Sellicks Beach air quality final report

Issued June 2017

EPA 1104/17: This report discusses air quality monitoring data, findings and recommendations based on monitoring conducted from January 2016 to February 2017 at Sellicks Beach.

Introduction

One of the EPA's environmental goals is good quality air. To support this goal the Environment Protection Authority (EPA) conducts ambient air quality monitoring at locations around South Australia. Monitoring is one of the tools used to improve understanding of air pollution patterns and trends, and the impacts on local communities.

Following an escalation of community concerns toward dust impacts from the local quarry in Sellicks Beach, monitoring was initiated to quantify and understand the levels of particulate matter in air and its likely impacts.

The EPA has been working closely with local quarry operator Southern Quarries, to monitor and manage its dust emissions. For more than four decades, the quarry has been a significant supplier of dolomite aggregates and crushed rock suitable for use in concrete as well as asphalt grade aggregates and road-based material. Southern Quarries had its EPA licence amended recently to manage offsite dust impacts through an EPA approved dust management plan. The company's licence condition also requires them to implement mitigating measures to manage offsite dust impacts including but not limited to the use of water sprays, water carts and sprinklers.

This report discusses air quality monitoring data, findings and recommendations based on monitoring conducted from January 2016 to February 2017. The authors have carefully examined data for particulate matter, in conjunction with wind speed and direction measurements and other available information that may assist in understanding sources of dust in the area. The location of the mobile monitoring station is shown in Figure 1.

Data in this report are assessed against ground level concentration criteria for PM_{10} and $PM_{2.5}$ in Schedule 2 of the *Environment Protection (Air Quality) Policy 2016*. Further information about ambient air quality is available on the EPA website.

Total suspended particulate material (TSP) is a class of particles which have equivalent aerodynamic diameters (EAD) less than 50 µm and includes a mixture of large and fine particles. EAD gives an indication of whether particles can be breathed into our lungs, irrespective of their physical size and shape. Larger particles with EADs greater than 10 µm are generally trapped in our noses and throats, so they do not reach the lungs; however, they may cause irritation, nuisance and soiling of surfaces. That said, PM_{10} particles may also be associated with visible dust, which is why this pollutant is often measured in conjunction with TSP.

Fine particles are often a complex mixture of materials arising from many sources, and are generally grouped into two categories, called PM_{10} and $PM_{2.5}$. Fine particles are able to enter the lungs and are known to have health effects.

Particles can originate from a variety of sources such as local activities, motor vehicles, domestic activities, or in areas such as Sellicks Beach, they may arise from wind-blown soil materials and even sea salt.

Figure 1 Aerial photo showing the location of EPA's mobile monitoring station

Over an extended period, the EPA became aware of community concerns relating to dust emissions in the Sellicks Beach area, including complaints from members of the community related to the quarry operation. As an evidence-based regulator, this prompted the EPA to establish an independent short term monitoring program to evaluate local air quality within the township. The media release announcing the EPA's dust monitoring is available on the website.

Meteorology (modelling) for the Sellicks Beach Area

Initially there was a limited understanding of local wind patterns around Sellicks Beach and Sellicks Hill. The EPA used TAPM (*The Air Pollution Model*) developed by CSIRO, to generate meteorology data for a range of elevations, in the absence of local monitored weather data. This was necessary because of the very complex terrain between Sellicks Hill and Sellicks Beach suburb, which often makes wind directions difficult to predict. Information from CSIRO for 2009 was used to model meteorology, as the year has been used as a representative year of typical weather conditions in the Metropolitan Adelaide area (Figure 2).

