CSIRO OCEANS & ATMOSPHERE FLAGSHIP
www.csiro.au

Lower Hunter Particle Characterisation Study

2nd Progress Report (Winter)

Mark F. Hibberd, Melita D. Keywood, David D. Cohen (ANSTO), Ed Stelcer (ANSTO), Yvonne Scorgie (OEH), and Scott Thompson (OEH)

October 2014

Prepared for
NSW Environment Protection Authority (Contact: Judy Greenwood)

Citation

Hibberd MF, Keywood MD, Cohen DD, Stelcer E, Scorgie Y and Thompson S (2014).
Lower Hunter Particle Characterisation Study, 2nd Progress Report (Winter). CSIRO, Australia.

Contact addresses:

CSIRO Oceans & Atmosphere Flagship
Private Bag 1
Aspendale, Vic 3195
Australia

Institute for Environmental Research, ANSTO
Locked Bag 2001
Kirrawee DC, NSW 2232
Australia

NSW Office of Environment and Heritage
PO Box A290
Sydney South, NSW 1232
Australia

Copyright and disclaimer

Important disclaimer

Cover photo

Site visit by some of the project team to the Newcastle sampling site on 20 August 2014. From left to right: Mark Hibberd, Peter Crabbe, Sherree Woodroffe, John Kirkwood, Yvonne Scorgie, Scott Thompson, David Cohen.

Contents

Acknowledgments

This project is funded by

- NSW Environment Protection Authority (EPA)
- NSW Office of Environment & Heritage
- NSW Department of Health
- CSIRO Climate & Atmosphere Theme
- ANSTO

The project is supported by the Project Management Team of Matt Riley, Yvonne Scorgie, Judy Greenwood, Ann Louise Crotty, Leanne Graham, Wayne Smith, John Kirkwood, Keith Craig, Mark Hibberd, Melita Keywood, David Cohen, and Ed Stelcer.

We acknowledge the contributions of the CSIRO project support team of Kate Boast and Paul Selleck, the ANSTO project support team of David Garton and Armand Atanacio, and OEH project field staff Scott Thompson, Gareth James and Stuart Masson.

Support provided by Orica Limited for the study by facilitating sampling at Stockton Air Quality Monitoring Site and making available monitoring records from this site is gratefully acknowledged.

Support extended by CSIRO Energy Centre for the establishment of study samplers on the grounds of the centre in Mayfield is acknowledged.

1 Introduction

The Lower Hunter Particle Characterisation Study (LHPCS) was initiated in 2013 and is being undertaken to provide the EPA and communities in the Lower Hunter with scientific information about the composition and likely sources of fine airborne particles in their local environment. The study represents a collaboration between the NSW Environment Protection Authority (EPA), the NSW Office of Environment and Heritage (OEH), NSW Health, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Nuclear Science and Technology Organisation (ANSTO). Following the establishment of governance arrangements and an independently peer reviewed study design, the one year airborne particle sampling program commenced on 2 March 2014.

This 2nd Progress Report documents the samples collected during the second quarter from June to August 2014 (Winter period) of the one year sampling program. It also includes an analysis of winds for the sampling period, some additional photographs of the sampling sites, and documents the project webpage.

1.1 Study Objectives

The Lower Hunter Particle Characterisation Study aims to determine the composition of $PM_{2.5}$ and PM_{10} air particles, and to identify major sources contributing to $PM_{2.5}$ and PM_{10} concentrations in the region to inform EPA's control programs[1].

Specific sub-objectives are as follows:

- Determine the composition and major sources contributing to $PM_{2.5}$ concentrations at sites representative of regional population exposures.
- Establish airborne particle composition and major sources contributing to $PM_{2.5}$ and PM_{10} concentrations at sites indicative of population exposures in areas near to the Newcastle Port.

1.2 Study Scope and Overview

The study comprises $PM_{2.5}$ sampling at four sites in the Lower Hunter region over a one year period, including two sites representative of wider community exposures in the region (Newcastle and Beresfield) and two sites indicative of public exposures in areas neighbouring the Newcastle Port (Stockton and Mayfield). PM_{10} sampling and analysis is also being undertaken for the Stockton and Mayfield sites in response to community requests that PM_{10} be addressed. The sampling site locations are shown in Figure 1.

Existing or planned ambient air quality monitoring sites were preferred locations since they allow timely establishment of study sampling sites. These sites also have continuous particulate matter and gaseous monitoring records and meteorological data that can be used during the source apportionment analysis. Selected study sites coincided with the existing OEH Beresfield Air Quality Monitoring (AQM) Station, the OEH Newcastle AQM Station, the Orica Fullerton Street Stockton AQM Station, and CSIRO Energy Centre in Mayfield West. Sampling is being conducted over the period 1 March 2014 to 28 February 2015. Since sampling commenced, OEH-operated AQM Stations have been commissioned at CSIRO Energy Centre in July 2014 and at the Orica Fullerton Street Stockton site in October 2014, as part of the Newcastle Local Air Quality Monitoring Network.

[1] $PM_{2.5}$ and PM_{10} refer to airborne particulate matter with an equivalent aerodynamic diameter of 2.5 micrometres and 10 micrometres respectively.

Figure 1 Overview of locations of sampling sites for Lower Hunter Particle Characterisation Study

A summary of the monitoring sites, equipment and filter types and sampling schedules for the study is given in Table 1.

Sample analysis for the $PM_{2.5}$ component will include Ion Beam Analysis (IBA) techniques and Ion Chromatography (IC) on the Teflon filters and organic and elemental carbon (OC/EC) analysis using a DRI Model 2001A Thermal-Optical Carbon Analyzer for the quartz filters.

The use of ANSTO ASP $PM_{2.5}$ cyclone samplers at each of the four sites provides the basis for gravimetric analysis to determine $PM_{2.5}$ concentrations. Combining results from the gravimetric analysis of the coarse ($PM_{2.5-10}$) and fine ($PM_{2.5}$) fractions from the GENT SFU sampling will allow PM_{10} concentrations to be determined.

Table 1 LHPCS monitoring sites, equipment, filter types and sampling schedule

MONITORING SITE:	EQUIPMENT, SIZE FRACTION AND FILTER TYPE	SAMPLING SCHEDULE
OEH Newcastle AQM Station	Two ANSTO Aerosol Sampling Program (ASP) $PM_{2.5}$ cyclone samplers – one collecting on Teflon filter and one on a quartz filter.	1-in-3 days
OEH Beresfield AQM Station	Two ANSTO ASP $PM_{2.5}$ samplers – one collecting on Teflon filter and one on a quartz filter.	1-in-3 days
CSIRO Energy Centre (OEH Mayfield AQM Station)	One GENT Stacked Filter Unit (SFU) sampling 'coarse' ($PM_{2.5-10}$) particles on a Nuclepore filter and 'fine' ($PM_{2.5}$) particles on a quartz filter. One ANSTO ASP $PM_{2.5}$ sampler collecting fine particles on a Teflon filter has been relocated to this site from the nearby former Steel River AQM station. (Separately funded program, with sampling done by OEH, analysis by ANSTO, and funded by the EPA.)	1-in-3 days
Orica Fullerton Street Stockton AQM Station (OEH Stockton AQM Station)	One GENT SFU sampling 'coarse' ($PM_{2.5-10}$) particles on a Nuclepore filter and 'fine' ($PM_{2.5}$) particles on a quartz filter. One ANSTO ASP $PM_{2.5}$ cyclone sampler collecting fine particles on a Teflon filter already in operation at this site. (Separately funded program with sampling and analysis undertaken by ANSTO, funded by Orica).	1-in-3 days

Chemical analysis of the $PM_{2.5-10}$ component will include IBA and IC on the Nuclepore filters in addition to black carbon (BC) being determined through the use of the Laser Integrated Plate Method (LIPM), which is a light absorption technique. Given that organic carbon is primarily in the fine fraction, the use of quartz filters to support OC/EC analysis of the coarse fraction is not required.

