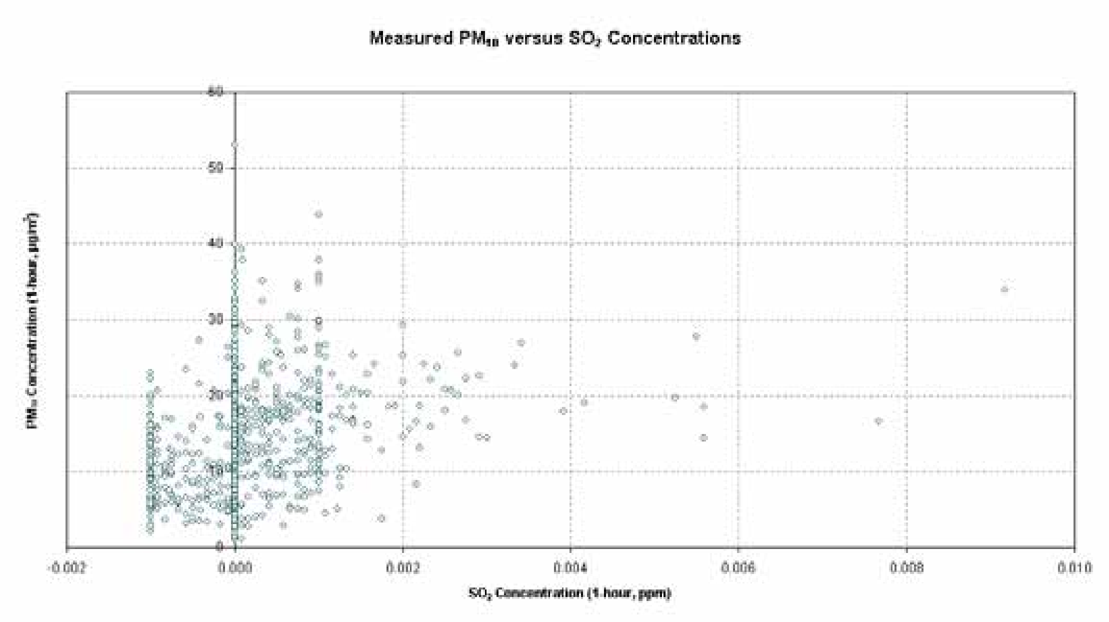


Figure 6.3: Measured PM_{10} Versus SO_2 Concentrations, Rowella (July and August 2005)

6.2 *Ti Tree Bend*

PM_{10} concentrations (1-hour and 24-hour averages, temperature corrected) measured at the Ti Tree Bend monitoring site in 2004 and during July and August 2005 are presented in Appendix C.

Figure 6.4 compares the PM_{10} levels recorded at Ti Tree Bend during July and August 2005 to those measured at Rowella for the same period. It indicates that ambient PM_{10} levels at Rowella are considerably lower than at Ti Tree Bend. This is likely to be due to Ti Tree Bend's closer proximity to Launceston, and the associated emissions from sources such as domestic heating and vehicle exhausts.

The 2004 monitoring data for Ti Tree Bend also indicates that peak PM_{10} concentrations tend to occur during the winter months, due to emissions from domestic fires for home heating, as well as an increased frequency and strength of temperature inversions and associated poor dispersive conditions. The PM_{10} concentrations measured at Rowella during July and August are therefore likely to cover the higher PM_{10} levels experienced in the region.

SO_2 and NO_2 concentrations are not measured by this monitoring station.

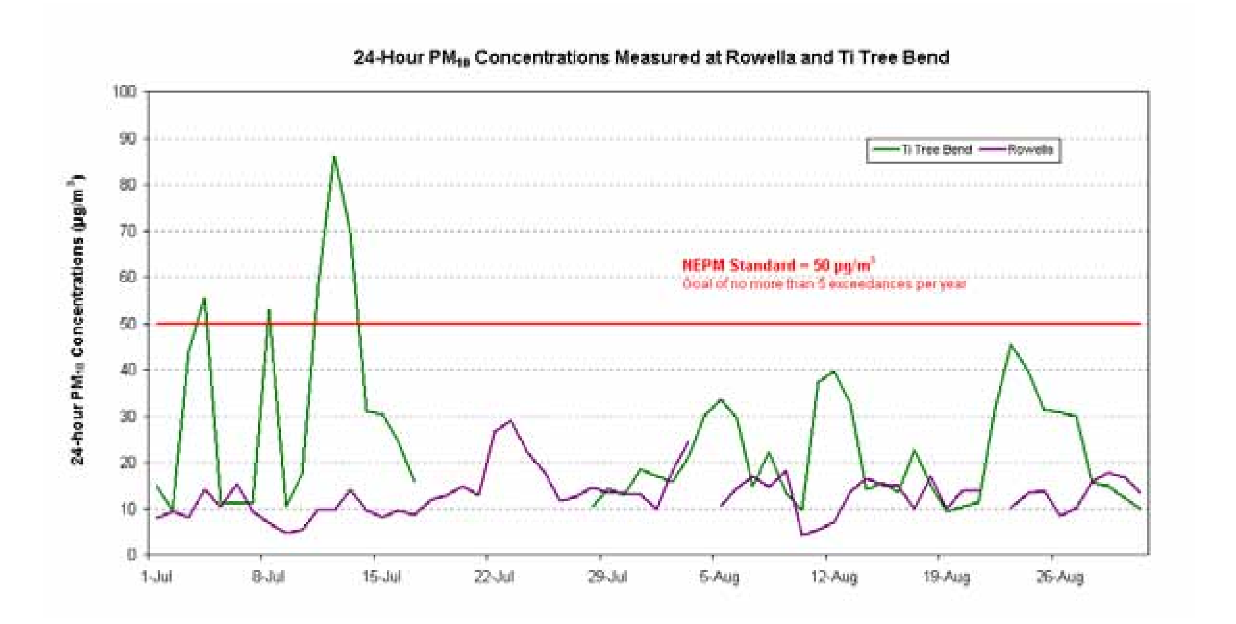


Figure 6.4: Comparison of PM_{10} Concentrations Measured at Rowella and Ti Tree Bend (July and August 2005)

7 MODELLING PREDICTIONS

7.1 Rowella – Without Mill (Background)

GHD has provided pollutant concentration predictions for receptors located near the Rowella monitoring station using a modelling grid with 1 km spacing, for July and August 2005. The results have been analysed to yield the concentrations predicted at the nearest receptor to the monitoring station, as well as the "local maximum" (the highest prediction of the five receptor points nearest to the monitoring site).

Modelling results in the IIS will be based on a finer 500 m modelling grid, which requires longer computational times than that available for this review. The use of a finer resolution grid in the IIS modelling will result in increased conservatism (over-prediction) in the modelling results[11]. Thus the analysis presented here provides a worst-case assessment of the model's accuracy.

7.1.1 Sulphur Dioxide

Time series plots of the 1-hour average SO_2 concentrations predicted at Rowella for July and August 2005 are shown in Appendix D, along with scatter plots of the concurrent measured and predicted 1-hour SO_2 concentrations.

Statistics of the modelled and monitored 1-hour and 24-hour average SO_2 data at Rowella are presented in Figure 7.1. The average of the 1-hour concentrations predicted for the nearest receptor is 2.2 times higher than the average of the measured values. The maximum 1-hour concentration predicted by the model at the nearest receptor over-predicts the measured maximum by 17%. The 24-hour results given by the modelling similarly over-predict the measured levels.

Quantile-quantile (Q-Q) plots are often used to assess model performance, where observed and predicted data are each ordered from highest to lowest and the corresponding values are then plotted. A 45-degree reference line is also plotted. If the two sets come from a population with the same distribution, the points should fall approximately along this reference line. Any systematic deviation from the line x = y is taken to indicate a bias in the model (Cooper, 1999). Data falling outside the 'factor of two' confidence limit (indicated by the orange lines) are deemed to fall outside the US EPA model acceptability criterion. The Q-Q plots provide a means for assessing the differences to be seen between the observed and predicted concentrations, but do not provide a means for assessing whether the predicted maxima are for similar meteorological conditions as when observed (Irwin, 2000).

Q-Q plots are shown in Figure 7.2 for the nearest receptor and local maximum 1-hour SO_2 predictions. For concentrations greater than 0.005 ppm, the predicted results for the nearest receptor fall within the acceptability criterion. The 24-hour Q-Q plots (Figure 7.3) demonstrate over-prediction of the measured levels.

[11] By increasing the density of grid points, the chance of encountering higher concentrations is increased.

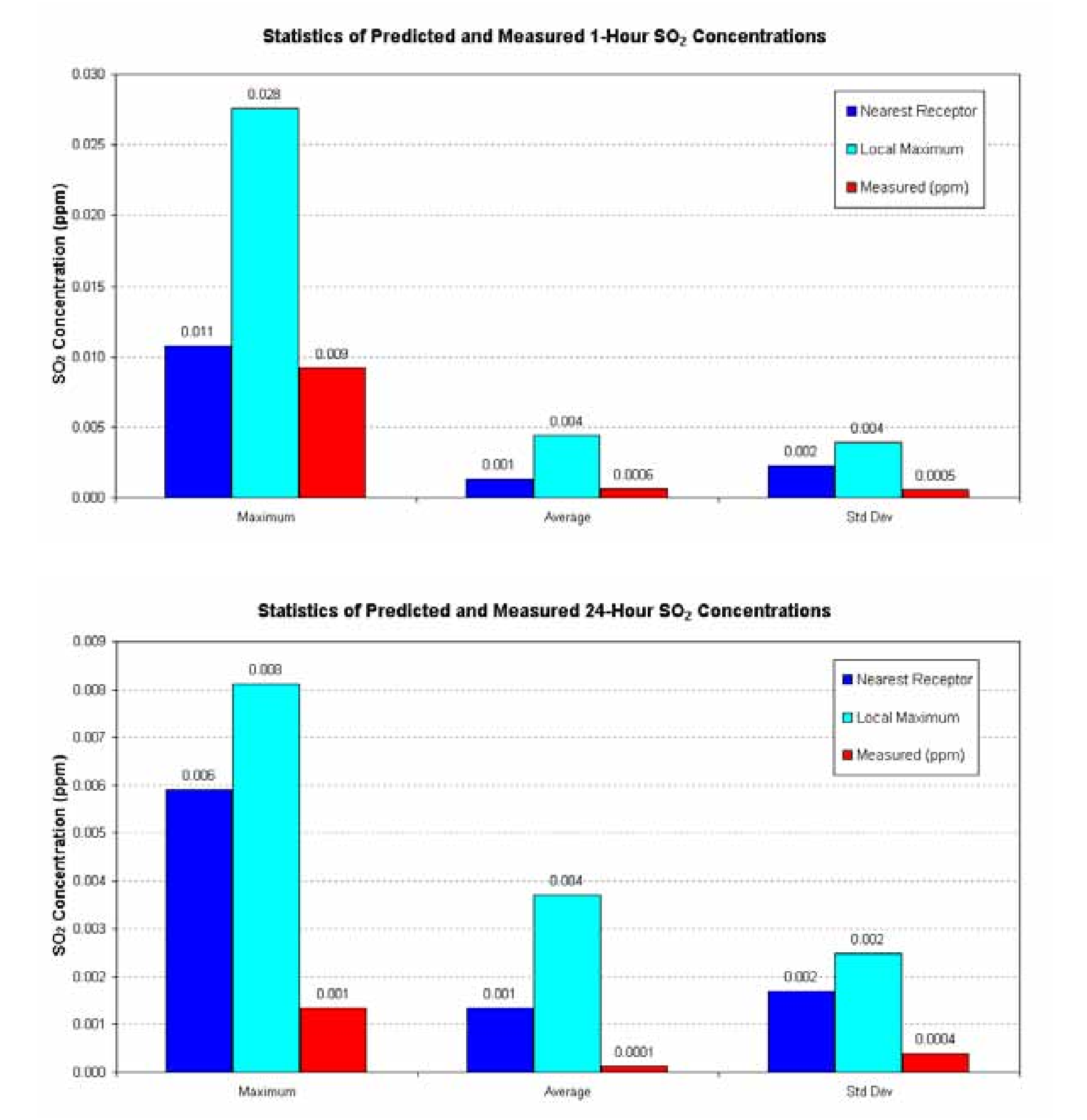


Figure 7.1: Statistical Properties for Measured and Modelled SO_2 Concentrations at Rowella

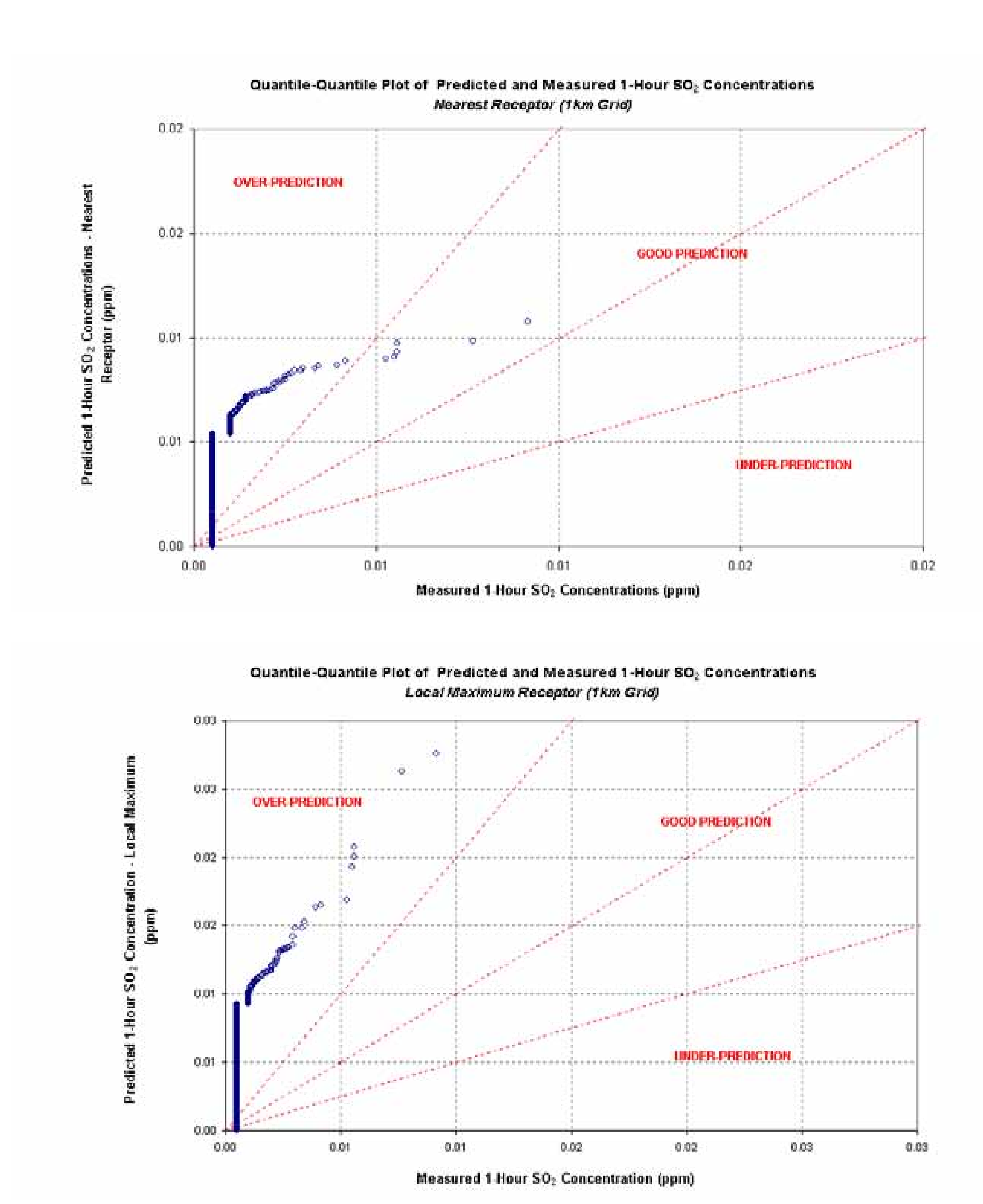


Figure 7.2: Quantile-Quantile 1-Hour SO_2 Plots for Rowella

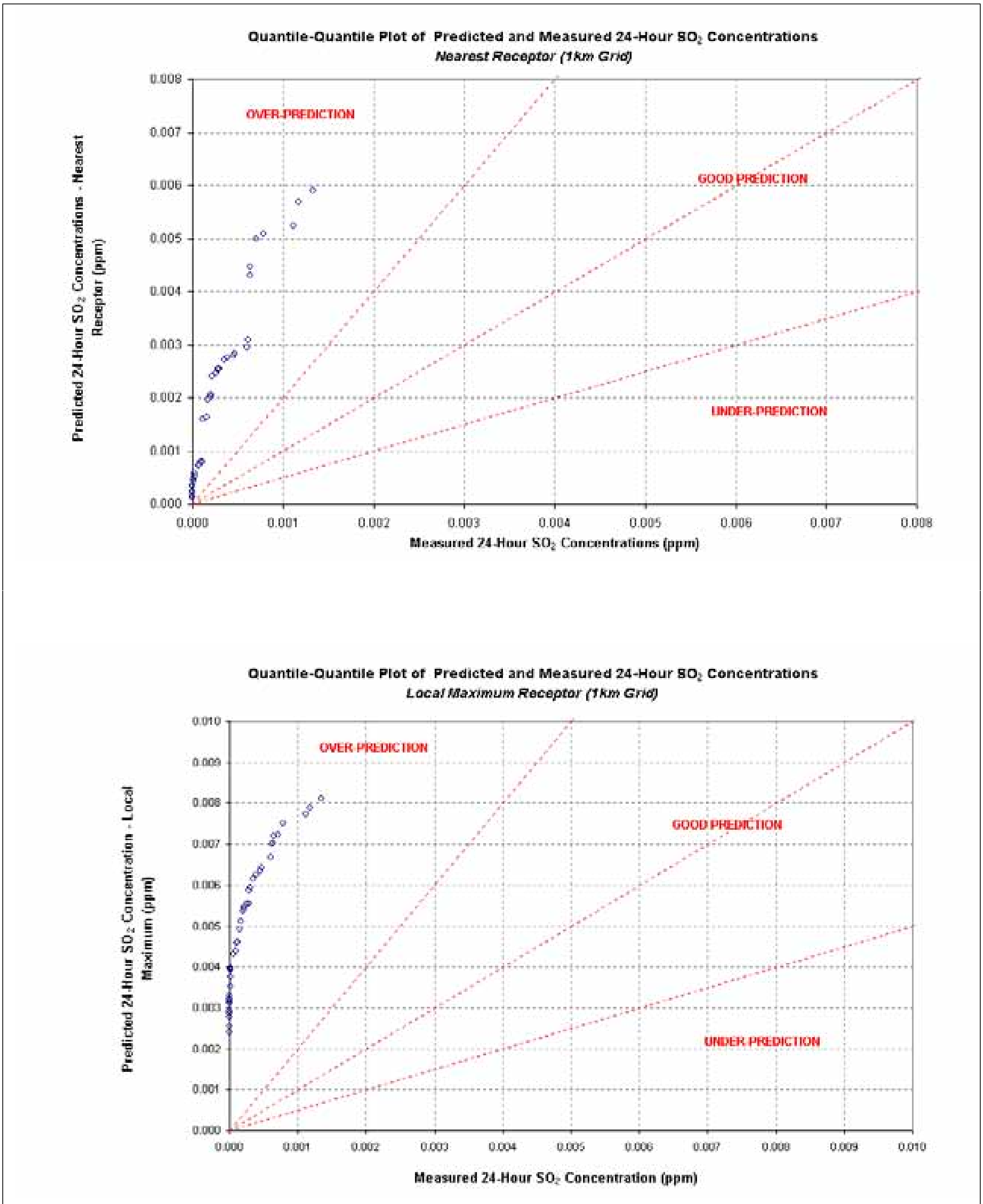


Figure 7.3: Quantile-Quantile 24-Hour SO_2 Plots for Rowella

7.1.2 Nitrogen Dioxide

Time series plots of the 1-hour average NO_2 concentrations predicted at Rowella for July and August 2005 are shown in Appendix D and compared against the measured data obtained from the monitoring station. Plots of concurrent measured and predicted 1-hour NO_2 concentrations at Rowella are also provided in Appendix D.

