

NERMN Air Monitoring 2012

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Bay of Plenty Regional Council
Environmental Publication 2012/02

5 Quay Street
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*Working with our communities for a better environment
E mahi ngatahi e pai ake ai te taiao*





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Cover Photo:

The author explaining to Otumoetai Primary School children how the air monitoring equipment works. The new signage on the monitoring hut was designed by a number of the pupils.

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Executive summary

This report includes a review of the Bay of Plenty Regional Council's Air NERMN programme. It reports on air quality data collected from 1998 to 2011 inclusive, it also includes a review of the monitoring programme and provides guidance and recommendations as to the future direction of this programme.

In October 2004, the Government introduced the national environmental standards for air quality (NES-AQ). The ambient standards set the minimum requirements that outdoor air quality should meet for a range of air pollutants in order to protect human health. In 2004, when the air quality standards were put in place, it was expected that all airsheds would comply with the PM₁₀ standard by 2013. However, by late 2009, MfE estimated that there would be 15 airsheds which would not comply in time, including Auckland, which represents nearly 30% of New Zealand's population. There was concern that the 2013 deadline was unachievable. In response, the air quality standards were amended in June 2011 with one of the main changes being extending the target date for regional councils to meet the ambient PM₁₀ standard. New split target dates are 1 September 2016 (airsheds with between 1 and 10 exceedances of the ambient PM₁₀ standard) and 1 September 2020 (airsheds with 10 or more exceedances of the ambient PM₁₀ standard). The Rotorua Airshed uses the latter 2020 date.

The Bay of Plenty Regional Council operates nine air quality monitoring sites located in Tauranga, Rotorua and Whakatāne. The monitoring schedule highlights the removal of the Pererika monitoring station due to commercial development at the location and the addition of an investigative site at Te Puke for PM₁₀ for one year. PM_{2.5} monitoring is also to be undertaken on an annual rotation basis in the three main urban centres.

The monitoring results continue to show that particulate matter is an issue within the Rotorua Airshed and steps have been undertaken to address this problem. Regional investigative monitoring, coupled with the long term monitoring, should continue to be undertaken in order to identify any other 'hotspots' within the region and to comply with NES-AQ requirements. Adverse health effects from particulate exposure are now better understood and thus this contaminant should continue to be the main focus of the monitoring programme.

Due to the SO₂ exceedances recorded historically in the Mount Maunganui industrial/port area monitoring should continue at the Totara Street site. This will improve the understanding of the ambient levels of this contaminant, and will add value to any further investigative work required in this area.

Monitoring results for CO are well below the National Environmental Standard and hence this module of the programme has been removed.

Concerns about possible health effects from H₂S will only be resolved through long term health studies and these will continue to need supporting ambient data. To date the historical data shows no long-term trends which are discernable, this reflects the nature (episodic in many cases) of the geothermal source and the effects of meteorology within the Rotorua urban area.

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Part 1: Introduction

The Bay of Plenty Regional Council is required to undertake monitoring activities as part of its statutory responsibilities under the Resource Management Act 1991 (RMA) and the Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and Other Toxics) Regulations 2004.

In December 2003 the Bay of Plenty Regional Air Plan was made operative. The purpose of this plan is to enable Bay of Plenty Regional Council to promote the sustainable management of the Bay of Plenty air environment.

Section 5.5 of the Air Plan outlines plan monitoring and review. Information for plan monitoring will be drawn from a range of NERMN monitoring programmes including data collection and the resulting analysis performed and documented in this report.

The current Natural Environmental Regional Monitoring Network (NERMN) is based around a regional network of monitoring sites designed for regional state-of-the-environment monitoring, documentation and reporting. Natural environment monitoring determines the overall regional impact of activities on environment quality.

This report includes a review of the Bay of Plenty Regional Council's Air NERMN programme. It reports on air quality data collected to date, it also includes a review of the monitoring programme and provides guidance and recommendations as to the future direction of this programme.

The report objectives are briefly outlined below:

- (i) To assess air quality changes in Bay of Plenty between 1997 and the end of 2011 and compare against the National Environmental Standard for Air Quality (NES-AQ).
- (ii) To compare current trends with earlier assessments.
- (iii) To provide information to assist in reviewing the current monitoring schedule.

Part 2: National Environmental Standard

2.1 Overview

In October 2004, the Government introduced the national environmental standards for air quality. These air quality standards were issued as Regulations in accordance with sections 43 and 44 of the RMA.

They included:

- seven standards banning activities that discharge significant quantities of dioxins and other toxics into the air
- five ambient air quality standards for carbon monoxide (CO), particulate matter less than 10 micrometres in diameter (PM₁₀), nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and ozone (O₃)
- a design standard for new woodburners installed in urban areas, and
- a requirement for landfills over 1 million tonnes of refuse to collect greenhouse gas emissions.

The ambient standards are a subset of the ambient air quality guidelines which set the minimum requirements that outdoor air quality should meet for a range of air pollutants in order to protect human health and the environment¹. Most of the guideline values adopted in New Zealand have been taken from guidance provided by overseas organisations such as the World Health Organisation².

The Regulations were subsequently amended in December 2004 (SR 2004/433), July 2005 (SR 2005/214) and November 2008 (SR 2008/375). These amendments were largely made for technical reasons.

In 2004, when the air quality standards were put in place, it was expected that all airsheds would comply with the PM₁₀ standard by 2013. However, by late 2009, the Ministry estimated that there would be 15 airsheds which would not comply in time, including Auckland, which represents nearly 30% of New Zealand's population. There was concern that the 2013 deadline was unachievable.