The chemical composition of all the samples will subsequently be input into receptor modelling using a mathematical technique called Positive Matrix Factorisation (PMF) to identify factors and the contribution of each factor to the total $PM_{2.5}$ and PM_{10} concentration. The key source of emissions in each factor will be identified using a range of information including source characteristics, wind data and the pattern of seasonal variation in the factor.

The First Progress Report (PDF, 1.4MB - July 2014) provides more information on the study method and the sampling program commissioning phase, as well as details about the samples collected during the first quarter (autumn) sampling period.

2 Report on June-August 2014 Sampling

2.1 Long-term Regional Air Quality Monitoring

The OEH-operated air quality monitoring stations at Beresfield, Newcastle and Wallsend characterise regional air quality and provide a framework for the detailed particle characterisation study. PM_{10}, $PM_{2.5}$, ozone (O_3), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO) and meteorology (wind speed, wind direction, air temperature and relative humidity) are continuously measured at these stations.

Long-term time series of PM_{10} and $PM_{2.5}$ for the period October 2012 – August 2014 are shown in Figure 2 and Figure 3. Data are included from the OEH monitoring stations and the site at Stockton run by Orica. Table 2 lists some key statistics of the 2013 PM_{10} and $PM_{2.5}$ results – average, median, maximum, and number of days exceeding the criteria.

The figures show stronger regional variations in PM_{10} than $PM_{2.5}$ concentrations. The PM_{10} levels recorded at Stockton are generally higher and characterised by some localised peaks not evident at the regional air quality monitoring stations. $PM_{2.5}$ levels measured at the Stockton monitoring station are comparable to levels measured at the OEH Beresfield and Wallsend stations for much of the year, with average and median levels being in the same range.

Figure 2 shows that the PM_{10} values are lowest during both March – August periods, whereas $PM_{2.5}$ are lowest in January – April (Figure 3). A clearer picture of the relative importance of the fine and coarse fractions of PM_{10} is provided by Figure 4, which shows the smoothed (31-day running average) of the $PM_{2.5}/PM_{10}$ ratio at the four sites. The almost two years of data shows an annual trend of the $PM_{2.5}/PM_{10}$ ratio being highest in winter and lowest in summer. Reasons for this will be more fully explored during the final stages of the study when source apportionment modelling is undertaken.

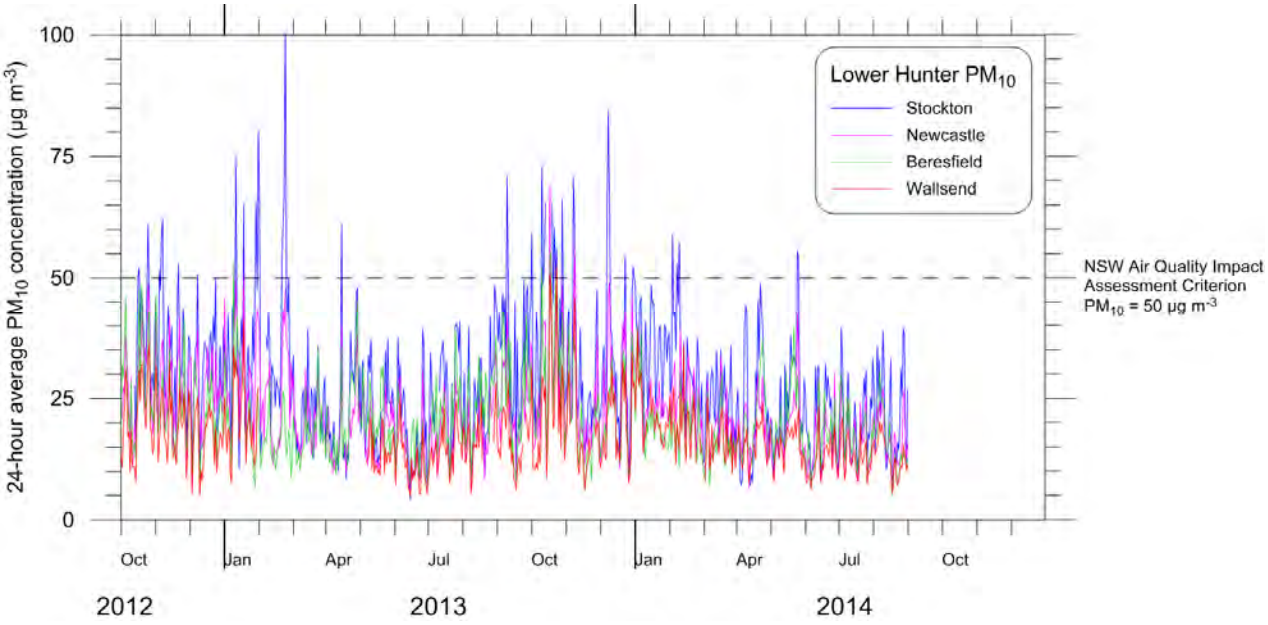


Figure 2 Long-term time series of 24-hour average PM_{10} concentrations recorded at the OEH Lower Hunter monitoring stations and the Orica Fullerton Street Stockton monitoring station (Oct 2012 – August 2014)

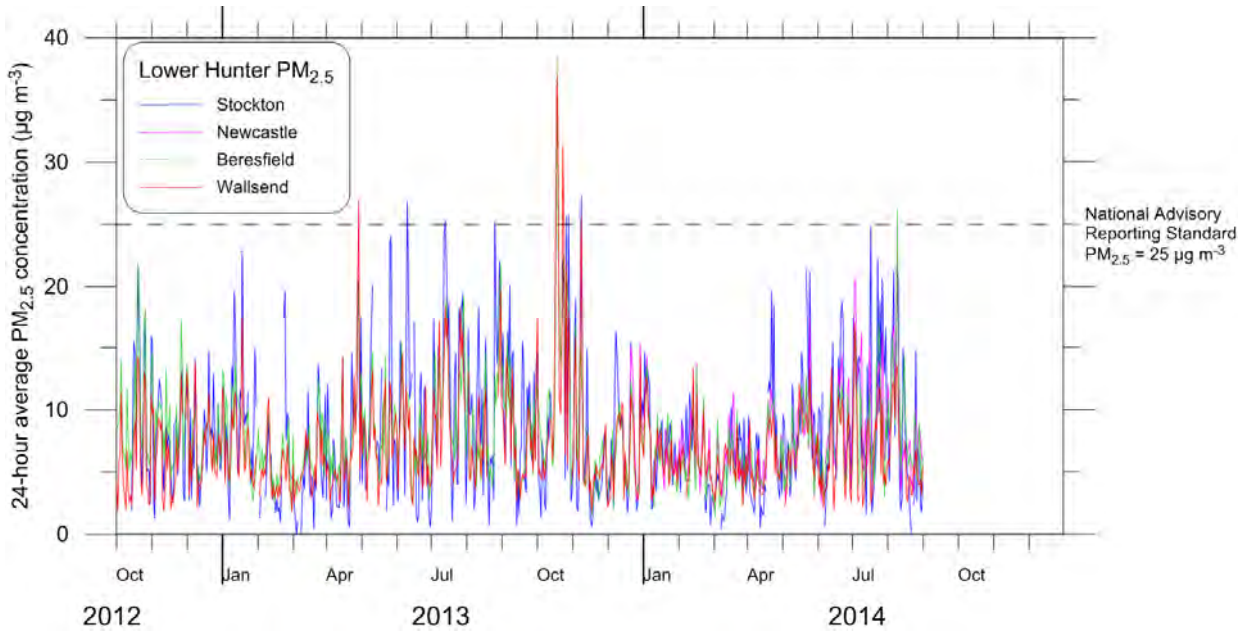


Figure 3 Long-term time series of 24-hour average $PM_{2.5}$ concentrations recorded at the OEH Lower Hunter monitoring stations and the Orica Fullerton Street Stockton monitoring station (Oct 2012 – Aug 2014)