Statistics of the modelled and monitored 1-hour average NO_2 data at Rowella are presented in Figure 7.4. The average of the 1-hour concentrations predicted for the nearest receptor is 97% of that of the measured values, while the maximum 1-hour concentration predicted by the model at the nearest receptor over-predicts the measured maximum by 39%.

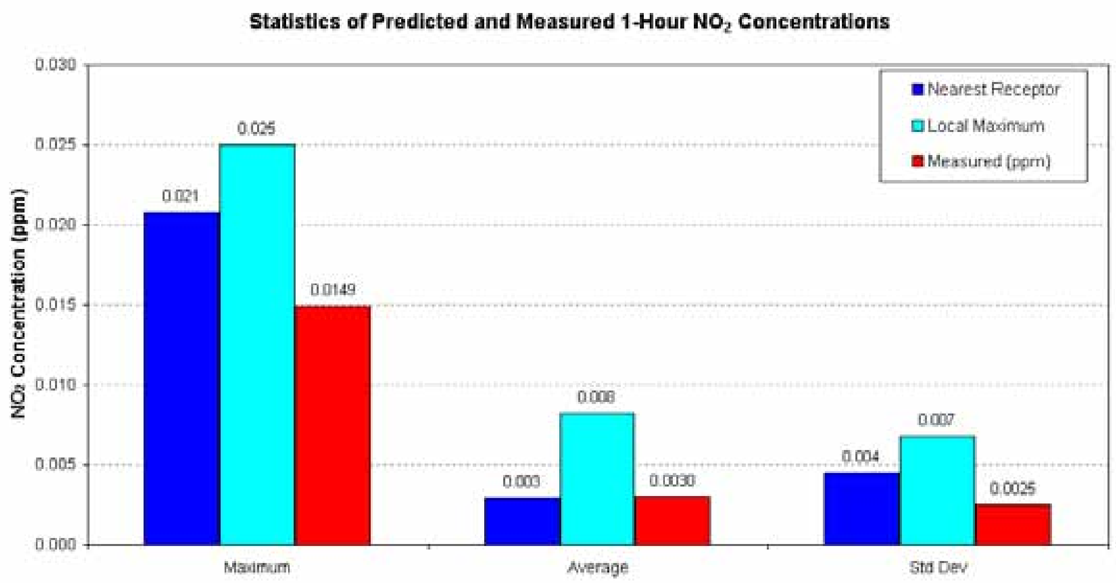


Figure 7.4: Statistical Properties for Measured and Modelled NO_2 Concentrations at Rowella

Q-Q plots are shown in Figure 7.5 for the nearest receptor and local maximum 1-hour NO_2 predictions. These plots show that the modelling results for the nearest receptor fall within the factor of two (red lines in the figures) acceptability criterion set by the US EPA for model acceptability, except at very low concentration values. At the more critical higher concentration values, the model tends to over-predict and provide conservative estimates of actual levels.

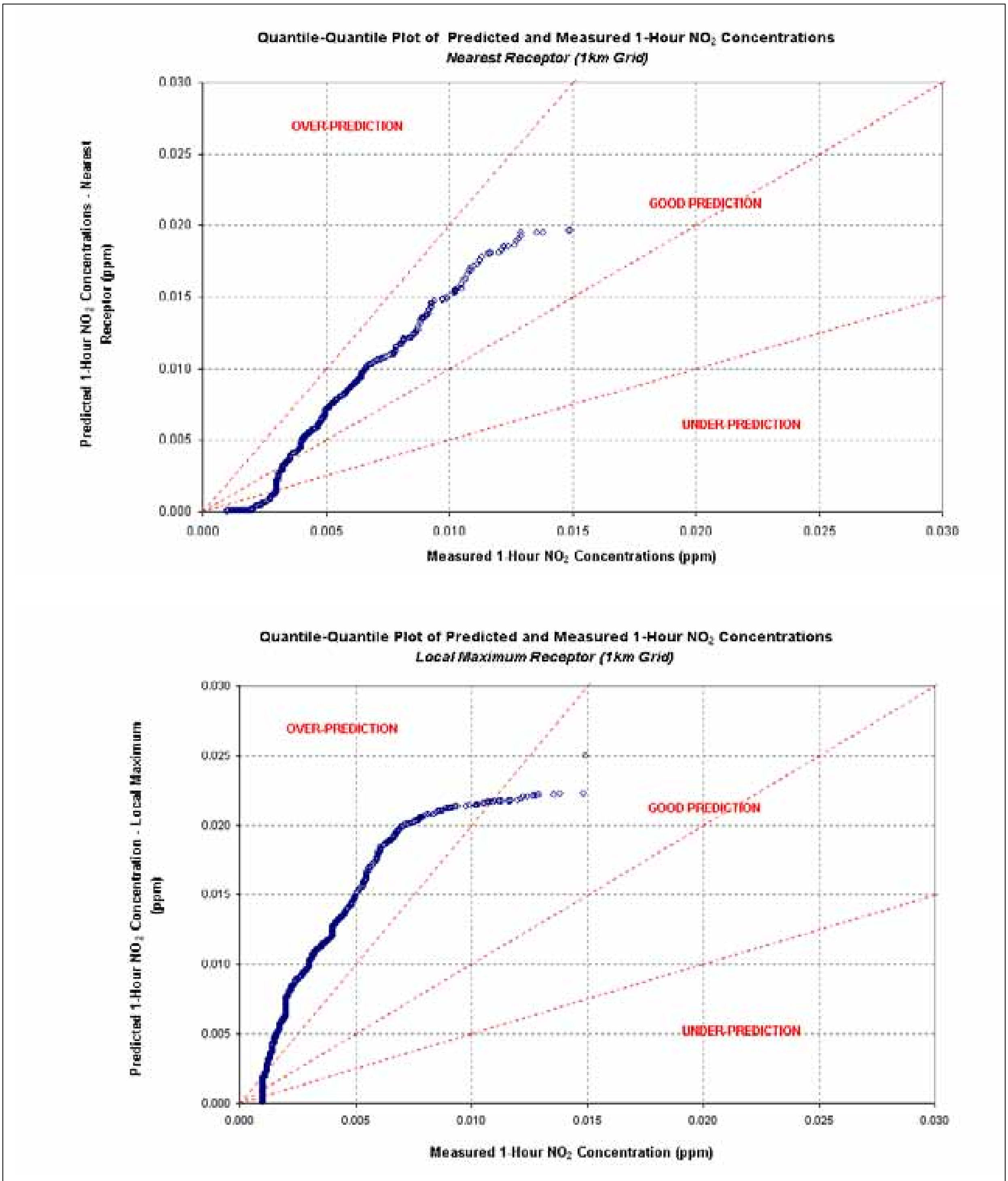
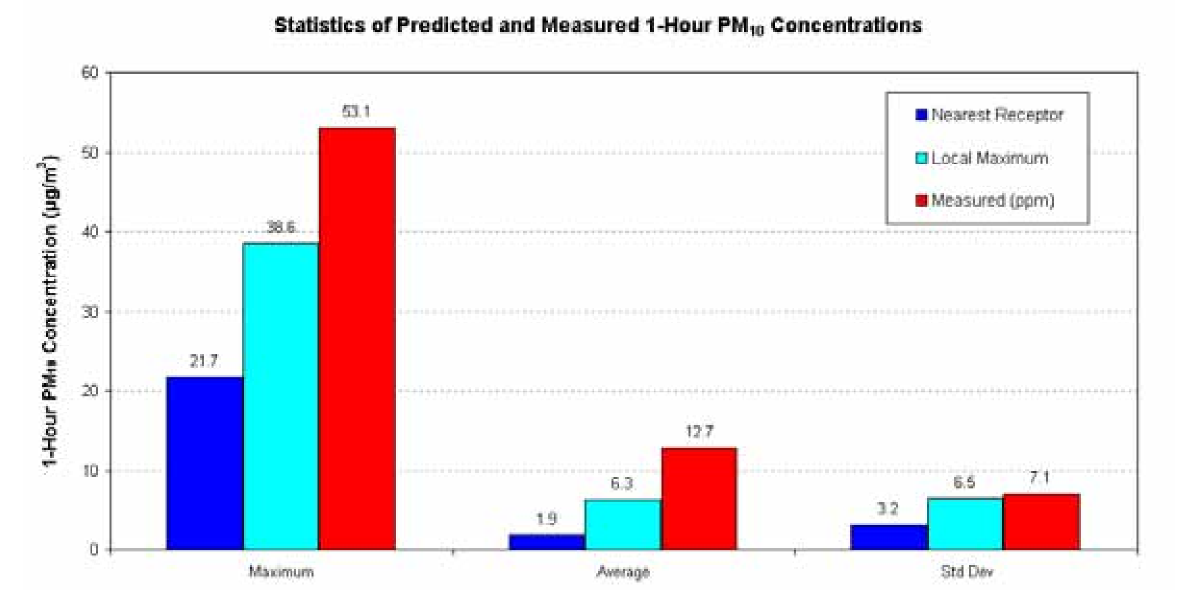


Figure 7.5: Quantile-Quantile 1-Hour NO_2 Plots for Rowella

7.1.3 PM_{10} – 1km Grid Results

Time series plots of the 1-hour and 24-Hour average PM_{10} concentrations predicted at Rowella (based on the 1km receptor grid) for July and August 2005 are shown in Appendix D and compared against the measured data obtained from the monitoring station. Plots of concurrent measured and predicted 1-hour and 24-Hour PM_{10} concentrations at Rowella are also presented in Appendix D. Statistics of the modelled and monitored 1-hour and 24-hour average PM_{10} data at Rowella are given in Figure 7.6.



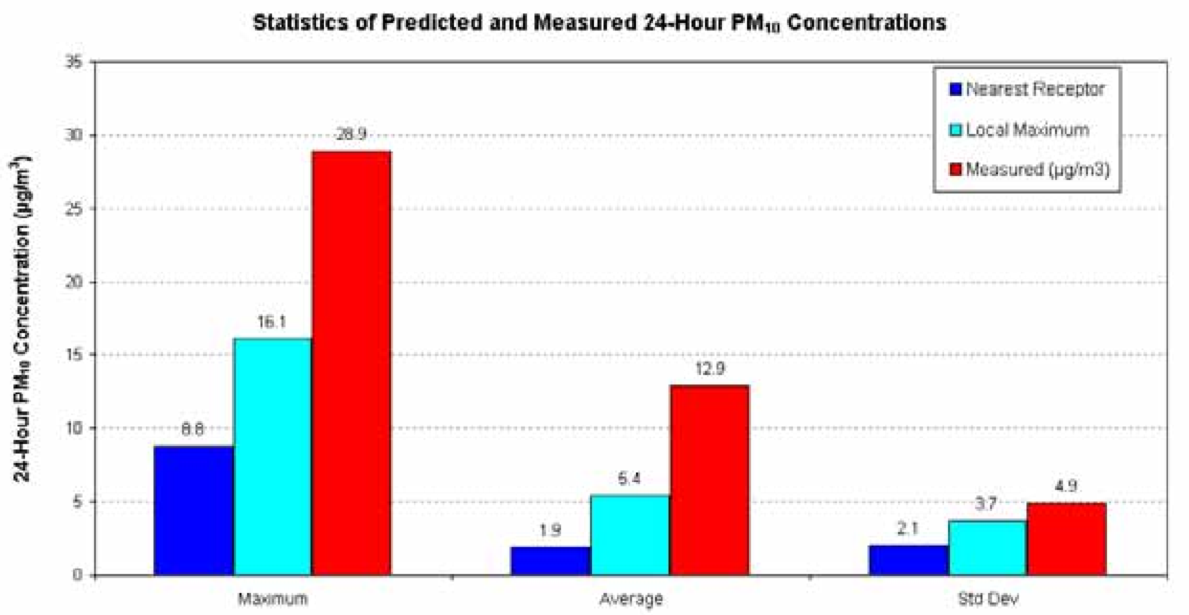


Figure 7.6: Statistical Properties for Measured and Modelled PM_{10} Concentrations at Rowella (July and August 2005)

The average of the 1-hour concentrations predicted for the nearest receptor is 15% of that of the measured values. The maximum 1-hour concentration predicted by the model at the nearest receptor under-predicts the measured maximum by 60%. The 24-hour results given by the modelling also consistently under-predict the measured levels.

Q-Q plots are shown in Figure 7.7 (1-hour averages) and Figure 7.8 (24-hour averages) for the nearest receptor and local maximum PM_{10} predictions at Rowella for July and August 2005. The concentrations predicted for the nearest receptor on the 1 km grid significantly under-predict the measured values and fall outside the factor of two (red lines in the figures) acceptability criterion set by the US EPA for model acceptability.

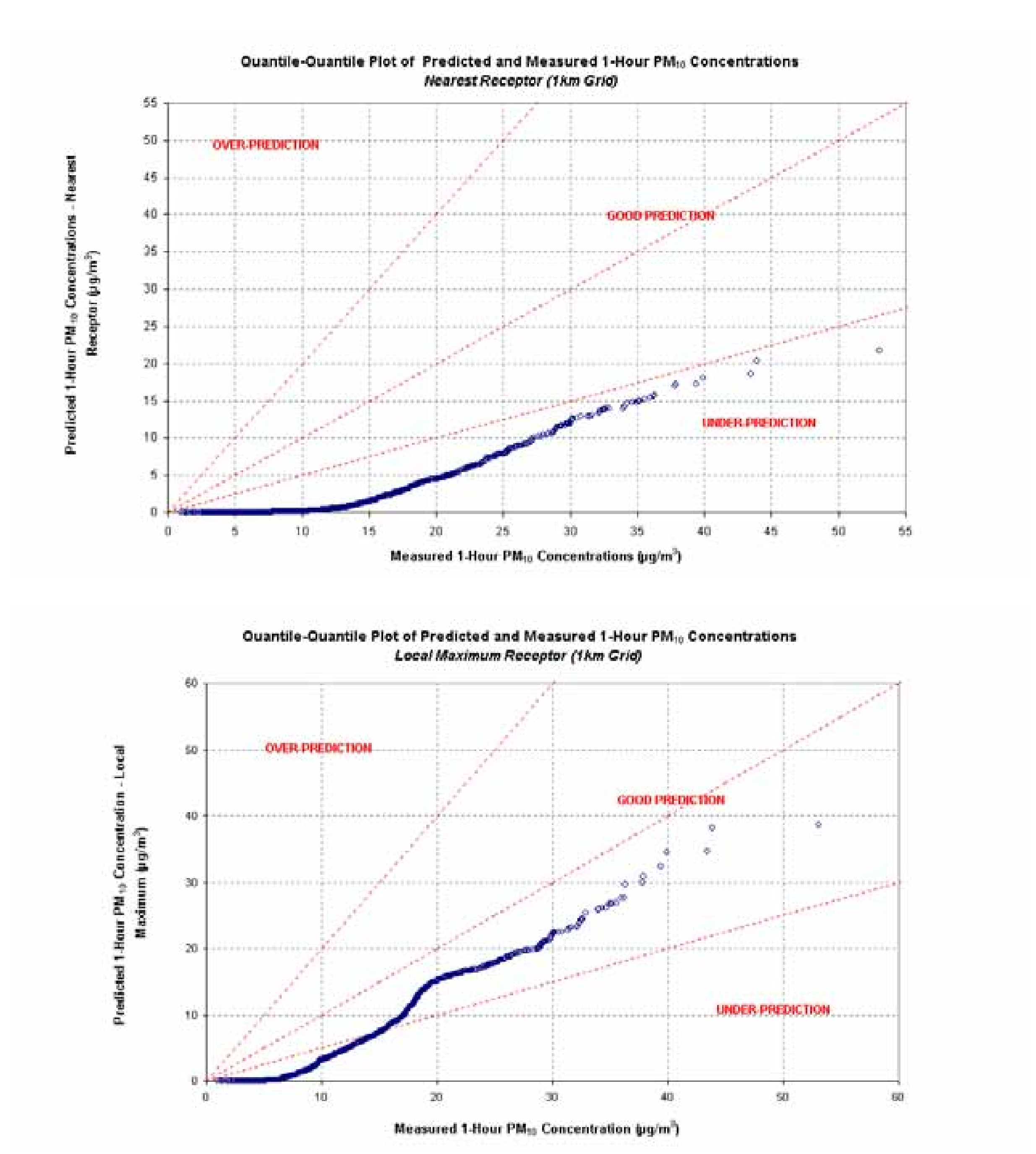


Figure 7.7: Quantile-Quantile 1-Hour PM_{10} Plots for Rowella (July and August 2005)

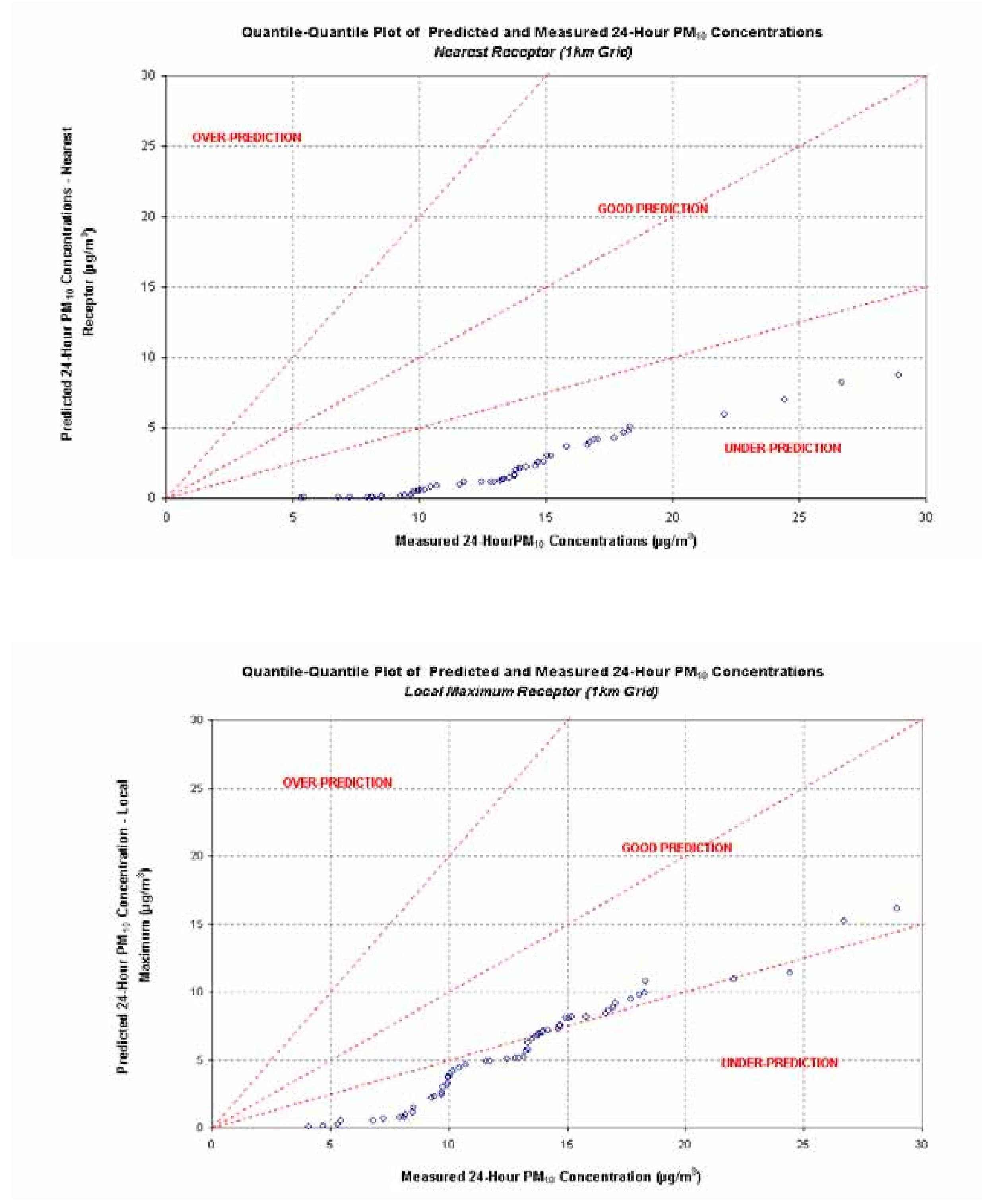


Figure 7.8: Quantile-Quantile 24-Hour PM_{10} Plots for Rowella (July and August 2005)

7.1.4 PM_{10} – 500m Grid Results

As the model predictions using the 1 km receptor grid consistently under-predict compared to the measured levels at Rowella, we have done a further analysis based on 500 m grid data provided by GHD. Due to the increased computational times associated with this finer grid resolution and instabilities in the model (which have since been rectified in consultation with CSIRO, the model developer), slightly less information is available than for the 1 km grid (53 days rather than 59 days). However, these results compare more directly to the modelling that will be used in the IIS assessment. Key statistics for the 500 m grid model predictions, compared to the monitored levels, are given in Figure 7.9.