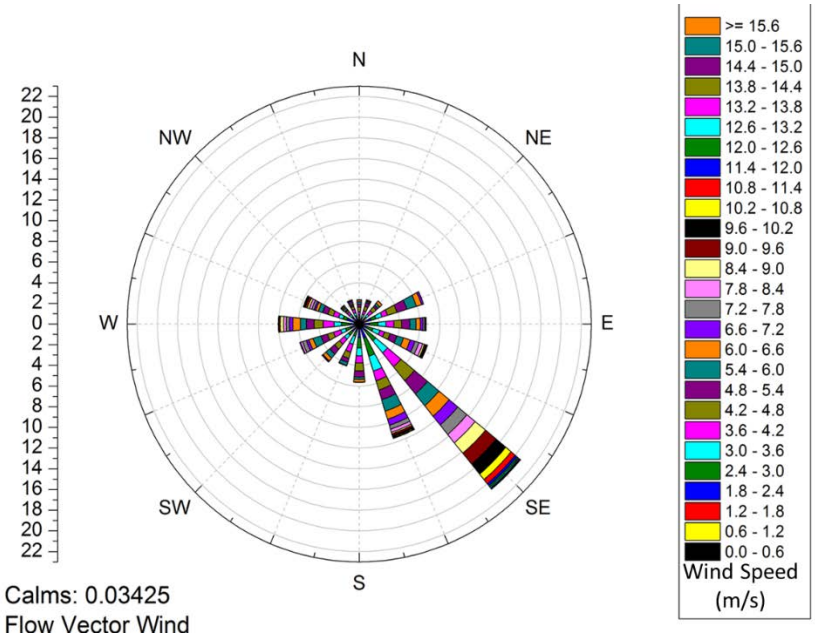

Figure 2 Annual wind rose for 2009 generated by a mathematical model

Some of the early observations from local meteorology data analysis were:

- Wind speeds at Sellicks Hill are generally very high – a significant proportion of hourly winds are recorded at speeds above 8 m/s (~30 km/hr).
- Overall, on an annual basis, wind from the southeast sector dominates at Sellicks Beach.
- Local topography near Sellicks Hill starts influencing wind directions for lower wind speeds (less than 8 and 4 m/s ie 15 km/hr)
- Higher wind speeds may raise nuisance dust; however it is the fine particles (PM_{10} or $PM_{2.5}$) which can travel further even at lower wind speeds as they are readily lifted and carried on the wind. Therefore, continuous real time TSP/ PM_{10} monitoring was required along with meteorology measurements to understand local sources of dust.
- The results from the analysis provided the basis for negotiating the locations of boundary air quality monitors as part of the dust management plan, required under EPA licence for Southern Quarries.

Based on the understanding of wind patterns, prevailing wind directions and other site selection criteria[1] the EPA mobile monitoring station was located in the Blue Water Estate on Arcadia Crescent, Sellicks Beach (Figure 1). The station was deployed on 14 January 2016 to monitor dust ie total suspended particulates (TSP), particles (PM_{10} and $PM_{2.5}$) and meteorological conditions. Monitoring concluded on 28 February 2017.

Polar plots, dust sources and seasonal variation

A polar plot is a graphic representation of the data that describes how short-term (1-hour) concentrations of a pollutant vary with wind speed and direction. This can provide information about where pollution may be coming from at any given time during the day, and the conditions under which concentrations are recorded. It needs to be emphasised that the short-term averages do not provide direct information about potential health impacts on communities. Our criteria for health impacts of particles are based on 24-hour and annual averages, for which graphs are presented later in the report. However, hourly averages can show episodes or patterns of increased particle concentrations during the day, so are useful in sorting out where they may have come from.

[1] Other selection criteria include safe access to the monitoring station, safety of deployed monitoring equipment, isolation from nearby trees or major structures which may compromise the quality of data and access to power supply to operate the monitoring station.

The polar plots in this section show results coloured from blue to red, representing increasing concentrations. Separate graphs are shown for PM_{10} and TSP. Each point on the graph represents a 1-hour average concentration, which occurred when the wind was blowing from a certain direction towards the station at a certain speed. The result is a collection of coloured patches representing many hourly recordings.

Red patches indicate higher average concentrations, while blue patches show very low average concentrations. The deepest red colour represent the highest 1-hour concentrations recorded for the whole period. In addition, wind speed and direction are important variables that can assist in identifying different sources. The distance of the coloured patches from the centre of the graph indicates how fast the wind was blowing on average, when the readings were recorded. So, for example the centre point is 'dead calm', while the edges show the greatest wind speeds.