Table 2 Key statistics of the 2013 PM_{10} and $PM_{2.5}$ monitoring results

MONITORING SITE	BERESFIELD	NEWCASTLE	STOCKTON	WALLSEND
PM_{10} (2013)				
Average	21.4 ± 9.1	22.7 ± 10.0	29.6 ± 14.8	17.4 ± 8.0
Median	19.1	20.5	26.6	15.5
Maximum	55.3	69.0	100.5	52.5
Days>50 µg m^{-3}	5	4	28	2
$PM_{2.5}$				
Average	8.2 ±4.4		8.6 ±6.2	7.7 ±4.8
Median	7.2		7.3	6.2
Maximum	38.4		32.6	37.0
Days>25 µg m^{-3}	1		7	6

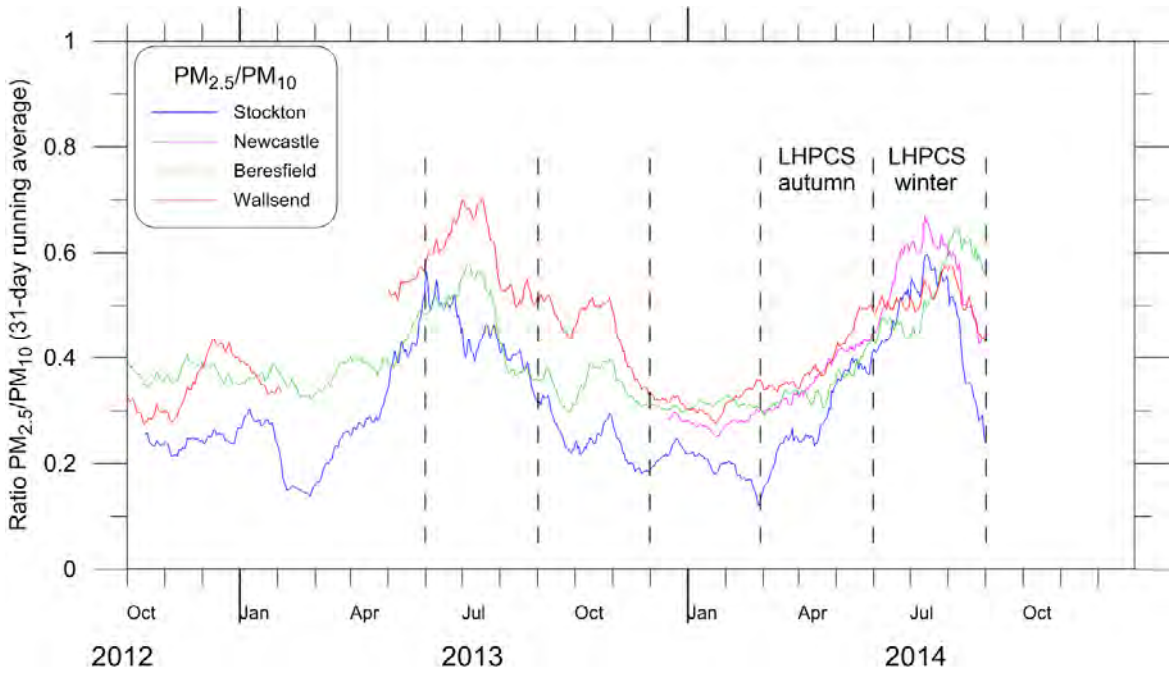


Figure 4 Long-term time series of $PM_{2.5}/PM_{10}$ ratio (31-day running average) recorded at the OEH Lower Hunter monitoring stations and the Orica Fullerton Street Stockton monitoring station (Oct 2012 – Aug 2014)

2.2 Sampling Report

Table 3 lists the status of the sample collection for the second 3 months of the study, with sample collection rates of 100% achieved for each sampler-filter train noted. This exceeds the LHPCS aim of a 95% valid sample collection rate.

In July 2014, a comprehensive OEH-operated AQM Station was installed at the CSIRO Energy Centre sampling site at Mayfield. The sampling equipment, previously installed on poles, was moved to the roof of the new AQM station shed, matching the installations at the other LHPCS sites. This is not expected to have any impact on the sampling results.

In mid-August, water entered the flow transducer in the GENT sampler at Mayfield due to a loose cap. This led to loss of integrated flow data but the flow volumes are able to be estimated from the initial settings and knowledge of the sample loadings. This is not expected to lead to loss of data, just a slight increase in the uncertainty of the final results for a few sample days. The flow transducer was replaced on 28 August. Procedures have been introduced to ensure that this issue does not re-occur.

Table 3 Status of sample collection for Winter sampling period (June-August 2014)

SITE	BERESFIELD $PM_{2.5}$		NEWCASTLE $PM_{2.5}$		MAYFIELD PM_{COARSE} & $PM_{2.5}$			STOCKTON PM_{COARSE} & $PM_{2.5}$		
SAMPLE DATE	ASP TEFLON	ASP QUARTZ	ASP TEFLON	ASP QUARTZ	ASP TEFLON $PM_{2.5}$	GENT NUCLEPORE PM_{COARSE}	GENT QUARTZ $PM_{2.5}$	ASP TEFLON $PM_{2.5}$	GENT NUCLEPORE PM_{COARSE}	GENT QUARTZ $PM_{2.5}$
03/06/2014	✓	✓ C	✓	✓ C	✓	✓	✓	✓	✓	✓
06/06/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
09/06/2014	✓	✓ C	✓	✓ C	✓	✓	✓ C	✓	✓	✓ C
12/06/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15/06/2014	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C	✓	✓ C	✓ C	✓
18/06/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
21/06/2014	✓	✓ C	✓	✓ C	✓	✓	✓	✓	✓	✓
24/06/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
27/06/2014	✓	✓ C	✓	✓ C	✓	✓	✓ C	✓	✓	✓ C
30/06/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
03/07/2014	✓	✓ C	✓	✓	✓	✓	✓ C	✓	✓	✓ C
06/07/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
09/07/2014	✓	✓	✓	✓ C	✓	✓	✓	✓	✓	✓
12/07/2014	✓	✓	✓	✓	✓ roof	✓ roof	✓ roof	✓	✓	✓
15/07/2014	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C
18/07/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
21/07/2014	✓	✓	✓	✓ C	✓	✓	✓	✓	✓	✓
24/07/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
27/07/2014	✓	✓	✓	✓ C	✓	✓	✓	✓	✓	✓
30/07/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
02/08/2014	✓	✓ C	✓	✓ C	✓	✓	✓	✓	✓	✓ C
05/08/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
08/08/2014	✓ C	✓	✓	✓ C	✓	✓	✓ C	✓	✓	✓ C
11/08/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14/08/2014	✓ C	✓ C	✓ C	✓ C	✓ C	✓ C	✓	✓ C	✓C	✓
17/08/2014	✓	✓	✓	✓	✓	✓ fl	✓ fl	✓	✓	✓
20/08/2014	✓	✓ C	✓ C	✓ C	✓	✓ fl	✓ fl	✓	✓	✓
23/08/2014	✓	✓	✓	✓	✓	✓ fl	✓ fl	✓	✓	✓
26/08/2014	✓	✓ C	✓	✓ C	✓	✓ fl	✓ fl	✓	✓	✓
29/08/2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sample collection rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Notes: ✓ - Filter sample collected; C – control (unexposed) filter included; roof – samplers moved to roof of Mayfield shed on 10/7/2014;
fl – problems with measurement of flow rate, samples collected but flow volumes estimated leading to somewhat higher uncertainty in final results

2.3 Daily PM Results from the Monitoring Sites

Figure 5 shows the time series of 24-hour average $PM_{2.5}$ concentrations measured at the Newcastle, Beresfield and Stockton monitoring sites using the standard TEOM and BAM equipment for the winter period (June – August) of the study. The green bars highlight the days when 1-in-3-day sampling was carried out for the current study. It shows that these are representative of the full period, including days with both high and low concentrations.