Figure 7.9 shows that using a 500 m grid resolution, the model over-predicts the maximum 1-hour average recorded during July and August 2005 by around 65%. The maximum 24-hour average, however, is under-predicted by around 50%.

Q-Q plots are shown in Figure 7.10 (1-hour averages) and Figure 7.11 (24-hour averages) for the nearest receptor and local maximum PM_{10} predictions at Rowella for July and August 2005. These plots show that the 1-hour concentrations predicted by the model for the 500 m grid provide better predictions of measured levels than the 1 km grid. While the model still under-predicts the measured concentrations at lower levels, at concentrations above 30 $\mu g/m^3$ (1-hour average), the model predictions comply with the factor of two (red lines in the figures) criterion set by the US EPA for model acceptability. Importantly, the model provides conservative over-predictions of actual levels at concentrations above 40 $\mu g/m^3$ (1-hour average). The under-prediction of lower concentrations is of less concern as the assessment in the IIS will be focussing on peak concentration predictions, which are relevant to the ambient air guideline level.

The 24-hour average PM_{10} concentrations predicted by the model on the 500 m grid still underestimate the levels measured at Rowella, but as the PM_{10} concentrations increase the model accuracy improves. However, it is important to note that many sources of PM_{10} emissions in the region are not included in the model. The under-prediction therefore reflects this lack of completeness in the PM_{10} emissions inventory. This is discussed further in Section 7.1.5.

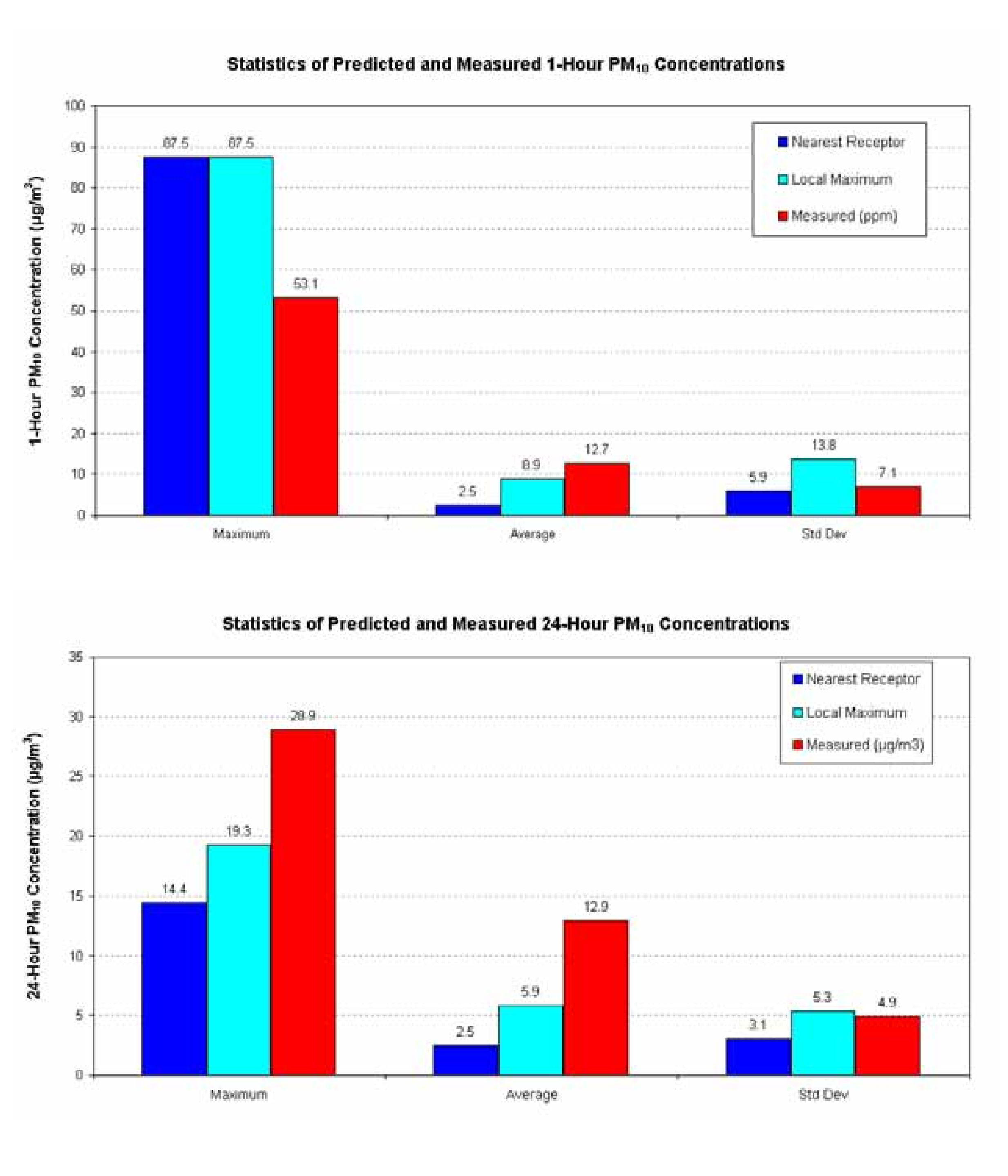


Figure 7.9: Statistical Properties for Measured and Modelled PM_{10} Concentrations at Rowella – 500 m Grid (July and August 2005)

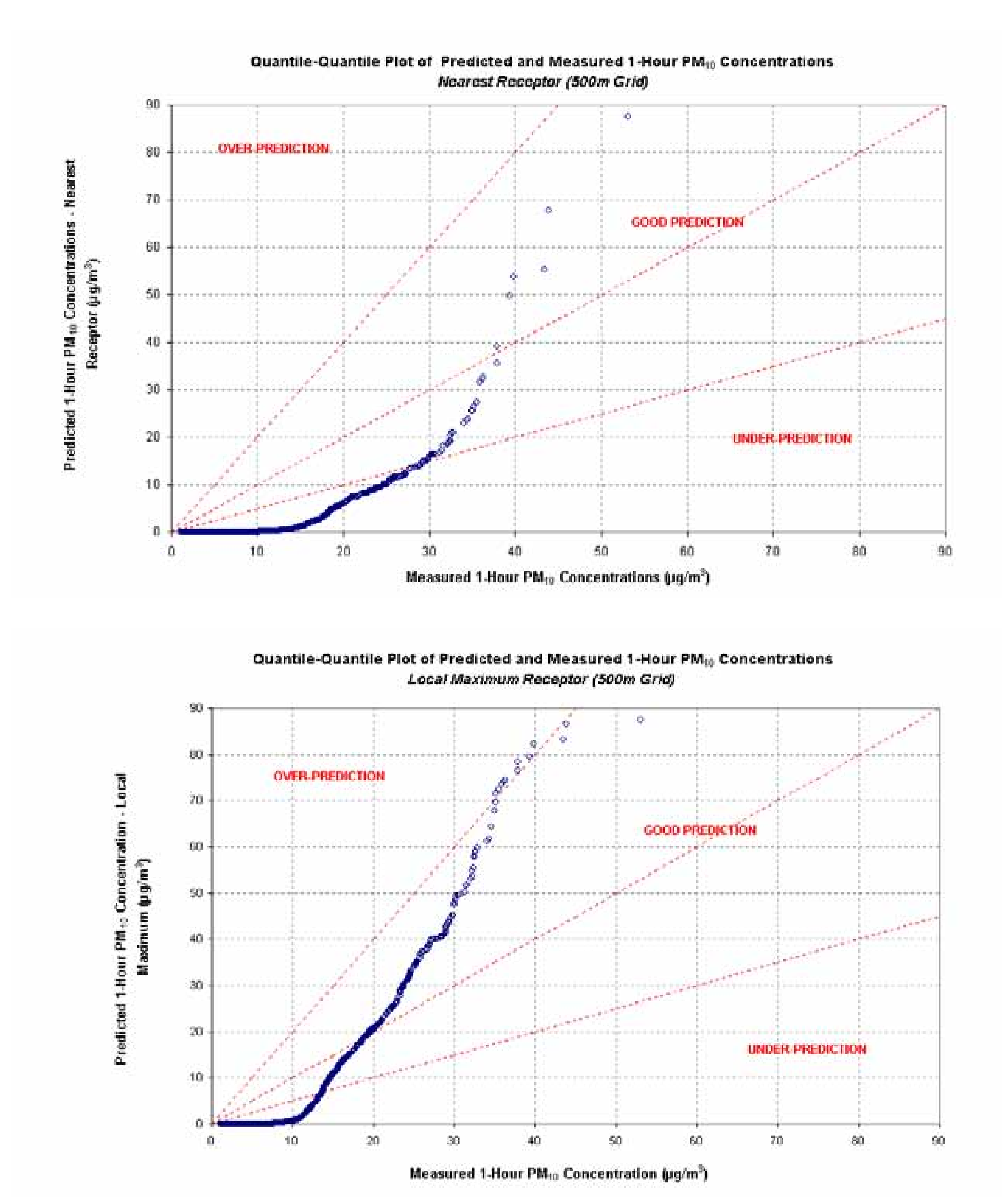


Figure 7.10: Quantile-Quantile 1-Hour PM_{10} Plots for Rowella – 500 m Grid (July and August 2005)

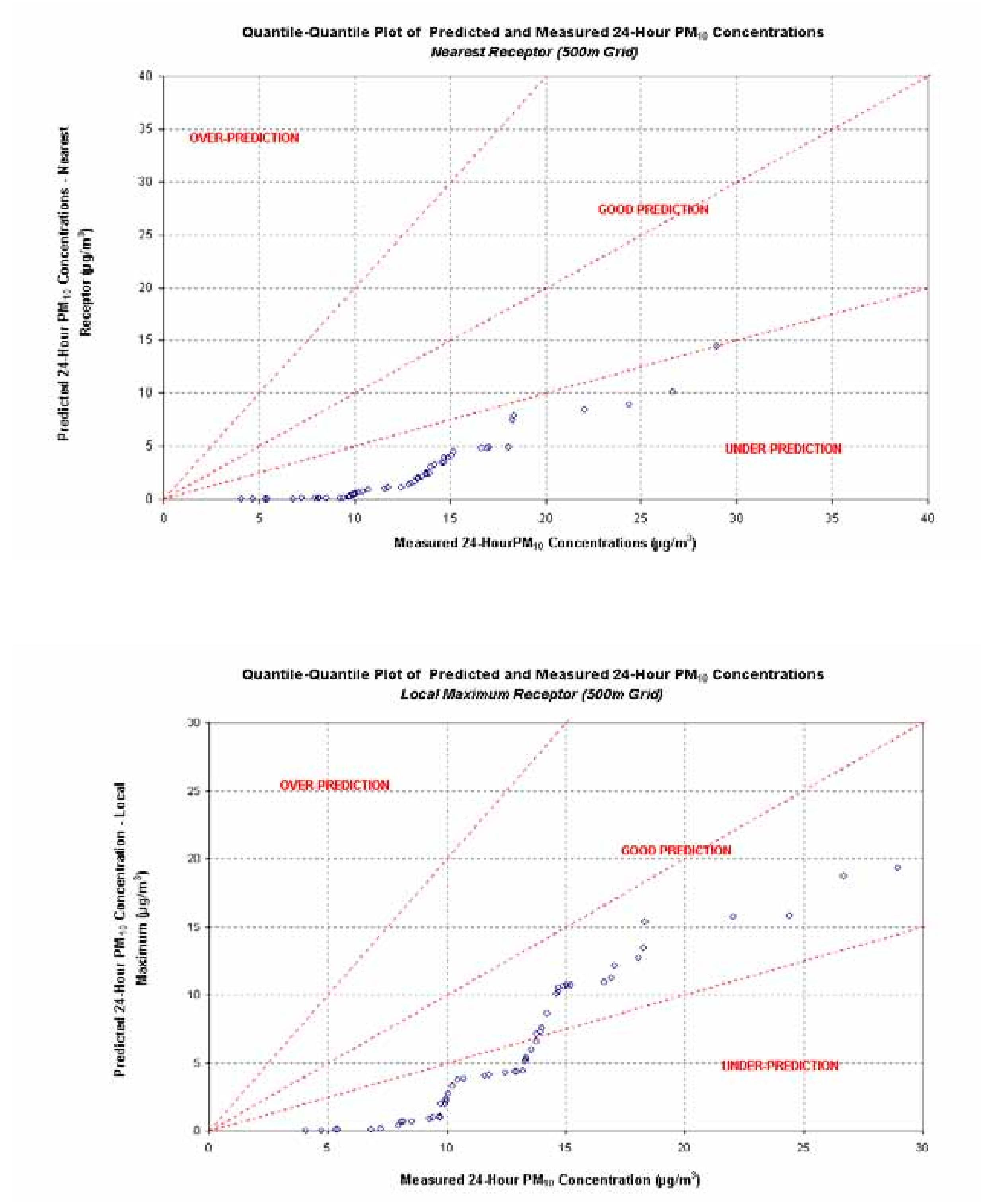


Figure 7.11: Quantile-Quantile 24-Hour PM_{10} Plots for Rowella – 500m Grid (July and August 2005)

7.1.5 Analysis of Wind Direction Influences on PM_{10} Concentrations

To further investigate the influence of wind direction on model under-prediction of background PM_{10} concentrations, pollution roses have been prepared for both the measured and predicted 1-hour PM_{10} concentrations as shown in Figure 7.12 and Figure 7.13. In addition, Figure 7.14 presents 3D plots of measured and predicted PM_{10} concentrations versus wind direction and wind speed. These plots indicate, for example, that significant levels of PM_{10} associated with westerly to northwesterly winds are not well simulated by the model. Figure 7.14 shows that higher measured PM_{10} levels are often associated with stronger northwesterly winds. Generally, strong winds are associated with lower concentrations of the pollutants that are emitted at relatively constant rates from industrial sources. Although there is a general underestimation of PM_{10} in the model results, owing to the fact that many sources of particles are not included in the emissions data driving the model[12], this specific underestimation associated with stronger winds from the northwest sector appears to be associated with a significant sea salt component.

The proximity and the direction of the ocean (to the northwest) in relation to the Rowella monitoring station makes sea salt aerosols a significant contributor to particulate levels at the site. The grey residue accumulated on the glass fibre filter of the TEOM has been analysed by ANSTO to provide information on the particulate sources. High relative proportions of sodium (Na) and chloride (Cl) were determined in the sample (27% and 50% w/w, respectively), leading to the conclusion that sea salt (NaCl) is a dominant component of the particles collected. However, only one sample has been analysed, and the method does not allow for the analysis of carbon, which could be a significant component of the sample. Therefore, the fraction of sample associated with Na and Cl may, in fact, be lower than the relative proportions of these elements determined by the analysis. Certainly the contribution of sea salt will vary over time according to weather conditions and will probably range both higher and lower than the level found in the sample analysed to date.

Notwithstanding these factors, it is evident that sea salt is present and this is consistent with data from other locations. For example, measurements at seven sites in Spain, for example, have estimated sea salt PM_{10} fractions to vary from <1% in Madrid (inland) to about 25% in the Canary Islands (Querol, 2004) and estimates as high as 60% have been reported for marine background sites in California (Chow et al, 1996).

Sea salt has been estimated to contribute about 2.5 - 3 $\mu g/m^3$ to the coarse particle fraction ($PM_{2.5\text{-}10}$) in residential Brisbane (Chan *et al.*, 2000), which would be about 20% of the PM_{10} for such a site. A major influence on PM_{10} in inner city Brisbane has also been reported to be from elements usually associated with marine aerosols, Na and Cl, for long term measurements (Thomas and Morawska, 2002).

D'Abreton *et al*. (2005) reported on a particle study in Gladstone, Queensland using ANSTO's PIXE elemental analysis, and found that sea salt was a dominant component of particles associated with easterly (onshore) winds. The equivalent at Rowella is winds from the north-western sector.

An ongoing program of monitoring the sea salt component of particulate levels has been established by Gunns, using dedicated filters, and this will provide additional data for use in preparing the air impact assessment for the IIS.

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[12] Most of these sources are likely to be natural or rural in nature (e.g., marine aerosols, wind-blown dust, dust from agricultural practices, smoke from natural and man-induced fires, etc.). Under-prediction of PM_{10} is a common issue for modelling where only limited emission inventories (e.g., industrial and urban sources only) are available.

