HAWKE'S BAY
REGIONAL COUNCIL

28th July 2017

Hon. Nick Smith
Minister for the Environment
Parliament Buildings
Wellington 6160

Dear Minister,

APPLICATION UNDER NATIONAL STANDARDS FOR AIR QUALITY – REGULATION 16A EXCEPTIONAL CIRCUMSTANCES

The Hawke's Bay Regional Council is seeking a determination that an exceedance of the National Air Quality Standards for PM_{10} in the Awatoto Airshed on 29th April 2017 was an exceptional circumstance. A completed application form and additional supporting information accompany this letter and support the five criteria that define exceedances caused by exceptional or natural events:

1. the exceedance was caused by the events assessed,
2. the circumstances were beyond the reasonable control of the Council,
3. the circumstances could not be planned for,
4. the event was unusual,
5. determining that the circumstances were exceptional is consistent with the purpose of the RMA.

If you require any further information or have any questions, please do not hesitate to contact me.

Thank you for your consideration in this matter.

Yours sincerely

K. M. Kozyniak

Dr Kathleen Kozyniak
Principal Scientist Climate and Air

P 06 833 8055 | F 06 835 3601
kathleen@hbrc.govt.nz | www.hbrc.govt.nz

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Ministry for the Environment
Manatū Mō Te Taiao

OFFICE USE ONLY

Application no:

Date received:

Date accepted:

Resource Management (National Environmental Standards for Air Quality) Regulations 2004 – Regulation 16A Exceptional Circumstances

APPLICATION FORM

Before completing this form please read section 3.8 of the 2011 User's Guide to the revised National Environmental Standards for Air Quality.

Need more help? If you have any questions email air@mfe.govt.nz.

Please send your completed application form and all attachments to air@mfe.govt.nz.

Alternatively, if attachments are too large to email, please post hard copies of the application form and all attachments, along with a CD containing all files, to:

Air Quality NES Exceptional Circumstances
Ministry for the Environment
PO Box 10362
Wellington 6143

1. Applicant details	
Name of regional council	Hawke's Bay Regional Council
Contact person	Dr Kathleen Kozyniak
Position	Principal Scientist - Air
Email address	kathleen@hbrc.govt.nz
Telephone number	06 833 8055
Mobile number	
Postal address	159 Dalton Street, Napier 4110
2. Details of exceedance event	
Contaminant	PM_{10}
Date of exceedance *(must not be >3 months from date this application is received)*	29th April 2017
Relevant airshed	Awatoto Airshed
Monitoring station and technical specifications of monitor	Awatoto Air Quality Site, 80 Waitangi Road. Site details are provided in Appendix I. Beta Attenuation Monitor (BAM) approximately 1.5 years old and housed in an air conditioned hut. BAM make and model: Thermo FH62C14.

Summary of monitoring reading showing exceedance event	The 24 hour average PM_{10} on the 29th April 2017 was 75 µg/m^3. Further information is provided in Appendix 2 and an excel file of measurements is attached. The source of the particulate is believed to be sea salt.			
Analysis of baseline data	Please refer to Appendix 3.			
Source speciation or other analysis	Samples of particulate were collected on the exceedance day as part of a source speciation study at the Awatoto monitoring site. While a final report on the study is not yet complete, preliminary results from that day are inconclusive. More detail is provided in Appendix 4.			
Explanation of any previous exceedance event/s from this monitoring station in the past 5 years	51 µg/m^3 on 16th July 2012 – likely source was earthworks. 59 µg/m^3 on 11th June 2013 – likely source was sea salt. 55 µg/m^3 on 11th June 2014 – attributed to sea salt and deemed an exceptional event. 64 µg/m^3 on 1st October 2014 – attributed to sea salt and deemed an exceptional event. 53 µg/m^3 on 28th January 2015 – likely sources were sea salt and earthworks. 80 µg/m^3 on the 29th March 2015 – unknown local source.			
Monitoring readings covering exceedance event	☒ Attached	☐ Not attached		
3. Details of exceptional circumstances				
Exceptional circumstances leading to exceedance	☐ Localised impact on a monitor	☐ Anthropogenic extreme event	☒ Natural disaster or natural extreme event	☐ Other
Explanation of circumstances leading to exceedance event	A large, slow moving low pressure system to the east of New Zealand generated a long period southeast swell along the North Island east coast and high seas around Hawke's Bay. The resulting sea spray is believed to have raised particulate levels in the Awatoto airshed above normal background levels when the wind was onshore. Significant wave heights were building prior to the day of the exceedance and peaked on 28th and 29th April before receding the next day. Please see Appendix 5 for further detail.			
Reasons why these circumstances were beyond the reasonable control of the regional council	Natural events are beyond the reasonable control of the Council and it is believed the exceedance was the result of an exceptional amount of sea salt in onshore winds during a period of high seas. The high seas are attributed to a long period swell generated by an intense slow moving pressure system located to the east of the country in late April 2017.			
Supporting evidence *(eg, meterological report)*	☒ Attached	☐ Not attached		

28/7/2017

Dated

Signed

APPENDIX 1 – SITE INFORMATON

Site Name – Awatoto AQ

Site Location – 80 Waitangi Road, Awatoto

Map Reference NZMG 2846750E 6176930N, NZTM 1936791E 5615302N

Region and Monitoring zone – Hawke's Bay, Awatoto Airshed

Airshed Type – Industrial

Owner (Operator) – Hawke's Bay Regional Council (HBRC)

Parameters monitored –

- PM_{10} (Thermo FH62C14 Beta Attenuation Monitor, <2 years old)
- $PM_{2.5}$ (5014i Beta Attenuation Monitor, <1 year old)
- Wind direction and speed
- Temperature
- Humidity

Monitoring period –

- PM_{10}, wind speed, humidity and temperature -15th February 2012 to present
- Wind direction – 10th May 2012 to present
- $PM_{2.5}$ – 8th September 2016 to present

Height above ground – PM_{10} and $PM_{2.5}$ approximately 4 m, climate parameters 6 m (see Figure 1.1 for the site configuration)

Nearest SH and Local Road with Direction – SH2 75 m E, Waitangi Road 23 m W.

Nearest tree – 20 m

Figure 1.1: HBRC's air quality and climate site at Waitangi Road, Awatoto. The hut on the left houses a Thermo FH62C14 BAM measuring PM_{10} and the hut on the right houses a Thermo FH62C14 BAM measuring $PM_{2.5}$. The mast with climate instruments is adjacent to the hut on the right.

Location Map and Additional Notes

The Awatoto airshed lies near the coast south of Napier and comprises industrial and rural land. It is approximately 3 km long and for the most part lies within 800 m of the shoreline but extends to 1km from the coast at its widest point. The rural land lies on the western side of the airshed and industry is concentrated on its eastern border in a strip less than 300 m wide.

HBRC's monitoring site is located approximately 200 metres west of the shoreline and 1 km from its northern border (Figure 1.2). Ravensdown Limited, a fertiliser manufacturer, dominates the area immediately to the south of the monitoring site. Ravensdown monitors PM_{10} on the eastern boundary of the airshed as a requirement of its air discharge consent.

HBRC chose the site for the following reasons:

- it is situated amongst the exposed population,
- the property is otherwise unused,
- it is relatively free of obstacles,
- easily accessible and has a power supply,

- fairly centrally located within the narrow strip of industrial activity,
- able to capture at least some industrial sources of PM_{10} in most wind directions and particularly the prevailing wind which has a westerly component.

Consideration has been given to moving the site beyond 500 m from the coast to place it beyond the "sea spray zone" but this would limit the effectiveness of sampling. It would place the monitor out of the industrial zone, meaning emissions from industry would be captured only in easterly conditions and in an area where human exposure is negligible.

Figure 1.2 An aerial photo of the Awatoto airshed showing the locations of the HBRC and Ravensdown's air quality sites.

APPENDIX 2 – MONITORING SHOWING THE EXCEEDANCE EVENT

On Saturday 29th April 2017, hourly PM_{10} concentrations at Awatoto AQ ranged from 8 to 136 $\mu g/m^3$ and averaged 75 $\mu g/m^3$ over 24 hours. The previous day's concentrations were relatively high, averaging 48 $\mu g/m^3$. Average PM_{10} concentrations recorded at the Ravensdown site were roughly double those at Awatoto AQ, measuring 86 and 151 $\mu g/m^3$ on the 28th and 29th April respectively.

