

# Ambient PM<sub>10</sub> monitoring adjacent to four unsealed roads in Northland

(Wright, Opouteke, Ngapipito and Piplwai Roads – March/April 2013)



Putting Northland first

## Introduction

The Northland Regional Council (NRC) received a number of complaints about dust nuisance from vehicle traffic travelling on unsealed roads over the past summer. A number of these complaints were initially investigated by setting up “deposition gauge dust monitors” to measure dust levels at affected sites between November 2012 and January 2013. The deposition gauge monitoring results for Wright, Opouteke, Ngapipito and Pipiwai Roads are presented in Appendix 1.

In order to investigate further and address concerns raised by the residents affected by road dust, and at the request of the Medical Officer of Health for Northland (Northland Health), the NRC conducted additional monitoring to determine the levels of smaller (<10 microns diameter – “PM<sub>10</sub>”) particles in the dust being experienced by the residents living adjacent to Wright, Opouteke, Ngapipito and Pipiwai Roads. The PM<sub>10</sub> monitoring was undertaken during the period 14 March to 10 April 2013.

The NRC hired a PM<sub>10</sub> monitoring device from Watercare and obtained a report from Watercare summarising the results of the data recorded by the device. The purpose of this NRC report is to provide additional information to aid in the interpretation of Watercare report (attached as Appendix 5) and to assist Northland Health in its assessment of the health risk from the dust occurring at the affected sites.

## PM<sub>10</sub>

Particulate matter is a collective term used to describe very small solid or liquid particles such as dust, fume, smoke and mist or fog. Particulate material, which has an aerodynamic diameter of less than 10 microns (µm), is referred to as “PM<sub>10</sub>” (see Figure 1). PM<sub>10</sub> in the atmosphere originates from both natural, e.g. wind blown dust, forest fires, and anthropogenic activities, e.g. automobile exhausts, solid fuel burning.

PM<sub>10</sub> is small enough to be inhaled. Research has shown that fine particles are more responsible for specific health effects. The National Environmental Standard (NES)<sup>1</sup> set by the Ministry for the Environment (MfE) for PM<sub>10</sub> in order to protect human health is 50 µg/m<sup>3</sup> averaged over a 24 hour period (MfE 2004).



**Figure 1 Particulate matter 10µm size (USEPA)**

<sup>1</sup> More information on the NES can be obtained on the MfE's website at the following link: <http://www.mfe.govt.nz/laws/standards/air-quality-standards.html>

## Monitoring Methodology

A Met One Environmental Beta Attenuation Monitor (E-BAM) with a PM<sub>10</sub> inlet was used for this monitoring. This instrument draws 16.7 litres per minute atmospheric air and measures the mass concentration of PM<sub>10</sub> by use of beta attenuation. This instrument is designed to draw PM<sub>10</sub> via a vacuum pump on to a filter tape. The filter tape is located between a C<sup>14</sup> source and a detector. As the mass of PM<sub>10</sub> increases on the filter tape, the beta count is reduced. The relationship between the decrease in beta count and particulate mass is computed and, a continuous “real time” concentration (in µg/m<sup>3</sup>) of particulate is measured and used to calculate the 24 hour averages in accordance with the Ministry for the Environment’s (MfE) National Environmental Standard for Air Quality<sup>1</sup>. The E-BAM was run on electricity supplied from the dwelling at each of the sites it was set up at.

## Results

The Watercare report summarises the 24 hour average concentrations of PM<sub>10</sub> obtained from data collected at 10 minute intervals by the E-BAM. The data summary is based on the “Good Practice Guide for Air Quality Monitoring and Data Management 2009” (MfE). The Watercare report does not summarise or discuss the 10-minute data or hourly average PM<sub>10</sub> concentrations recorded by the E-BAM. However, those data are referred to in this report. It is noted that the Watercare report uses the term “100% valid data”. This is where data was measured by the E-BAM continuously at 10 minute intervals throughout a calendar day from midnight to midnight. If data measurement commenced part way through a calendar day, then a full set of data was not measured for that day and so that partial data set is not stated as being 100% valid/100% complete. For example, if data recording commenced at mid-day, then the data set for that day would be stated as 50% valid.

### Wright Road

The PM<sub>10</sub> monitor was positioned 44 metres away from edge of the road at 634 Wright Road. This monitor was set up on 14 March and monitoring began at 1110 hours and finished at 0910 hours (New Zealand Standard Time) on 22 March 2013. It is important to note that during this period a dust suppressant (“Dust-Lock”) was applied onto the road on 16 March to reduce dust levels. The 24 hour average PM<sub>10</sub> concentrations for the site were well within National Environmental Standards (NES) for air quality (50 µg/m<sup>3</sup>). However, in addition to the effect of the dust suppressant, wind was blowing away from the E-BAM towards the road during the monitoring period which would have decreased the amount of dust measured by the E-BAM. Furthermore, eight millimetres of rainfall was recorded on 17 March at the NRC Waipao/Poroti rain gauge. The monitoring details for the site are presented in Table 1 below.

**Table 1: Monitoring details for Wright Road site (wind direction used at all sites was obtained from NIWA, Kaikohe station)**

Date	24-hour PM <sub>10</sub> (µg/m <sup>3</sup> )	Day	Wind direction	Rainfall mm @ Waipao/Poroti	Site notes
14/03/2013	28	Thursday	ENE	0	Monitor set up
15/03/2013	33	Friday	ENE	0	
16/03/2013	14	Saturday	NE	0	Dust suppressant applied
17/03/2013	39	Sunday	N	8	
18/03/2013	25	Monday	WNW	0	Monitor removed



Hourly average PM<sub>10</sub> concentration peaked at 0600 hours. The highest hourly average concentration of 146 µg/m<sup>3</sup> was recorded at midnight on 17 March and the second highest of 140 µg/m<sup>3</sup> was recorded at 0600 on 15 March. The higher concentrations in the morning could have been due in part to calm conditions when there was little or no wind to blow the dust away from the site. The daily, diurnal, and hourly average PM<sub>10</sub> concentrations for the site are summarised in graphs in Appendices 2, 3 and 4.



**Photo 1: Location of E-BAM at Wright Road site (NZTM: 1694305E 6053381N)**

## Opouteke Road

The E-BAM was located 12 metres from the edge of the road at 442 Opouteke Road. It is noted that the road was treated with dust suppressant in December 2012. There was a power failure at the site between Tuesday 19 March at 1700 hours and 20 March at 1000 hours which reduced the amount of data collected. The highest 24 hour PM<sub>10</sub> average concentration recorded was 321 µg/m<sup>3</sup> on 22 March 2013. All daily PM<sub>10</sub> concentration averages at this site were above the NES of 50 µg/m<sup>3</sup>. The location of the E-BAM was close to the road and so the wind direction would not have had much effect on PM<sub>10</sub> results, and rainfall in the Opouteke area was low during the period monitoring. The monitoring details for the site are presented in Table 2 below.

**Table 2: Monitoring details for Opouteke Road site**

Date	24-hour PM10 (µg/m <sup>3</sup> )	Day	Wind direction	Rainfall mm @ Opouteke	Site notes
18/03/2013	70	Monday	WNW	1.5	Monitor set up
19/03/2013	71	Tuesday	SW	1.0	
20/03/2013	83	Wednesday	SSW	2.0	
21/03/2013	<b>68</b>	Thursday	ESE	0.0	
22/03/2013	321	Friday	ESE	0.0	Monitor removed

The hourly averages at this site peaked between 0400 and 1000 hours in the morning and again between 1300 and 1600 hours in the afternoon. The daily, diurnal, and hourly average PM<sub>10</sub> concentrations for the site are summarised in graphs in Appendices 2, 3 and 4.



**Photo 2: Location of E-BAM at Opouteke Road site (NZTM: 1677476E 6049096N)**

### Ngapipito Road

The E-BAM was located 27 metres away from the edge of the road at 1120 Ngapipito Road. The daily average PM<sub>10</sub> concentrations exceeded the NES (50 µg/m<sup>3</sup>) on most days during the monitoring period. The highest concentrations were recorded when the wind was ESE, when road dust would have blown in towards the E-BAM. This site also showed the highest deposition gauge dust results among the four unsealed roads monitored in February 2013 (results in Appendix 1). The monitoring details for the site are presented in Table 3 below.