The average and standard deviation of the $PM_{2.5}$ concentrations for the June – August period were 9.1 ± 4.3 µg m^{-3} at Newcastle, 8.6 ± 4.1 µg m^{-3} at Beresfield, and 9.6 ± 5.8 µg m^{-3} at Stockton. At all three sites, these averages are approximately 2 µg m^{-3} higher than those recorded during the autumn sampling period.

Note that the Newcastle $PM_{2.5}$ instrument was installed in December 2013 but the data was not included in the usual automated QA checks of the Data Logger and the AquisNet data collection and reporting system until 18 August 2014. Normal maintenance has been done on this instrument since installation. The Newcastle $PM_{2.5}$ data shown here, collected prior to 18 August 2014, has undergone manual QA checking by OEH to

- remove data less than -2.5 µg/m^3 (normal negative check)
- check the data against the PM_{10} 24-hour average data, which is in accordance with the 1-day average NEPM standard.

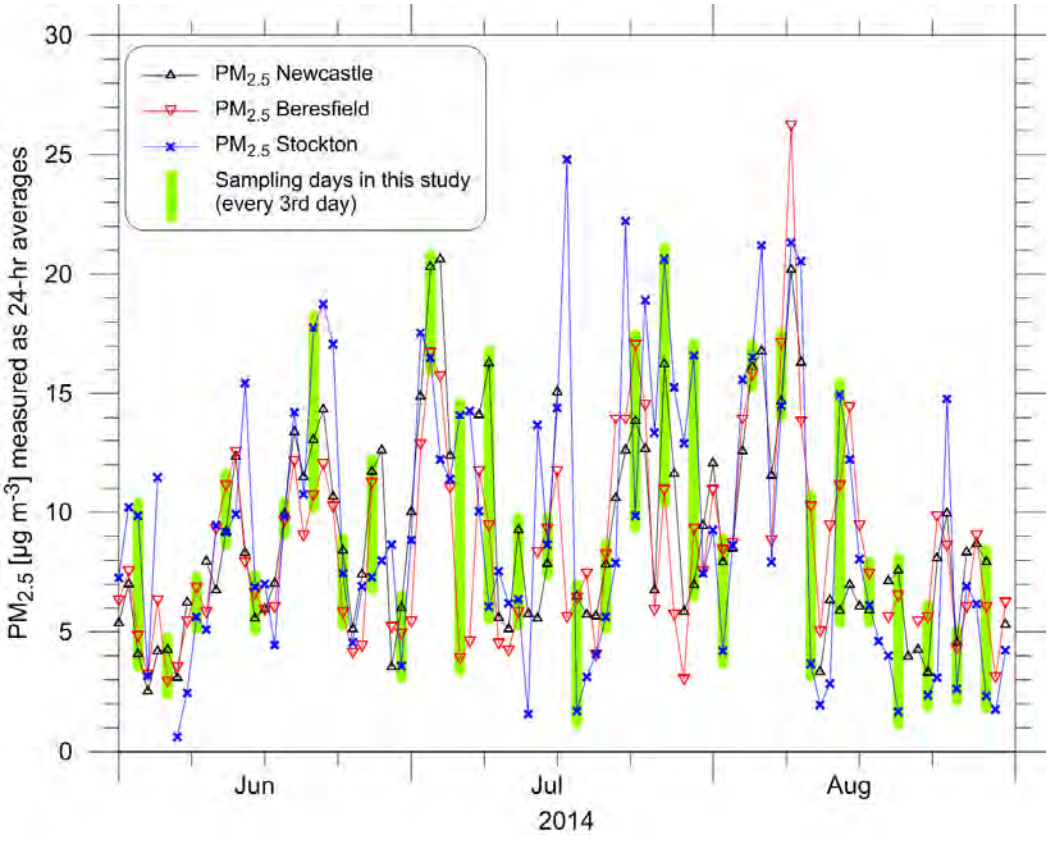


Figure 5 Winter time series of 24-hour average $PM_{2.5}$ concentrations measured at the Newcastle, Beresfield and Stockton sites using the standard BAM (Beta Attenuation Monitor) equipment. The green bars show the days when sampling for the current study was carried out.

Figure 6 shows the equivalent results for PM_{10} concentrations. As above, the green bars highlight the days when 1-in-3-day sampling was carried out for the current study, and show that these are generally representative of the full period, including days with both high and low concentrations. However, most of the high PM_{10} days at Stockton in the second half of the period were not sampling days. The data show that the highest hourly concentrations on these days coincided with easterly winds.