At Marewa Park in Napier, which lies 2 km from the coast, the PM_{10} concentration on 29th April was 16 $\mu g/m^3$ and in Hastings, approximately 9 km inland, it was 12 $\mu g/m^3$. Further north, in the Whirinaki airshed, the PM_{10} concentration measured by Pan Pac Forest Products Limited was 33 $\mu g/m^3$. The monitor in the Whirinaki is located 200 m from the coast and has a shelterbelt of large pine trees between it and the sea. Figure 2.1 shows the location and recorded concentration of the monitoring sites.

Figure 2.2 shows the profile of hourly PM_{10} and $PM_{2.5}$ concentrations through 29th April 2017, along with wind direction, wind speed and humidity. Hourly wind speeds reached a maximum of 16 km/h late at night but averaged 8 km/h for the day. Winds were mostly northwest until dawn, then they varied between southeast and northeast for the remainder of the day. PM_{10} concentrations were highest in conditions when winds were from the easterly sector.

$PM_{2.5}$ concentrations did not exceed the World Health Organisation guideline for the 24 hour average (i.e. 25 $\mu g/m^3$) and measured 12 $\mu g/m^3$. The highest hourly maximum was 21 $\mu g/m^3$. Relative humidity had a mean value of 72% and the mean temperature was 18°C, with a narrow range of 17-19°C.

The concentration rose for 27th April 2017 in Figure 2.3 shows the highest concentrations occurred in winds from the northeast and southeast.

Seas were high throughout the 29th April and had been building through the week (Figure 2.4). Significant wave heights, measured at the Port of Napier buoy, reached a maximum of 2.7 m late on 28th April and during 29th April. As the wave heights progressively increased, PM_{10} concentrations tended to rise whenever winds turned easterly (onshore). Significant wave heights of this magnitude lie toward the extreme tail of wave height distributions at the Port of Napier (Figure 2.5). The wave period was approximately 14 seconds, suggesting that it was a long-period swell generated over a significant fetch.

The weekend occurrence of the exceedance, the coincidence of high concentrations at sites near the coast, the high seas and a pattern of increased concentrations with onshore winds, indicate that the source of the exceedance is most likely sea salt.

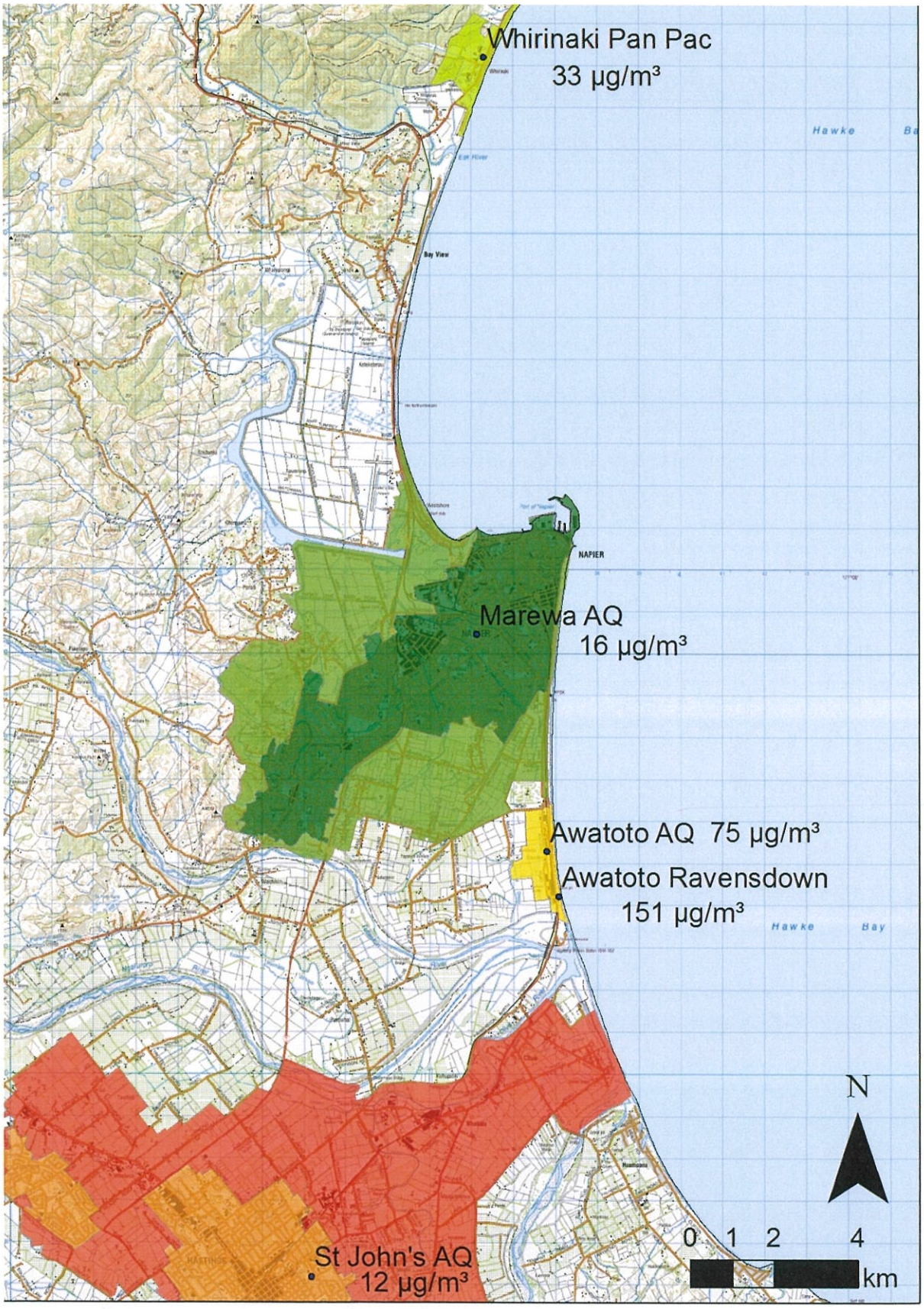

Figure 2.1: 24 hour average PM_{10} concentrations on 29th April at monitoring sites in Hawke's Bay. All sites monitor PM_{10} using a Thermo FH62C14 BAM.

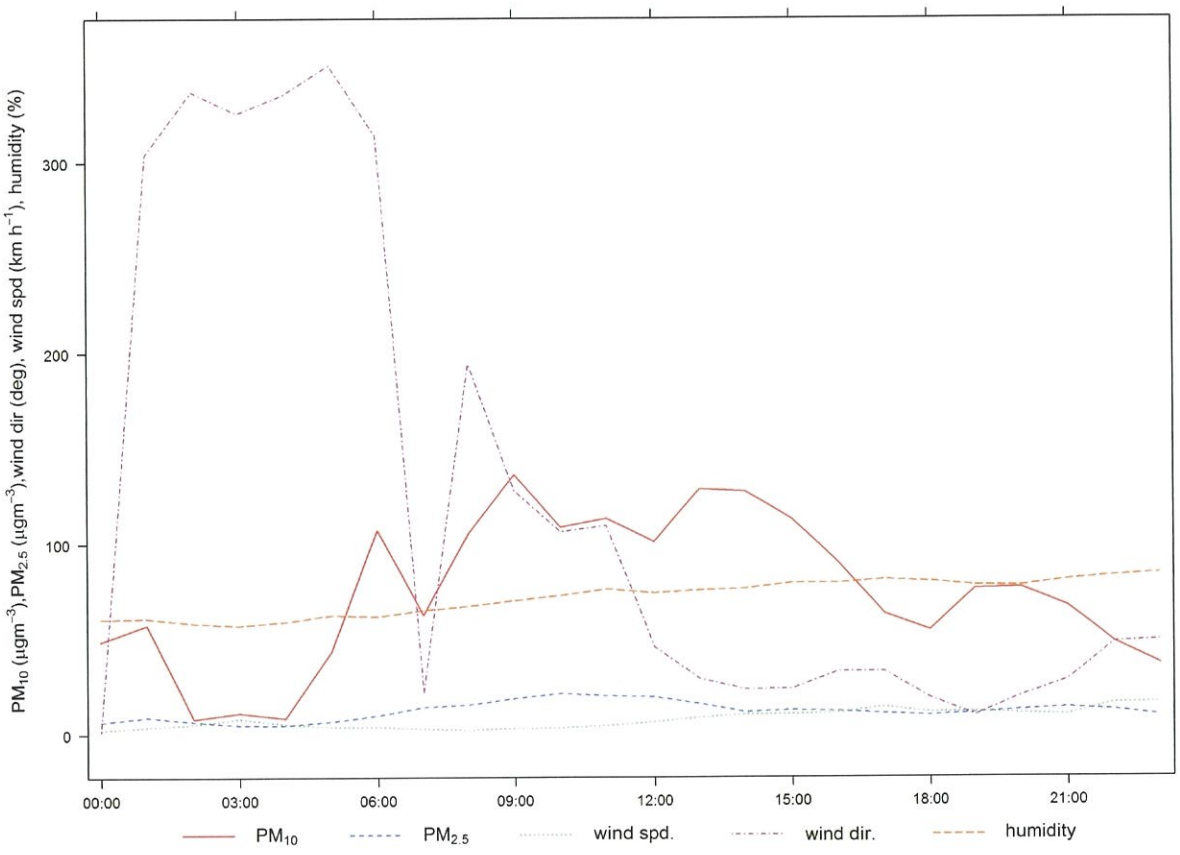

Figure 2.2: Hourly PM_{10} and $PM_{2.5}$ concentrations, wind direction, wind speed and humidity during 29th April 2017.