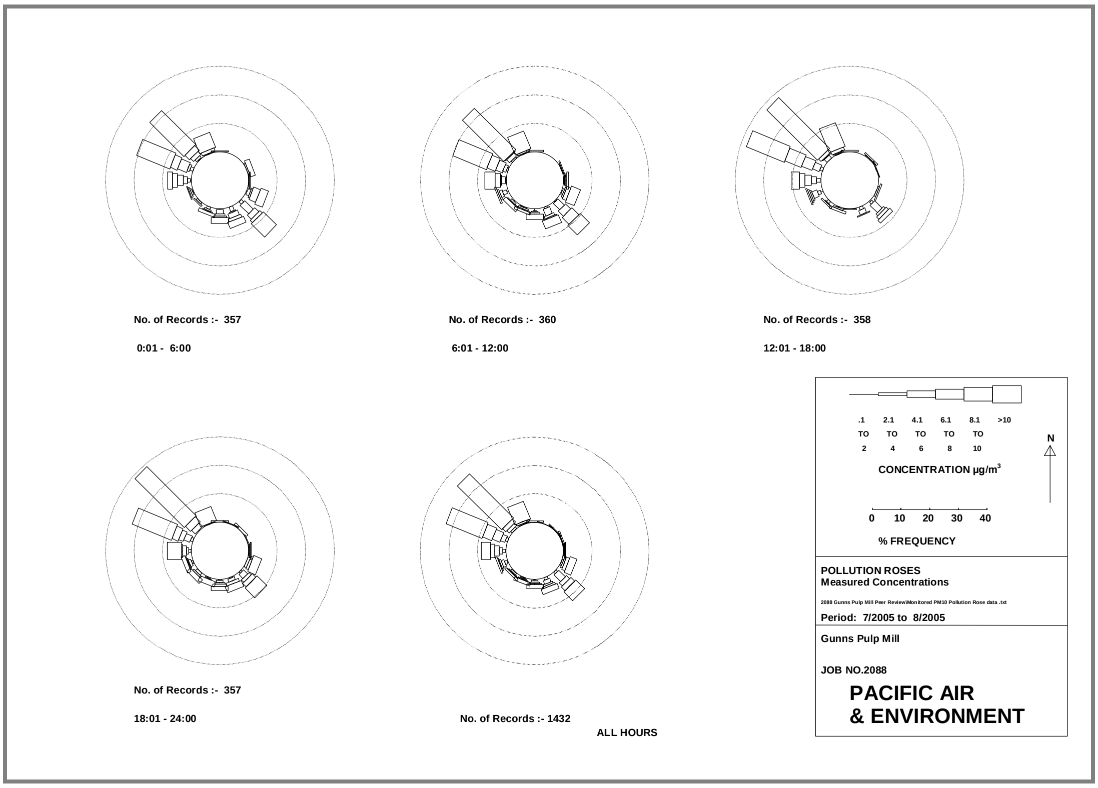


Figure 7.12: Pollution Rose for 1-Hour PM_{10} Concentrations Measured at Rowella (July and August 2005)

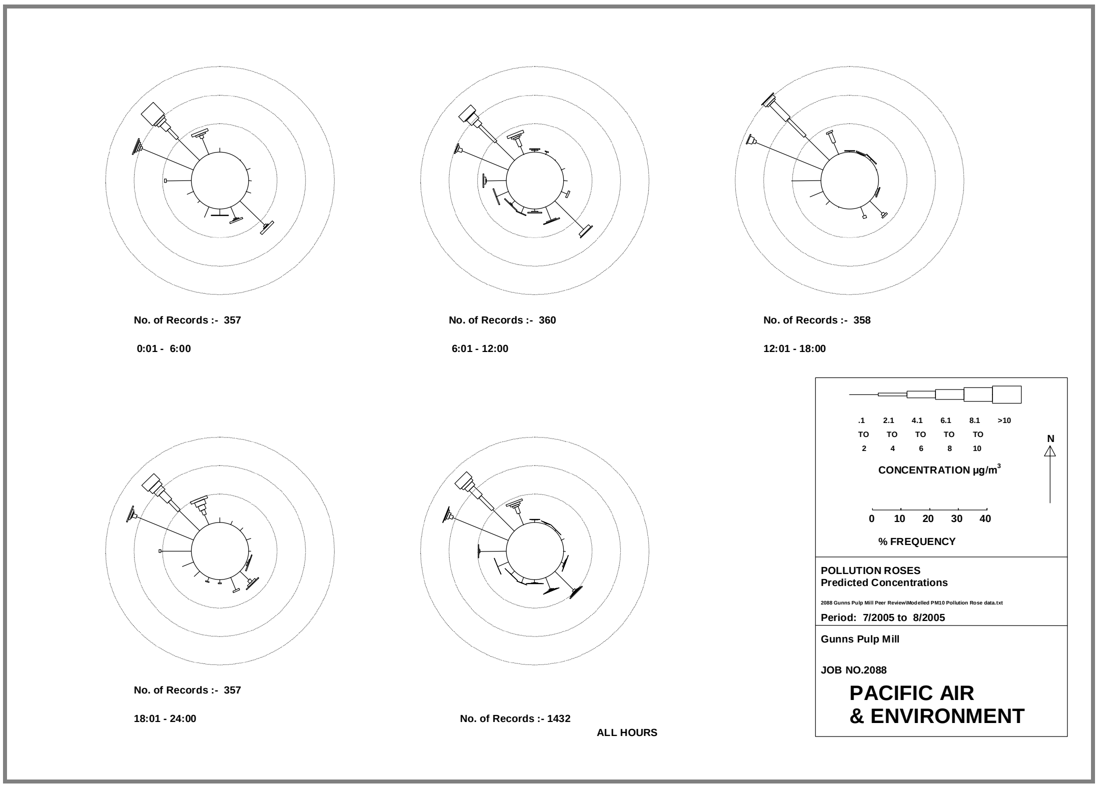
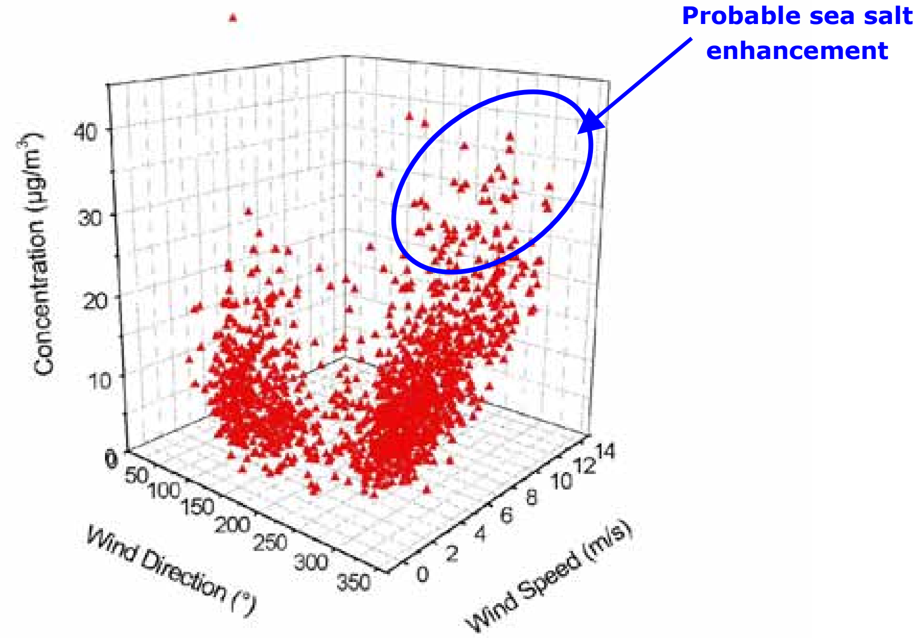


Figure 7.13: Pollution Rose for 1-Hour PM_{10} Concentrations Predicted at Rowella (July and August 2005)

Observed 1-Hour PM_{10} Concentrations:



Predicted 1-Hour PM_{10} Concentrations:

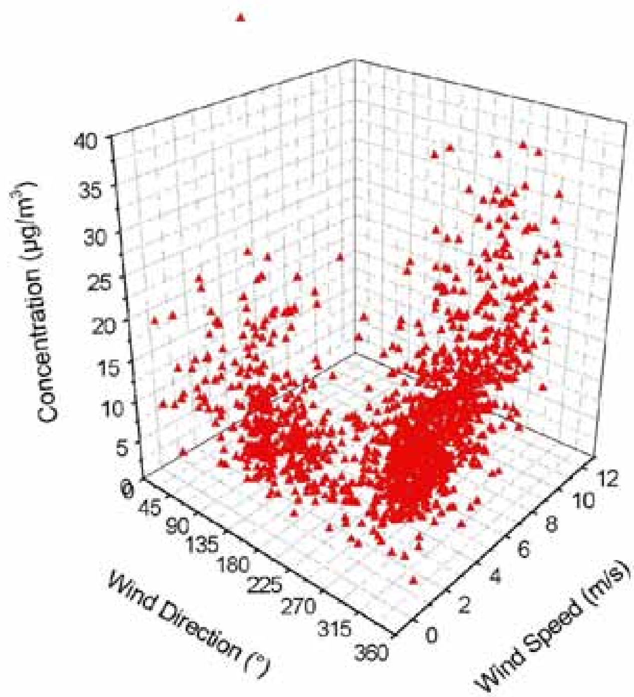


Figure 7.14: 3D Plots of 1-Hour PM_{10} Concentrations, Wind Speed and Wind Direction for Rowella (July and August 2005)

7.2 Ti Tree Bend – Without Mill (Background)

7.2.1 PM_{10}

Q-Q plots are shown in Figure 7.15 (1-hour averages) and Figure 7.16 (24-hour averages) for the 'nearest receptor' and 'local maximum' PM_{10} predictions at Ti Tree Bend for 2004. Q-Q plots for July and August 2005 are shown in Figure 7.17 and Figure 7.18. The Q-Q plots show that the model consistently under-predicts the measured values at Ti Tree Bend, with the results falling outside the factor of two (red lines in the figures) acceptability criterion set by the US EPA for model acceptability. This type of result is common for PM_{10} and is very likely to reflect the influence of other sources of particulate in the vicinity of the monitoring station which are not included in the model. The Ti Tree Bend site is close to Launceston, and it is important to note that wood heaters are the only PM_{10} sources included in the model. Other sources such as motor vehicles, industry, wind-blown dust, pollen, agricultural activities, bushfires and sea salt are not included. Further, it is possible that the way in which the wood heater emissions are represented in the model may contribute to underestimation in the vicinity of the Ti Tree Bend monitoring site, but this effect is not likely to be large, and will not affect model predictions over the wider region.

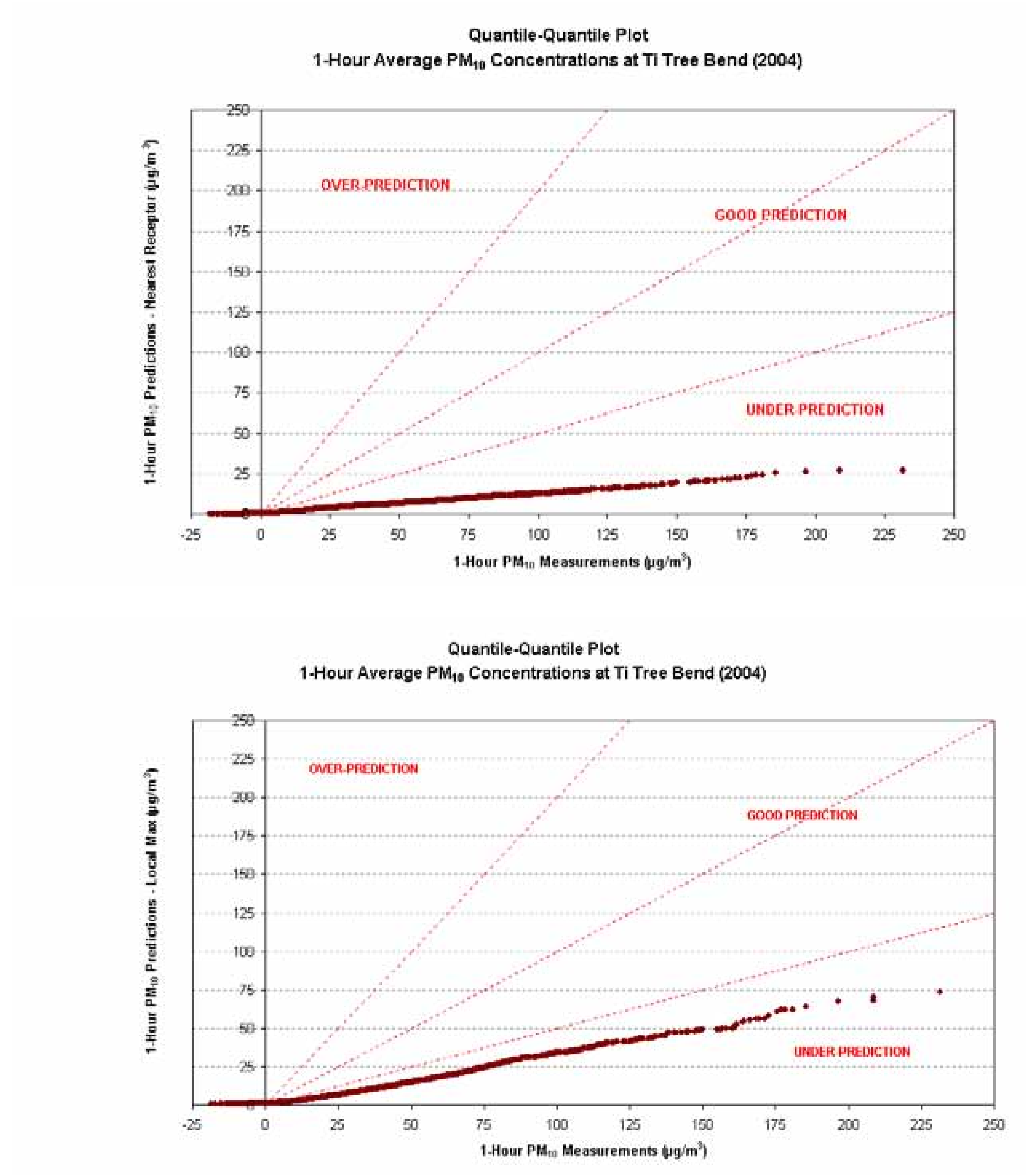
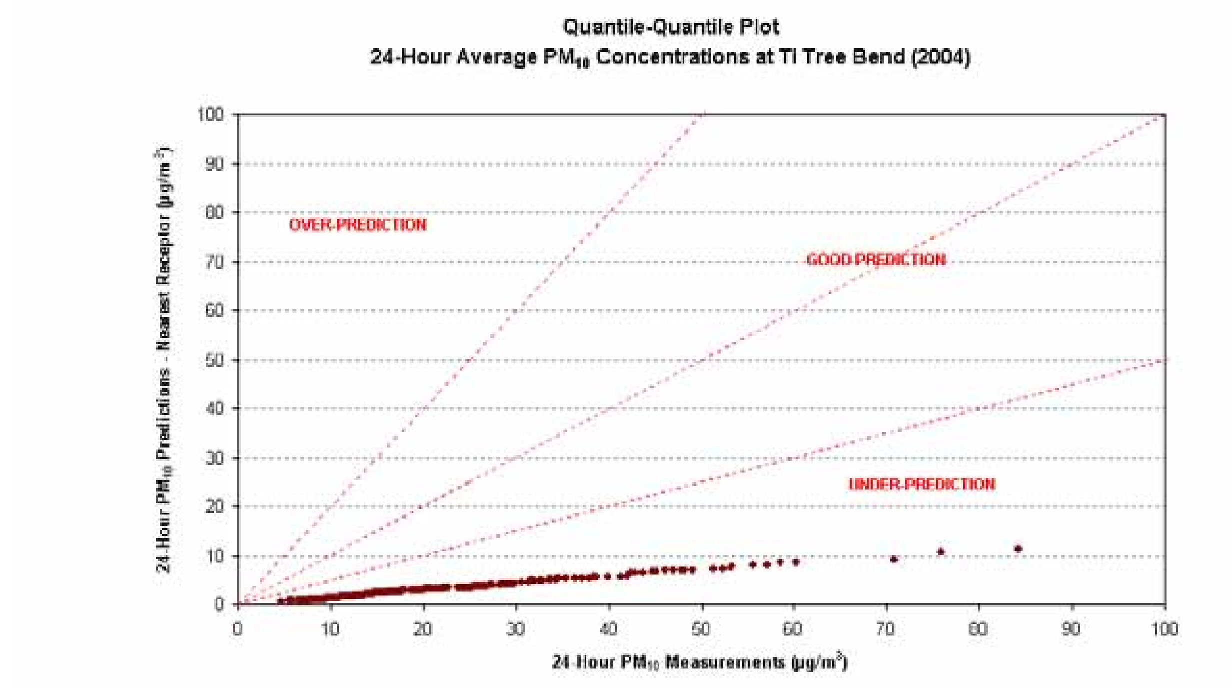


Figure 7.15: Quantile-Quantile 1-Hour PM_{10} Plots for Ti Tree Bend (2004)



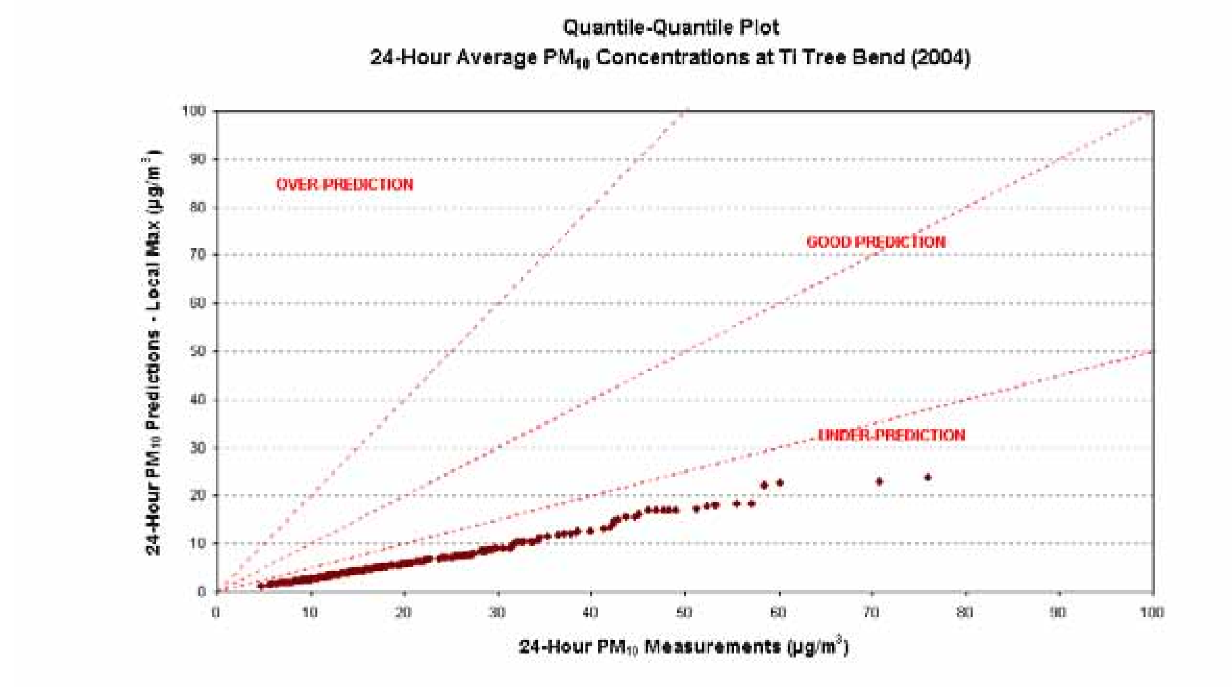
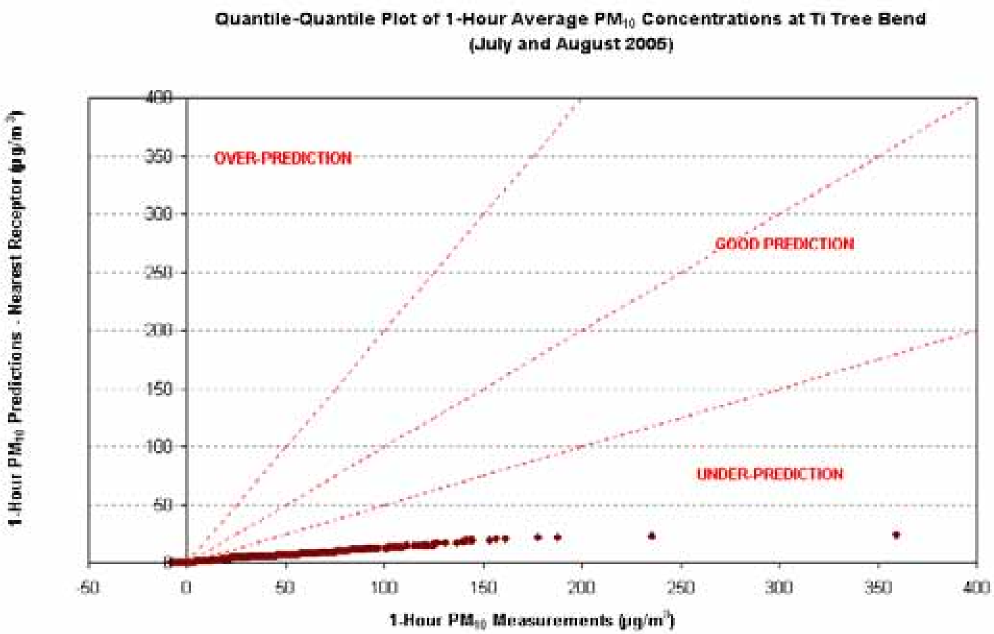