**Table 3: Monitoring details for Ngapipito Road site**

Date	24-hour PM <sub>10</sub> (µg/m <sup>3</sup> )	Day	Wind direction	Rainfall mm @ Ngapipito	Site notes
22/03/2013	58	Friday	ESE	0	Monitor set up
23/03/2013	<b>112</b>	Saturday	ESE	0	
24/03/2013	<b>83</b>	Sunday	S	0	
25/03/2013	<b>76</b>	Monday	ENE	0	
26/03/2013	<b>63</b>	Tuesday	SSE	0	
27/03/2013	<b>98</b>	Wednesday	SE	0	
28/03/2013	<b>101</b>	Thursday	ESE	0	
29/03/2013	<b>51</b>	Friday	ENE	0	
30/03/2013	36	Saturday	NE	0	
31/03/2013	<b>74</b>	Sunday	NE	29.0	
1/04/2013	40	Monday	SSE	0.5	
2/04/2013	147	Tuesday	NNE	0.5	Monitor removed

Hourly averages at this site peaked between 0800 and 1000 hours in the morning and also between 2000 and 2200 hours in the evening. There was 29 millimetres of rainfall on 31 March which would explain the lower PM<sub>10</sub> concentrations recorded during the following day. The daily, diurnal, and hourly average PM<sub>10</sub> concentrations for the site are summarised in graphs in Appendices 2, 3 and 4.



**Photo 3: Location of E-BAM at Ngapipito Road site (NZTM: 1682980E 6079223N)**

### Pipiwai Road

The PM<sub>10</sub> monitor was located 14 metres away from the edge of the road at 4116 Pipiwai Road. Monitoring began after a period of rainfall at the end of March and the road in front of the E-BAM had been getting watered to suppress the dust up until 2 April when monitoring began. Monitoring details for the site are presented in Table 4 below.

**Table 4: Monitoring details for Pipiwai Road site**

Date	24-hour PM <sub>10</sub> (µg/m <sup>3</sup> )	Day	Wind direction	Rainfall mm @ Poroti	Site notes
2/04/2013	100	Tuesday	NNE	0	Monitor set up
3/04/2013	32	Wednesday	N	0	
4/04/2013	32	Thursday	SSW	3.0	
5/04/2013	44	Friday	SW	0	
6/04/2013	31	Saturday	SSW	0.5	
7/04/2013	21	Sunday	NNE	0	
8/04/2013	19	Monday	E	2.0	
9/04/2013	39	Tuesday	SSE	0	
10/04/2013	35	Wednesday	ENE	5.5	Monitor removed

PM<sub>10</sub> concentrations were below the daily NES of 50 µg/m<sup>3</sup>. The rain and road watering prior to the monitoring, and the showers during the monitoring period, would have suppressed some of the road dust resulting in lower PM<sub>10</sub> concentrations than if the road had been dry. The daily, diurnal, and hourly average PM<sub>10</sub> concentrations for the site are summarised in graphs in Appendices 2, 3 and 4.



**Photo 4: Location of E-Bam at Pipiwai Road site (NZTM: 1687296E 6063313N)**

## Summary

- The NRC set up a PM<sub>10</sub> E-BAM monitor at or near residential dwellings adjacent to four different unsealed roads in Northland (Wright, Opouteke, Ngapipito and Pipiwai Roads) over the period 14 March to 10 April 2013.
- Twenty one days of “100% valid data” (i.e. a full set of data was continuously measured at 10 minute intervals over a 24 hour period (calendar day) from midnight to midnight) was measured during the monitoring period.
- Out of the 21 days of the 100% valid data, there were nine days when the daily average NES of 50 µg/m<sup>3</sup> was exceeded with the majority of the exceedances and the highest average hourly PM<sub>10</sub> concentrations being recorded at the Ngapipito Road site.

## Data Limitations

- The PM<sub>10</sub> E-BAM monitor used is not a Ministry for the Environment approved National Environmental Standard (NES) for Air Quality instrument for PM<sub>10</sub> monitoring.
- While it is likely the majority of PM<sub>10</sub> measured by the E-BAM originated from the unsealed roads, PM<sub>10</sub> particles can also originate from other sources like fires, sea spray, pollen, and automobile exhausts.
- When examining the data from the different sites it is clear that PM<sub>10</sub> concentrations were peaking over short periods of time which is attributed to the intermittent nature of vehicle traffic at the sites. For example, over a 10 minute period on the 17 March at Wright Road 686 µg/m<sup>3</sup> of PM<sub>10</sub> was measured, whereas the 24 hour average PM<sub>10</sub> concentration for 17 March was substantially less (39 µg/m<sup>3</sup>) and below the NES. However, the NES addresses longer term exposure and not short-term exposure to PM<sub>10</sub>. Therefore, the hourly and 10 minute average PM<sub>10</sub> concentrations measured cannot be assessed against the NES.

## Appendix 1: Dust gauge monitor results for each site

Deposition Gauge (DP gauge) dust monitoring is a cost effective and easy way of assessing dust nuisance. The gauge is made from a plastic open topped cylinder/bucket and is mounted at an approximate height of 1.5 metres above the ground. It catches the settling dust particles over a fixed surface area over a period of time – usually  $30 \pm 2$  days. After leaving the monitor out for a month the dust is removed from the equipment (using distilled water), filtered, weighed and reported in terms of the weight of dust collected per unit of surface area and over the fixed period of time, i.e. in  $\text{g}/\text{m}^2/30\text{days}$ . DP gauge monitoring is conducted as per the quality standard ISO4222.2.

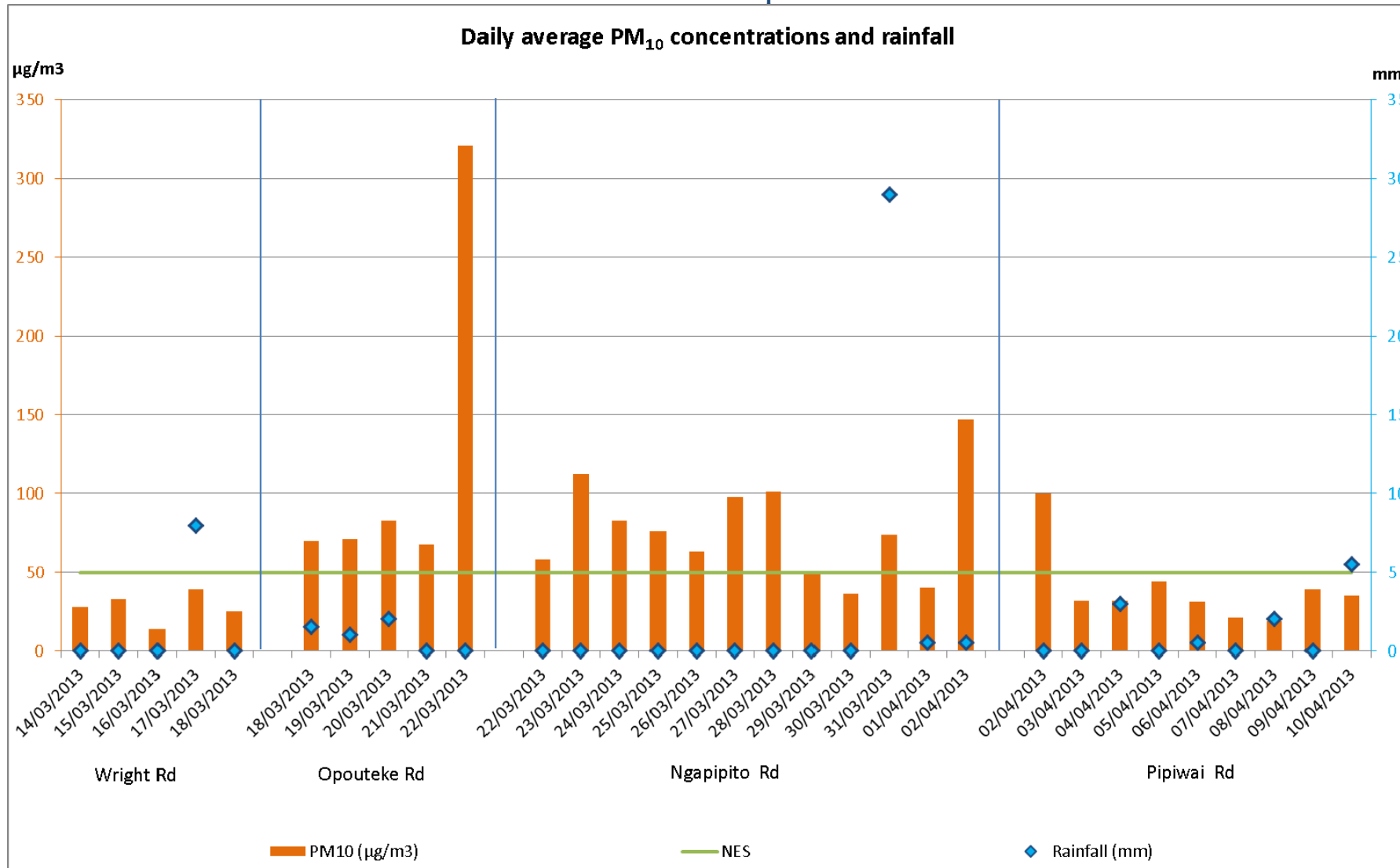
There is no national limit/standard for deposited dust particle concentration. The Ministry of Health previously specified a guideline value of 4 grams per square metre per 30 days over and above background concentrations. Values above this have been known to result in dust nuisance complaints. Typical background concentrations for rural Northland range between 5 and 15 grams per square metre per 30 days depending on multiple factors including the season, weather, location, wind speed/direction etc.