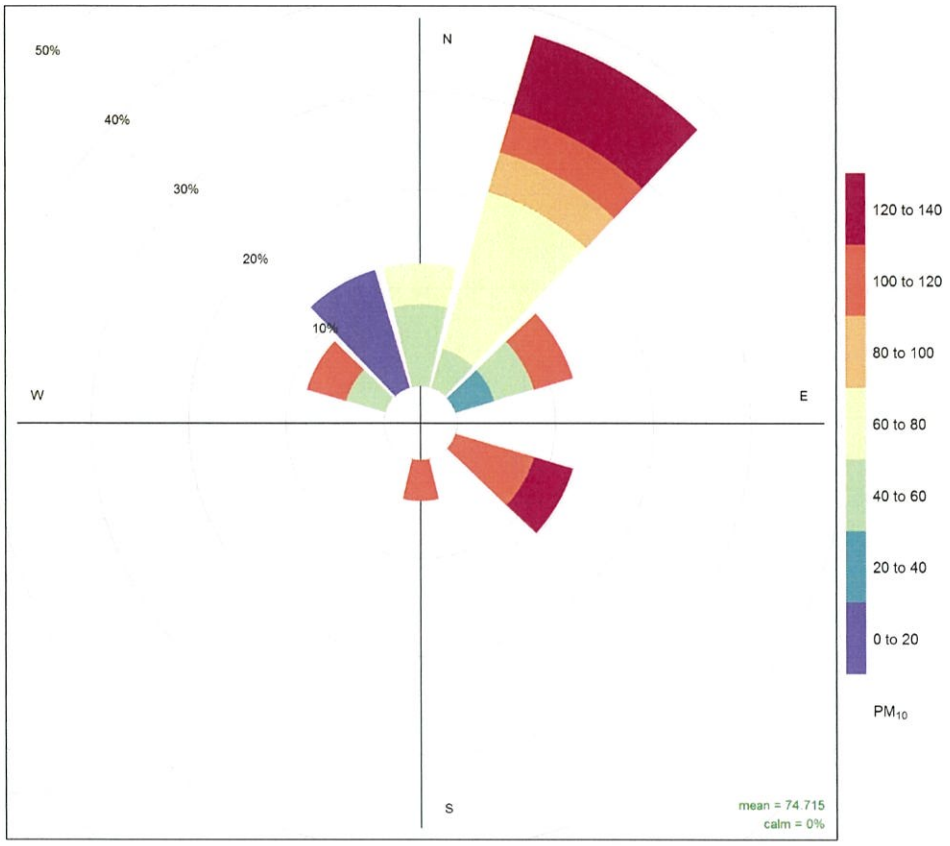

Figure 2.3: Concentration rose of hourly PM_{10} concentrations ($\mu g/m^3$) by wind direction for 29th April 2017.

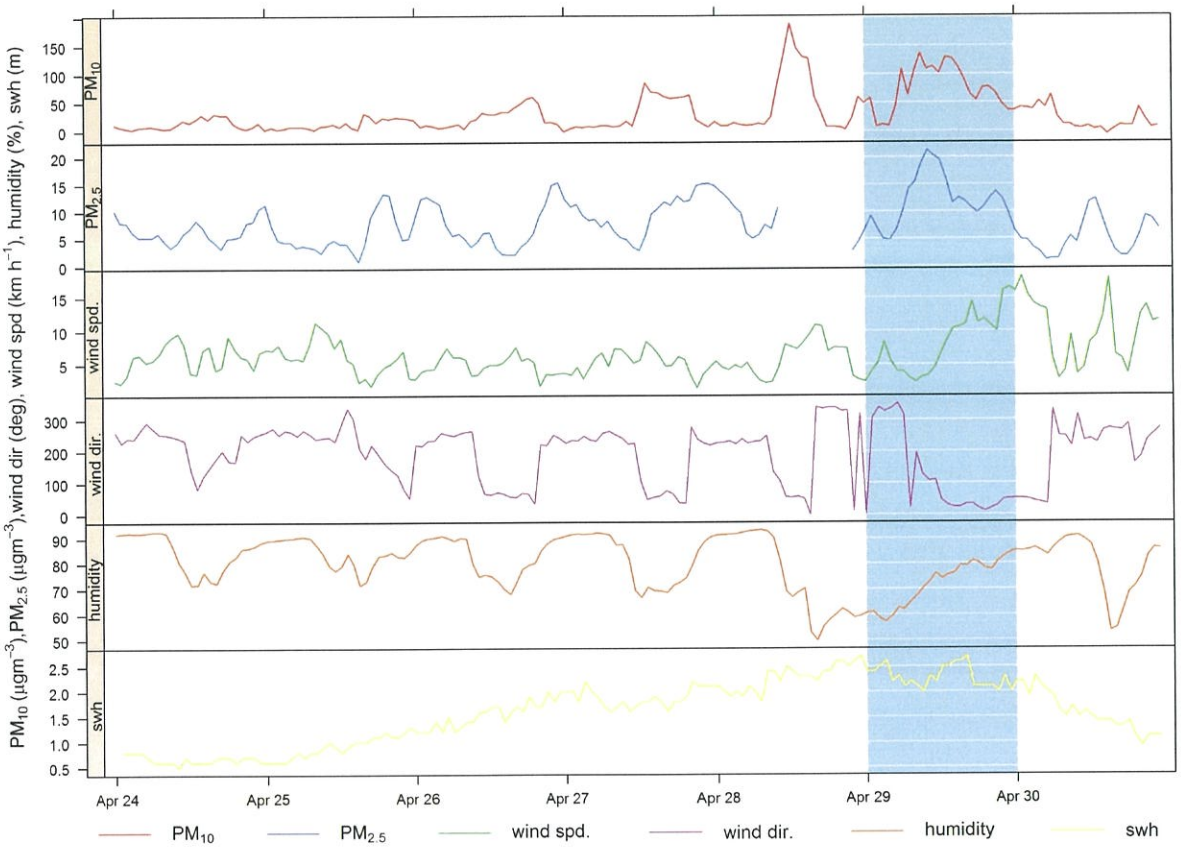

Figure 2.4: Hourly averages of PM_{10} (top), $PM_{2.5}$ (second from top), wind speed (third from top), wind direction (third from bottom), humidity (second from bottom) and significant wave height (swh) (bottom) from 24th to 30th April 2017. PM_{10}, $PM_{2.5}$ wind speed, wind direction and humidity are measured at the Awatoto monitoring site and wave heights at Port of Napier. The day the PM_{10} standard was exceeded, 29th April, is shaded in blue.