Figure 7.16: Quantile-Quantile 24-Hour PM_{10} Plots for Ti Tree Bend (2004)



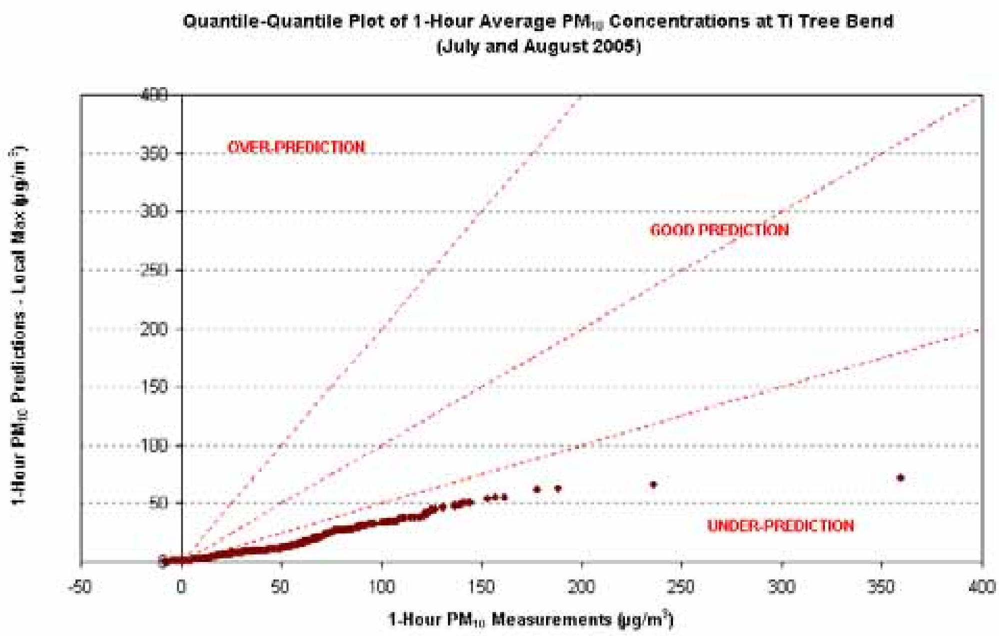


Figure 7.17: Quantile-Quantile 1-Hour PM_{10} Plots for Ti Tree Bend (July and August 2005)

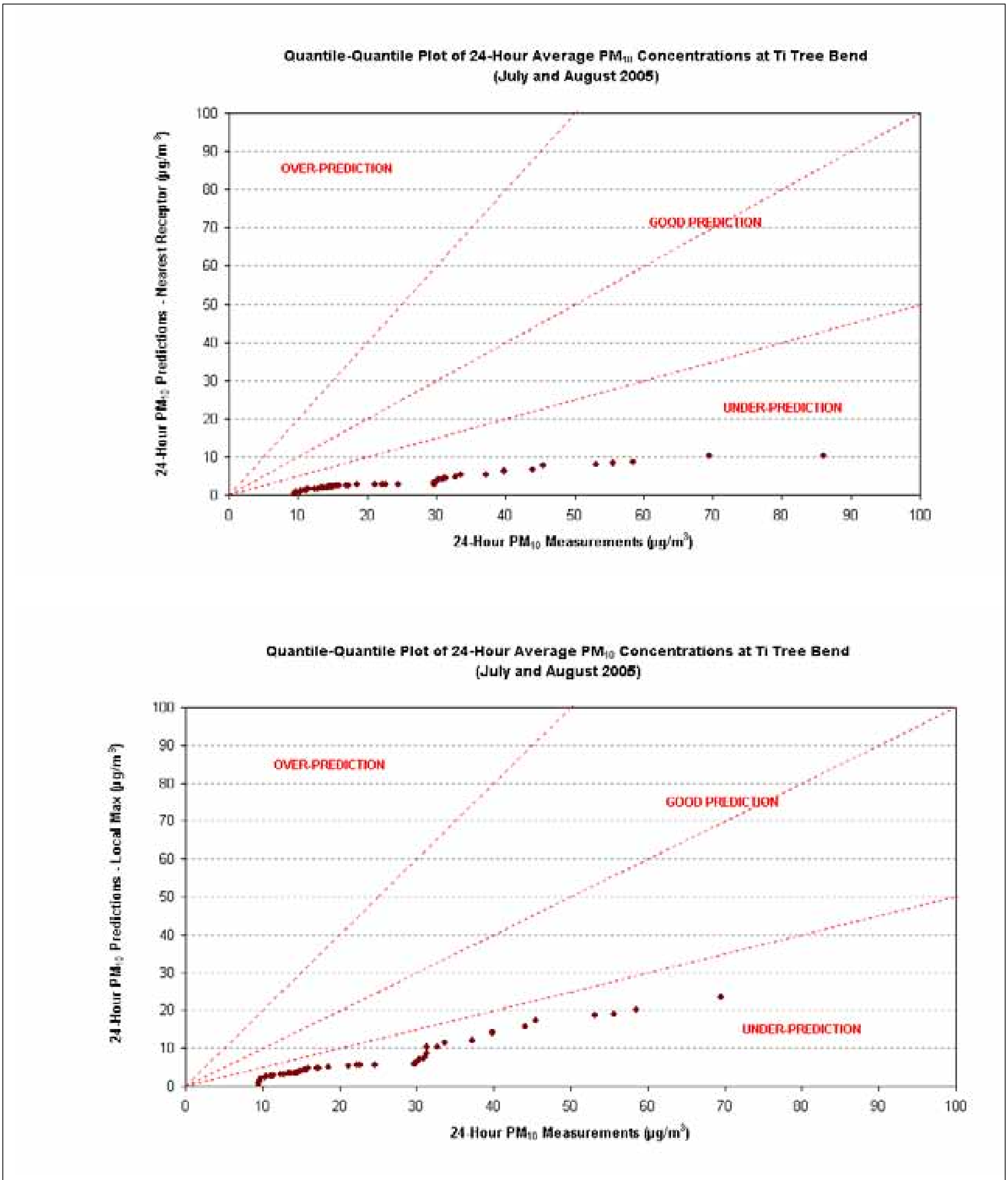


Figure 7.18: Quantile-Quantile 24-Hour PM_{10} Plots for Ti Tree Bend (July and August 2005)

7.3 With Mill Emissions Included

7.3.1 Rowella

Figure 7.19 to Figure 7.21 present the key statistics for SO_2, NO_2 and PM_{10} concentrations predicted by the model, with and without the proposed mill emissions included, for the nearest receptor to the Rowella monitoring station. These modelling results are for the full 2004 meteorological dataset and are based on a 500 m modelling grid resolution.

The graphs show that the emissions from the proposed pulp mill at Bell Bay are predicted to have a negligible impact on ambient concentrations of SO_2, NO_2 and PM_{10} at Rowella. The changes in the peak and average pollutant concentrations are well within the accuracy of the model, and indicate that there would not be any measurable increases in ambient SO_2, NO_2 and PM_{10} concentrations at the monitoring site.

In some of the following figures, the predicted maximum concentrations with the mill included are less than for the baseline model results without the mill. The very small differences arise from details of the model calculation procedures, but essentially indicate no change in concentrations.

Thus, the modelling performed to date suggests that the airshed capacity in the area will not be adversely affected by the mill emissions. Further analysis of the modelling results for the full study area will be provided in the IIS.

Monitoring of TRS at Rowella confirms that existing levels are extremely low. Most recordings have been of zero concentration. No model results are yet available for TRS.

7.3.2 Ti Tree Bend

Figure 7.22 presents the key statistics for PM_{10} concentrations predicted by the model, with and without the proposed mill emissions included, for Ti Tree Bend. As for the Rowella monitoring results, this plot indicates that the emissions from the proposed pulp mill at Bell Bay are predicted to have a negligible impact on ambient concentrations of PM_{10} levels at Ti Tree Bend.

The IIS will address in full the potential impacts of the proposed mill emissions on air quality within the Tamar Valley area and in Launceston. However it is noted here that PM_{10} emissions from the mill will only have the potential to impact on the Launceston area when the wind is blowing up the valley from the northwest Elevated background concentrations at Launceston, however, generally occur during stable, down-valley southeast wind conditions, and under these conditions the emissions from the mill would break through the low inversion layer and not be brought down to ground level. Thus the potential for elevated concentrations in Launceston due to the mill is very limited.

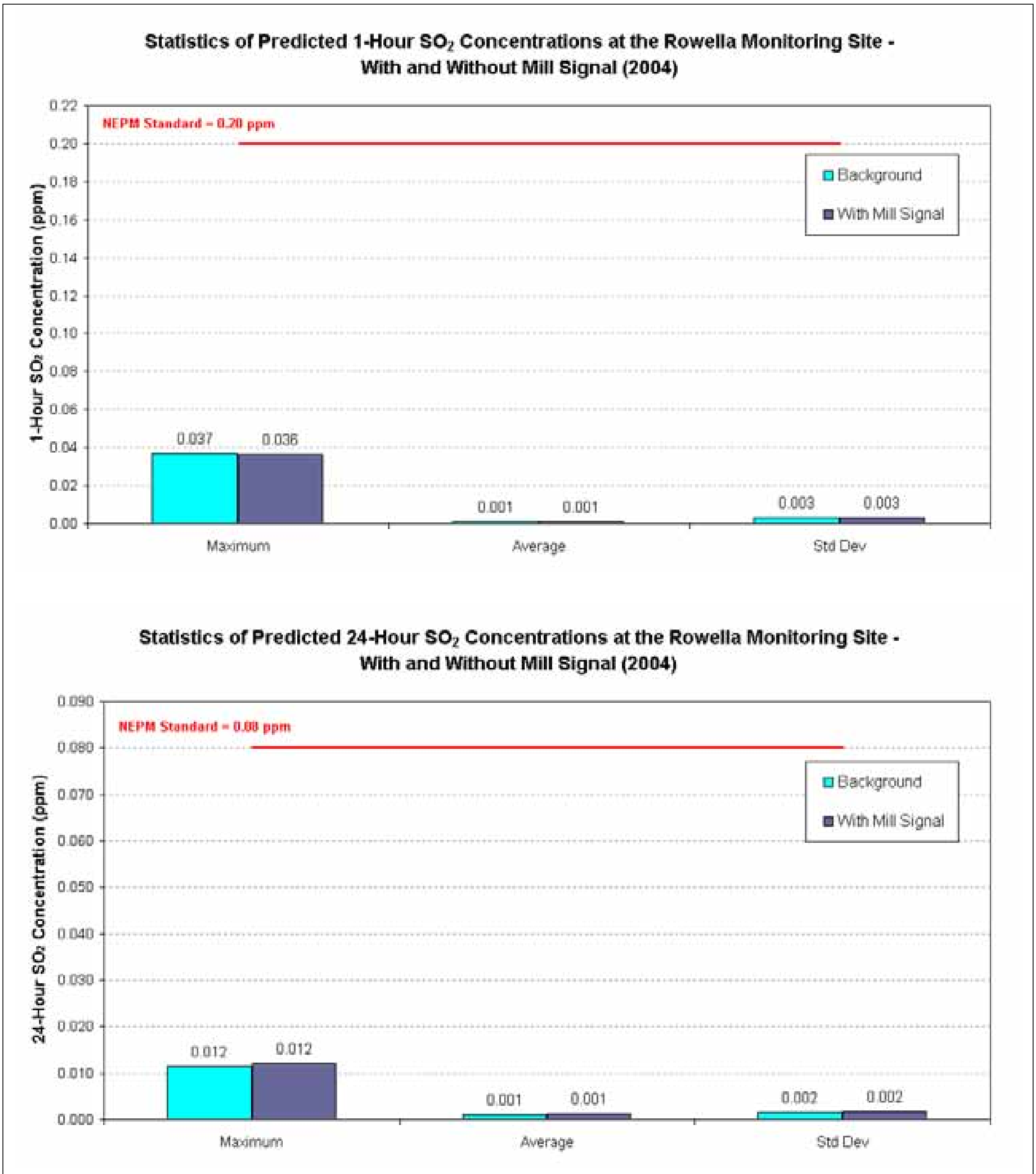


Figure 7.19: Statistics of SO_2 Concentrations Predicted at Rowella With and Without the Proposed Mill Emissions (2004)

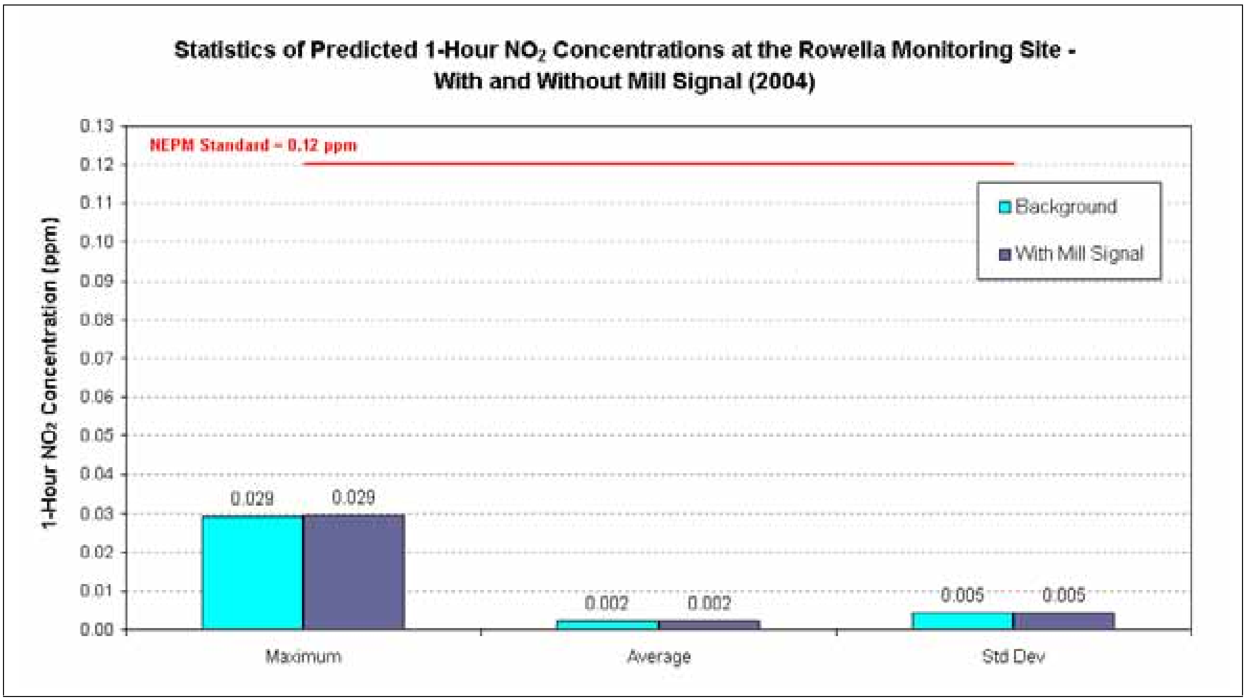


Figure 7.20: Statistics of NO_2 Concentrations Predicted at Rowella With and Without the Proposed Mill Emissions (2004)

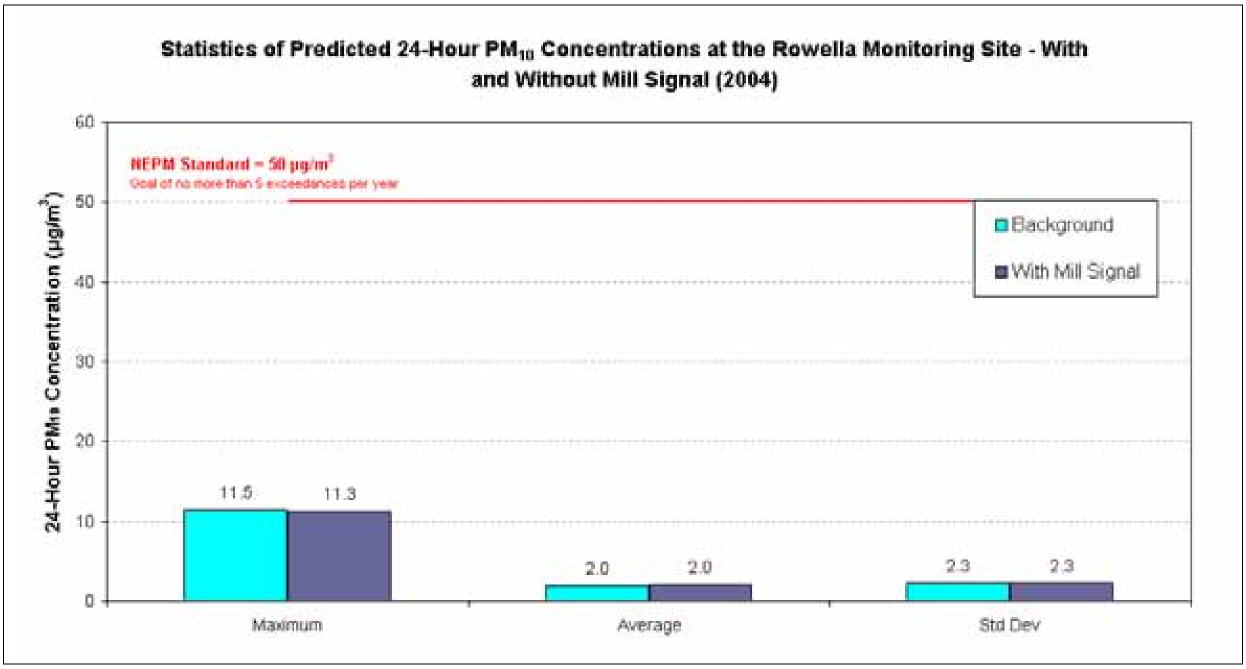


Figure 7.21: Statistics of PM_{10} Concentrations Predicted at Rowella With and Without the Proposed Mill Emissions (2004)