Overall trend

The polar plot for TSP indicates that airborne dust in Sellicks Beach originated from many directions under the influence of variable wind speeds. Monthly TSP polar plots are available separately on the EPA website. The monitoring data indicates that dust comes from three major wind direction sectors: east-southeast, southwest- northwest and north-northeast.

Further it appears that for the southwest-northwest quadrant the wind carries dusts at speeds as low as 1 m/s (approximately 4 km/hr). In contrast, wind speeds from the east-southeast are required to be least 3 to 5 m/s (11 to 18 km/hr), before significant dust levels are recorded and concentrations increase with rising wind speed. Monthly polar plots also indicate seasonal changes in the sources of dust. Recognising this, polar plots for TSP/ PM_{10} are presented according to the season, in addition to those for the whole study period. Polar plots for PM_{10} exhibited similar patterns to those for TSP.

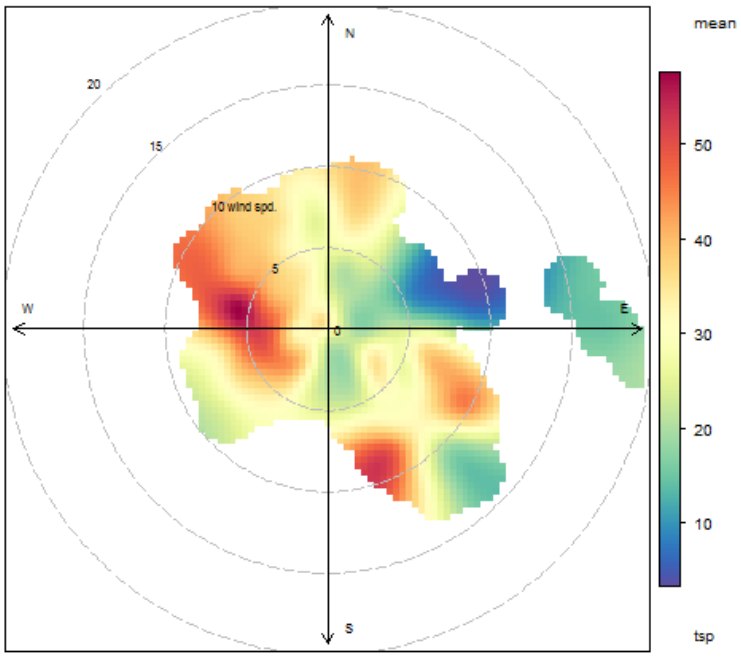

Figure 3 Polar plot for TSP (1-hour averaged data in µg/m³)

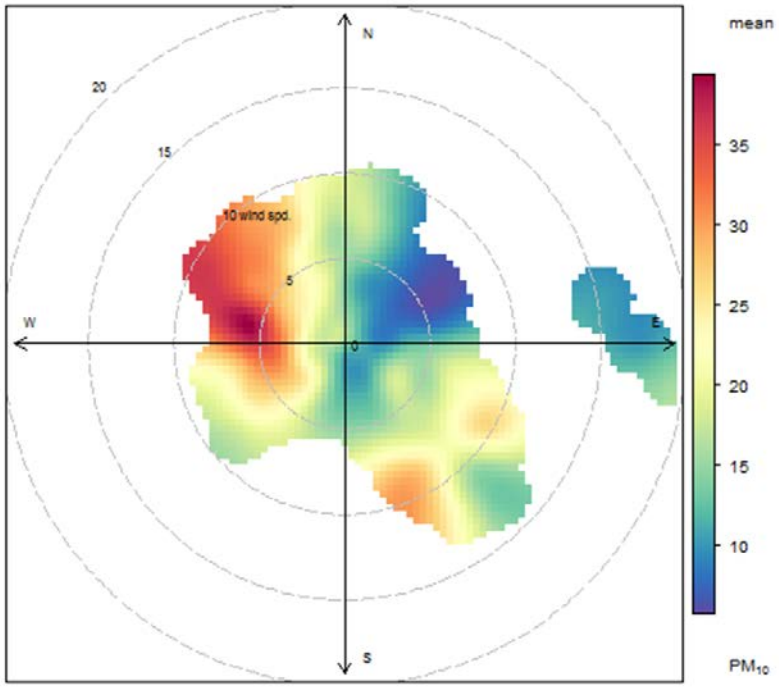

Figure 4 Polar plot for PM_{10} (1-hour averaged data in µg/m^3)