The table below shows the DP gauge monitoring results for four unsealed roads in Northland at periods during the 2012-2013 summer, with concentrations above the Ministry of Health's guideline (minus an assumed background concentration of  $15 \text{ gm}^2/30 \text{ days}$ ) in bold. Soluble dust is not considered to cause dust nuisance.

Location	Monitoring period	Dust ( $\text{gm}^2/30 \text{ days}$ )	
		Insoluble	Soluble
<b>442 Opouteke Road</b>	15 November to 13 December 2012	<b>66.78</b>	0.86
<b>4116 Pipiwai Road</b>	15 November to 13 December 2012	<b>21.81</b>	5.16
<b>3872 Pipiwai Road</b>	15 November to 13 December 2012	7.85	4.91
<b>634 Wright Road</b>	24 January to 22 February 2013	<b>28.84</b>	5.50
<b>1120 Ngapipito Road</b>	8 February to 8 March 2013	<b>77.52</b>	6.60

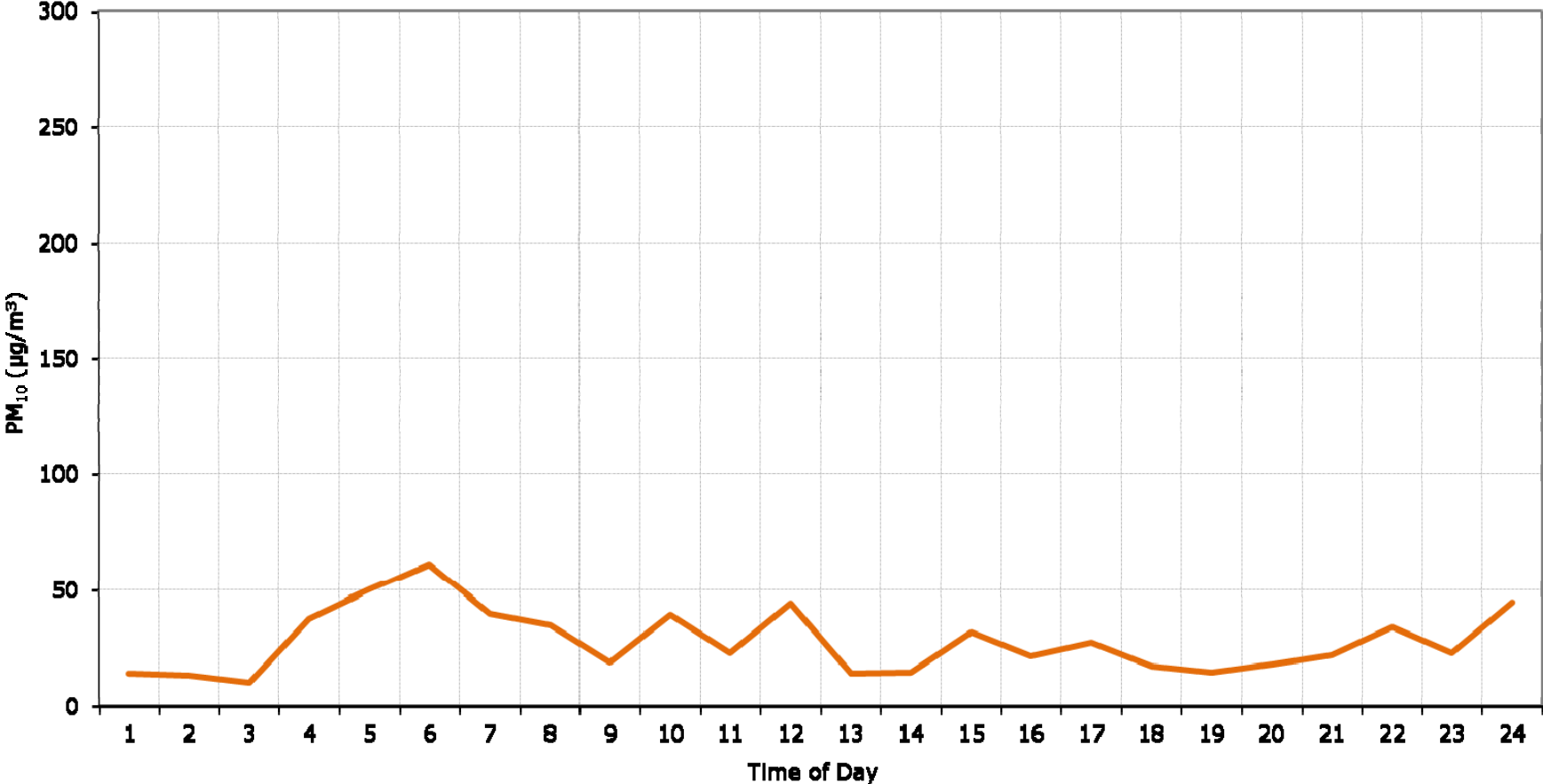


## Appendix 2: Daily average PM<sub>10</sub> concentrations per site

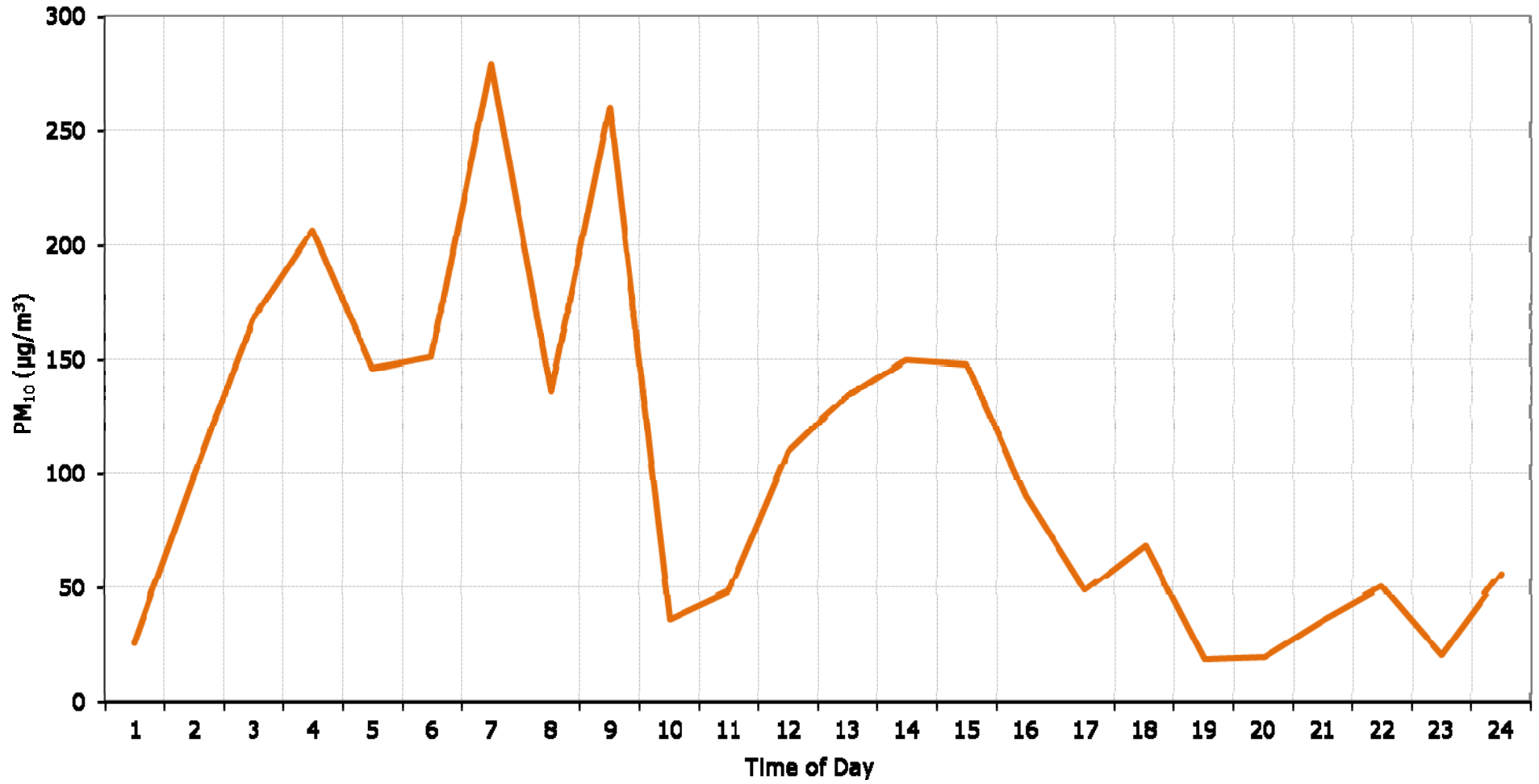


# Appendix 3: Diurnal average PM<sub>10</sub> concentrations per site (New Zealand Standard Time)

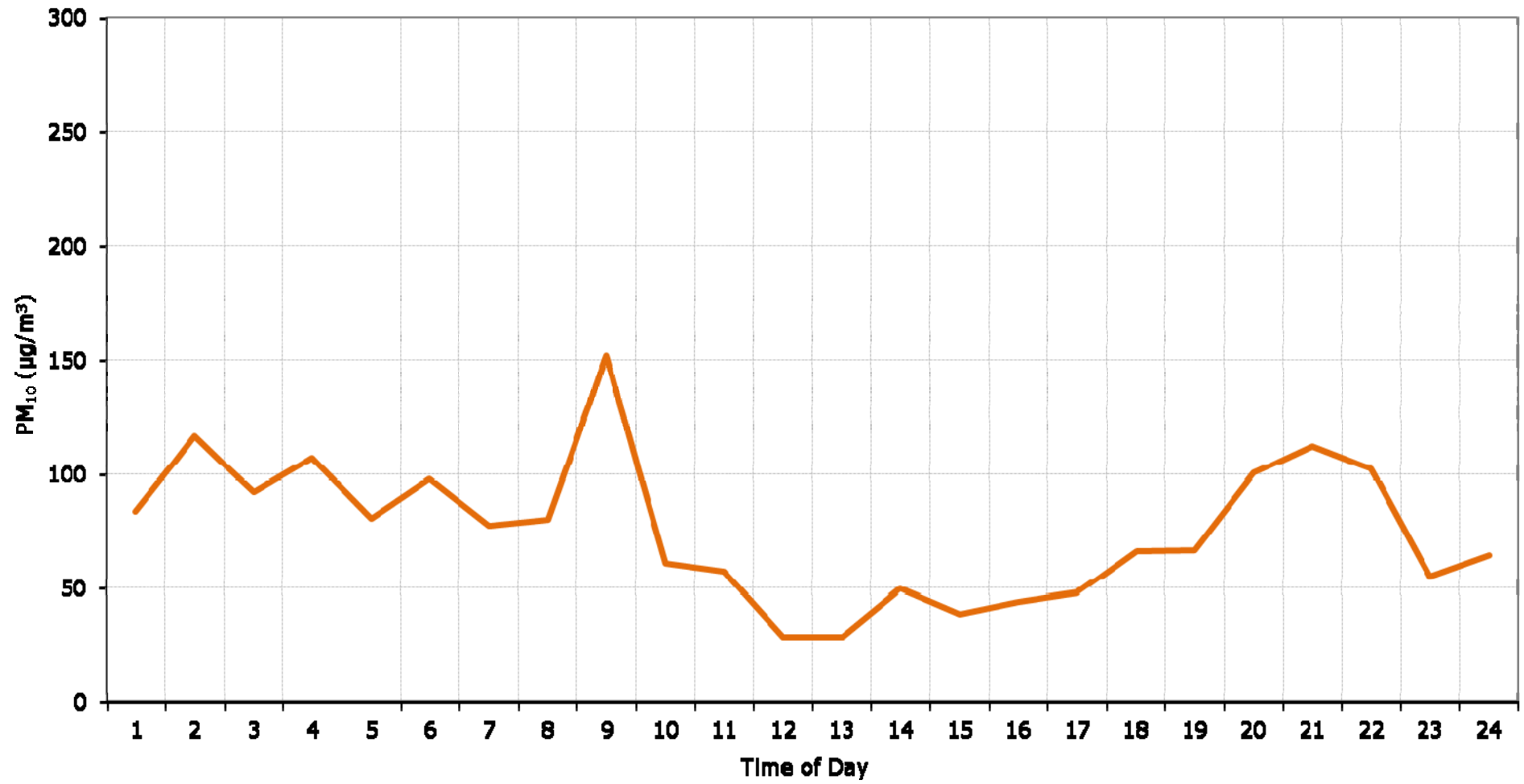
## Wright Road Diurnal PM<sub>10</sub> Concentrations