In response, the air quality standards were amended in June 2011 with the main changes being:

- Extending the target date for regional councils to meet the ambient PM₁₀ standard. New split target dates are 1 September 2016 (airsheds with between 1 and 10 exceedances of the ambient PM₁₀ standard) and 1 September 2020 (airsheds with 10 or more exceedances of the ambient PM₁₀ standard).
- Making provision for the exclusion of exceptional events (e.g., dust storms, volcanic eruptions).

¹ Ministry for the Environment. 2002. *Ambient Air Quality Guidelines*, Report ME437 prepared by the Ministry for the Environment and the Ministry of Health. Wellington: Ministry for the Environment. Available from www.mfe.govt.nz

² World Health Organisation. 2006. *Air Quality Guidelines Global Update 2005, Particulate matter, ozone, nitrogen dioxide and sulphur dioxide*. Denmark. WHO Regional Office for Europe. Available on www.who.int

- Requiring 'offsets' from certain new industries with PM₁₀ discharges in 'polluted' airsheds from September 2012, replacing the current restrictions on industrial consents.
- Prohibiting new solid fuel-burning open fires in homes in polluted airsheds from September 2012.

In addition, the Regulations now allow for a rule, resource consent, or bylaw that is more stringent than these Regulations to prevail over the Regulations.

A key element of this standard is the designation of "airsheds" under sub-clause 14 of the Regulation. These are to be specified by the Minister for the Environment by a notice in the Gazette.

2.1.1 Rotorua Airshed

In response to the Ministry for the Environment's request to nominate airsheds, The Bay of Plenty Regional Council has currently designated only one airshed for the Bay of Plenty region, this is the Rotorua Airshed³.

The location and extent of this area was based on local air quality monitoring data, air emission inventories, air discharge consents, council staff knowledge, geophysical, population and meteorological information. The extent of the airshed was further qualified by a detailed airshed modelling exercise⁴.

During winter the Rotorua basin is prone to ground based radiation inversions and cooling katabatic winds causing a confinement of the airmass above the city. On other occasions during winter, settled conditions associated with post frontal ridging and the emission outputs from domestic heating result in elevated particulate concentrations.

To better understand the distribution of PM₁₀ in the airshed three monitoring sites have been in operation within this area of interest.

³ New Zealand Gazette, 2005, *Bay of Plenty Regional Airshed Notice*, New Zealand Gazette, No. 141, 25 August 2005.

⁴ Fisher, G. et. al., 2007, *Rotorua Airshed Modelling Investigation*, Client report, Endpoint Ltd., Auckland

Part 3: Ambient Monitoring Sites

3.1 Monitoring methods

The MfE Good Practice Guide⁵ and the NES-AQ regulations¹ recommend a set of methodologies for ambient air quality monitoring. These are as shown in Appendix 1 and are implemented in the Bay of Plenty Regional Council monitoring programme.

The current monitoring sites maintained by the Council are listed (along with metadata) in Table 3.1.

3.2 Quality assurance

All monitoring sites are currently operated by the Bay of Plenty Regional Council. The operation of these sites is undertaken in accordance with the Environmental Data Services Field Practice Manual⁶ and the MfE guidance document⁵. Operation includes maintenance of the site and instrumentation and calibration of the monitoring equipment.

The Environmental Data Services Air Quality Office Practice Manual⁷ outlines procedures for the provision of quality assured data.

As a form of external audit on the instrument operation an inspection programme is conducted using Ecotech Pty Limited every 18 months. Ecotech is an ISO 9001 and NATA accredited Australian company. Reports from Ecotech provide calibration, service results and comments regarding the operation of the site and instrumentation.

⁵ Ministry for the Environment. 2009. *Good Practice Guide for Air Quality Monitoring and Data Management 2009*. Wellington: Ministry for the Environment.

⁶ Environment Bay of Plenty, 1998, *Field Practice Manual*, Internal document.

⁷ Environment Bay of Plenty, 1999, *Air Quality Office Practice Manual*, Internal document.

Table 3.1 Reported monitoring site details (Sites marked with * are those for which detailed analysis is presented in Section 4).