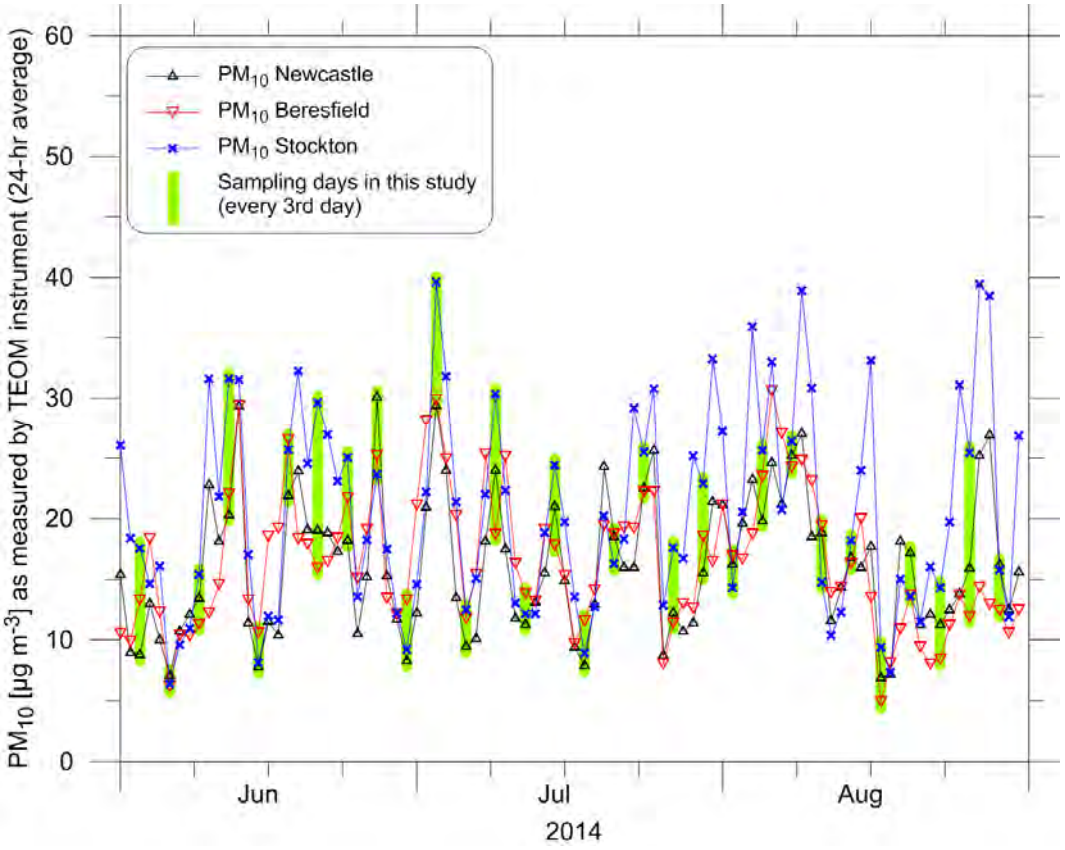


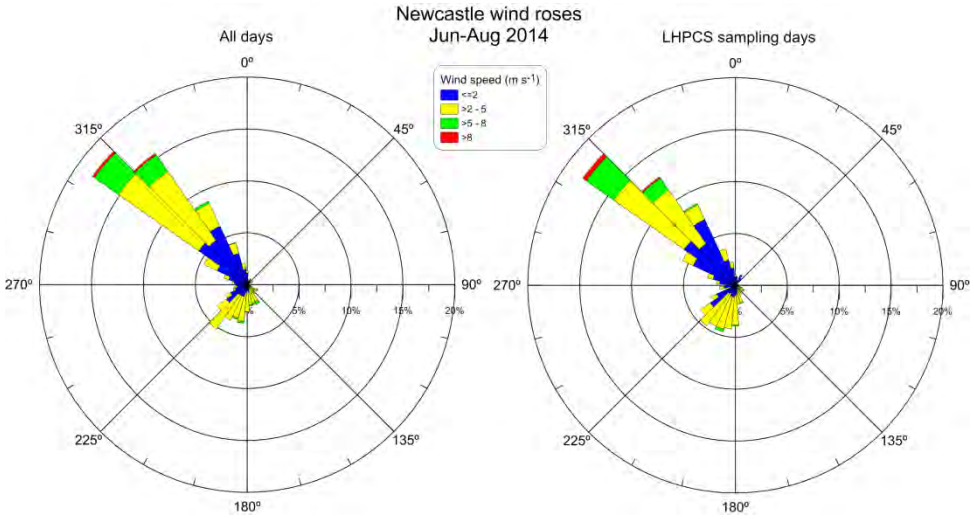
Figure 6 Winter time series of 24-hour average PM_{10} concentrations measured at the Newcastle, Beresfield and Stockton sites using the standard TEOM (Tapered Element Oscillating Microbalance) equipment. The green bars show the days when sampling for the current study was carried out.

The average and standard deviation of the PM_{10} concentrations for June – August were 16.2 ± 5.7 µg m^{-3} at Newcastle, 16.5 ± 5.7 µg m^{-3} at Beresfield, and 20.7 ± 8.3 µg m^{-3} at Stockton. At all three sites, these averages are 2 – 4 µg m^{-3} lower than those recorded during the autumn sampling period. This is the opposite trend to that found for $PM_{2.5}$, which is due in part to the larger proportion of PM_{10} in winter being in the fine fraction (<2.5 µm) than the coarse fraction (2.5 – 10 µm), but probably also to slight differences between the characteristics of the instruments used to measure $PM_{2.5}$ (BAM) and PM_{10} (TEOM).

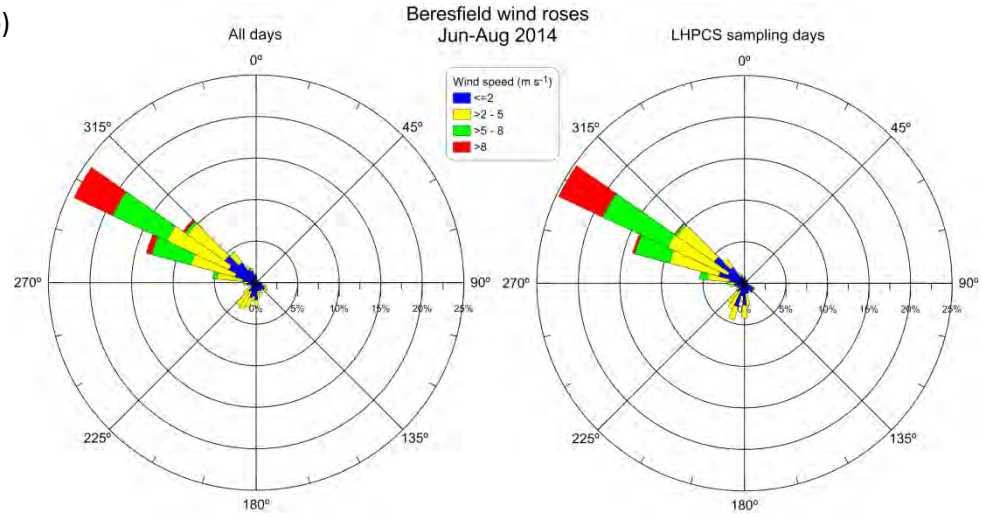
2.4 Wind and pollution roses

Figure 7 presents the wind roses at the sampling sites for the winter sampling period and shows that the winds were predominantly north-westerlies (i.e. blowing from the north-west) and that the strongest winds were from this direction. Most of the rest of the winds were south to south-westerlies with lower wind speeds. Furthermore, there is almost no difference between the wind roses computed for the 1-day-in-3 sampling days (right-hand side) and those for the full 92 days of winter (left-hand side), which confirms the representativeness of the sampling days.

(a)



(b)



(c)

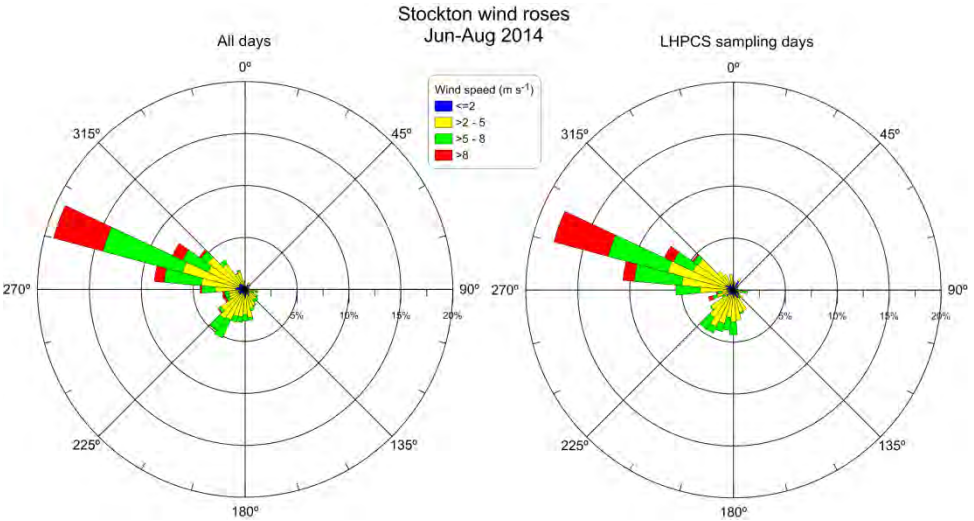


Figure 7 Wind roses for the Winter period at Newcastle, Beresfield and Stockton showing close agreement between all days (left-hand side) and the 1-day-in-3 sampling days (right-had side). [Note: a wind rose shows the frequency of winds plotted by wind direction, with colour bands showing wind ranges. The length of each band is proportional to the frequency of wind from that direction.]

In the same way that a wind rose depicts the distribution of wind speeds at each wind direction, a pollution rose depicts the distribution of pollution concentrations at each wind direction. It is an easily understood means of showing which wind directions are associated with the various pollution concentrations.

Figure 8 and Figure 9 show the PM_{10} and $PM_{2.5}$ pollution roses computed using the hourly-averaged continuous monitoring data from the sampling sites but restricted to above average concentrations, namely PM_{10} > 20 µg m^{-3} and $PM_{2.5}$ > 10 µg m^{-3}. This shows the high concentration results more clearly.

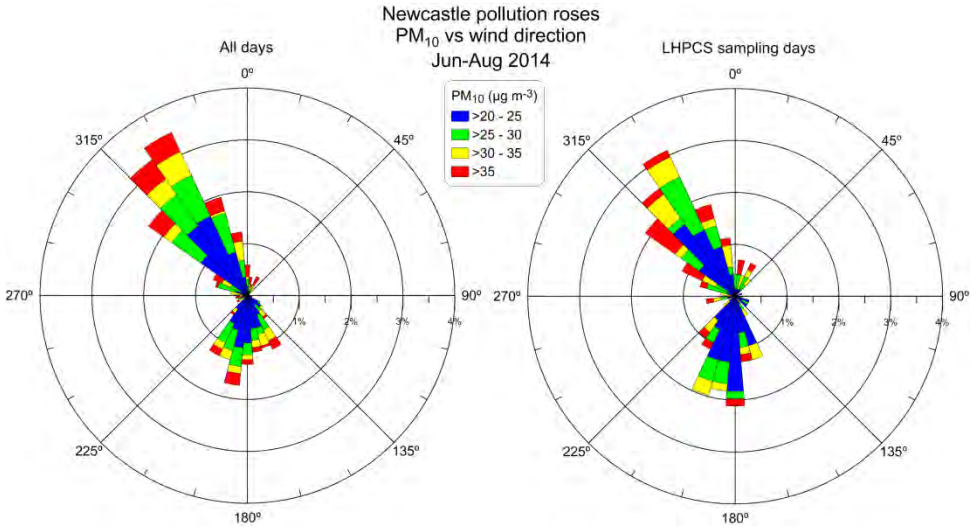
For PM_{10}, the Newcastle site shows elevated levels for both north-westerly and southerly winds, although a higher proportion of north-westerlies have the highest concentrations. In contrast, at the Beresfield and Stockton almost all elevated concentrations are associated with north-westerly winds, although at Stockton a few of the highest concentrations occur for south-easterly and north-easterly winds.