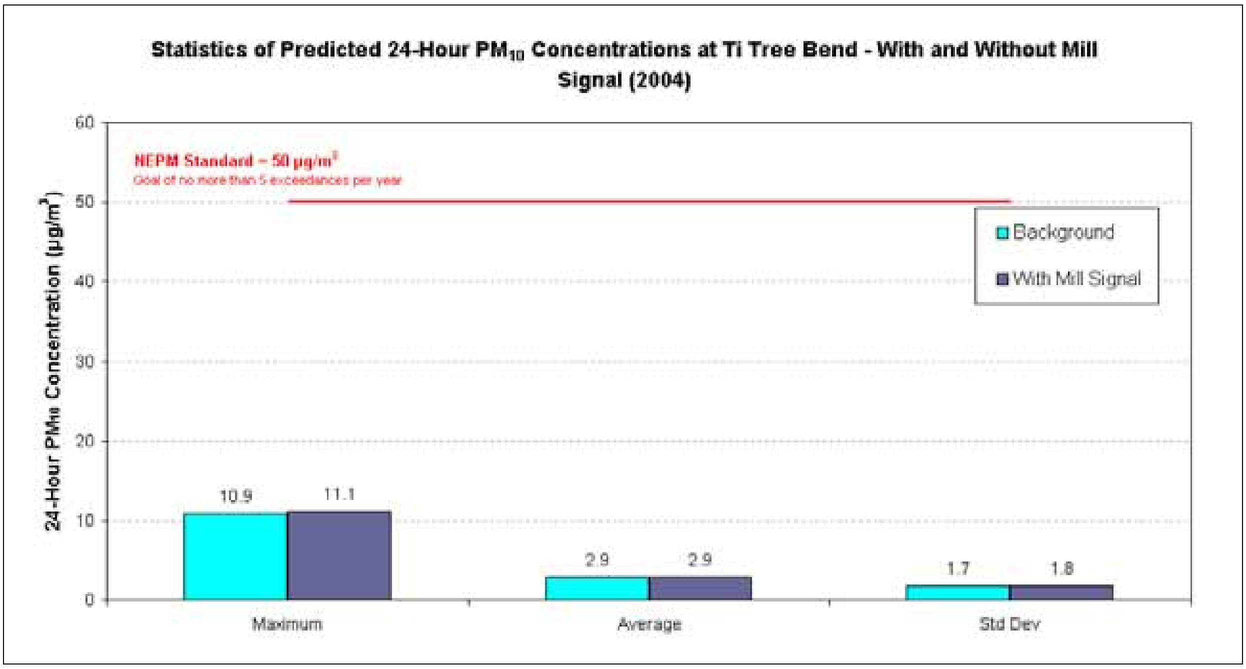


Figure 7.22: Statistics of PM_{10} Concentrations Predicted at Ti Tree Bend With and Without the Proposed Mill Emissions (2004)

8 CONCLUSIONS

Table 8.1 summarises the results of the model validation exercise. Based on the data available to date, the validation exercise indicates that the model:

- over-predicts background SO_2 and NO_2 concentrations;
- over-predicts background PM_{10} levels at 1-hour concentrations above 40 µg/m^3. It under-predicts at levels between 30 – 40 µg/m^3 and does not comply with acceptability criteria limits at less critical lower levels below 30 µg/m^3; and
- under-predicts background 24-hour average PM_{10} levels at concentrations below 30 µg/m^3 but provides improved estimates of measured levels as concentrations increase.

Table 8.1: Comparison Between Predicted (Nearest Receptor) and Measured 1-Hour Concentrations at Rowella (July and August 2005)

Pollutant	1-Hour Maximum		Comments
	Measured	Predicted	
SO_2 (ppm)	0.009	0.011	TAPM over-predicts below 0.01 ppm but is within acceptable limits at higher levels.
NO_2 (ppm)	0.015	0.021	TAPM under-predicts below 0.003 ppm but is within acceptable limits (slightly over-predicts) at higher levels.
PM_{10} (µg/m^3)	53	22 (1 km grid)	TAPM under-predicts and is outside acceptable limits on the 1 km grid.
		88 (500 m grid)	TAPM under-predicts below 30 µg/m^3 but is within acceptable limits above this level, and slightly over-predicts above 40 µg/m^3.

The reduced accuracy of the model in predicting ground level PM_{10} concentrations is most likely to be due to the difficulty of including all sources of particulate in the model. This is a common issue when inventorying and modelling particulate levels, as in almost any environment there will be significant emissions of particulate from diffuse sources such as motor vehicles, wind-blown dust, pollen, agricultural activities, bushfires and sea salt, all of which are difficult to quantify and characterise for modelling purposes. Particulate matter from these sources, however, would not normally be expected to contain the types of contaminants found in combustion-related particulate matter, which is known to impact on human health, and which should be adequately characterised in the model.

Additional analyses have been performed to further investigate the influence of wind direction on the tendency of the model to under-predict background PM_{10} concentrations. This analysis showed that significant levels of PM_{10} associated with westerly to northwesterly winds are not well simulated by the model. This specific underestimation associated with stronger winds from the northwest sector appears to be associated with a significant sea salt component. A chemical analysis of the grey residue accumulated on the glass fibre filter of the TEOM yielded high relative proportions of sodium (Na) and chloride (Cl) in the sample (27% and 50% w/w, respectively) which points to the conclusion that sea salt (NaCl) is a dominant component of the particles collected. An ongoing program of monitoring the sea salt component of particulate levels has been established by Gunns, using dedicated filters, which will provide additional data for use in preparing the air impact assessment for the IIS.

A review of the preliminary modelling data available for Rowella and Ti Tree Bend with and without the emissions from the proposed pulp mill included, indicate that the emissions from the proposed mill are predicted to have a negligible impact on ambient concentrations of SO_2, NO_2 and PM_{10} at these locations. The changes in the peak and average pollutant concentrations are well within the accuracy of the model, and indicate that there would not be any measurable increases in ambient SO_2, NO_2 and PM_{10} concentrations at the monitoring site. Thus, the modelling performed to date suggests that the airshed capacity in the area will not be adversely affected by the mill emissions. Further analysis of the modelling results for the full study area will be provided in the IIS.

While model results for TRS are unavailable, background monitoring indicates very low (mostly zero) TRS concentrations. Hence, fugitive mill emissions can be considered to be the only significant contributor to future TRS levels in the airshed. The airshed capacity for TRS is relatively large given the very low background.

Overall, the tendency of the model to over-predict the measured pollutant concentrations at higher levels means that the modelling should provide conservative overestimates of background levels, especially at the more critical, higher concentrations. While ongoing monitoring will provide additional data to further verify this conclusion, the information available to date indicates that use of the modelled background concentrations will provide a suitably conservative (i.e. stringent) assessment of the local airshed's capacity to accommodate the proposed development.

There is no suggestion from the data provided by GHD that the airshed capacity is currently being approached or exceeded, except with respect to PM_{10} in the vicinity of Launceston, or that the mill emissions will have other than a negligible impact on the airshed capacity. Given this situation and that the monitoring data will not be needed to directly model or predict the impact of the mill on air quality, we consider that a full 12 months of monitoring would not add any significant value to the assessment of air quality, and that a shorter duration of monitoring poses no significant risk of leading to erroneous conclusions in the IIS. By the time Draft IIS is submitted, approximately 6 months' data encompassing winter, spring and summer will be available.

9 REFERENCES

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APPENIDIX A

ROWELLA MONITORING STATION DETAILS

APPENDIX A - ROWELLA MONITORING STATION DETAILS

The Rowella monitoring station comprises:

- An air-conditioned monitoring shelter;
- SO_2 analyser;
- $NO/NO_2/NO_X$ analyser;
- TEOM real time particulate monitor;
- TRS converter and analyser;
- Relative humidity sensor;
- Temperature sensor;
- Naturally aspirated radiation shield; and
- Met One Solid State Sonic Wind Sensor.

The SO_2 monitor is an ultra violet fluorescence spectrometer designed to continuously measure low levels of sulphur dioxide in ambient air. The USEPA has designated this analyser as an equivalent method.

The $NO/NO_2/NO_X$ monitor uses gas phase chemiluminescence detection to perform continuous analysis of nitric oxide, total oxides of nitrogen, and nitrogen dioxide. The USEPA has designated this analyser as an equivalent method.

The TEOM particulate monitor is a true gravimetric instrument that draws air through a filter at a constant flow rate, continuously weighing the filter and calculating near real time (10 minute intervals) mass concentrations. The weighing principal is similar to a microbalance.

The ultrasonic wind sensor has three equally spaced ultrasonic transducers on a horizontal plane. The sensors measure the time it takes the ultrasound to travel from one transducer to another, with the transit time being measured in both directions. The transit time depends on the wind velocity. For zero wind velocity both the forward and reverse transit times are the same. With wind along the sound path, the upwind transit time increases and the downwind transit time decreases. Measuring the six transit times allows wind velocity to be measured for each of the three ultrasonic paths, which are offset to each other by 120°.

The detection limits of the analysers are reported to be as follows:

- TRS: 200 ppt or 0.3042 $\mu g/m^3$ as H_2S
- NO_X: 1.0 ppb
- SO_2: 1.0 ppb
- TEOM PM_{10}: 0.1 $\mu g/m^3$
- Vector wind speed: 0.1 m/s
- Vector wind direction: 1 deg
- Sigma: 1 deg

(Reference at zero degrees Celsius and 101.3 kilopascals.)

APPENIDIX B

ROWELLA MONITORING DATA

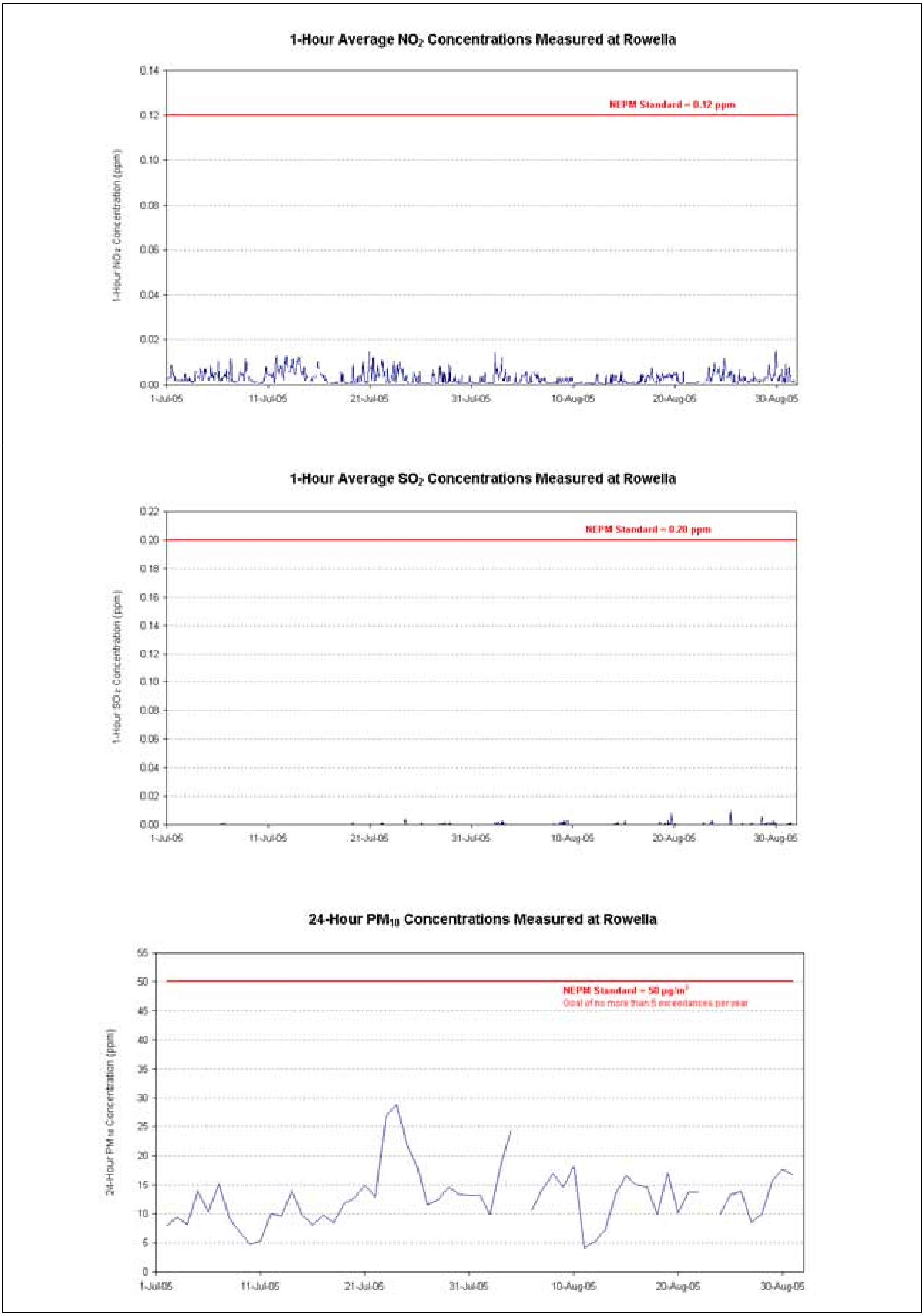


Figure B.1: NO_2, SO_2 and PM_{10} Monitoring Data for Rowella (July and August 2005)

APPENIDIX C

TI TREE BEND MONITORING DATA

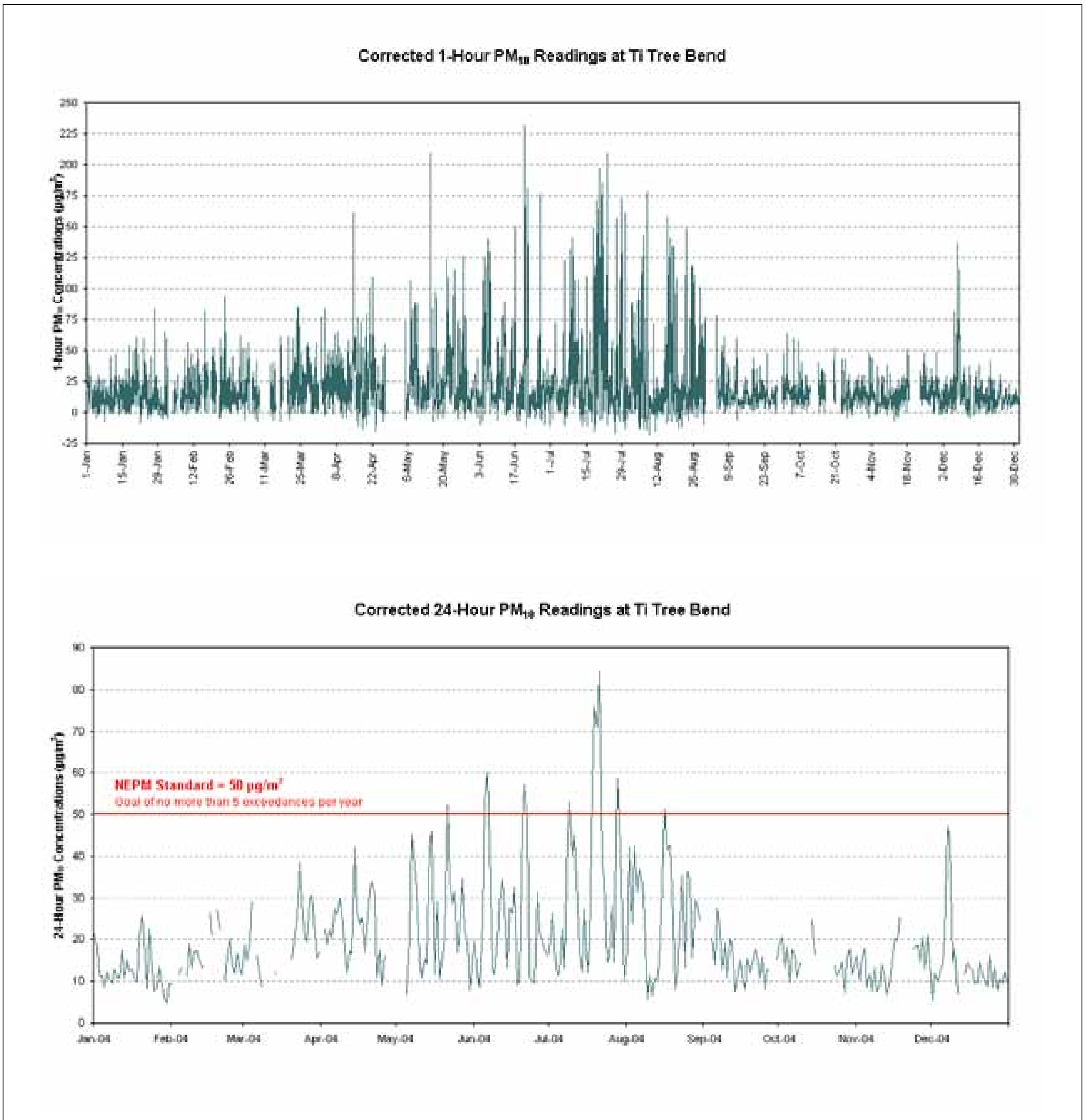


Figure C.1: Measured 1-Hour and 24-Hour PM_{10} Concentrations, Ti Tree Bend 2004

Note: PM_{10} levels are measured at Ti Tree Bend using a TEOM monitor and negative data represents occasions when more mass was evaporated off the TEOM filter than was deposited on it. The DPIWE correction attempts to estimate an hourly mean concentration that an unheated instrument would record and is based on observed correlations between 24-hour average TEOM and high volume air sampler measurements, as a function of the ambient air temperature.