Site Title	Pererika*	Edmund Road*	Ngapuna*	Te Ngae	Pongakawa*	Otumoetai*
Location	Pererika Street, Rotorua	Corner of Linton Park Recreational Reserve (adjacent to 51 Edmund Road), Edmund Road, Rotorua.	Located within the grounds of Sealed Air (Cryovac Limited), Te Ngae Road, Rotorua.	Te Ngae Road, Rotorua	Pongakawa Bush Road	Otumoetai Road, Tauranga
Land/site owner	Pukeroa Oruawhata Trust	Rotorua District Council	Sealed Air - Cryovac Limited	NIWA depot building, Te Ngae Road	Private land owner	Otumoetai Primary
Site height above sea	280 metres (±6 m)	290 metres	288 metres	320 m	102 metres (±6 m)	65 metres (±6 m)
Region	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty	Bay of Plenty
Co-ordinates	U16: 943 353 (NZMG 2794248 6335478)	U16: 9185, 3577 (NZMG 2791852 6335771)	U16: 9784, 3479 (NZMG 2797841 6334793)	V15: 9549 3456 (NZMG 2795488 6334955)	V15: 1732 6349 (NZMG 2817320 6363490)	U14: 8675 8680 (NZMG 2786835 6386414)
Directions to site	The site is situated on the Pukeroa Oruawhata Trust (ex Telecom Works Depot) property, off Pererika Street, Rotorua.	Travelling north along Edmund Road, the site is located on the right-hand side in Linton Park Recreational Reserve, adjacent to residential property 51 Edmund Road.	Travelling along Te Ngae Road, turn into Sealed Air (Cryovac), where the site is located at the rear of the facilities. Sign in at reception before entering.	Located in the NIWA depot building	Travel 50 kilometres along Thornton Road/State Highway 2 towards Tauranga. Turn left at Pongakawa School Road and travel 1.5 km before turning left into Old Coach Road. Travel 1.5 kilometres until; reaching Pongakawa Bush Road then travel 3.9 kilometres before turning left into a gate marked with Dairy Shed number 21565. Park at the milking shed and walk 160 m north to the site.	Travel along Otumoetai Road, Tauranga to the corner of Darragh and Otumoetai Roads. The shed is located in the south eastern corner of the school field.
Contaminant monitored	PM ₁₀	PM ₁₀	CO & PM ₁₀	H ₂ S	PM ₁₀	CO & PM ₁₀
Monitoring objectives	Long term PM ₁₀ monitoring in residential area. This site has been decommissioned in late 2011 as a result of large scale commercial development of the Pukeroa Oruawhata Trust property. No replacement is planned.	Long-term residential and commercial PM ₁₀ monitoring.	Long-term commercial PM ₁₀ and CO monitoring. Primarily initiated as a response to complaints, this site now assists in monitoring commercial PM ₁₀ contribution to Rotorua LAMA.	Assess the levels of H ₂ S in areas that are likely to have higher emissions from several directions. Sites will also assist in the monitoring exposure levels of the people in that area.	Long term PM ₁₀ monitoring in background area.	Long term CO and PM ₁₀ monitoring in residential area.
Site type	Urban PM ₁₀ site	Residential and Commercial PM ₁₀	Primarily commercial with residential & traffic contribution.	Natural (ambient) H ₂ S	Background PM ₁₀ site	Urban CO, PM ₁₀
Equipment	FDMS TEOM	FDMS TEOM	FDMS TEOM, ML9830	ML9850 with thermal oxidiser.	Partisol 2025	FDMS TEOM, ML9830
Site topography	The site is located in a large yard with a row of single storey buildings 100 m to the south and another group of buildings 250 m to the south east. Amohau Street is located 50 m to the north. The yard is located on the edge of a residential area.	Situated on gently undulating area within Linton Park Recreational Reserve (Western Heights). Commercial area to the east, and residential surrounding the site.	Situated on a flat area in Ngapuna industrial area, with Lake Rotorua about 1km to the north-west.	Situated on a flat area about 360 m north of the Rotorua racecourse.	Large flat paddock with surrounding rolling countryside.	Situated on a flat area within the Otumoetai suburb, which is an elevated region to the west of Tauranga City.
Location and direction of major sources	Residential home heating surrounds the site.	Residential source direction is 360 degrees, with some commercial source from directional arc 40 degrees to 130 degrees.	Industrial/Commercial source is 360 degrees, with some traffic contribution from Te Ngae Road 125 m to the south-east. Also, domestic source from Lynmore to the south-east.	Natural, multiple sources, major source are the Whakarewarewa area to the south and active geothermal area on the lake margins to the northwest.	Rural paddock sources. 360 degrees as possible source direction.	Source direction is 360 degrees. Residential properties in the clockwise arc from 0 to 180 degrees. Otumoetai Road is located in the immediate vicinity in the arc from 181 to 359 degrees.
Planned development of site	Decommissioned in late 2011.	Permanent	Permanent	Permanent	Permanent	Permanent

Site Title	Morland Fox Park*	Totara Street*	King Street, Whakatane.*
Location	Located within the grounds of Morland Fox Park, Greeton, Tauranga	Corner Waimarie and Totara Street, within Tauranga City Council compound.	Adjacent to Maori Wardens Office, 7a Victoria Ave. Whakatane
Land/site owner	Tauranga City Council	Tauranga City Council	Whakatāne District Council
Site height above sea level	34 metres	3 metres	10 metres
Region	Bay of Plenty	Bay of Plenty	Bay of Plenty
Co-ordinates	U14: 8625, 8093 (NZMG 2786259 6380936)	U14: 9138, 8838 (NZMG 2791384 6388383)	W15: 5989, 5247 (NZMG 2859898 6352477)
Directions to site	Travelling along Cameron Road, turn into Oban Road. Proceed to the end of Oban Road where access to Morland Fox Park. The monitoring station is directly across the soccer fields.	Located at Waimaie/Totara Streets intersection.	Located east of King Street, behind the Kopeopeo shopping centre.
Contaminant monitored	PM ₁₀	SO ₂	PM ₁₀
Monitoring objectives	Long term residential PM ₁₀ monitoring.	Assess commercial contribution, and vehicle peak emissions at busy intersection in Mount Maunganui.	Long-term residential area PM ₁₀ monitoring.
Site type	Urban PM ₁₀	Commercial and peak traffic SO ₂	Urban/Commercial PM ₁₀
Equipment	FDMS TEOM	EC9850	FDMS TEOM
Site topography	Open park area to the immediate north, with residential surroundings.	Flat area with empty paddock to east, busy road running (Totara Street) north/south to the west, and surrounded by industrial activity.	Situated on a flat area with a carpark to the north, and surrounding residential and commercial.
Location and direction of major sources	Residential source direction is 360 degrees.	Busy road (Totara Street) to the west from 190 degrees to 350 degrees, and commercial source direction is 360 degrees.	Residential and commercial source direction is 360 degrees.
Planned development of site	Permanent site.	Permanent site.	Permanent site.