Opouteke Road Diurnal PM<sub>10</sub> Concentrations

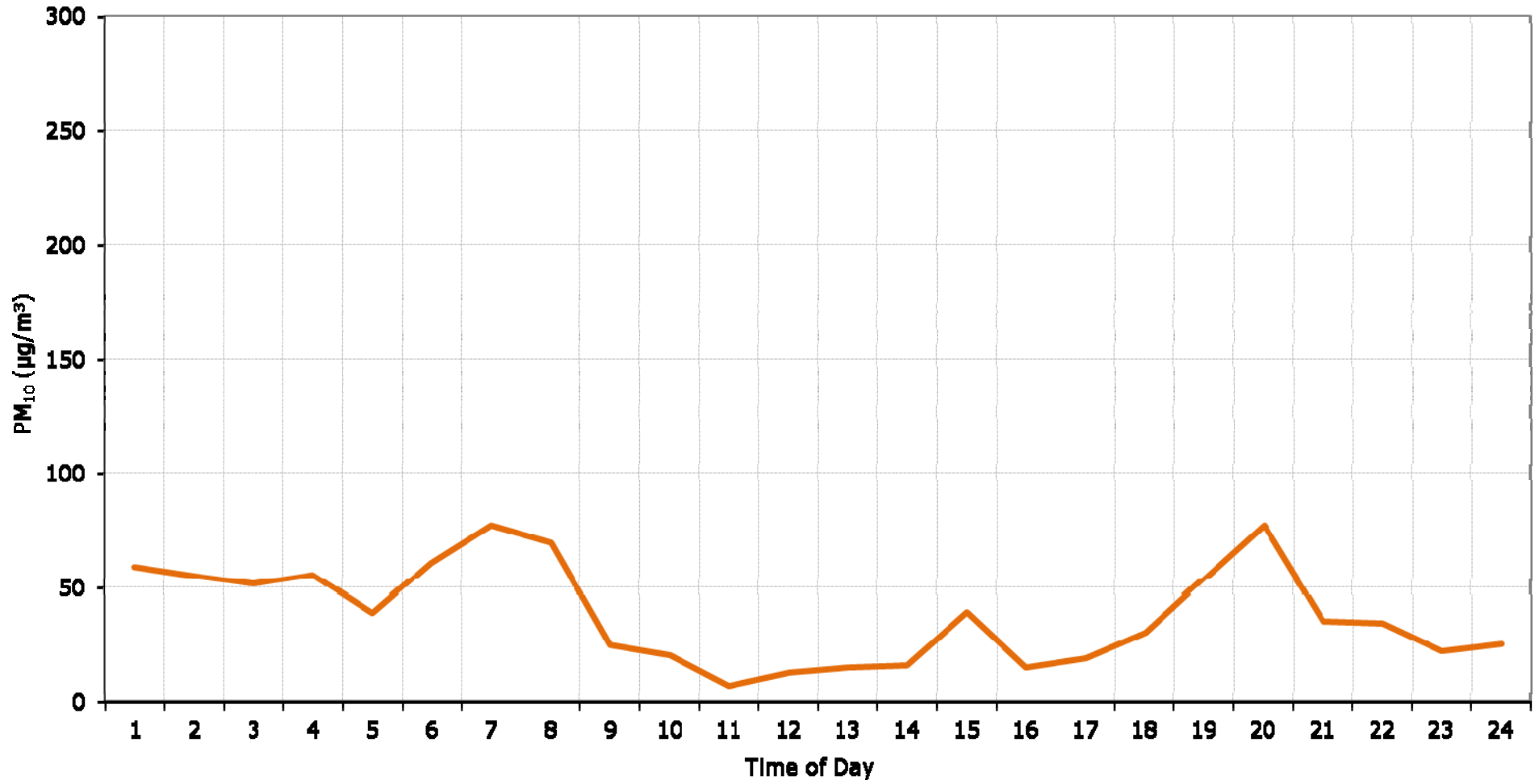


Ngapipito Road Diurnal PM<sub>10</sub> Concentrations

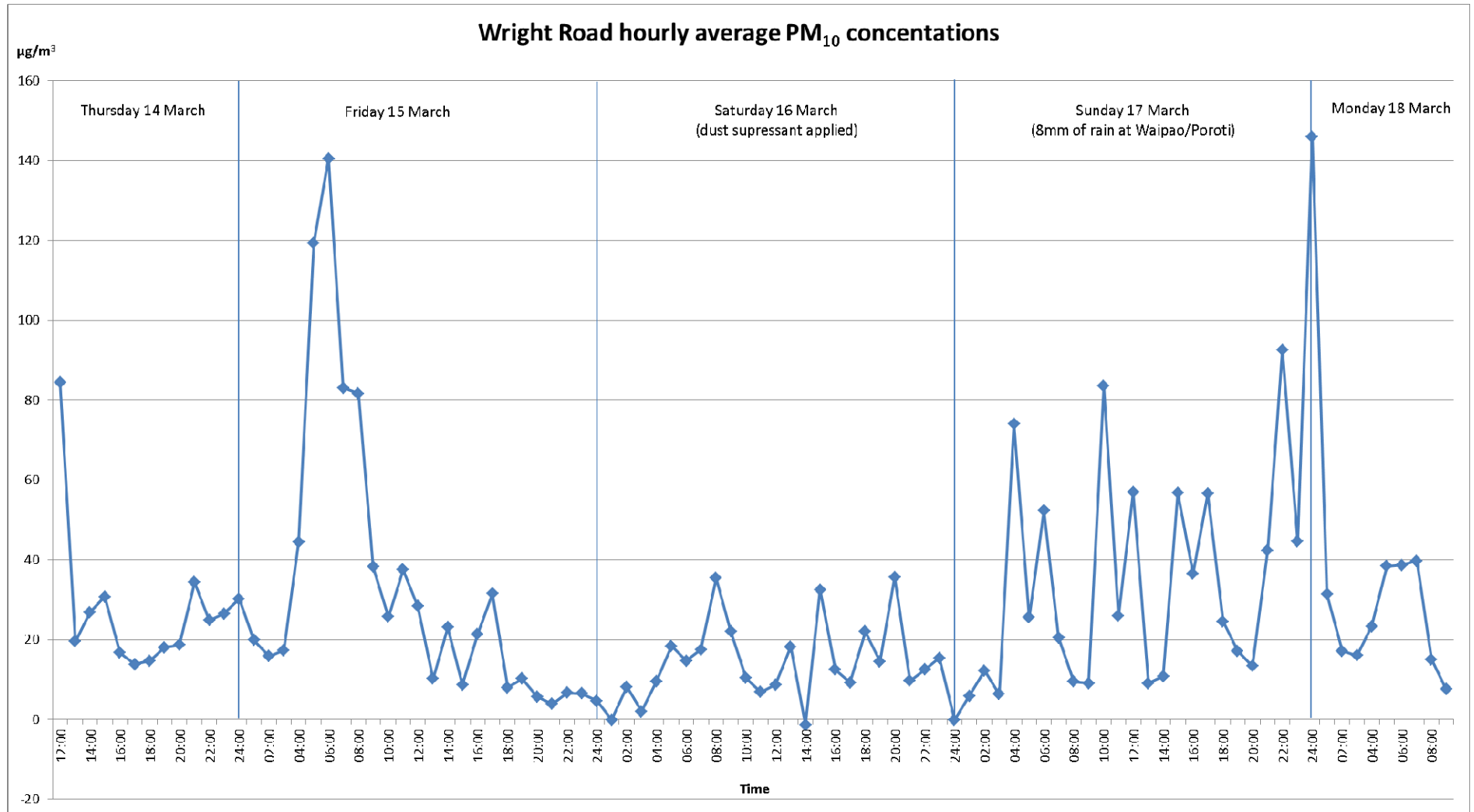




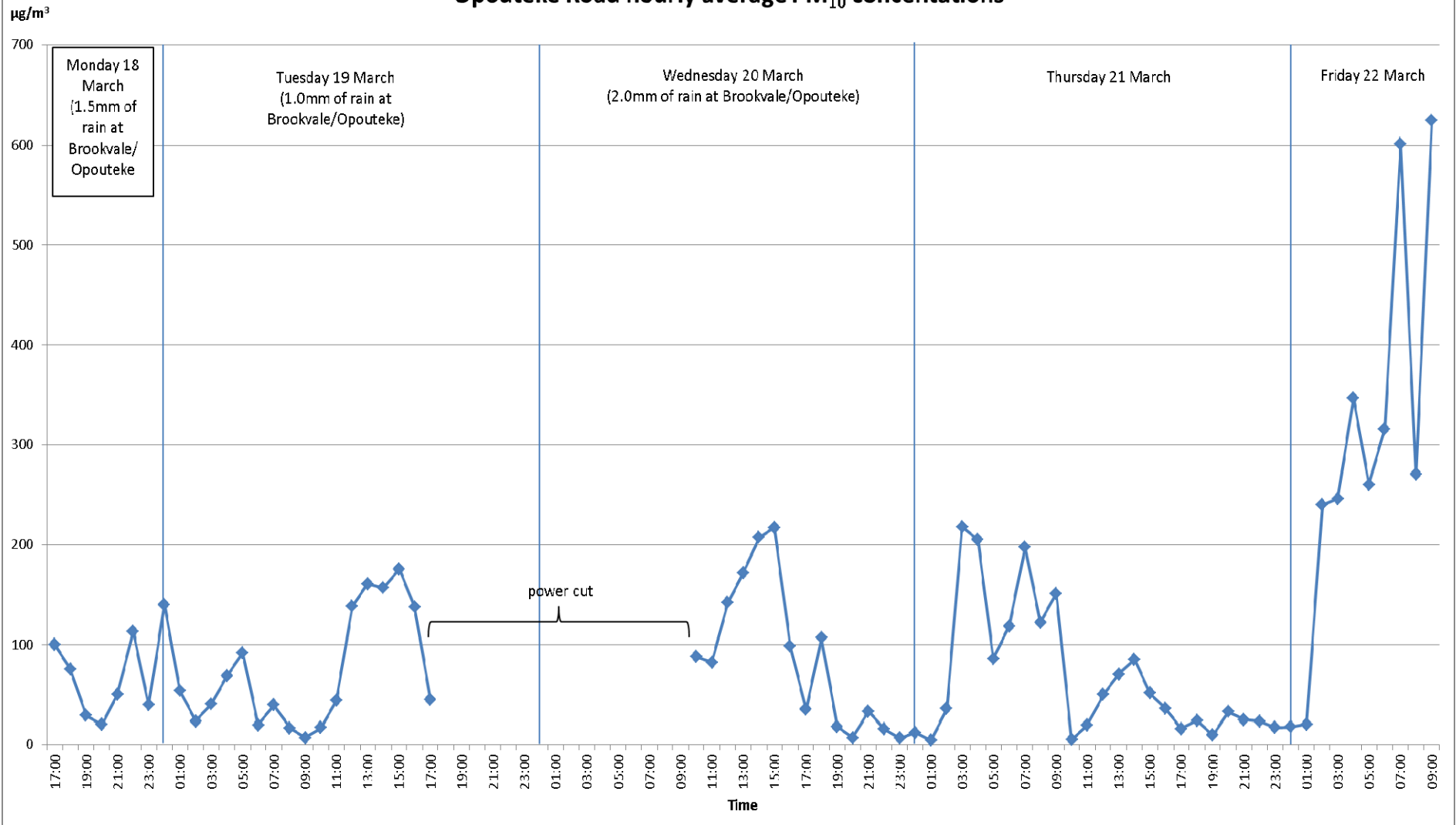
Piplwai Road Diurnal PM<sub>10</sub> Concentrations