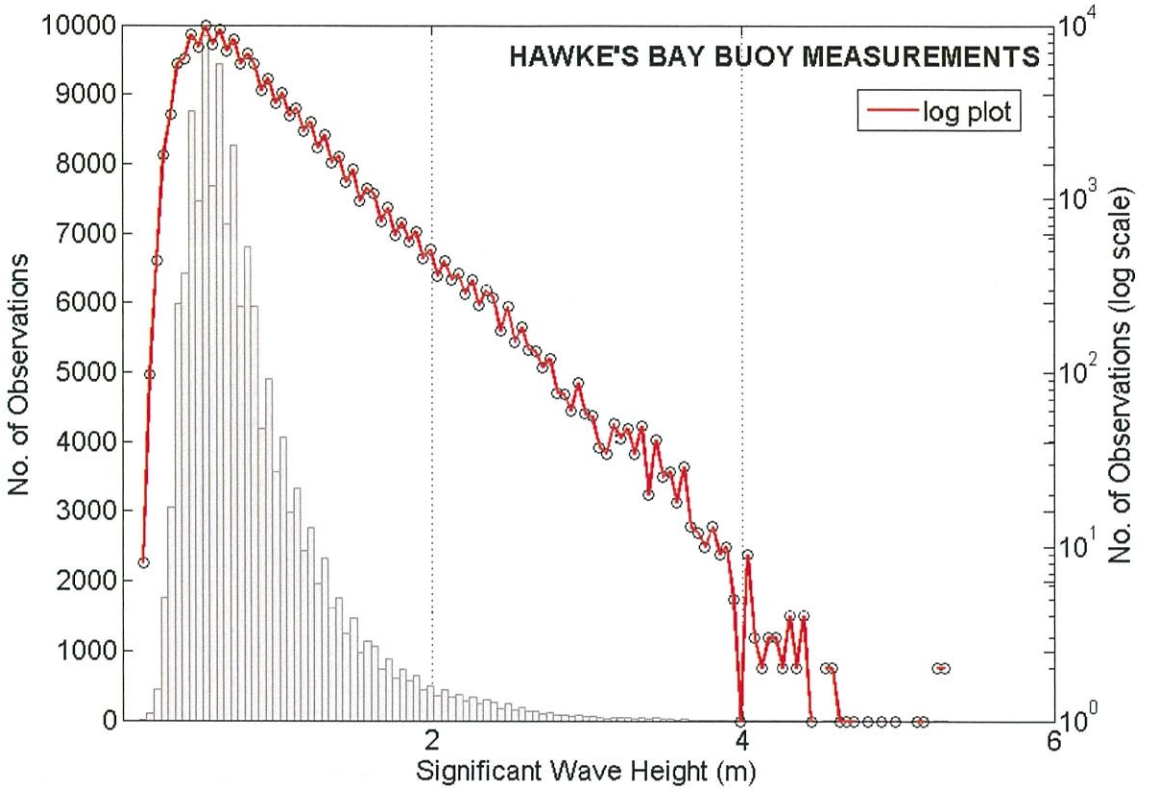

Figure 2.5: Histogram of significant wave heights measured by the Port of Napier buoy from 2000 to 2010 (Komar and Harris, 2014[1])

References

Komar, P.D. and Harris, E., 2014: Global Cllimate Change and Barrier-Beach Responses. HBRC Report No.AM 14-02 HBRC Plan No. 4600

APPENDIX 3 – BASELINE DATA

Average daily PM10 concentrations

PM_{10} has been monitored at the site since 2012. Figure 3.1 shows a boxplot of daily PM_{10} concentrations for each month since May 2012. The record is relatively short but a pattern is starting to emerge whereby higher monthly concentrations tend to occur during late summer. This is mostly likely due to sea breezes occurring more often, bringing with them sea salt (Figure 3.2). Exceedances exhibit no distinct seasonality, with all seasons having at least one.

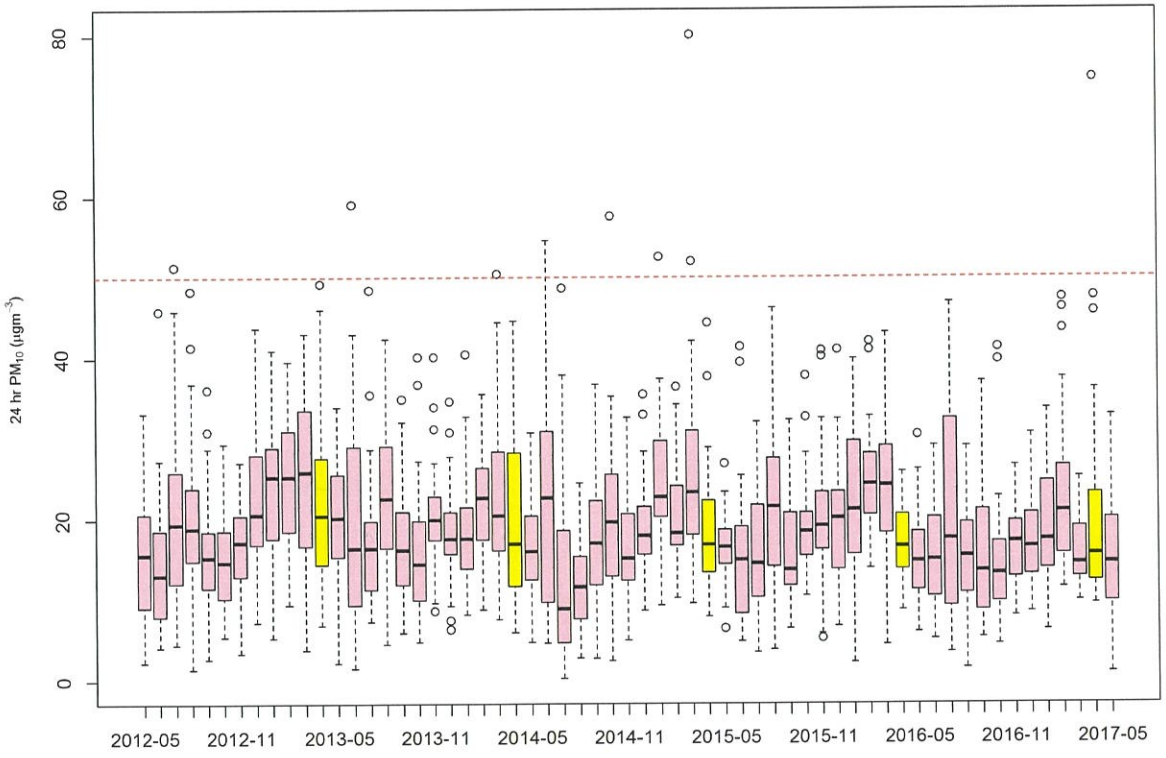

Figure 3.1: Box and whisker plot of 24 hour average PM_{10} concentrations, on a monthly basis, from May 2012 to May 2017. April months are coloured yellow. Median values are shown by thick black lines, the top and bottom sides of the box represent the upper and lower quartiles, dashed black lines extend to 1.5 times the inter-quartile range and outliers are indicated by black circles. The red dashed line represents the NES for PM_{10}.

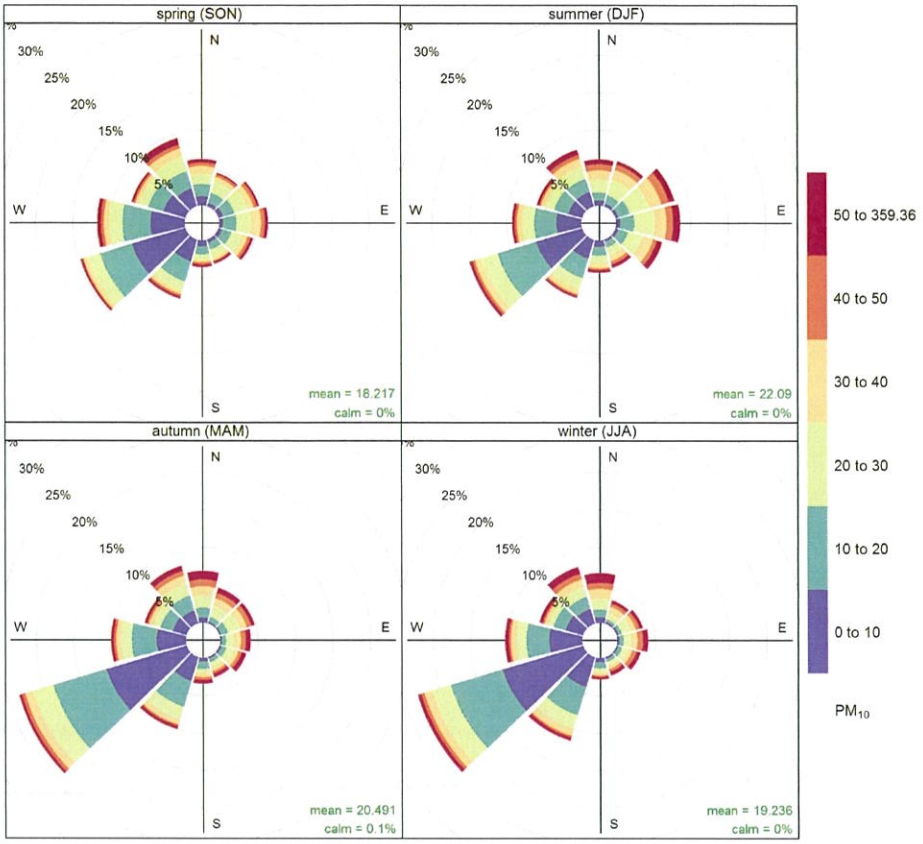

Figure 3.2: Concentration rose of hourly PM_{10} concentrations by season at Awatoto AQ, based on data from 2012 to 2017.