Part 4: Ambient Monitoring Results

4.1 Environmental Performance Indicators (EPI)

Environmental performance indicators (EPI) for air quality are used to measure and report on the state of our air environment.

The air indicators selected (Table 4.1) are 'state' indicators. State indicators provide a picture of the current state of the environment judged by comparing the monitoring results to MfE standard values (Table 4.2).

Table 4.1 Air Quality State Indicators

Category	Measured Value	Comment
Excellent	<10% of the standard	Of little concern, if maximum values are less than a tenth of the guideline, average values are likely to be much less.
Good	10–33% of the standard	Peak measurements in this range are unlikely to impact air quality.
Acceptable	33–66% of the standard	A broad category, where maximum values might be of concern in some sensitive locations but generally at a level which does not warrant dramatic action.
Alert	66–100% of the standard	A warning level, which can lead to exceedences if trends are not curbed.
Action	Exceeds the standard	Exceedences of the standard are a cause for concern and warrant action if they exceed the NES-AQ permissible occasions.

Table 4.2 National Environmental Standards for reported contaminants.

Contaminant	Standard value	
	Threshold concentration	Permissible excess
PM ₁₀	50 micrograms per cubic metre expressed as a 24-hour a mean.	Rotorua Airshed - 3 exceedences by 1 September 2016 and 1 exceedance by 1 September 2020. Elsewhere in region - 1 exceedance by 1 September 2016.
Sulphur dioxide	350 micrograms per cubic metre expressed as a 1-hour mean.	9 hours in a 12-month period
	570 micrograms per cubic metre expressed as a 1-hour mean.	Not to be exceeded at any time
Hydrogen sulphide ^a	7 micrograms per cubic metre expressed as a 1-hour mean.	-

a – value is based on an odour nuisance level and is a NZAAQG value¹.

4.2 Monitoring results

The results reported in this section are from the air monitoring sites marked with an asterisk in Section 3. For the purpose of this report the data will be reported in relation to the NES-AQ, however where the contaminant is not covered by the standards then the MfE Guidelines¹ will be used for comparison.

4.2.1 Particulate Matter

Results from the PM₁₀ monitoring sites are shown graphically in Figure 4.1. These plots show the EPI results on an annual basis for the period of the record.

Edmund Road, Rotorua

The period of record covers six years now with records beginning in March 2006. The annual results to date show large numbers of exceedances (23, 27, 36, 21, 16 and 7 for 2006, 2007, 2008, 2009, 2010 and 2011 respectively) of the standard during the 'heating season'⁸. For ~80% of the time the air quality is of an 'Acceptable' or better quality.

The maximum recorded 24 hour concentration is 162µg/m³ and a strong seasonal pattern with dramatic winter time increase is shown in the annual datasets. The same seasonal pattern is present in the diurnal dataset with the summer data showing the very slight influence of traffic. The springtime data shows the effect of the end of heating season as concentrations increase in the early evening. Autumn has a bimodal pattern with evening domestic heating emissions now being recorded with a morning peak as residents relight their fires. The winter data shows the full effect of domestic heating with a marked peak present in the morning followed by a return to elevated base levels during 12:00 to 16:00 as the emission reduce, turbulence develops and mixing occurs. This situation reverses quickly around 17:00 as fires are lit and concentrations continue to increase as the mixing height reduces and stability in the lower airmass occurs.

⁸ Iremonger, S. & Graham, B., 2006, *Rotorua Domestic Heating Survey*, Environmental Publication 2006/14, Environment Bay of Plenty, p29.