In contrast, the $PM_{2.5}$ pollution roses are similar at all sites and dominated by north-westerly winds. At Newcastle the maximum is for 320° winds, whereas at Beresfield it is for 300° winds and at Stockton for even more westerly 290° winds. In all case, there is close agreement between the results for the 1-day-in-3 sampling days (right-hand side) and those for the full 92 days of winter (left-hand side).

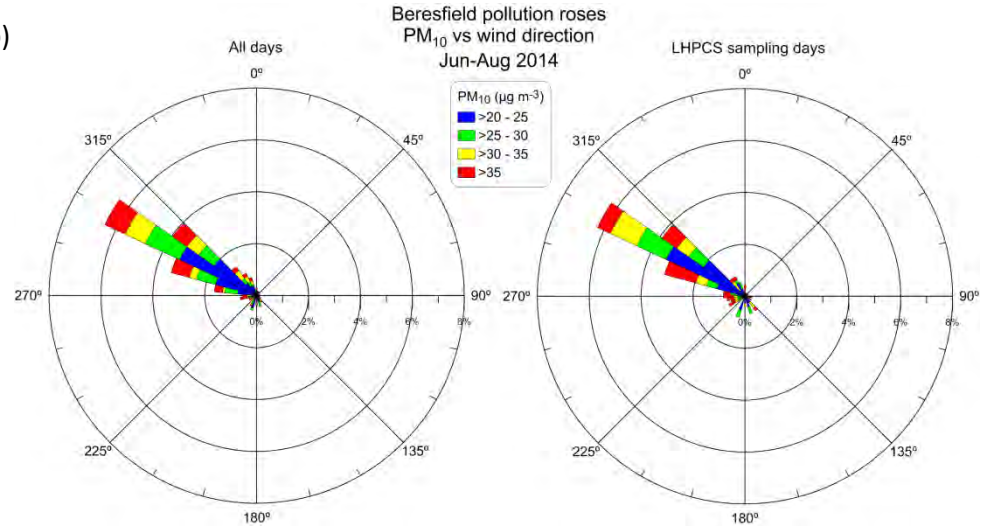
2.5 Summary

The sampling conducted during the June to August 2014 period was successfully undertaken and will support chemical analysis and source apportionment for the Winter season. This is concluded based on the overall sample collection rate of 100% achieved, and sampling days generally coinciding with low, high and average ambient particle concentration measurements across all sampling sites. However, most of the high PM_{10} days at Stockton in the second half of the winter period did not coincide with sampling days. Peak hourly concentrations on such days were noted to occur with easterly (onshore) winds. There have been no significant issues with filter shipping and analysis of filter samples is ongoing. Study results will be presented in the Final Study Report due for publication early in 2016.

(a)



(b)



(c)

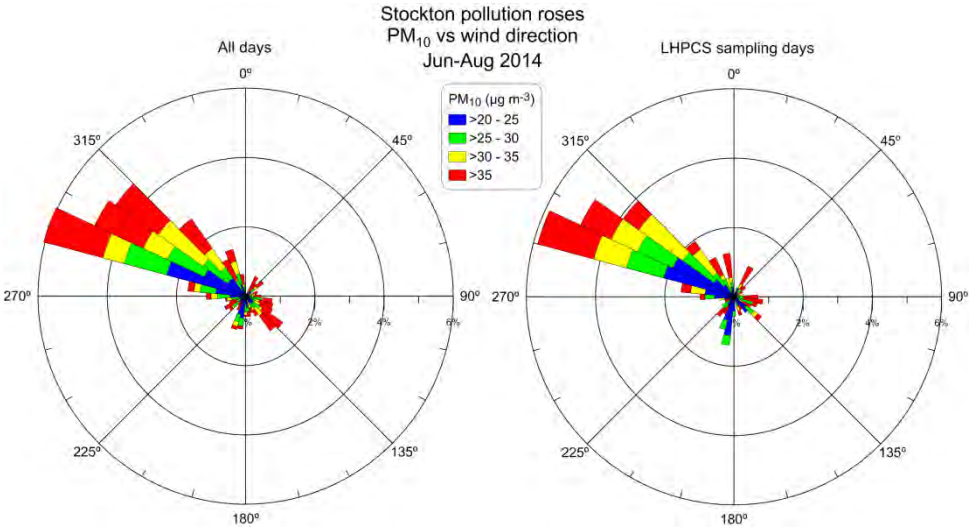


Figure 8 PM_{10} pollution roses for PM_{10} > 20 µg m^{-3} for the Winter period at Newcastle, Beresfield and Stockton showing close agreement between all days (left-hand side) and the 1-day-in-3 sampling days (right-had side). [Note: these pollution roses depict the distribution of PM_{10} concentrations at each wind direction.]