Measurements collected to date indicate that hourly PM_{10} concentrations tend to peak between midday and 6 pm, when wind speed also peaks (Figure 3.3). This pattern is evident on all days of the week, though concentrations during weekends tend to be marginally lower than during weekdays. The pattern is consistent with a polar plot (Figure 3.4), which shows the highest hourly concentrations tend to occur in higher wind speeds and mainly in directions from northwest through northeast to southeast. Exceedances days are most likely to occur in winds from an easterly direction (Figure 3.5). The predominant wind direction at the site is however southwest (Figure 3.6).

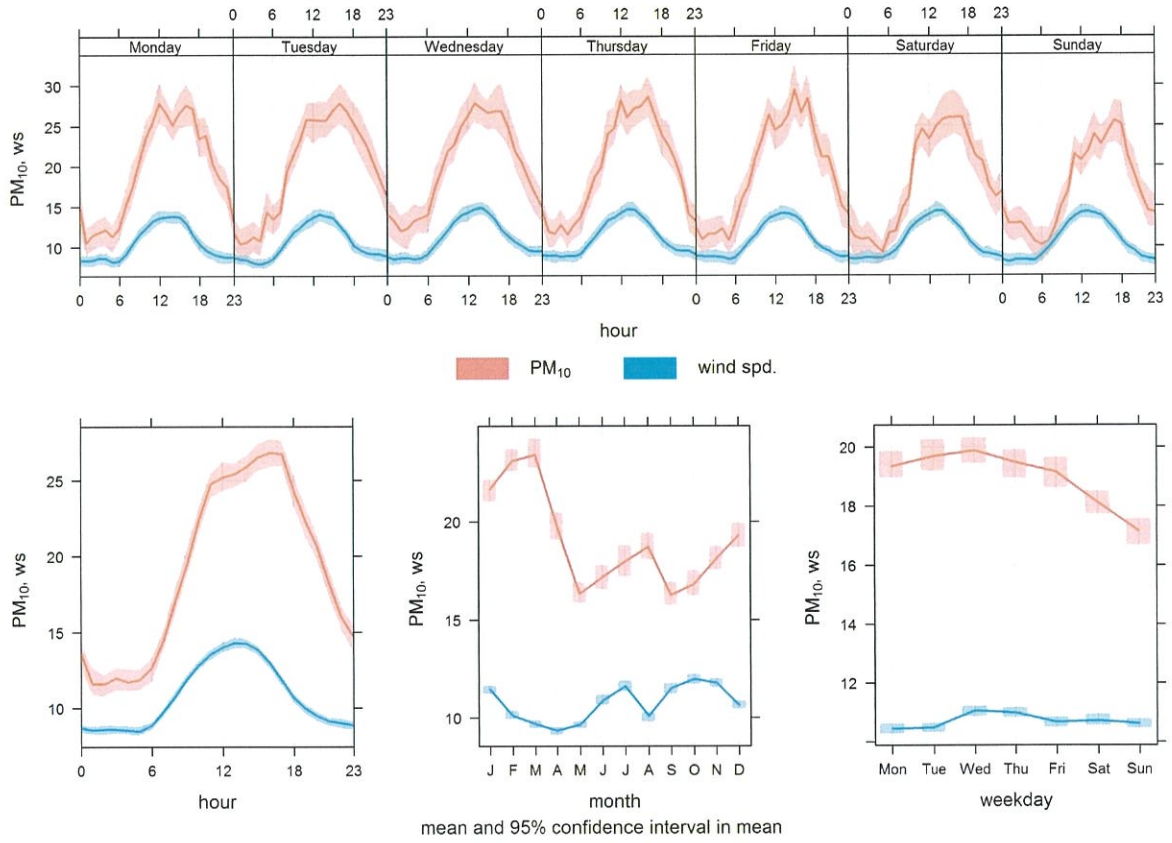

Figure 3.3: The variation of PM_{10} concentrations (μgm^{-3}) and wind speed (km h^{-1}) at the Awatoto site by hour, day and month based on data collected since the site was established in 2012.

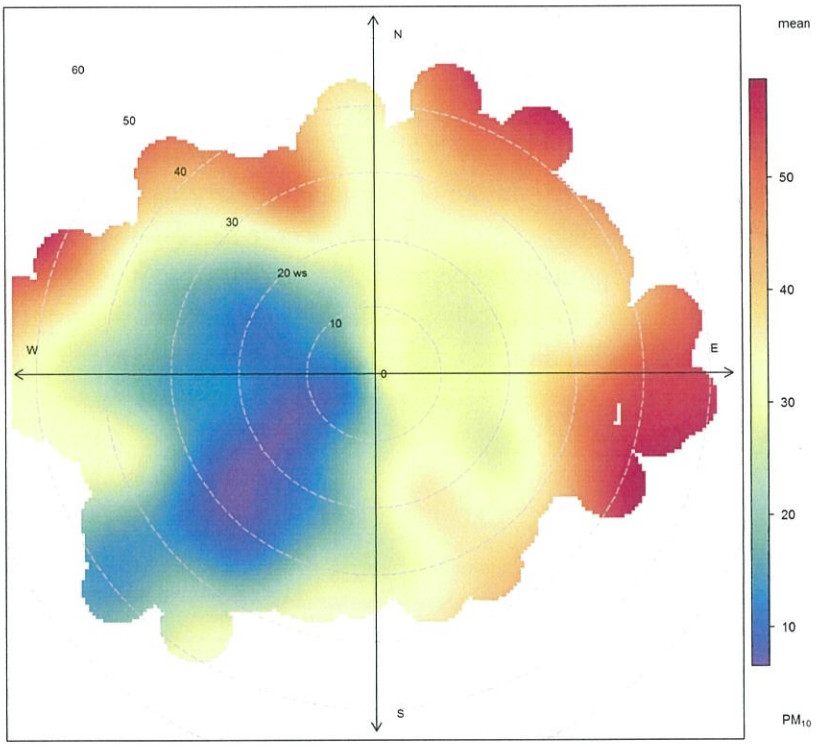

Figure 3.4: Hourly PM_{10} (μgm^{-3}) by wind direction and wind speed (km h^{-1}) at Awatoto, 2012 to 2017.

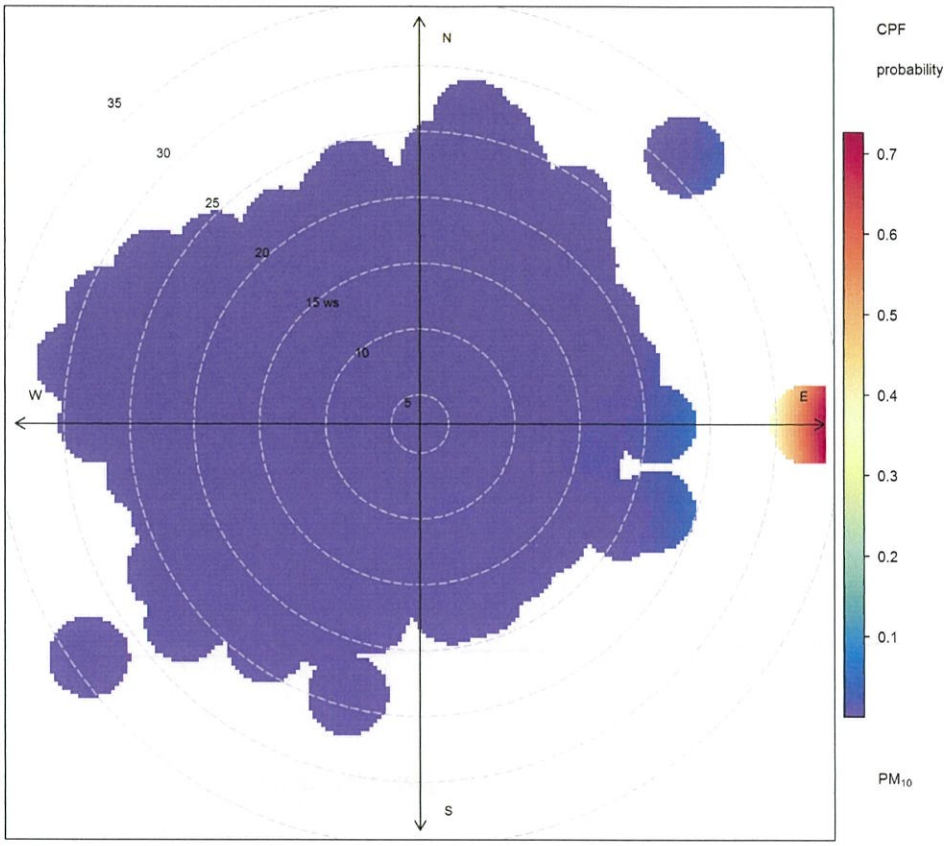

Figure 3.5: The probability of daily mean PM_{10} concentrations being greater than 50 $\mu g/m^3$ at Awatoto AQ. The probabilities are conditional upon wind direction and wind speed (km h^{-1}). Concentric lines are wind speed intervals in km h^{-1} and wind direction is indicated by the compass points.