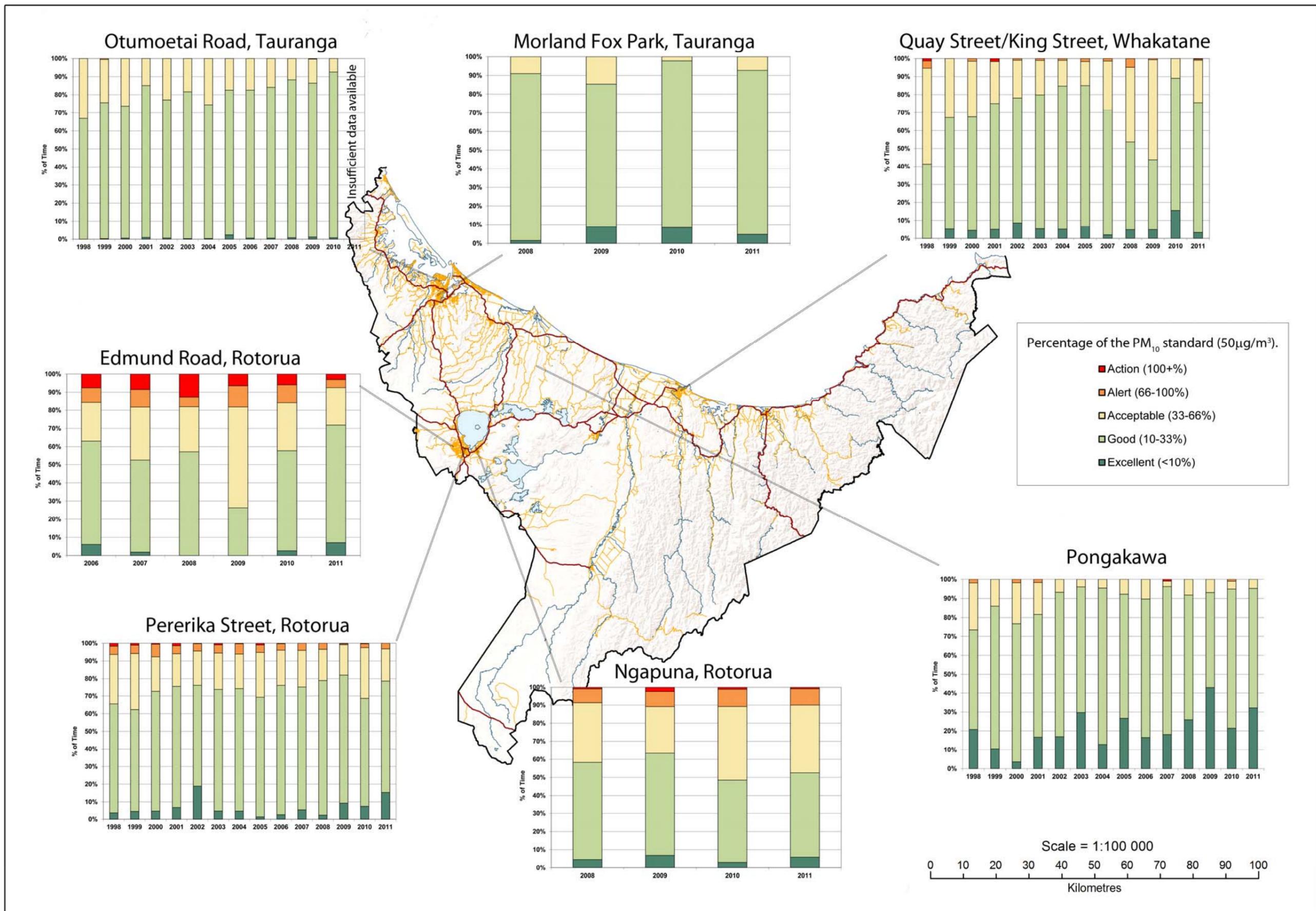


Figure 4.1 Particulate matter (PM₁₀) indicators as a percentage of the standard over time.

Pererika Street, Rotorua

For the majority of time the PM₁₀ values are measured in the 'Good' air quality category. However during the winter months, air quality reduces into the 'Acceptable' and 'Alert' categories. For less than one percent of the time the air quality is within the 'Action' category. Occasional exceedances of the PM₁₀ NES-AQ do occur at this site during the winter months. On average 2.3 exceedances have occurred per year with a maximum number of six recorded in 1998. This seasonal increase is reflected in the annual and diurnal datasets, with winter time being the time of elevated concentrations.

The 14 years of record shows the variability in air quality as a result of cycles in meteorological patterns. The emission source profile for Rotorua over this period would not have changed dramatically as the population is generally stable and the impact of the NES woodburner regulations since 2004 would only be minor and not detectable with the current monitoring regime. Major positive shifts in air quality are expected to occur with the implementation of the Rotorua Air Quality Action Plan⁹ initiatives.

In late 2011 the monitoring instrumentation was decommissioned due to significant redevelopment of the Pukeroa Oruawhata Trust property where the site was located. Monitoring of PM₁₀ in the Rotorua Airshed will continue at the Edmund Road and Ngapuna sites.

Ngāpuna, Rotorua

Two detailed reports of particulate matter data recorded, site surveys and other air quality related information collected is summarised in recent environmental reports^{10,11}.

The period of record at this monitoring site is shorter than the other two Rotorua sites with records beginning in 2007. Greater than 90% of the time for 2008 the air quality measured in relation to fine particulate matter was acceptable or better. Annual datasets for all years show a number of exceedances of the NES-AQ. Concentrations presented often only just exceed the standard value of 50µg/m³ and are typically well below the levels recorded at the peak neighbourhood site in Edmund Road on the western side of Rotorua City (90 percentile = 50µg/m³, max. = 162µg/m³). The diurnal data shows trends that are more subdued than the residential site data. Spring and summer show the higher values with peaks occurring in the afternoon as wind speeds increase and material from a number of sources throughout the area is mobilised.

Otumoetai Road, Tauranga

For the majority of time the PM₁₀ values are measured in the 'Good' air quality category (>70% of the record). However during the winter months, air quality can reduce and fall into the 'Acceptable' category. During the 14 years of monitoring air quality has never been within the 'Action' category.

⁹ <http://www.boprc.govt.nz/media/31788/Publication-100604-RotoruaAirActionPlanBooklet.pdf>

¹⁰ Iremonger, S.D., 2009, *Ngapuna Air Quality Monitoring report 2008*, Environment Bay of Plenty, Environmental Publication 2009/02, p42.

¹¹ Iremonger, S.D., 2010, *Ngāpuna Industrial Area Dust Survey 2010*, Environment Bay of Plenty, Environmental Publication 2010/17, p47.

The annual data shows little variation in daily average values throughout the year. Summer time values are often equal or exceed winter time values which is a trend markedly different from other urban monitoring sites within the region. Domestic heating patterns also differ and coupled with a strong meteorological and topography influences this annual pattern is not unexpected.