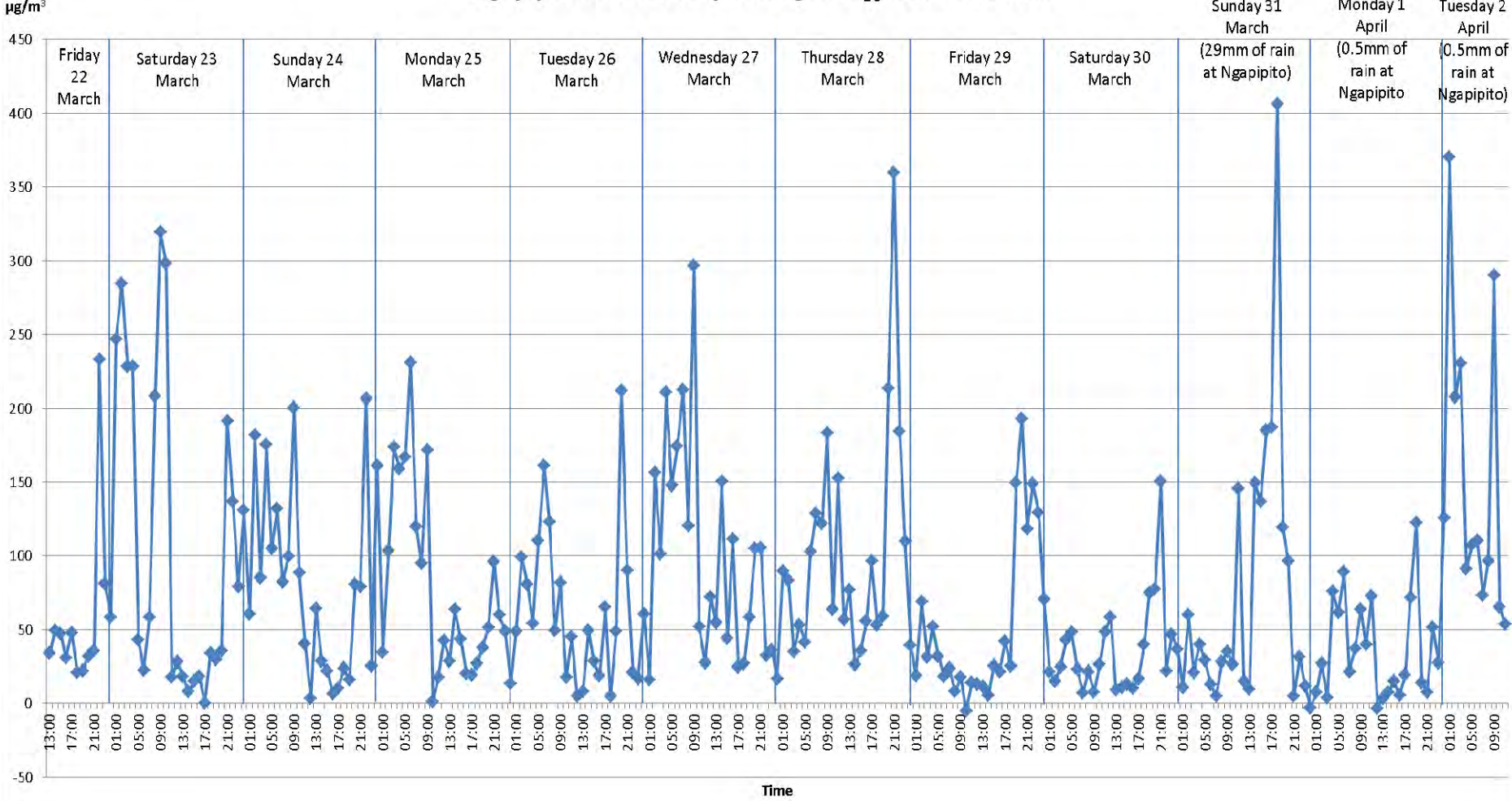
## Appendix 4: Hourly average PM<sub>10</sub> concentrations per site (New Zealand Standard Time)



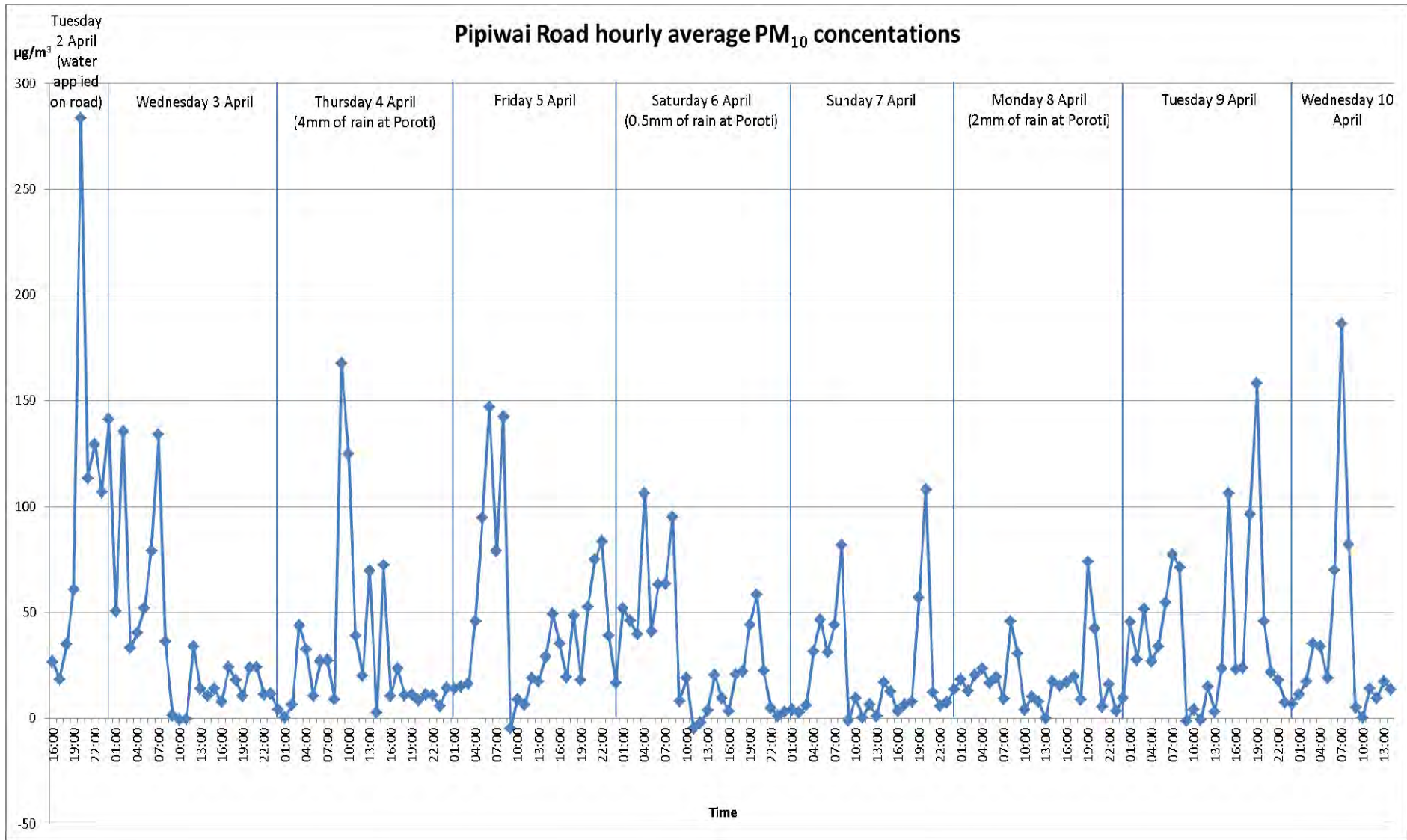
### Opouteke Road hourly average PM<sub>10</sub> concentrations