Seasonal trends

This section discusses TSP and PM_{10} polar plots for seasonal trends.

Summer 2016

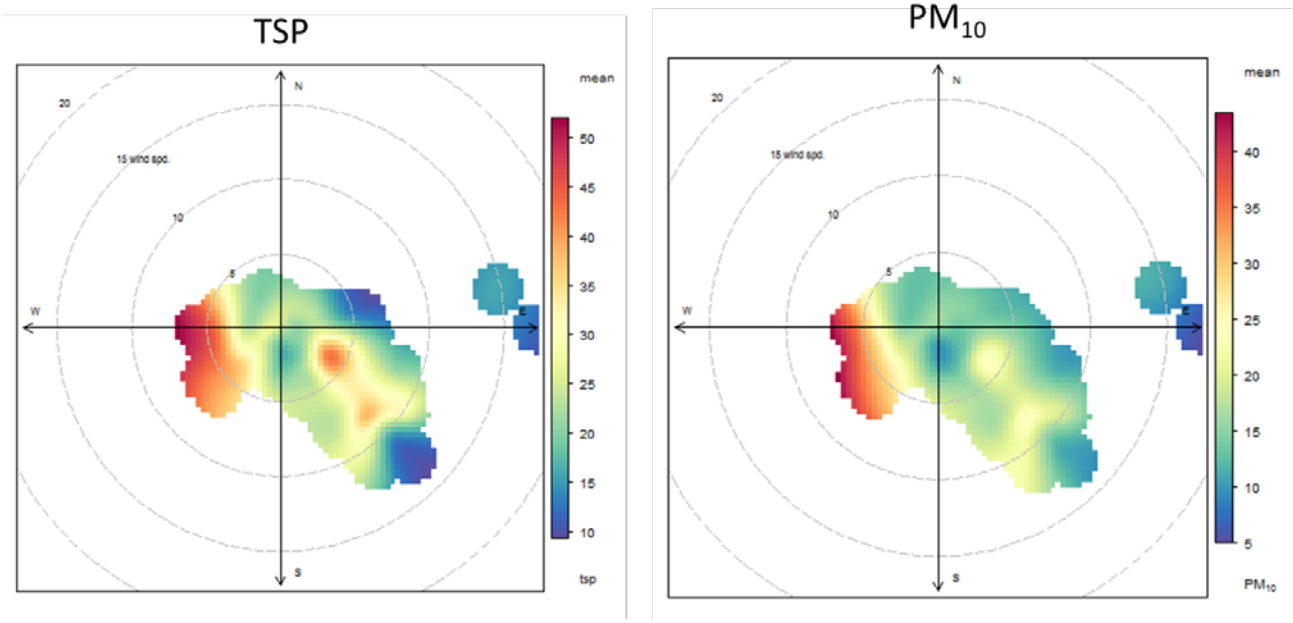

Figure 5 Summer 2016 polar plots for TSP and PM_{10} (1-hour averaged data in µg/m^3)

In 2016 summer, TSP originated mainly from the southwest-west sector and were associated with wind speeds of 3 to 8 m/s (11 to 29 km/hr). Some visible dust also originated from the southeast with minimum wind speeds of 4 m/s (14 km/hr) and dust levels further rose with increasing wind speeds. The polar plot for PM_{10} exhibits similar patterns.