On a daily scale the winter time data shows the dominating effect of domestic heating sources, with a noticeable increase in the morning on top of the traffic contribution and then an increase being recorded during the evening as emissions from wood burners impact the site. The diurnal data also shows elevated levels for summer during the day which would be the result of the daily sea breeze transporting marine derived particles across the area.

Morland Fox Park, Tauranga

Intermittent PM₁₀ monitoring has been undertaken at this location due to instrumentation problems. The dataset to date consists of mainly non-wintertime data, however a partial wintertime record was captured in 2009. The 2009 annual average was 9.8µg/m³, the maximum value for this period was 31µg/m³. At the time of this report the site is operational.

King Street, Whakatāne

The period of record at this monitoring site is continuing to grow. Initial monitoring in Whakatāne was undertaken at Quay Street¹² for a period of eight years (1998 – 2005). The data from this more recent period shows that for more than 95% of the time the air quality in relation to PM₁₀ concentration is acceptable or better. This is slightly worse than what was recorded at Quay Street but understandable due to the differing locations and impacting emission sources.

A wintertime build up in concentrations is evident as is expected for this location. There are however other periods of time where elevated values are measured, further inspection of these periods show a probable mixture of some anthropogenic sources but wind information supports natural contributions from the nearby coastal environment (this pattern is also evident in a short period of monitoring undertaken in the Henderson Street area during May to October, 2008¹³).

Seasonal diurnal data shows the typical winter time profile, with increases in concentration in the evening and morning (8-10 am). The autumn data has the same but a more subdued profile. Spring and summer data shows a stable profile with little change throughout the day although summer data does show the effects of the sea breeze bringing material from the coastal environment and the intermediate land between the coastline and the sampler. Interestingly there are times when the drainage flows (referred to by local iwi as Te Hau Okiwa¹⁴) during the cooler months provide a “cleaner and flushing” air mass over the urban area.

Pongakawa

As expected, values recorded at this site predominantly fall in the “Excellent” and “Good” categories. With “Excellent” being met approximately 20% of the time.

¹² Iremonger, S. D., 2008, *NERMN Air Monitoring 2007*, Environment Bay of Plenty, Environmental Publication 2008/01, p74.

¹³ Iremonger, S.D., 2009, *Whakatāne West Air Quality monitoring report*, Environment Bay of Plenty, Internal report, p19.

¹⁴ Te Ao Hou, The New World, May 1957, No.18. *A Dog Barks in the Night*. Mereana.

(<http://teahou.natlib.govt.nz/journals/teahou/issue/Mao18TeA/c22.html>)

An annual trend is evident, as expected general dust production is negatively correlated with pasture growth and rainfall, thus resulting in increases in PM₁₀ in the summer months. A full period average of 9.5µg/m³ has been calculated and the 24-hour maximum to date is 51µg/m³ (October 2007) which is attributed to mechanical agricultural activities around the site.

At both a regional and national level this is an important monitoring site, as quantification of the regional background component is vital for the planning and assessment of cost effective emission reduction strategies for airshed investigations, and for establishing baselines for resource consents relating to new discharges.

4.2.2 Hydrogen sulphide

It has been recognised for many years that the concentrations of hydrogen sulphide in geothermal areas, such as Rotorua, are often well above levels that would be classified as unacceptable by most general air quality criteria¹⁵. Routine monitoring by the Bay of Plenty Regional Council has been undertaken at several sites in the city. Annual average concentrations are between 75 and 150 µg/m³¹² and yet, there are no obvious signs of concern amongst residents regarding the possible effects – in fact, some consider the geothermal environment to be healthier than elsewhere¹⁶.

Hydrogen sulphide monitoring for the last annual period has been limited to the site located at the NIWA facility in Te Ngae Road. This will change in the near future with the inclusion of a new site at the Arawa Bowling Club (approximately 1 km due north of the Whakarewarewa thermal area).

For 2010 the annual average figure from the Te Ngae Road site was 115 µg/m³ with a peak one hour value of 2541 µg/m³ just before midnight on the 3 November. For 2011 the average was 110 µg/m³ for the period January – February and June –July inclusive¹⁷. The 1 hour maximum value for this period was 2540 µg/m³ on the 19 June 2011.

4.2.3 Sulphur dioxide

A full analysis of the SO₂ datasets recorded at Mount Maunganui can be found within the Bay of Plenty Regional Council Environmental Publication 2011/03, titled *Mount Maunganui Ambient Sulphur Dioxide Monitoring*. An excerpt from the executive summary follows below.

The international understanding of adverse health effects due to ambient SO₂ exposure continues to improve and exposure limits are being refined as this information becomes available. Some of this work was reflected in the National Environmental Standard (NES) for New Zealand, whereby a multilevel standard was adopted in 2004. However, more recent work by the World Health Organisation (WHO) and United States Environmental Protection Agency (EPA) has resulted in a significant lowering of their recommendations for ambient limits.

The SO₂ emission source situation at Mount Maunganui is a complex one with a number of source types. Industry is the largest single source with consents being issued for these activities. The traffic contribution is also noticeable in the datasets and depending on proximity to roadways the concentrations can vary markedly. Other sources include shipping and train activity.

¹⁵ Thom, N. G. and Douglas, R. T. (1976). *A Study of Hydrogen Sulfide Levels in the Geothermal Areas of Rotorua, New Zealand*. In: Fourth International Clean Air Congress, Tokyo, pp. 565-568.

¹⁶ Daily Post, (2007), *Quote from local resident in: Health Fears Prompt Major Sulphur Study*. The Daily Post, Rotorua, 15 May, 2007.