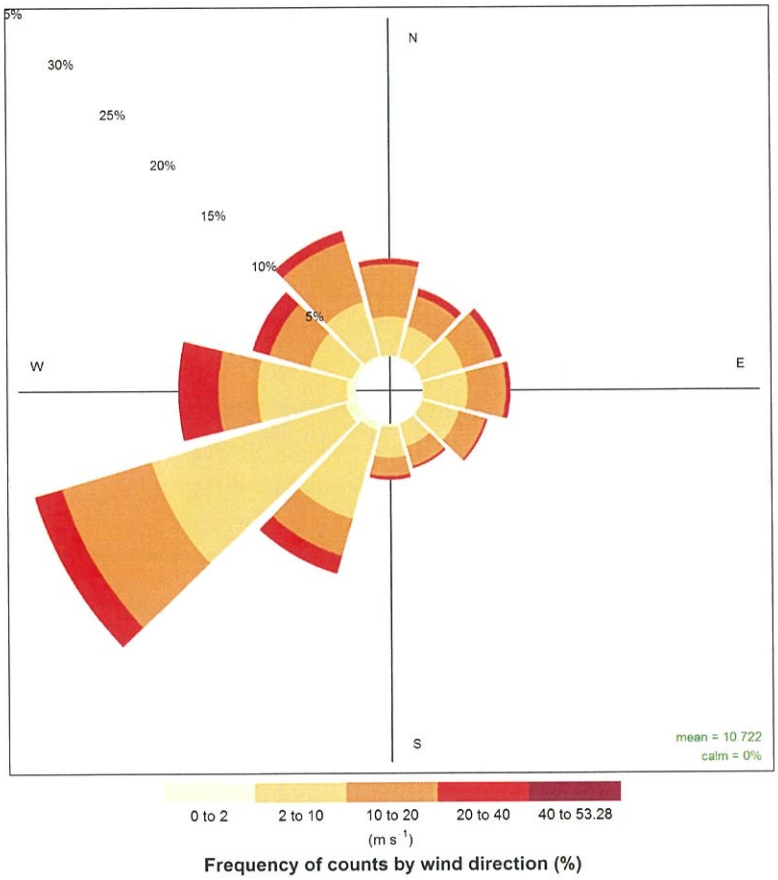

Figure 3.6: Wind rose for Awatoto AQ, based on data since monitoring began in 2012.

Natural sources are likely to contribute significantly to particulate concentrations in the Awatoto airshed. A brief study was undertaken in 2010 to estimate salt and soil contributions to daily PM_{10} concentrations at Ravensdown's beachfront monitoring site, using a technique based on measured levels of Na and Si[1]. The study comprised 26 days of valid PM_{10} samples and spanned the months of February to early June. The average contribution of sea spray to the samples collected was estimated to be 31% and the contribution of soil was 27%, together totalling more than half of the particulates. The contribution of sea spray is expected to decrease with distance from the coast and is expected to be slightly lower at the Council's site, which lies 200 m inland.

A study of particle origin in May 2014[2], collected PM_{10} from the HBRC monitoring site. Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis was used to examine 15 samples collected on a strip of tape from a Beta Attenuation Monitor in March 2014. However, laboratory procedures removed and discarded the soluble material on the samples, limiting the analysis to the insoluble component. This meant the contributions of different types of particulate to the total mass collected could not be quantified.

The samples included a day when the NES for PM_{10} was very near to being exceeded (7th March). Mineral dust formed the bulk of the insoluble material collected on that day and most other days (Table 2.1). The mineral dust had a siliceous appearance and was most likely produced by wind erosion of soil exposed by activities such as road works or ploughing.

Table 2.1: Constituents of PM10 samples collected at Awatoto AQ in March 2014, as a percentage of the insoluble fraction.

	5/3/2014	6/3/2014	7/3/2014	8/3/2014	15/3/2014	16/3/2014	17/3/2014	18/3/2014	19/3/2014	20/3/2014	21/3/2014	22/3/2014	23/3/2014	24/3/2014	25/3/2014	Overall %
Aluminium												6				0
Calcium Carbonate			6			10	14			11	5	6	16			5
Calcium Phosphate	3	29	13	35	29				20	16	14	28	11		18	14
Cement Dust	12	10	3		10	3	5	4				11	11		15	6
Coal	3	2			2											0
Fungi								8								1
Insect Debris			6			6	9	4	8			6	0	12		3
Metal Swarf			3			3	5			5						1
Mineral Dust	63	56	59	35	56	65	50	38	32	47	52	33	53	53	44	49
Paint			3				5									1
Pollen								19	8	11			0	12		3
Quartz	13		6	10		12	14	19	28	11	5	11	11	24	18	12
Rust				6					4		24				6	3
Soot								4								0
Talc	6	2		13	2											2
Zinc Sulphide								4								0
Ave WS (km h^{-1})	25.4	16.5	8.1	8.2	19.8	20.5	17.1	5.6	6.4	7.3	15.6	11.5	9.0	6.4	11.2	
Ave Wind Dir	237	205	187	187	129	183	307	198	170	193	207	217	170	175	255	
PM_{10} ($\mu g\ m^{-3}$)	**14.8**	**21.1**	**50.4**	**34.2**	**36.0**	**36.7**	**15.6**	**32.5**	**18.9**	**14.4**	**32.3**	**14.8**	**30.5**	**44.4**	**7.6**	

The source apportionment study that began in 2016 and will be completed in August 2017 aims to quantify the contribution of natural sources to particulate concentrations at Awatoto AQ.

References

[1] Wilton, E. 2010: Natural Source Contribution to Background PM_{10} in Awatoto. A report prepared for the Foundation for Science, Technology and Research.

[2] URS NZ Ltd (2014). Awatoto BAM PM10 Sample Analysis: Particulate Characterisation. A report prepared for the Hawke's Bay Regional Council, RM14-16, Plan No. 4707.

APPENDIX 4- SOURCE APPORTIONMENT

Preliminary Source Apportionment results for 29th April 2017

A source apportionment study has been underway at the Awatoto AQ site, with PM_{10} and $PM_{2.5}$ samples being collected every third day using a GENT instrument. Samples were collected on 29th April and have been examined by GNS Science, however the results have not been finalised. The preliminary assessment indicates that the gravimetric mass collected on the filters were very low – less than 1 µg/m^3 for $PM_{2.5}$ and approximately 10 µg/m^3 for the PM_{10}-$PM_{2.5}$ fraction. As noted by Dr Perry Davy (pers com, 2017), "the low $PM_{2.5}$ value is supported by equally low elemental mass, including black carbon which suggests it was not a combustion source".

The elemental mass tracks the gravimetric mass for most of the study samples examined so far, except the samples collected on 29th April (Figure 4.1). The reason for this is unknown at this point. Additionally, the source is uncertain. Dr Davy did observe spikes in measured elements such as the aforementioned black carbon, nor crustal matter or sea salt, "which really only leaves a pure organic particle source not associated with combustion or some other (instrumental, moisture?) anomaly."

The results are inconclusive, particularly given the differences in mass between the GENT filters and the BAM readings (including those at other sites in the region) with respect to both $PM_{2.5}$ and PM_{10}. Relative humidity was not exceptional and most, if not all, the region's BAMs have heated inlets, therefore it is not thought that moisture explains the discrepancy.