Autumn 2016

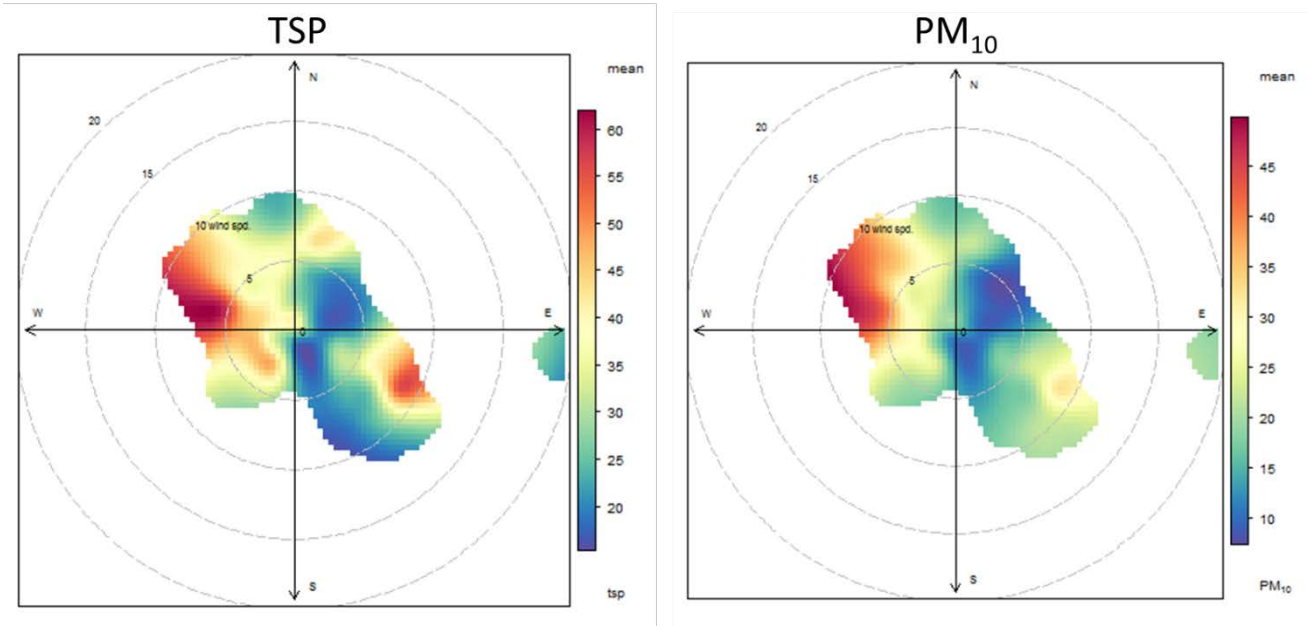

Figure 6 Autumn 2016 polar plots for TSP and PM_{10} (1-hour averaged data in µg/m^3)

In 2016 autumn, TSP and PM_{10} mainly originated from the west-northwest quadrant and were associated with variable wind speeds of 2 m/s to 11m/s (i.e. 7 km/hr to 40 km/hr). Some TSP and PM_{10} was also dominant from the east-southeast.