¹⁷ This non-conventional period was used due to instrumentation issues.

Monitoring of ambient SO₂ was undertaken at Mount Maunganui for a short period in 1994 and more recently has been part of the Bay of Plenty Regional Council's on-going environmental monitoring programme for air quality. This monitoring began in 2005 at the Totara Street site which is currently still operational. Several other sites have also been introduced since then, one operated by the Council in 2007 at Maru Street and one by Ballance Agri-Nutrients Ltd at the neighbouring Chevron industrial site.

The "peak" Totara site recorded exceedances of the NES in the earlier part of the record, however since 2007 no exceedances have been recorded. The other two monitoring sites (Maru and Chevron) have not registered any exceedances of the NES, although under certain meteorological conditions elevated levels have been recorded.

In addition to the data presented in the above mentioned recent report, the 2011 data has the following statistics. Annual average is 16µg/m³, maximum 1 hour is 283µg/m³, 72 days were recorded were the WHO 24 hour value¹⁸ (20µg/m³) was exceeded.

Current monitoring data suggests we do not have a problem with industrial emissions causing non-compliance with the current NES (but should await further developments). The prudent approach which should be taken is to continue to monitor ambient SO₂ and meteorology at the Totara site, to ensure that up-to-date data is available should any decision be made in the future to lower the NES.

¹⁸ WHO, 2006, *Air Quality Guidelines Global Update 2005 - Particulate matter, ozone, nitrogen dioxide and sulphur dioxide*, World Health Organization, 2006.

Part 5: Ambient Monitoring schedule

The Bay of Plenty Regional Council is required to undertake monitoring activities as part of its statutory responsibilities under the Resource Management Act, 1991 and the NES-AQ, 2004.

The Air Natural Environmental Regional Monitoring Network (Air NERMN) is based around a regional network of air quality monitoring sites designed for regional state-of-the environment monitoring, documentation and reporting. Natural environment monitoring determines the overall regional impact of activities on environment quality.

The proposed monitoring is in accordance with the Regional Monitoring and Sustainable Air Management programs as part of the NERMN programme in the current Ten Year Plan¹⁹.

This section is designed to provide guidance to the councils Environmental Data Service section on the required future monitoring. It combines the requirements of the NES-AQ and the existing NERMN air quality monitoring programme. Annual NES-AQ reporting will provide updates and possible new directions for some of the monitoring. This schedule was first proposed in 1996 and was reviewed and extended in 2005.

5.1 Proposed NES-AQ investigations

In addition to the Rotorua Airshed, five areas had been designated as requiring investigative PM₁₀ monitoring²⁰, based on limited monitoring and inventory data at the time:

- (a) Tauranga/Mount Maunganui
- (b) Ngongotaha
- (c) Kawerau
- (d) Whakatane
- (e) Te Puke

Since the proposal in 2005, monitoring has been undertaken at all of these sites, with the exception of Te Puke. This Te Puke monitoring is scheduled for 2012.

5.2 Particulate matter

The long term monitoring sites at Otumoetai should continue to be operated, as the thirteen years of record already collected at this site provides the basis for valuable trend detection. Otumoetai is part of a larger area which is projected to experience accelerated growth in the decades to come.

The site at Pongakawa is important as an indicator of background concentrations within the region. This is an important contribution when determining strategies for airsheds and assessing air discharge consent applications. The instrumentation at this site is about to be replaced, the Sequential Partisol will be replaced with a BAM²¹ which will increase the amount of data captured and reduce operating costs.

¹⁹ <http://www.boprc.govt.nz/media/31196/Plan-090716-TYP05NaturalEnvironment.pdf>

²⁰ Iremonger, S.D., 2005, *Bay of Plenty Local Air Management Areas*, Environmental Publication 2005/08, Environment Bay of Plenty, p29.

²¹ BAM – beta attenuation monitor

The Whakatane monitoring site (King Street) should be maintained as this is located in the middle of the third largest urban area in the region. It has a significant industry on the northwest boundary of the urban area and therefore ongoing monitoring of PM₁₀ is important for detecting the contribution from a variety of sources.

The Morland Fox Park site is located in a southern suburb within Tauranga City, an area which has been identified as 'worst case' for domestic heating emissions within the City, this site will be key in determining whether an airshed is needed in this area of the city.

The Edmund and Ngapuna sites should be continued as they are part of the current Rotorua airshed monitoring programme. They will be key sites in monitoring the success of the Rotorua Air Quality Action Plan⁹, and will provide direction if the strategies require modification.

The final site that requires PM₁₀ monitoring is Te Puke. The period of monitoring at Te Puke should be for a period of one year (2012), with daily sampling for May to September inclusive and every second day for the remaining non-winter periods if a sequential instrument is used.

Fine particulate PM_{2.5} monitoring has been scheduled for the three main urban areas within the region on a single instrument rotation basis. The first deployment will be at the Edmund Road site to collect a full set of measurements for 2012, then Whakatāne (King Street) in 2013, and finally Tauranga (site yet to be determined) in 2014.

In summary the following table outlines the particulate monitoring regime:

PM₁₀ instrument	Status
Edmund Road, Rotorua	Ongoing
Ngāpuna, Rotorua	Ongoing
Otumoetai, Tauranga	Ongoing
Morland Fox Park, Tauranga	Ongoing
King Street, Whakatāne	Ongoing
Pongakawa	Ongoing
Te Puke	Monitoring for 2012.
PM_{2.5} instrument	Status
Edmund Road, Rotorua	Monitoring for 2012.
King Street, Whakatāne	Monitoring for 2013
Tauranga site	Monitoring for 2014

5.3 Carbon monoxide

Carbon monoxide monitoring can be stopped due to the non-significance of recorded results to date throughout the region. The instrumentation should not be discarded, but carefully put aside, so if required in the future then they could be redeployed.