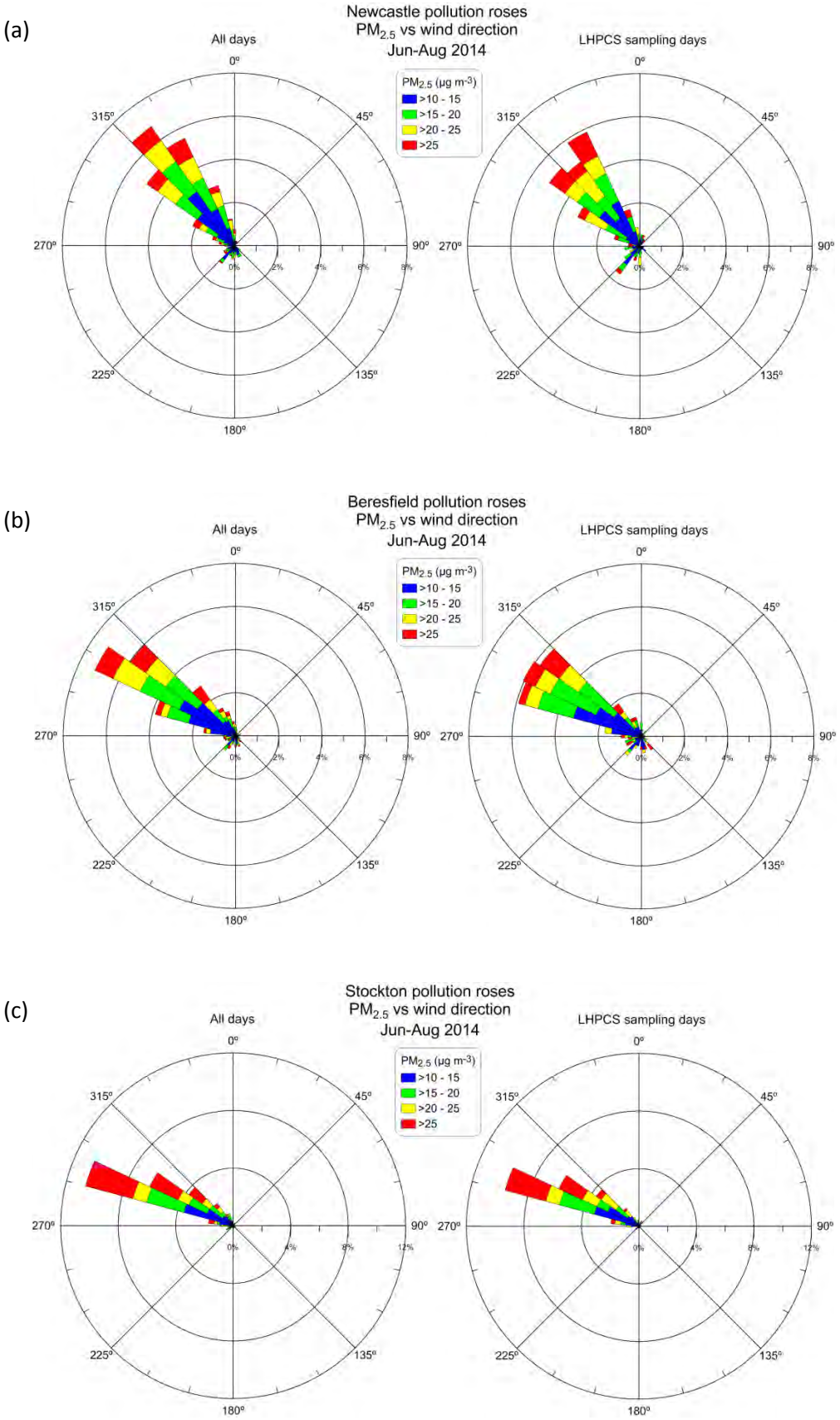


Figure 9 $PM_{2.5}$ pollution roses for $PM_{2.5}$ > 10 µg m^{-3} for the Winter period at Newcastle, Beresfield and Stockton showing close agreement between all days (left-hand side) and the 1-day-in-3 sampling days (right-had side). [Note: these pollution roses depict the distribution of $PM_{2.5}$ concentrations at each wind direction.]

3 Additional information

3.1 Site visits

The August monthly meeting of the Project Management Team was held in Newcastle and included a visit to all of the LHPCS monitoring sites. This provided an opportunity to understand the local environment around the sites and identify any local sources or features that might impact on interpretation of the results. Some additional photographs of the monitoring equipment were obtained, for example Figure 10 of the ASP sampler and Figure 11 of the GENT sampler, as well as Figure 12 of the various equipment sampling inlet locations.

Figure 10 Details of the ASP Sampler at the Newcastle site being inspected by David Cohen

Figure 11 Details of the GENT sampler at the Stockton site being inspected by Peter Crabbe

Figure 12 Identification of ASP, GENT and OEH inlets on the roof of the OEH Newcastle Air Quality Monitoring Station

Photographs of each of the monitoring sites and a 360° panorama around the sites are shown in the following figures:

- Newcastle - Figure 13 and Figure 14
- Beresfield - Figure 15 and Figure 16
- Mayfield - Figure 17 and Figure 18
- Stockton - Figure 19 and Figure 20.

Figure 13 Newcastle Air Quality Monitoring Station during the site visit from the project team

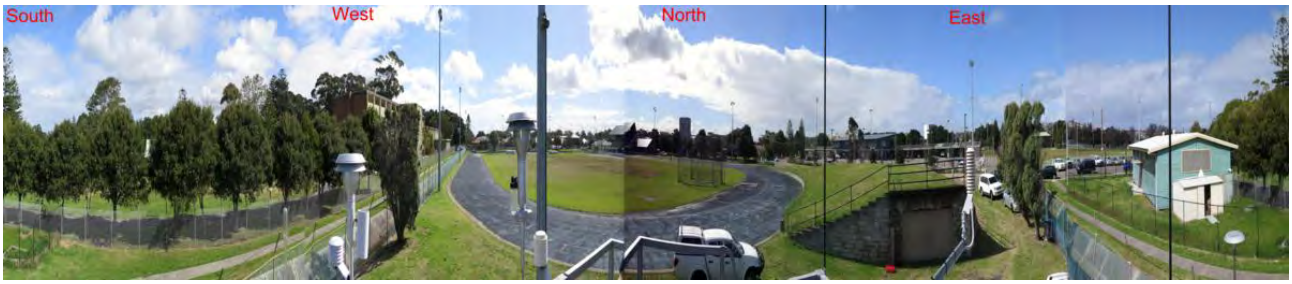


Figure 14 A 360° panorama from the roof of the Newcastle Air Quality Monitoring Station located next to the Athletics Field (vertically stretched to aid identification of features)

Figure 15 Beresfield Air Quality Monitoring Station located adjacent to Francis Greenway High School

Figure 16 A 360° panorama from the roof of the Beresfield Air Quality Monitoring Station (vertically stretched to aid identification of features)

Figure 17 Mayfield Air Quality Monitoring Station located in the grounds of the CSIRO Energy Centre

Figure 18 A 270° panorama in the vicinity of the Mayfield Air Quality Monitoring Station

Figure 19 View from the Stockton Air Quality Monitoring Station across the river to Kooragang Island.

Figure 20 A 360° panorama from the roof of the Stockton Air Quality Monitoring Station (vertically stretched to aid identification of features)

3.2 LHPCS information on the web

A web page for the LHPCS has been developed and went live on the NSW OEH website in March 2014 coinciding with the commencement of the one year sampling program (http://www.environment.nsw.gov.au/aqms/lowhunterparticle.htm). The content is reproduced on the following three pages. The first progress report for the autumn sampling period was posted on the study web page on 31 July 2014.

NSW GOVERNMENT | Environment & Heritage

Home > Air quality > Lower Hunter particle characterisation study

Lower Hunter Particle Characterisation Study

What is the Lower Hunter Particle Characterisation Study?

The Lower Hunter Particle Characterisation Study was initiated in 2013 to study the composition of airborne particles 2.5 micrometres and smaller in diameter ($PM_{2.5}$) in the Lower Hunter region, and the composition of particles 10 micrometres and smaller in diameter (PM_{10}) in the vicinity of the Newcastle Port.

The study is being undertaken to provide communities in the Lower Hunter with scientific information about the composition and likely sources of fine particles, invisible to the eye, in their local environment.

The study includes one year of sampling (March 2014 to February 2015) at four sites (Newcastle, Beresfield, Mayfield, Stockton), followed by sample analysis and modelling to identify the sources of air particles. $PM_{2.5}$ will be sampled at Newcastle and Beresfield to study air particles characteristic of the broader region, with $PM_{2.5}$ and PM_{10} sampled at Mayfield and Stockton situated in proximity to the Newcastle Port. Study findings will be released early in 2016.

What are the aims of the study?

The study aims to determine the composition of $PM_{2.5}$ and PM_{10} air particles and identify major sources contributing to $PM_{2.5}$ and PM_{10} concentrations in the region to inform NSW Environment Protection Authority control programs.

Specific objectives are to:

- determine the composition and major sources contributing to $PM_{2.5}$ concentrations at sites representative of regional population exposures.
- establish airborne particle composition and major sources contributing to $PM_{2.5}$ and PM_{10} concentrations at sites indicative of population exposures in areas near to the Newcastle Port.

Who is involved in the study?

The project is a collaborative study by the New South Wales (NSW) Environment Protection Authority (EPA), the NSW Office of Environment and Heritage (OEH), NSW Health, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Nuclear Science and Technology Organisation (ANSTO).

The NSW EPA has commissioned and is funding the study. The Climate and Atmospheric Science Branch of NSW OEH is managing the study with CSIRO and ANSTO the lead research partners. NSW OEH staff are conducting the one-year sampling campaign, with CSIRO and ANSTO responsible for sample analysis, evaluation and reporting of results.

A management team has been established to oversee the design, planning, implementation and documentation of the study and the communication of progress and study findings. This management team includes representatives from the EPA, OEH, NSW Health, CSIRO, ANSTO and a community representative nominated by the Newcastle Community Consultative Committee for the Environment (NCCCE).

Why does the study focus on PM2.5 but also address PM10?