Winter 2016

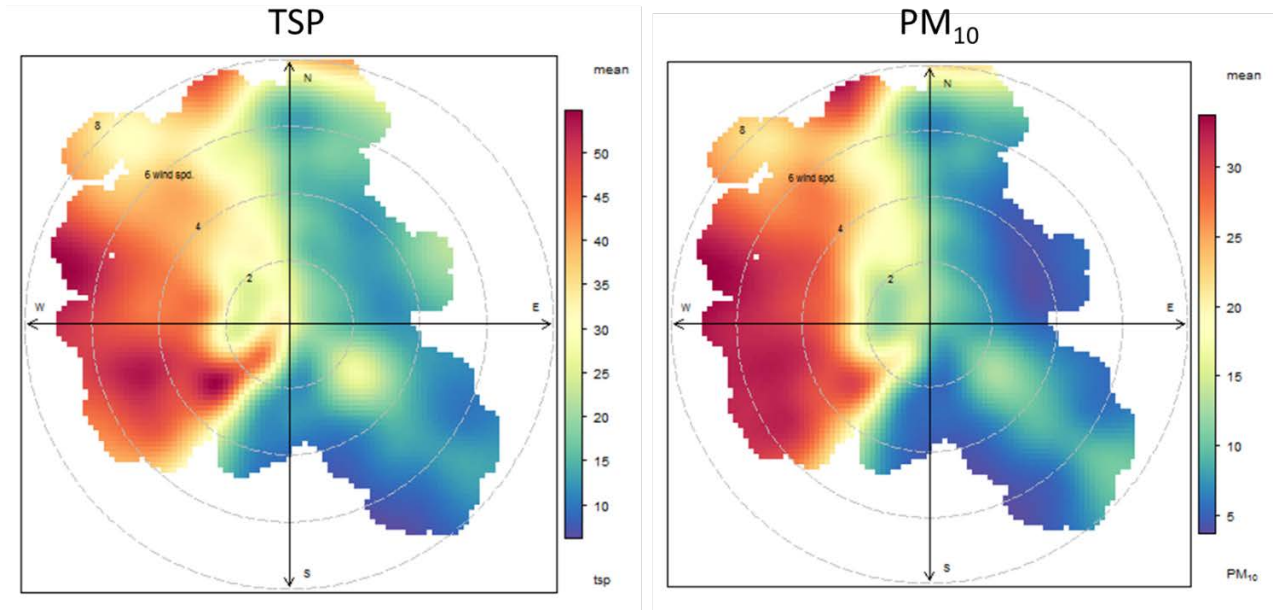

Figure 7 Winter 2016 polar plots for TSP and PM_{10} (1-hour averaged data in µg/m^3)

Winter 2016 exhibited patterns for TSP and PM_{10} concentrations, which were on average lower than the warmer months. Also during the winter most TSP and PM_{10} were associated with winds from the southwest to north-northwest, reflecting the change in wind direction during the cooler months.