5.4 Sulphur dioxide

Due to industry contributions and development in the port area, the monitoring at the Totara Street site for this contaminant should be continued. The Maru Street instrument should be relocated back into Rotorua.

In summary the following table outlines the SO₂ monitoring:

SO ₂ instrument	Status
Totara Street, Mt Maunganui	On-going

5.5 Hydrogen sulphide

The H₂S programme had been postponed due to the SO₂ monitoring requirements in Mount Maunganui. This focus is now changing and the full H₂S programme has been reinstated in Rotorua. This H₂S monitoring and historical work will be beneficial for fulfilling NERMN requirements and also contributing to the internationally funded H₂S long term exposure study²¹.

In summary the following table outlines the H₂S monitoring:

H ₂ S instrument	Status
Te Ngae Road, Rotorua	On-going
Arawa Bowling Club, Rotorua	Starting in early 2012

5.6 Meteorology

Basic meteorological parameters (wind speed, direction, air temperature) should be recorded at all of the air quality monitoring sites²². This additional information provides added value to the primary dataset in determining causes of elevated concentrations and long term source contributions.

In summary meteorological instruments should be operational at the following sites – Edmund Road, Ngāpuna, Otumoetai Road, Morland Fox Park, Totara Street, King Street, Pongakawa and Te Puke.

²² Ministry for the Environment. 2009. *Good Practice Guide for Air Quality Monitoring and Data Management 2009*. Wellington: Ministry for the Environment. Recommendation 8.

5.7 **Data capture rates**

Data capture rates continue to be monitored as an Environmental Data Services quality assurance tool and also as part of the performance target programme for the field technicians responsible for the operation of the equipment.

Generally high rates continue to be achieved although some sites have remained problematic (for a number of reasons). Timely checking of received telemetry data and frequent processing routines should aid in achieving the high capture rates required.

The replacement of most of the first generation particulate monitoring equipment (1996-1998) has occurred and this should result in increased ease of operation and maintenance for the field staff. Also the Pererika instrument should now be used as a hot swap device to help minimise data loss at the remaining particulate monitoring sites.

The removal of the CO gas analysers from the programme should also provide time requirement improvements (for both field and office practices) for relevant staff.

Part 6: Contaminant Summary

6.1 **Particulate matter (PM₁₀)**

Particulate matter is an issue within the Rotorua Airshed and steps have been undertaken to address this problem. Regional investigative monitoring (coupled with the long term monitoring) should continue to be undertaken in order to identify any other 'hotspots' within the region and to comply with NES-AQ requirements. Adverse health effects from particulate exposure are now better understood and thus this contaminant should be the main focus of monitoring. Improvements in air quality and meteorological monitoring equipment should also be investigated to ensure high capture rates are maintained.

6.2 **Carbon monoxide**

Monitoring results for CO are well below the National Environmental Standard and hence this module of the programme has been removed.

6.3 **Sulphur dioxide**

Due to the exceedances recorded historically in the Mount Maunganui industrial/port area monitoring should continue at the Totara Street site. This will improve the understanding of the ambient levels of this contaminant, and will add value to any further investigative work required in this area.

6.4 **Hydrogen sulphide**

Concerns about possible health effects will only be resolved through long term health studies and these will continue to need supporting ambient data. To date the historical data shows no long-term trends which are discernable, this reflects the nature (episodic in many cases) of the geothermal source and the effects of meteorology within the Rotorua urban area.

Appendices

Appendix 1 – Monitoring methods

Table A.1 Monitoring methods used by the Bay of Plenty Regional Council.

Contaminant	Method
PM ₁₀	TEOM (with co-location) and FDMS TEOM. United States Code of Federal Regulations, Title 40, Protection of Environment, Volume 2, Part 50, Appendix J, Reference method for the determination of particulate matter as PM ₁₀ in the atmosphere. or Australian Standard AS 3580.9.8:2008, Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM ₁₀ continuous direct mass method using a tapered element oscillating microbalance analyser or AS/NZS 3580.9.11:2008, Methods for sampling and analysis of ambient air – Determination of suspended particulate matter - PM ₁₀ beta attenuation monitors.
CO	Australian Standard AS3580.7.1:1992, Methods for sampling and analysis of ambient air, Determination of carbon monoxide, Direct-reading instrumental method.
SO ₂	Australian Standard AS3580.4.1:2008, Methods for sampling and analysis of ambient air, Determination of sulphur dioxide, Direct-reading instrumental method.
PM _{2.5}	AS/NZS 3580.9.11:2008, Methods for sampling and analysis of ambient air – Determination of suspended particulate matter - PM ₁₀ beta attenuation monitors.
H ₂ S	Australian Standard AS3580.4.1:2008, Methods for sampling and analysis of ambient air, Determination of sulphur dioxide, Direct-reading instrumental method. With the addition of a thermal oxidiser module.
Site setup	Australian Standard AS/NZS 3580.1.1:2007 Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment
Compressed gas	Australian Standard AS/NZS 3580.2.2:2009 Methods for sampling and analysis of ambient air - Preparation of reference test atmospheres - Compressed gas method