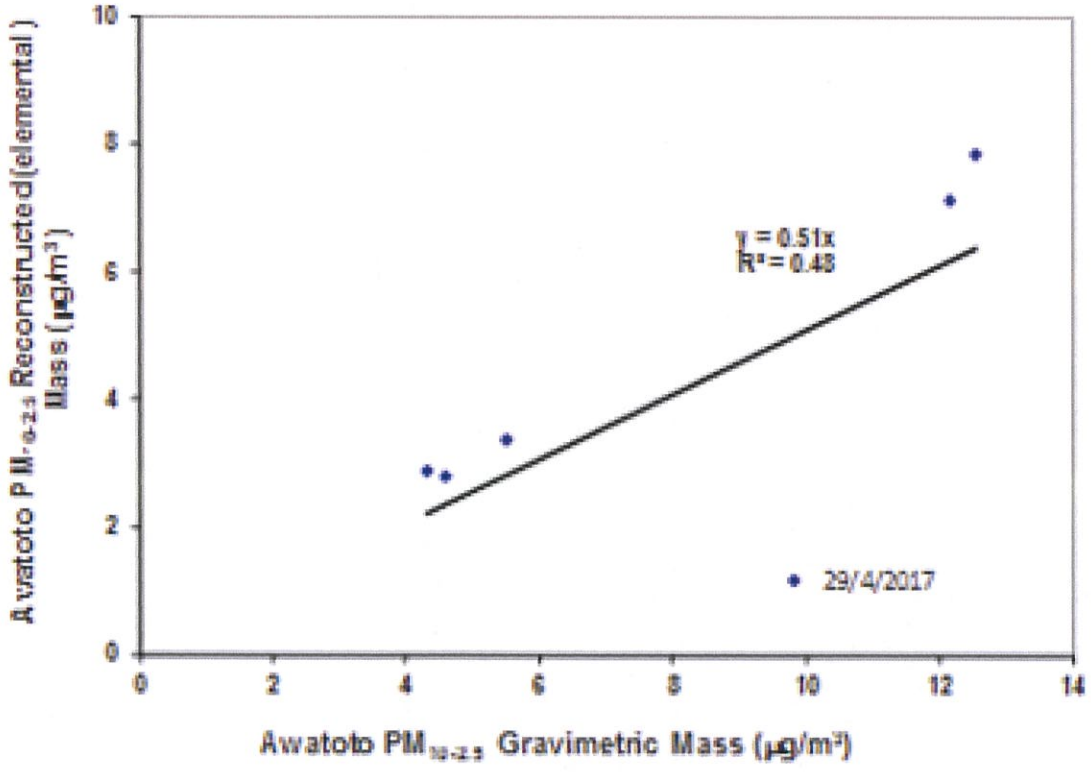

Figure 4.1: A scatterplot of gravimetric mass and elemental mass for samples analysed in the source speciation study undertaken during 2016/17 at Awatoto AQ. (Source: Dr Perry Davy)

APPENDIX 5 – METEOROLOGICAL CONDITIONS LEADING TO THE EXCEEDANCE

A ridge of high pressure extended over New Zealand during the week leading up to the exceedance event on Saturday 29th April 2017. An intense low pressure system was situated to the east of Chatham Islands and remained slow moving during the week (Figure 5.1). Wind speeds near the low reached gale force (Figure 5.2 and Figure 5.3) and they directed a long period swell to the east coast of the North Island. Satellite altimeter data supports the buoy measurements of approximately 3 m swells in the vicinity of Hawke's Bay (Figure 5.4)

Despite upper level winds turning northerly over the country as a front approached from the southwest, it appears the large, long period swell, was sufficient to generate significant amounts of sea spray that were measured at the air quality sites any time the surface wind was directed onshore.

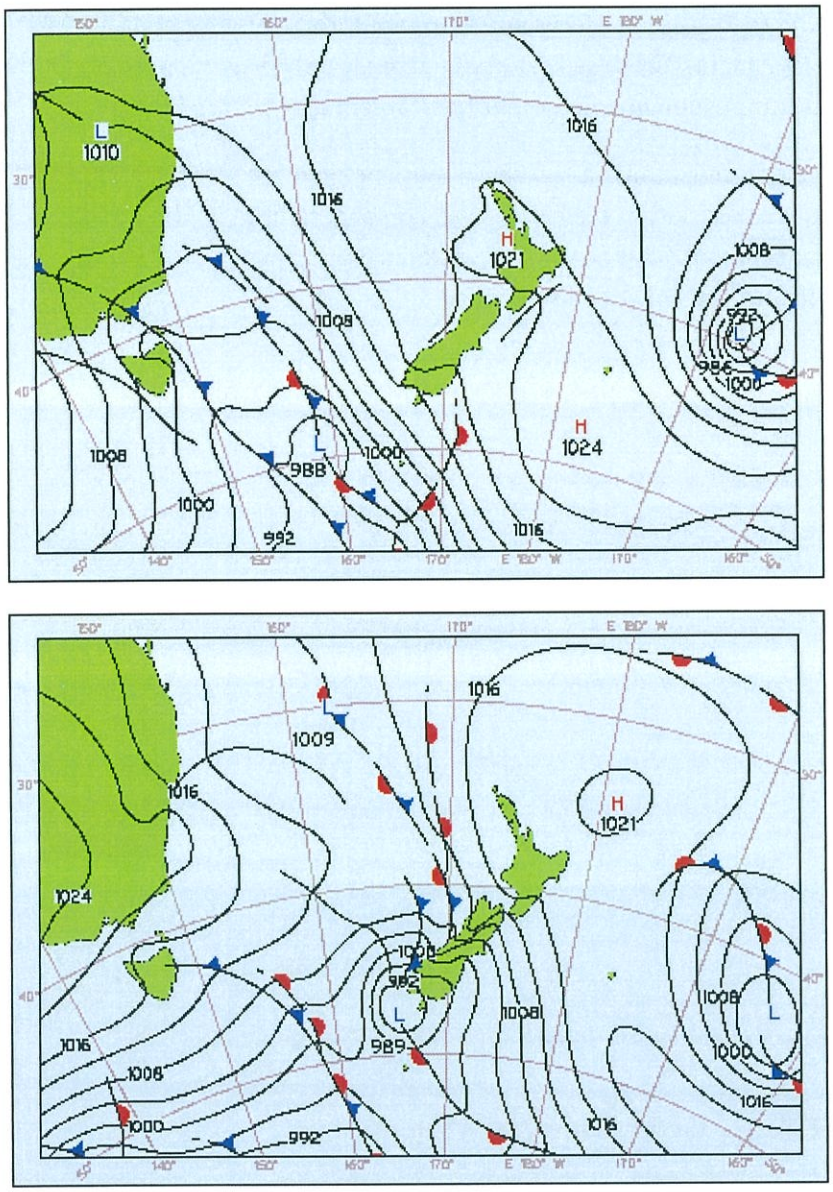

Figure 5.1: New Zealand Metservice mean sea level analysis chart for 6am 26th April 2017 (top) and 6am 28th April 2017 (bottom).

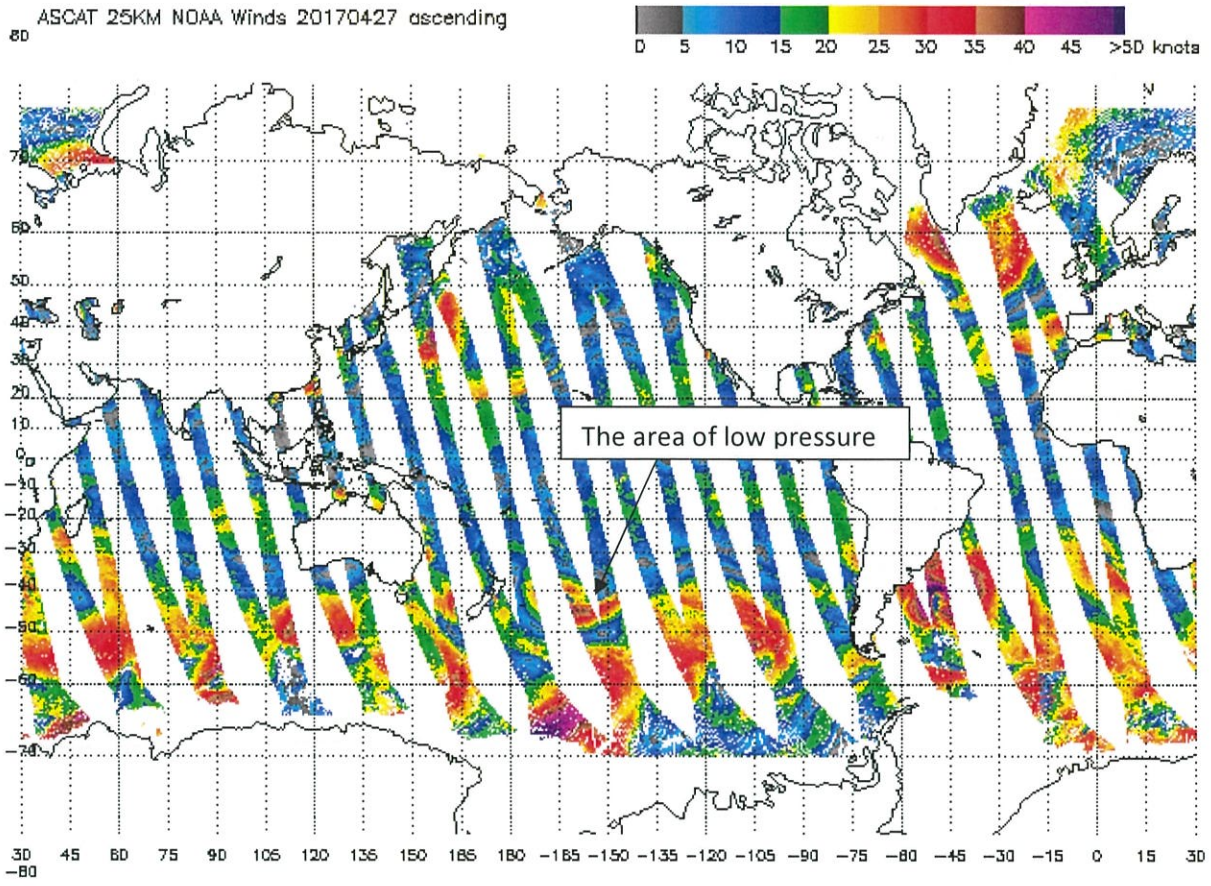

Figure 5.2: Ascat sea winds on 27th April 2017. An area of gale force winds is evident around the low pressure system to the east of New Zealand