### Ngapipito Road hourly average PM<sub>10</sub> concentrations







## Appendix 5: Watercare Services Ltd report



### Laboratory Services

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Our ref: O-2021143

16 April 2013

Obi Khanal  
Environmental Monitoring Officer – Air Quality  
Northland Regional Council  
Private Bag 9021  
Whangarei Mail Centre  
Whangarei 0148

Dear Obi

### **E-BAM PM<sub>10</sub> Ambient Air Monitoring Report for Northland Regional Council**

Attached is the ambient air quality monitoring report for 14 March to 10 April 2013. This report contains results particulate matter as PM<sub>10</sub>. Also attached (via email) is the corresponding data.

If you have any questions about these results, please contact me.

Yours sincerely

A handwritten signature in blue ink that reads "Kath McLeod".

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# Northland Regional Council



## E-BAM PM<sub>10</sub> Ambient Air Quality Monitoring Report 14 March to 10 April 2013

Prepared for  
Northland Regional Council

By



Laboratory Services  
Air Quality Department

E-BAM PM<sub>10</sub> Ambient Air Quality  
Monitoring Report  
14 March to 10 April 2013

*A report for*  
**Northland Regional Council**

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## 1. Summary

Ambient air quality monitoring within Northland, from 14 March to 10 April 2013 showed:

- There were nine exceedences of the National Environmental Standard for PM<sub>10</sub>.
- The highest PM<sub>10</sub> 24-hour concentration was 112µg/m<sup>3</sup> on 23 March 2013
- Most of the exceedences occurred at Ngapipito Road.

## 2. Introduction

In March 2013, Northland Regional Council (NRC) commissioned Watercare to conduct monitoring of particulate matter as PM<sub>10</sub> using a Met One E-BAM. The monitoring was carried out by NRC due to concerns about particulate matter from unsealed roads.

NRC staff situated the E-BAM at four locations around the Northland area during the monitoring period from 14 March to 10 April 2013.

In this report we provide:

- summary of results
- overview of the relevant exceedence limits
- overview of the method used
- brief description of the monitoring sites
- results of validated data.

## 3. Ambient Air Quality Levels

The measurements of air quality made in Northland can be compared with various air quality targets, guidelines or standards. The Ministry for the Environment (MfE) National Environmental Standards (NES) for air quality superseded the Ambient Air Quality Guidelines (AAQG) 2002. These limits are listed in Table 1.

**Table 1: AAQG and NES**

Pollutant	Averaging period	AAQG	NES
Particulates (PM <sub>10</sub> )	24-hour	50µg/m <sup>3</sup>	50µg/m <sup>3</sup>
	Annual	20µg/m <sup>3</sup>	No standard

## 4. Method

Measurements were made using a Met One Environmental Beta Attenuation Monitor (E-BAM). Airborne particulate matter less than 10µm in diameter (PM<sub>10</sub>) is drawn into the E-BAM at 16.7 litres per minute and uses the principle of beta ray attenuation. The unit continuously measures the intensity of beta particles passing through a filter tape, which calculates particulate matter.

All PM<sub>10</sub> concentrations were reported as µg/m<sup>3</sup> at standard temperature and pressure (0 °C and 1 atm). The time was set as New Zealand standard time. The 24-hour average concentrations can be compared with NES and other PM<sub>10</sub> methods. However, the E-BAM is not a NES reference method.

## 5. Site Descriptions

Table 2 lists the four monitoring locations with the corresponding monitoring periods and addresses. These four locations are situated along unsealed roads between State Highway 12 and State Highway 1 (Figure 1).

**Table 2: Site Locations**

<i><b>Location One – Wright Road</b></i>	
<b>Monitoring Period</b>	14-03-2013 10:50 to 18-03-2013 09:00
<b>Address</b>	634 Wright Road, Pipiwai
<i><b>Location Two – Opouteke Road</b></i>	
<b>Monitoring Period</b>	18-03-2013 16:00 to 22-03-2013 09:10
<b>Address</b>	442 Opouteke Road, Pakotai
<i><b>Location Three – Ngapipito Road</b></i>	
<b>Monitoring Period</b>	22-03-2013 13:00 to 02-04-2013 11:40
<b>Address</b>	1120 Ngapipito Road, Moerewa
<i><b>Location Four – Pipiwai Road</b></i>	
<b>Monitoring Period</b>	02-04-2013 14:50 to 10-04-2013 14:40
<b>Address</b>	4116 Pipiwai Road, Punakitere