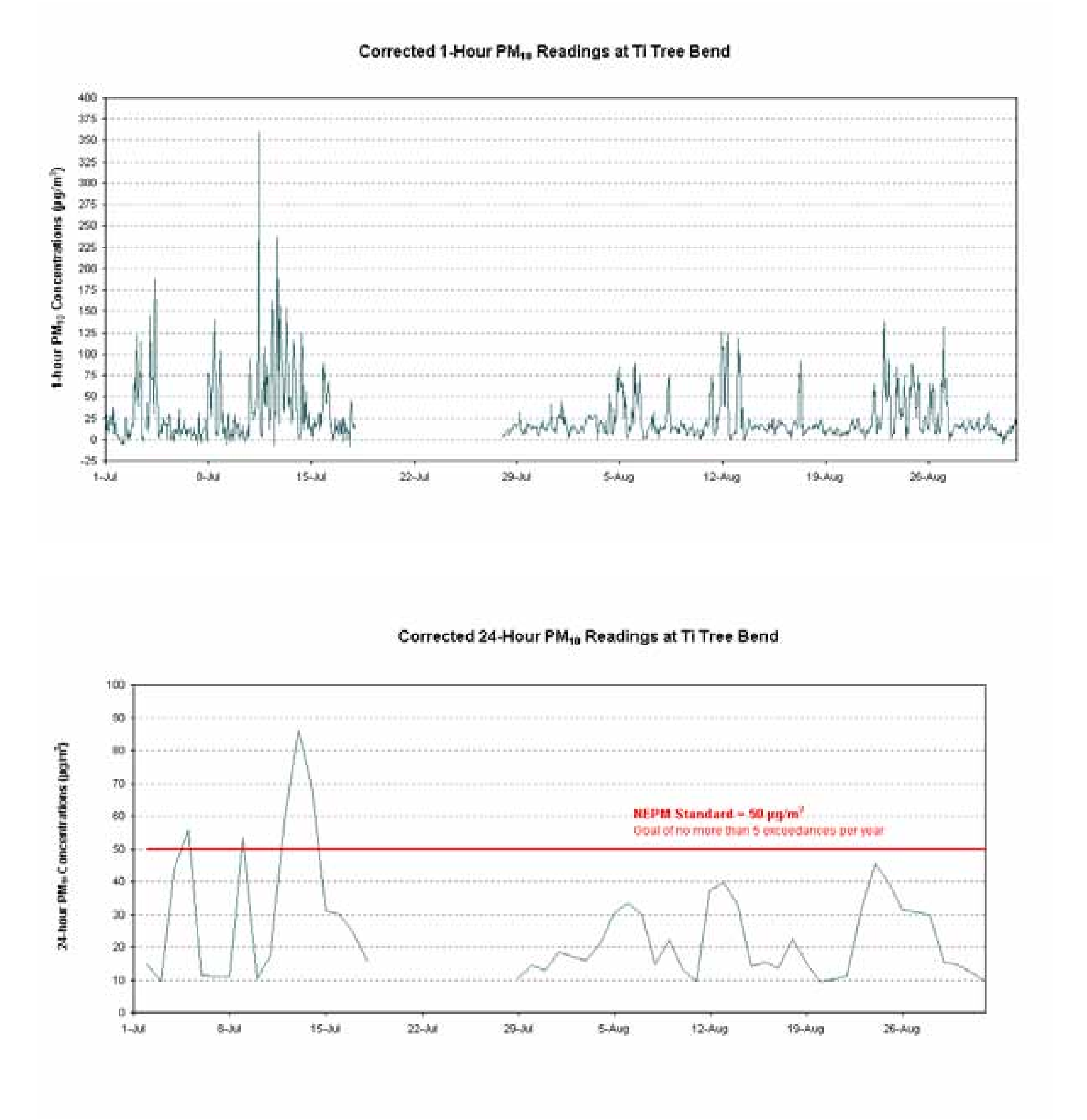


Figure C.2: Measured 1-Hour and 24-Hour PM_{10} Concentrations, Ti Tree Bend (July-August 2005)

APPENIDIX D

ROWELLA MODELLING PREDICTIONS

APPENDIX D - ROWELLA MODELLING PREDICTIONS

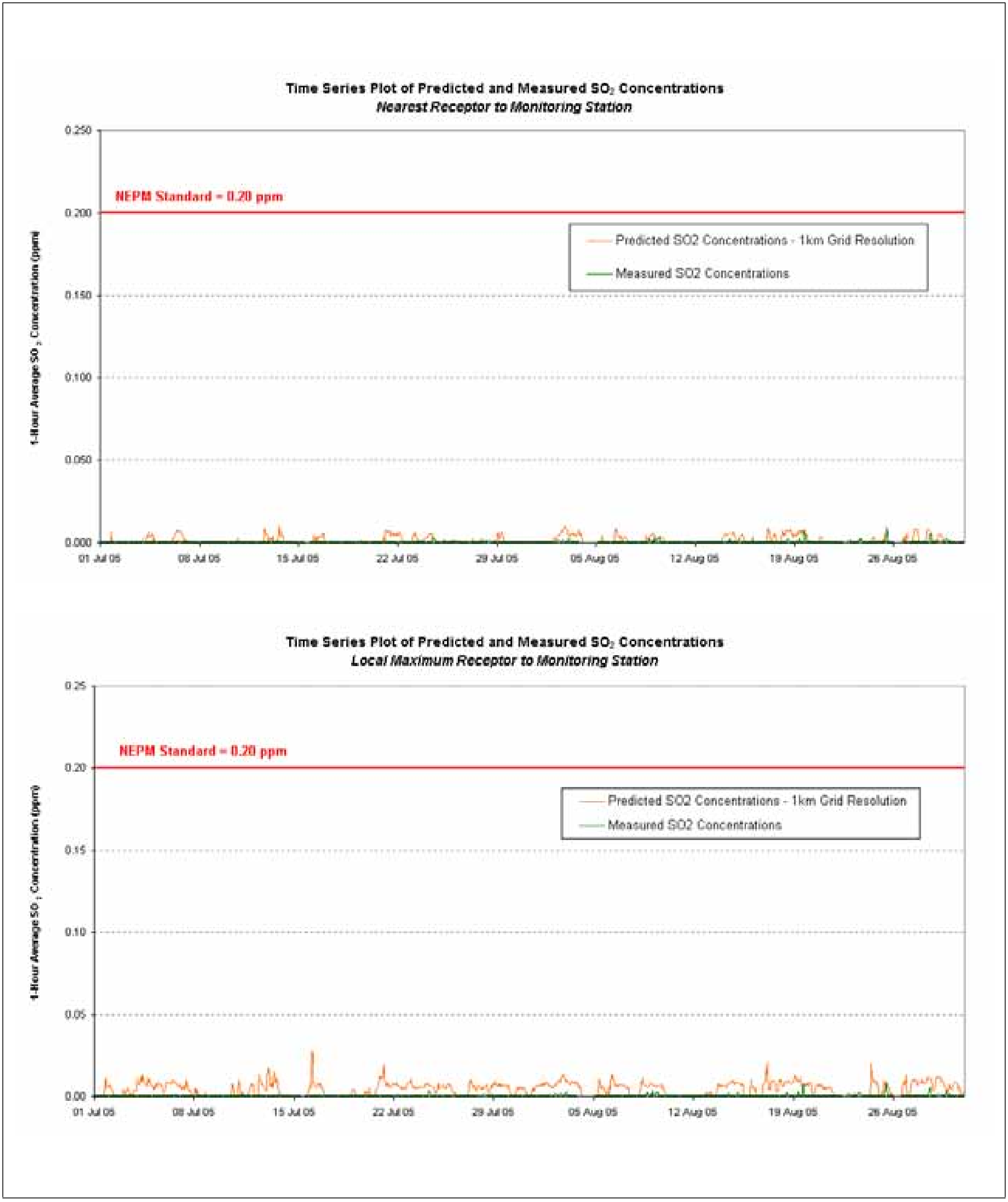


Figure D.1: Time Series Plots of 1-Hour Average Measured and Modelled SO_2 Concentrations at Rowella (July and August 2005)

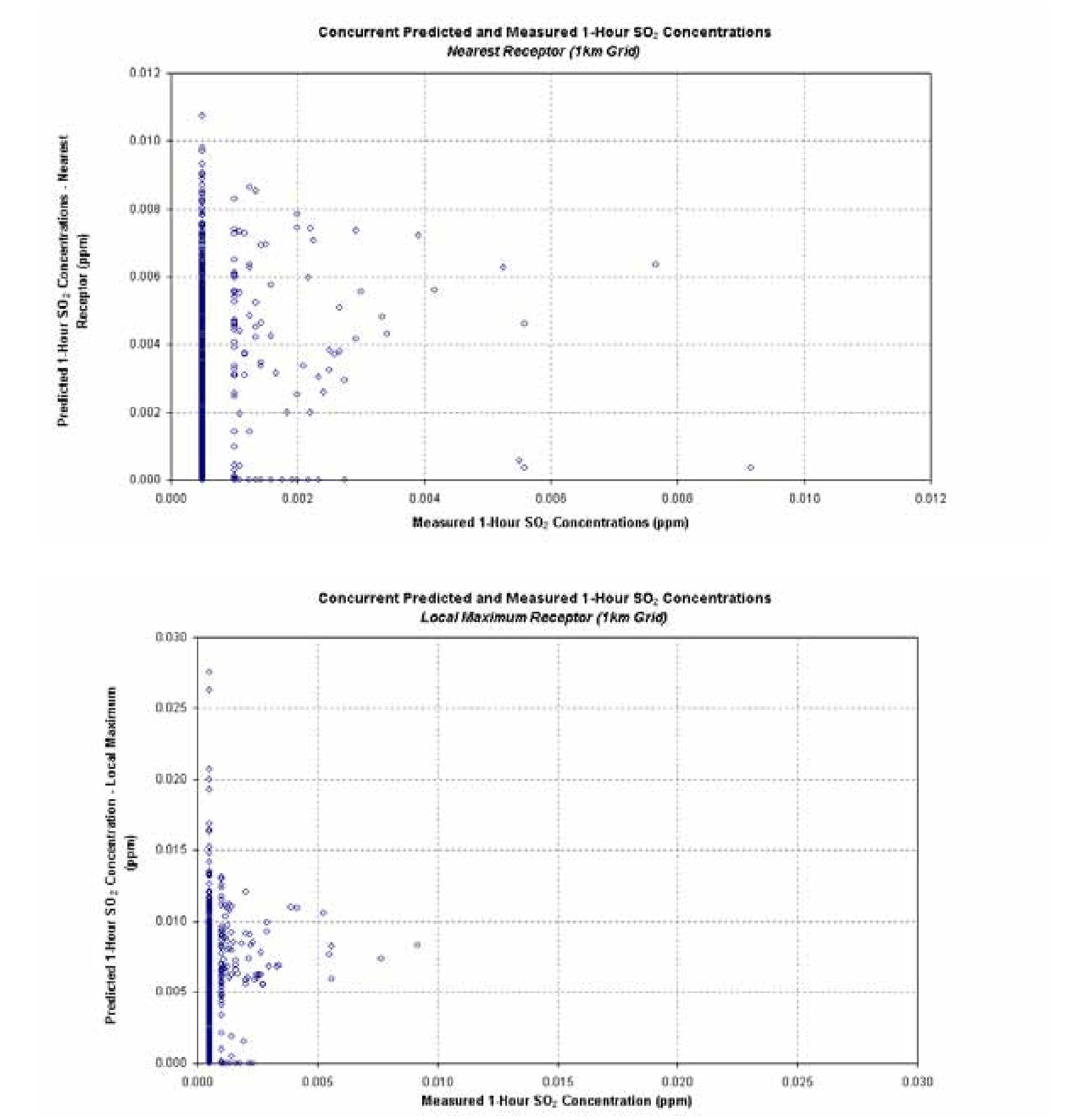


Figure D.2: Plots of Concurrent Measured and Modelled 1-Hour SO_2 Concentrations at Rowella

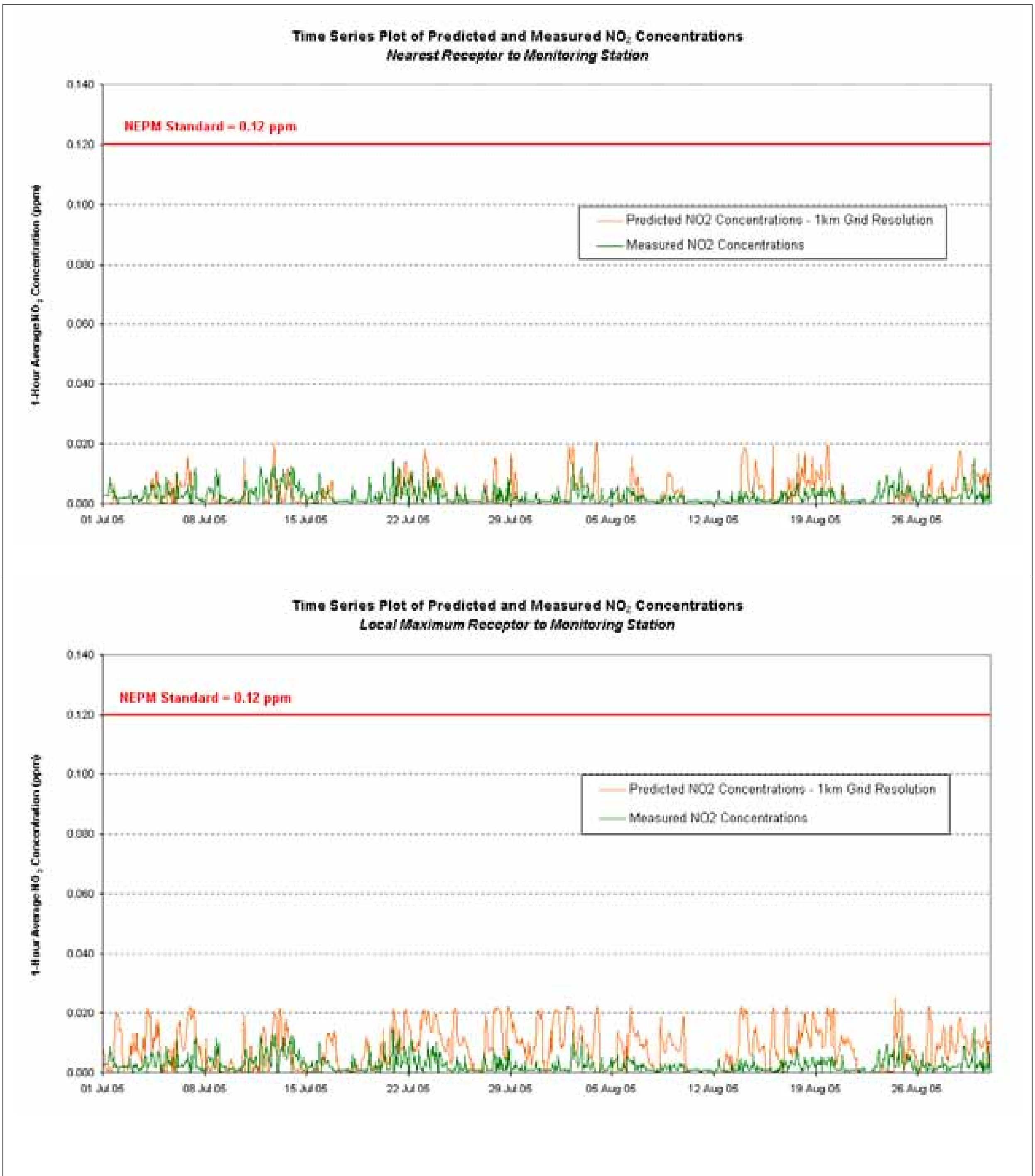


Figure D.3: Time Series Plots of 1-Hour Average Measured and Modelled NO_2 Concentrations at Rowella (July and August 2005)

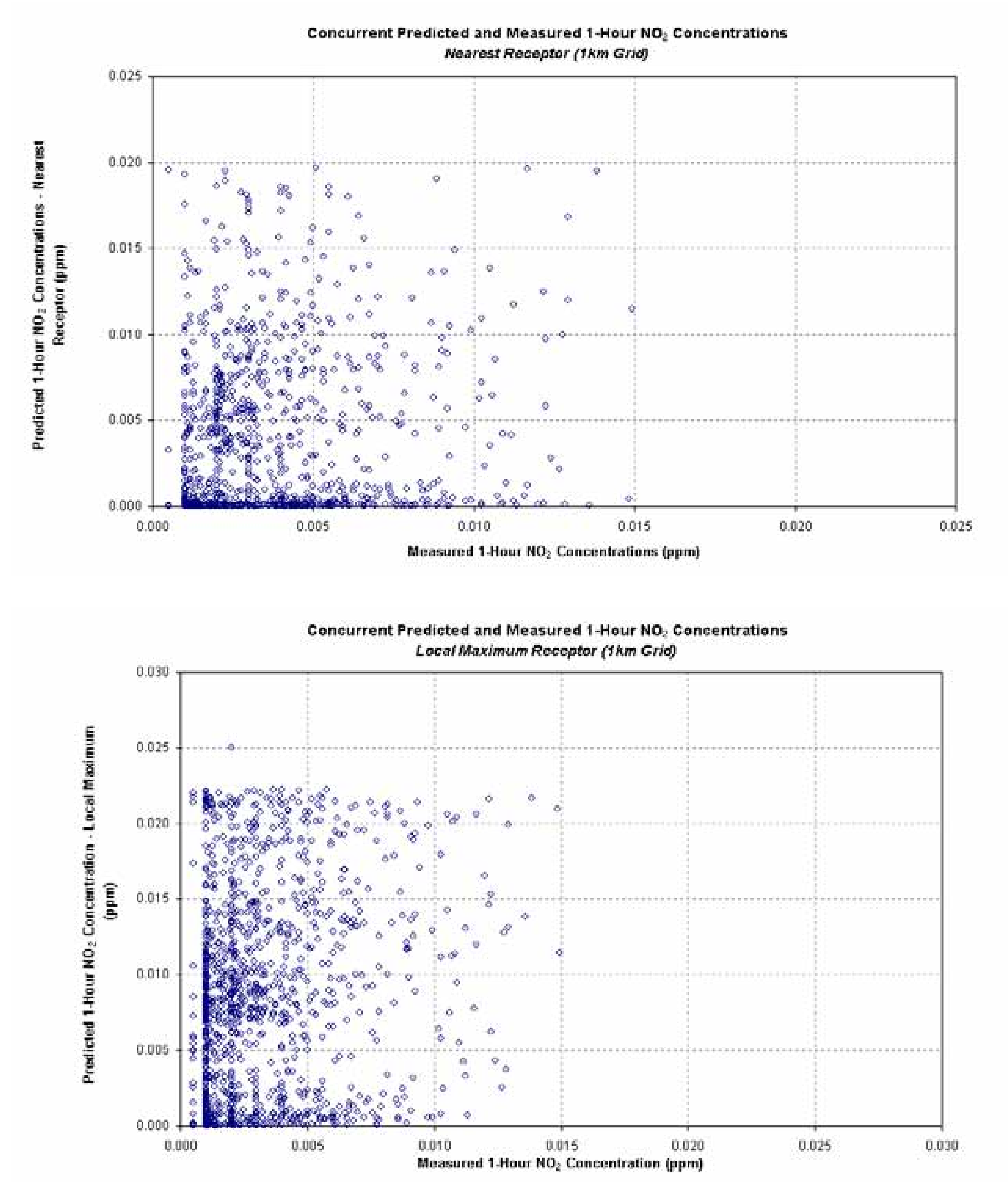


Figure D.4: Plots of Concurrent Measured and Modelled 1-Hour NO_2 Concentrations at Rowella