$PM_{2.5}$ sampling is being conducted at four sites in the Lower Hunter region over a one year period, including two sites representative of wider community exposures in the region (Newcastle and Beresfield) and two sites indicative of public exposures in areas neighbouring the Newcastle Port (Stockton and Mayfield).

AVAILABLE NOW

Download the first progress report (PDF 772KB)

Location of the four study sampling sites

Higher resolution map showing the location of the Newcastle, Mayfield and Stockton sampling sites

OEH Beresfield air quality monitoring station showing roof-mounted ASP samplers

Higher resolution map of the Beresfield site

$PM_{2.5}$ is associated with greater health risks than coarser particle pollution. While larger particles generally settle close to their source, smaller particles can remain suspended in the air and be carried over large distances, potentially causing impacts in areas far from their source. The evidence is clear that long-term exposure to $PM_{2.5}$ has a larger health effect than short-term exposure, suggesting that strategies that provide long-term reductions in particulate pollution are likely to produce the greatest health benefits.

The EPA consulted with the Newcastle community in August 2013 about the scope of the study. At the request of the community, the EPA expanded the study scope to include sampling and characterisation of PM_{10}. PM_{10} sampling and analysis will be done for the Stockton and Mayfield sites in response to community requests that PM_{10} be addressed.

How will the study be conducted?

The first stage of the study involved the establishment of the management team, the appointment of peer reviewers, and the documentation of the study design. This stage has been completed with the study design approved by the management team and reviewed by two independent peer reviewers prior to commencement of the sampling, analysis and progress reporting stage of the study.

Sampling will be undertaken at the Newcastle, Beresfield, Stockton and Mayfield sites between March 2014 and February 2015. Two sampler types are being used in the study, namely ANSTO Aerosol Sampling Program (ASP) $PM_{2.5}$ cyclone samplers (click on image 3 in right hand side bar) and GENT Stacked Filter Units (SFU) sampling 'coarse' ($PM_{2.5-10}$) particles and 'fine' ($PM_{2.5}$) particles at the same time.

Samples are collected for 24 hours every third day and sent to ANSTO and CSIRO for chemical and gravimetric mass analysis. Sample analysis will include ion beam analysis (IBA) techniques, ion chromatography (IC), organic and elemental carbon (OC/EC) analysis, and black carbon analysis using a light absorption technique.

The chemical composition of all the samples from each site will be analysed using an internationally recognised technique called positive matrix factorisation (PMF). PMF is widely applied internationally for identifying source fingerprints and source contributions to ambient pollution.

A similar study was completed for the Upper Hunter. The Upper Hunter Fine Particle Characterisation Study was commissioned by OEH and NSW Health and carried out by CSIRO and ANSTO. This study, successfully completed in September 2013, provided valuable information on the composition and sources of $PM_{2.5}$ concentrations in Muswellbrook and Singleton.

Where are the study sampling sites?

Sampling sites were selected to achieve the study objectives, taking into account the regional context including the local meteorology and air quality, locations of air emission sources, population distribution and locations of existing air quality monitoring stations.

Existing or planned air quality monitoring stations were preferred locations for study sampling sites since they allowed timely establishment of the study samplers. Continuously measured air pollution and meteorological monitoring data available at such sites also provides useful additional information to inform sample analysis.

The following air quality monitoring stations (click on image 1 in right hand side bar) have been selected as sampling sites for the Lower Hunter particle characterisation study:

- OEH Beresfield air quality monitoring station (i.e. the Beresfield site; click on image 4 in right hand side bar)
- OEH Newcastle air quality monitoring station (i.e. the Newcastle site)
- Fullerton Street Stockton air quality monitoring station. This station is operated by Orica but is proposed for development as one of the Newcastle air quality monitoring network stations (i.e. the Stockton site)
- CSIRO Energy Park, planned for installation of one of the Newcastle air quality monitoring network stations (i.e. the Mayfield site).

The Newcastle and Beresfield sites were selected to study fine air particles characteristic of the broader region, whereas the Mayfield and Stockton sites are situated in proximity to the Newcastle Port.

How will the results of this study be used?

This study will contribute significantly to improving the understanding of airborne particle composition and the likely sources of such particles that the populations in the Lower Hunter are exposed to. The results from this study will add to the evidence base that the NSW Government relies on to inform policies and programs aimed at reducing fine particle air pollution.

The EPA report, Managing Particles and Improving Air Quality in NSW, outlines a range of measures that are either in place or being developed to improve air quality in NSW and better inform the public. The plan also restates the NSW Government's commitment to improve the evidence base for action through monitoring and research.

The results and underlying data from this study will also be valuable to future studies in the region.

What are the health impacts of fine particles?

Exposure to fine particles is a significant health concern because they can pass through the throat and nose and enter deep into the lungs, where they can cause respiratory and circulation problems, particularly in elderly people, children and people with existing health conditions.

According to the World Health Organization (WHO), particulate matter affects more people than any other pollutant, and its effects on health occur at levels of exposure currently being experienced by most urban and rural populations in developed countries (see WHO, Air quality and health fact sheet).

Short-term and long-term exposure to particulate matter is associated with mortality and morbidity from cardiopulmonary disease. Over the short term, increases in 24-hour average concentrations of $PM_{2.5}$ and PM_{10} are associated with mortality and hospitalisations from cardiovascular and respiratory diseases. In the longer term, a robust association has also been demonstrated between annual average $PM_{2.5}$ and mortality from all causes and cardiopulmonary causes.

Progress reports and consultations

Prior to the commencement of the study, the EPA consulted with the Newcastle community on 13 August 2013 about the scope of the study. The NCCCE nominated a representative to the study management team to provide further opportunities for community inputs into the study design and implementation.

A series of progress reports will be published during the study to provide updates on the study status. Study results will be presented in the Final Study Report due for publication early in 2016.

The First Progress Report (PDF, 1.4MB - July 2014) provides more information on the study method and the sampling program commissioning phase, as well as details about the samples collected during the first quarter (autumn) sampling period.

Related sites

- Find out more about health-related issues at NSW Health
- Find out more about the EPA's other Lower Hunter air quality studies
- Find out more about CSIRO's work
- Find out more about ANSTO's work

Page last updated: 04 August 2014

3.3 Newcastle Local Air Quality Monitoring Network

Two of the sites being used for the Lower Hunter Particle Characterisation Study are part of the newly established Newcastle Local Air Quality Monitoring Network (NLAQMN), which comprises sites at Mayfield, Stockton and Carrington. It will provide additional information on the current air quality in Newcastle.

Following studies by the Environment Protection Authority (EPA) and the Office of Environment and Heritage (OEH), and advice from the NSW Health's Air Pollution Expert Advisory Committee, the EPA determined that a continuous local monitoring program for particulate matter less than 2.5 micrometres in diameter ($PM_{2.5}$) and 10 micrometres in diameter (PM_{10}), sulphur dioxide and nitrogen oxides would be beneficial for the Newcastle community.

The Newcastle Community Consultative Committee on the Environment (NCCCE) called for an air quality network in the Newcastle local government area and provided input into the selection of three new air quality monitoring locations at Mayfield, Stockton and Carrington. These stations complement the existing air quality monitors operated by the OEH in the Newcastle area.

The network is modelled on the successful Upper Hunter Air Quality Monitoring Network, which is funded by industry and operated by OEH on behalf of the EPA. The air quality data collected from the three stations in the NLAQMN is available to the public in close to real time via the OEH air quality web pages. Current monitoring results from the NLAQMN are updated hourly.

More information on the NLAQMN is available from www.environment.nsw.gov.au/aqms/newcastlelocalfaq.htm.

CONTACT US

t 1300 363 400
+61 3 9545 2176
e enquiries@csiro.au
w www.csiro.au

YOUR CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.

FOR FURTHER INFORMATION

CSIRO Oceans and Atmosphere Flagship
Mark Hibberd
t +61 3 9239 4400
e mark.hibberd@csiro.au
w www.csiro.au/cmar