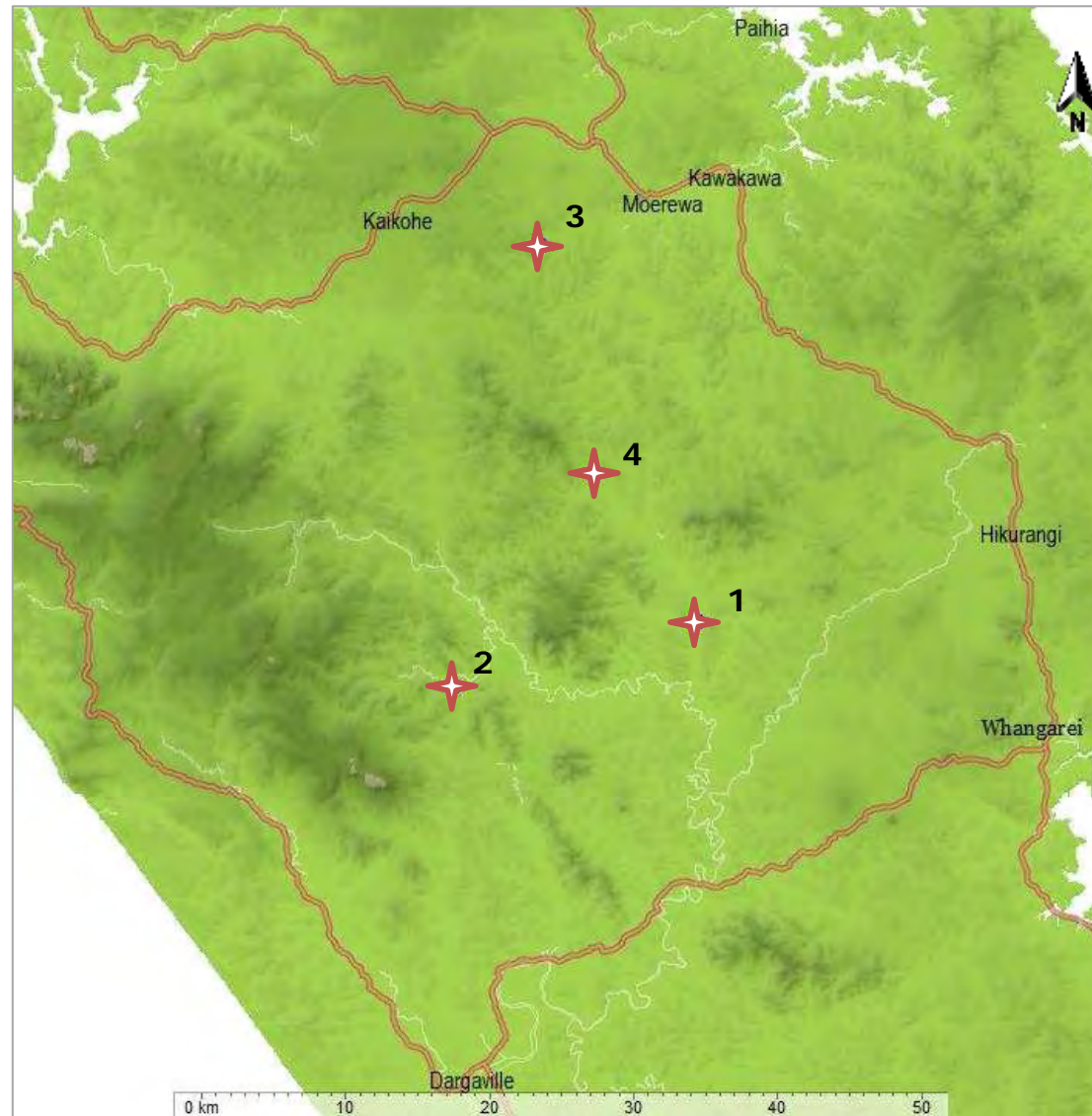


Figure 1: Map of the NRC air quality monitoring locations



## 6. Results

Table 3 displays the PM<sub>10</sub> results for the monitoring period from 14 March to 10 April 2013 at the four locations. There were nine valid exceedences of the 50µg/m<sup>3</sup> PM<sub>10</sub> NES (in orange) . Figure 2 graphically displays the 24-hour bar graph during the monitoring period. The *MfE Good Practice Guide for Air Quality Monitoring and Data Management* suggests that it is difficult to reach anything close to 100% valid data for long-term monitoring. For this report, the continuous 10-minute data has been compared against a target of 95%.

**Table 3: PM<sub>10</sub> data from 14 March to 10 April 2013**

Date	24-hour PM <sub>10</sub> (µg/m <sup>3</sup> )	Valid data (%)	Site notes
<i>Location One – Wright Road</i>			
14/03/2013	28	54%	Site commissioned
15/03/2013	33	100%	
16/03/2013	14	100%	
17/03/2013	39	100%	
18/03/2013	25	38%	Site decommissioned
<i>Location Two – Opouteke Road</i>			
18/03/2013	70	34%	Site commissioned
19/03/2013	71	74%	Less than 95% valid data
20/03/2013	83	62%	Less than 95% valid data
21/03/2013	68	100%	
22/03/2013	321	38%	Site decommissioned
<i>Location Three – Ngapipito Road</i>			
22/03/2013	58	49%	Site commissioned
23/03/2013	112	100%	
24/03/2013	83	100%	
25/03/2013	76	100%	
26/03/2013	63	100%	
27/03/2013	98	100%	
28/03/2013	101	100%	
29/03/2013	51	100%	
30/03/2013	36	100%	
31/03/2013	74	100%	
01/04/2013	40	100%	
02/04/2013	147	49%	Site decommissioned
<i>Location Four – Pipiwai Road</i>			
02/04/2013	100	39%	Site commissioned
03/04/2013	32	100%	
04/04/2013	32	100%	
05/04/2013	44	100%	
06/04/2013	31	100%	
07/04/2013	21	100%	
08/04/2013	19	100%	
09/04/2013	39	100%	
10/04/2014	35	61%	Site decommissioned

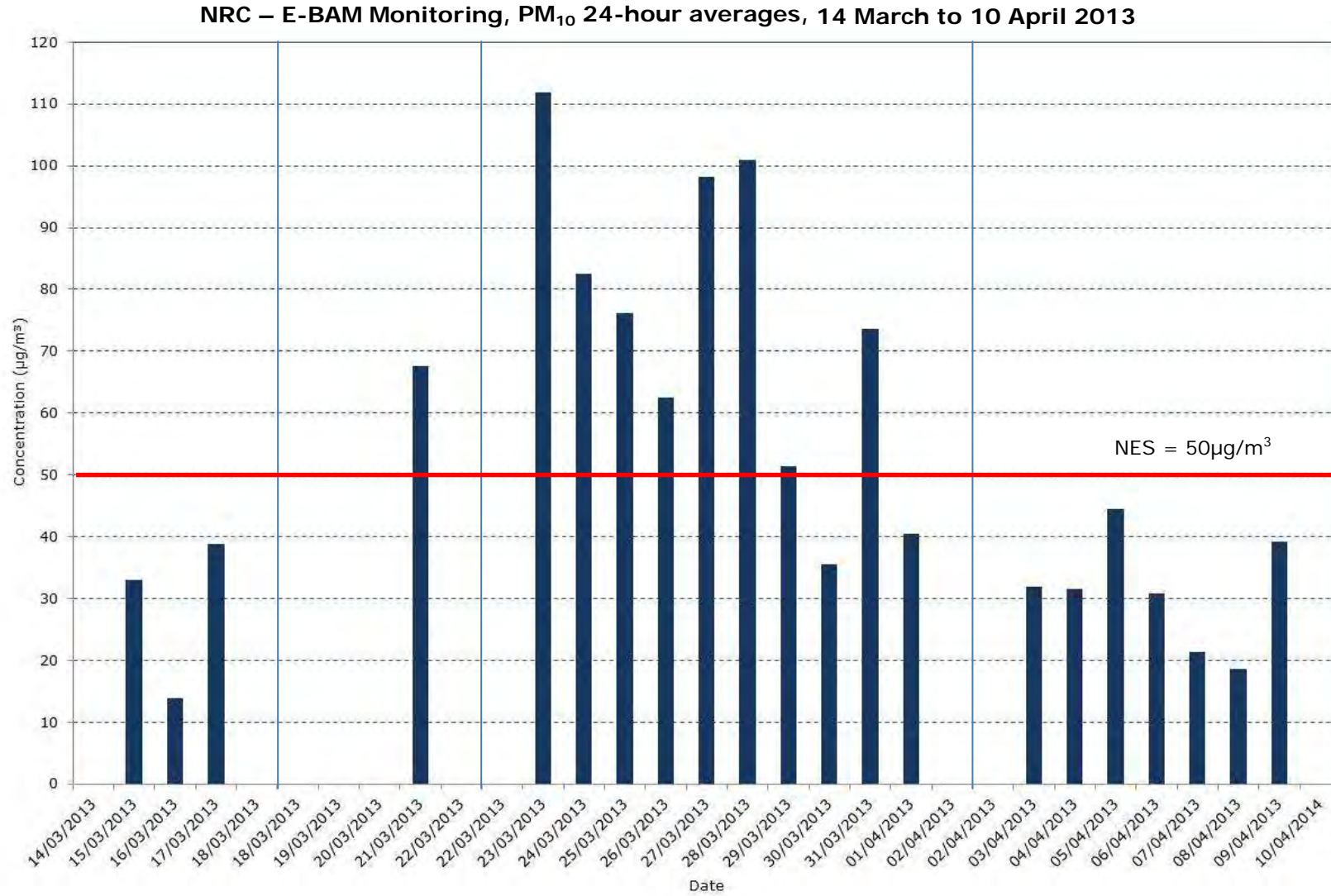


Figure 2: NRC – E-BAM Monitoring (24-hour averages)



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