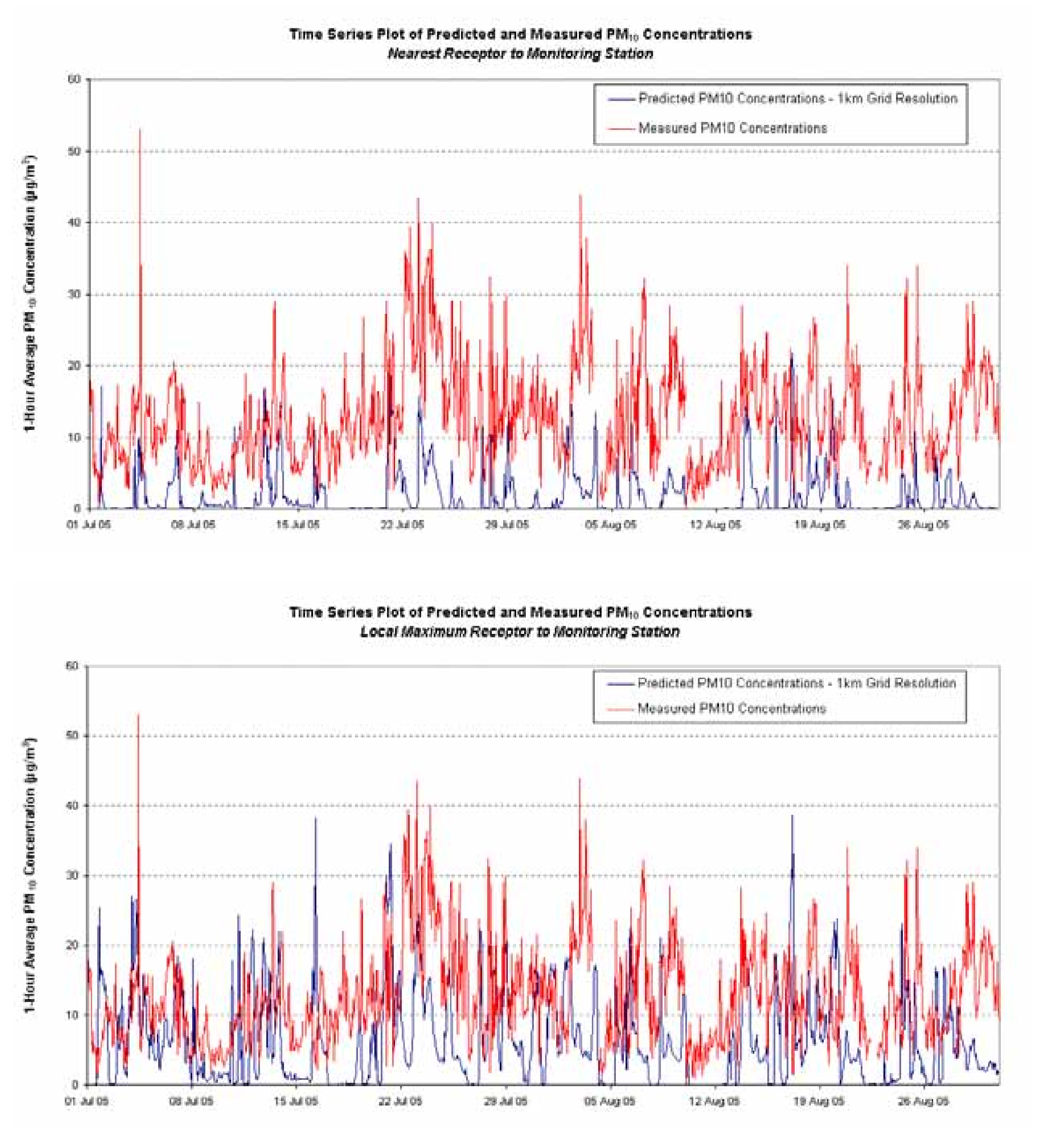
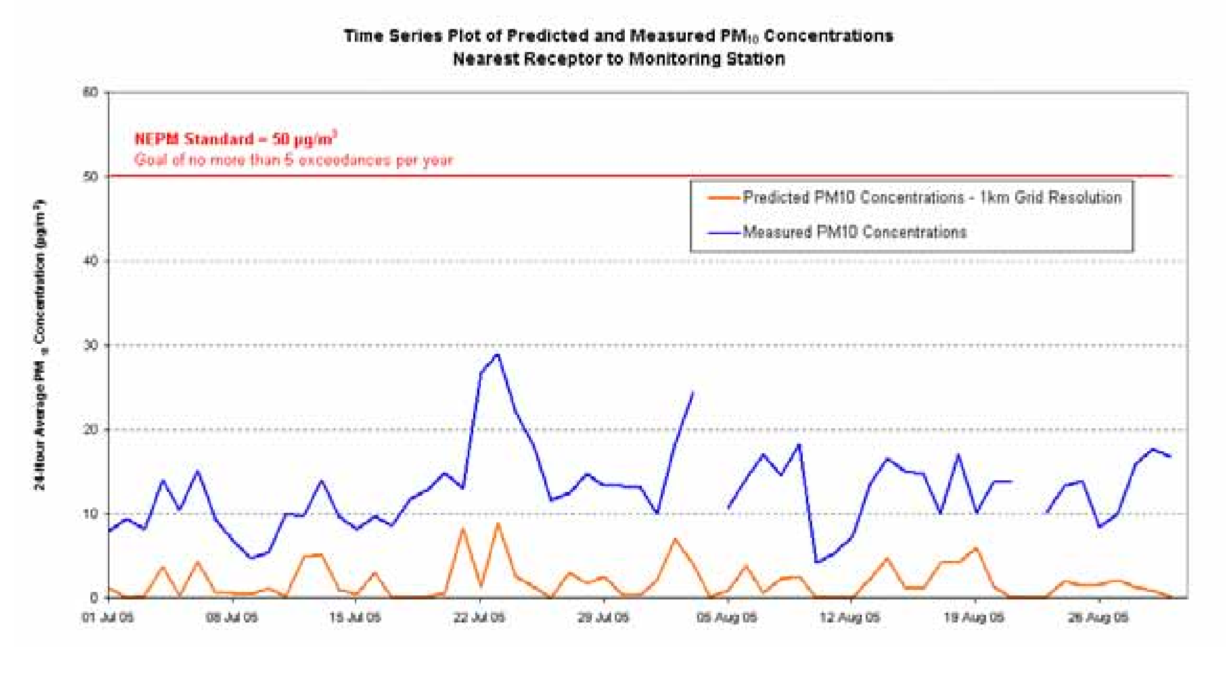


Figure D.5: Time Series Plots of 1-Hour Average Measured and Modelled PM_{10} Concentrations at Rowella (July and August 2005)



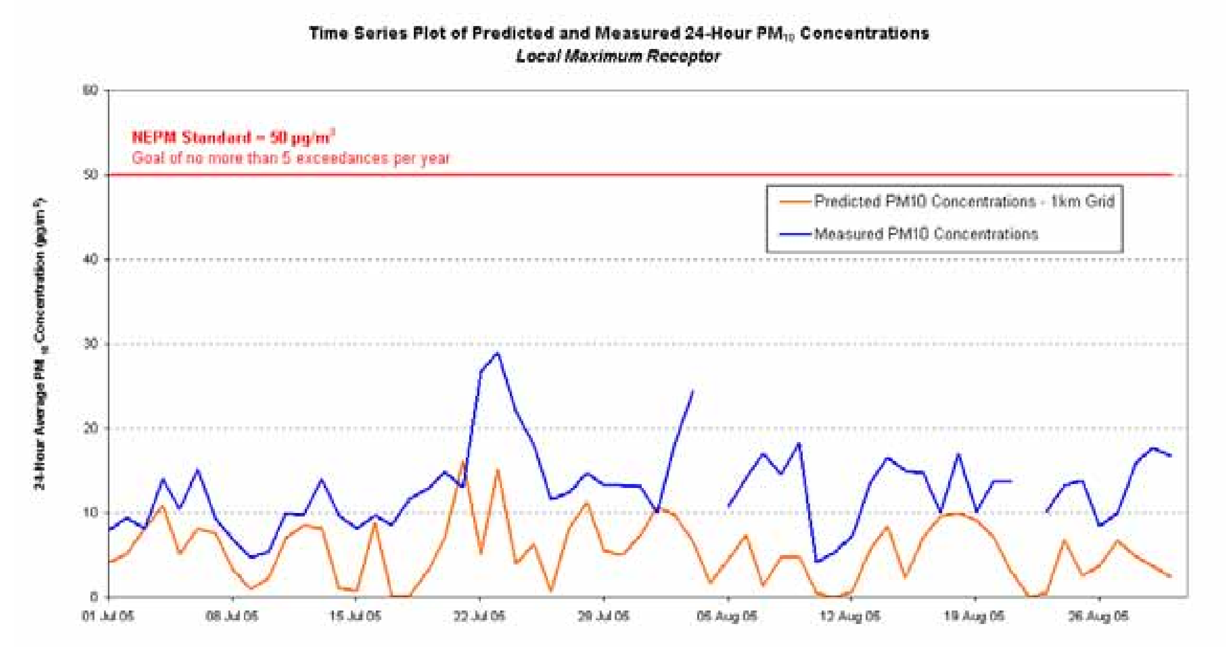
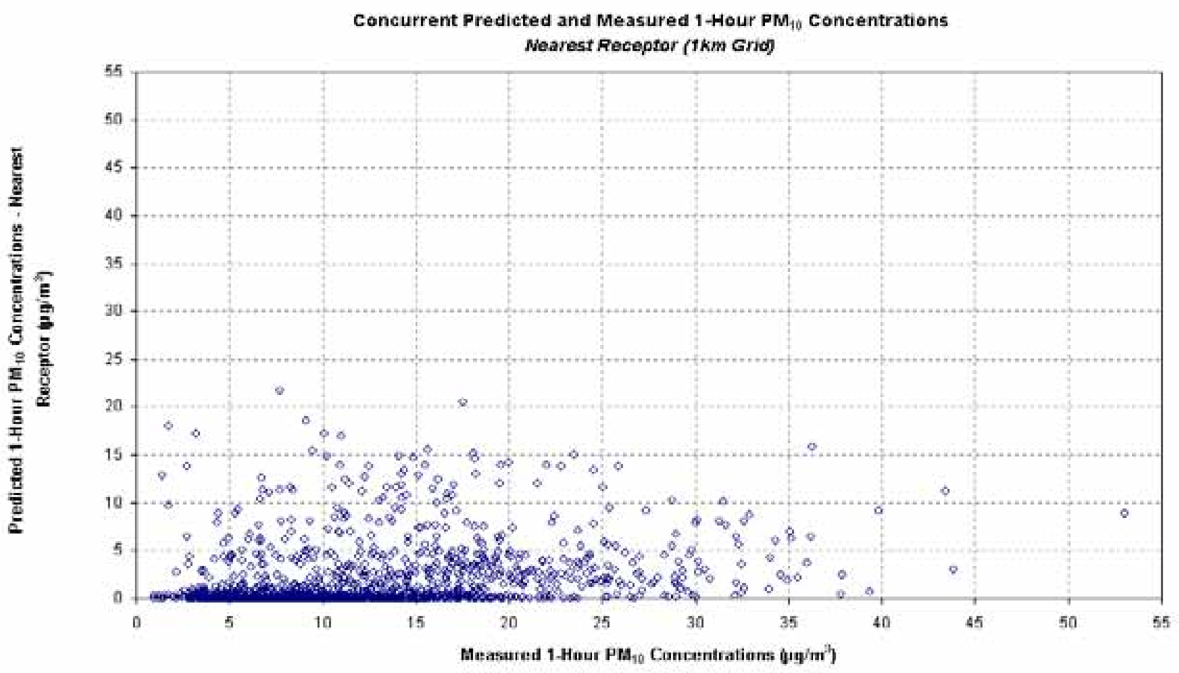


Figure D.6: Time Series Plots of 24-Hour Average Measured and Modelled PM_{10} Concentrations at Rowella (July and August 2005)



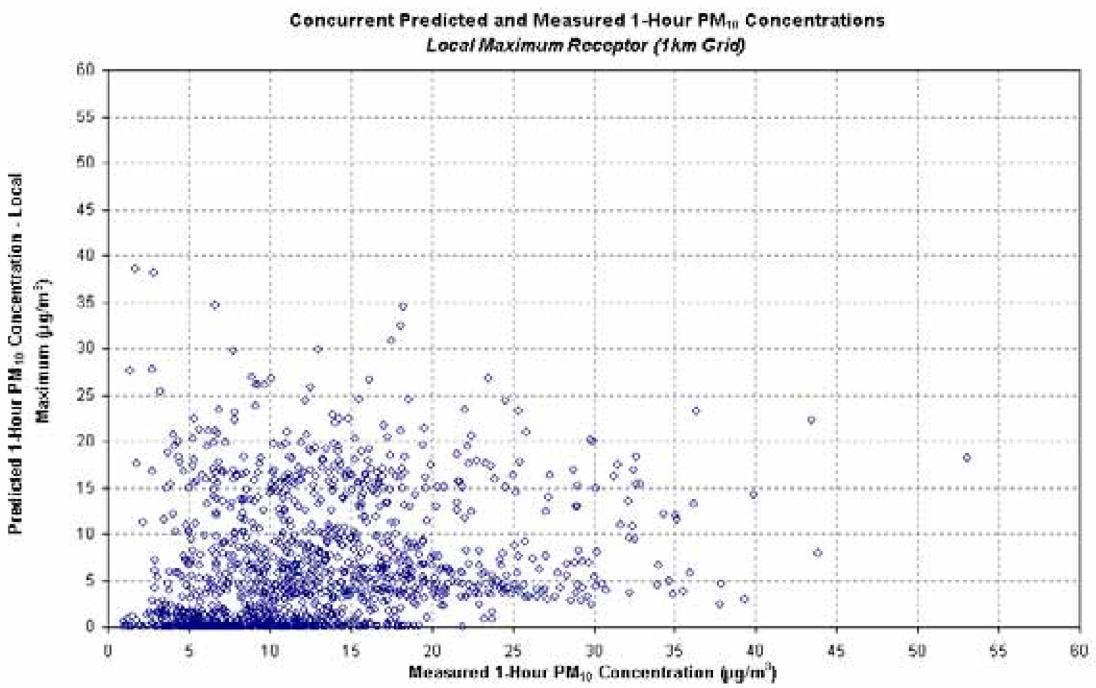
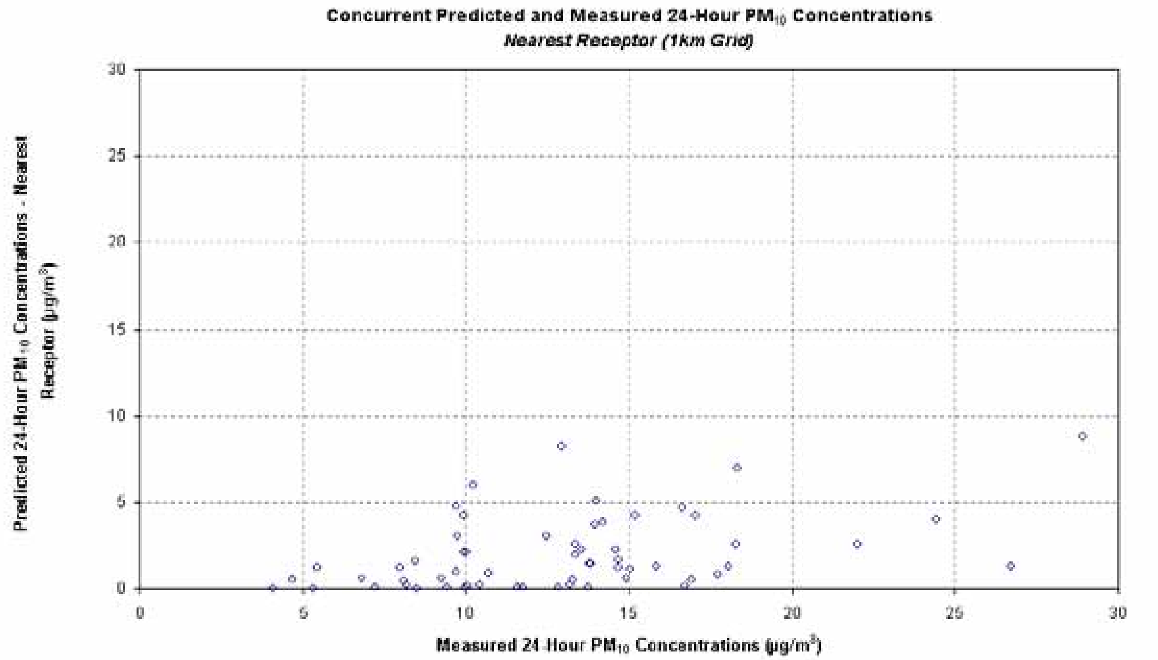


Figure D.7: Plots of Concurrent Measured and Modelled 1-Hour PM_{10} Concentrations at Rowella (July and August 2005)



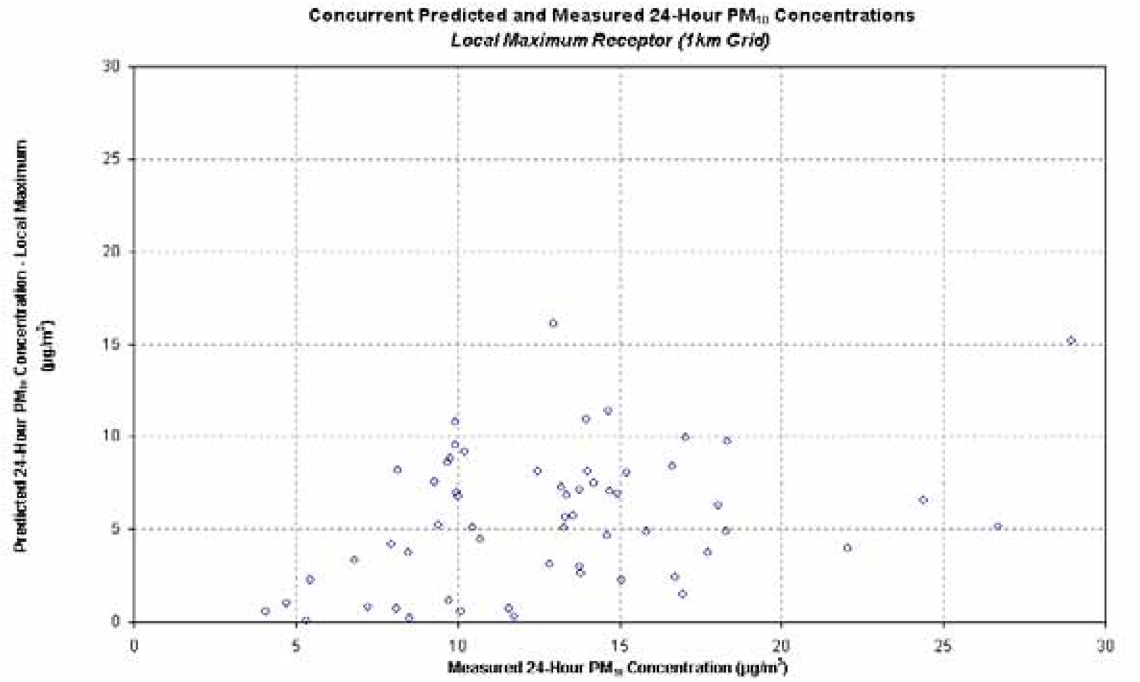


Figure D.8: Plots of Concurrent Measured and Modelled 24-Hour PM_{10} Concentrations at Rowella (July and August 2005)