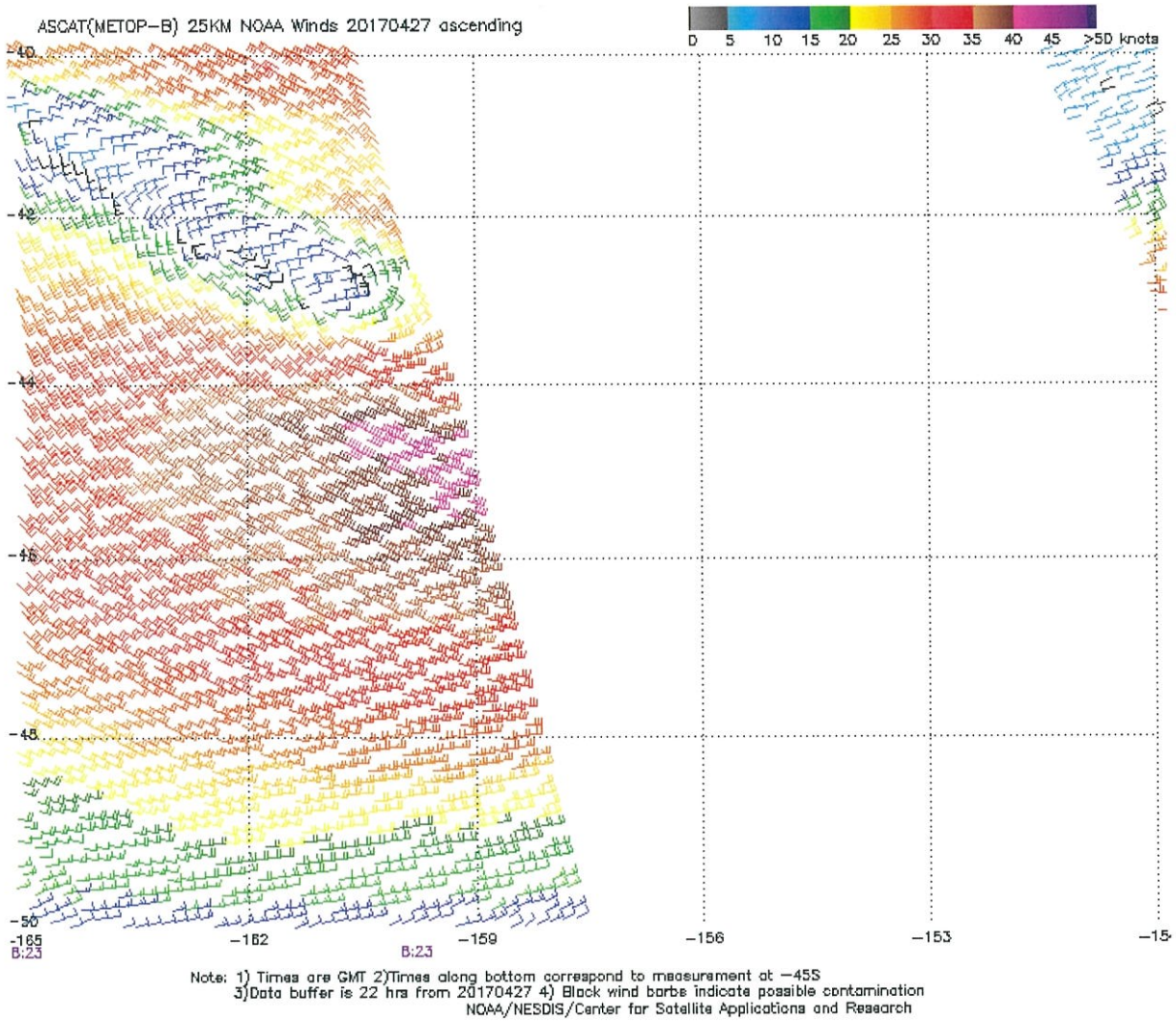

Figure 5.3: Ascat sea winds on 27th April 2017 centred around the low pressure system to the east of New Zealand featured in Figure 5.2. An area of gale force southeast winds are evident (https://manati.star.nesdis.noaa.gov/ascat_images/arch_25km_METB/AS2017117/zooms/WMBas22.png)

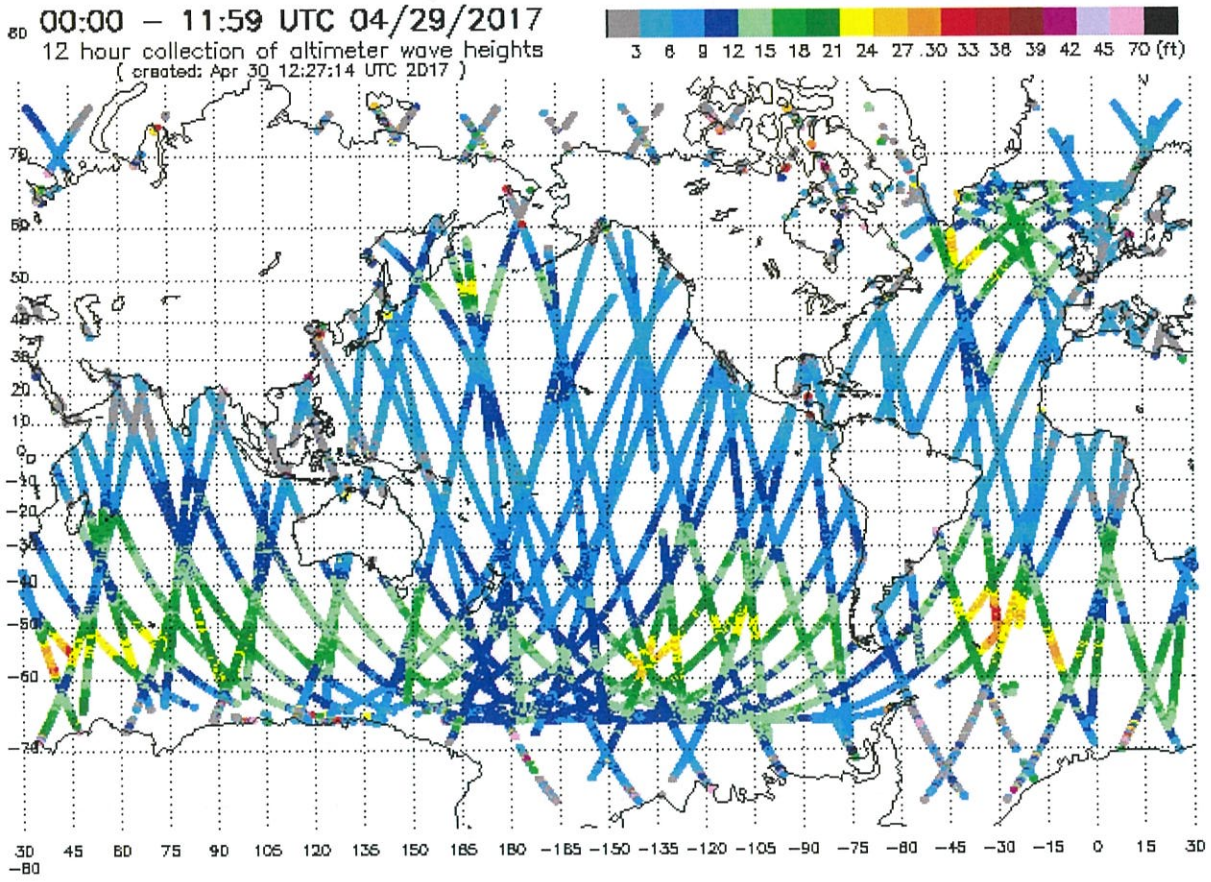

Figure 5.4: Satellite altimeter data showing mean wave heights for the period from midday to midnight 29th April 2017 (https://manati.star.nesdis.noaa.gov/datasets/SGWHData.php)