Spring 2016

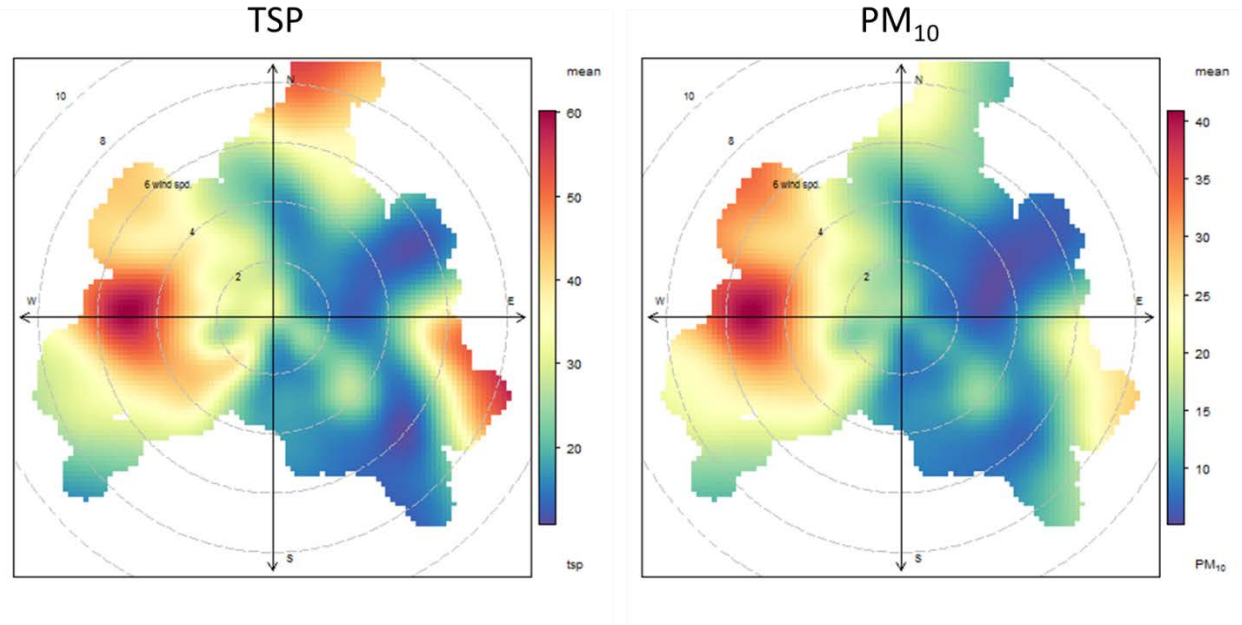

Figure 8 Spring 2016 polar plots for TSP and PM_{10} (1-hour averaged data in µg/m^3)

Summer 2017

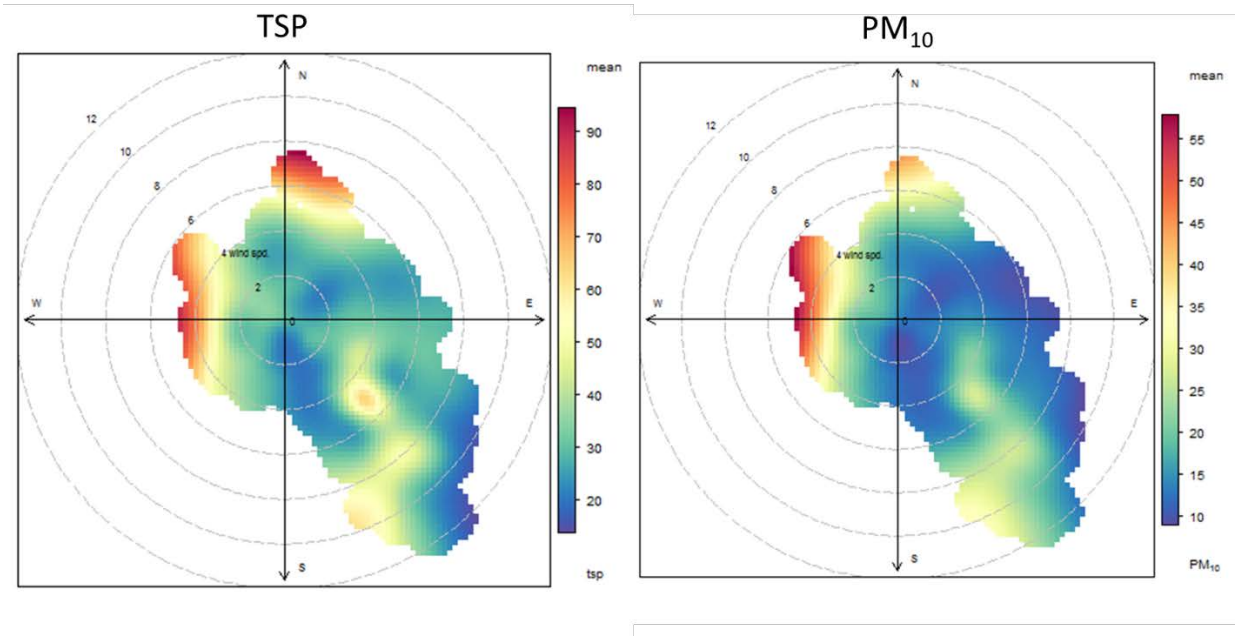

Figure 9 Summer 2017 polar plots for TSP and PM_{10} (1-hour averaged data in µg/m^3)

A similar summer pattern was repeated in 2017, except for some additional TSP and PM_{10} concentrations associated with wind from a northerly direction and wind speeds of 6 to 8 m/s (22 to 30 km/hr).

Comparison against ground level concentration criteria

Particles (PM_{10})

There was 1 exceedence of the 24-hour ground level concentration criterion for PM_{10} (50 µg/m^3) at Sellicks Beach on 9 February 2017. It was attributed to hot, dry and windy (strong SE winds) conditions specific to the Sellicks Beach and Sellicks Hill area. Any gap(s) in the data from the monitoring station were due to maintenance.

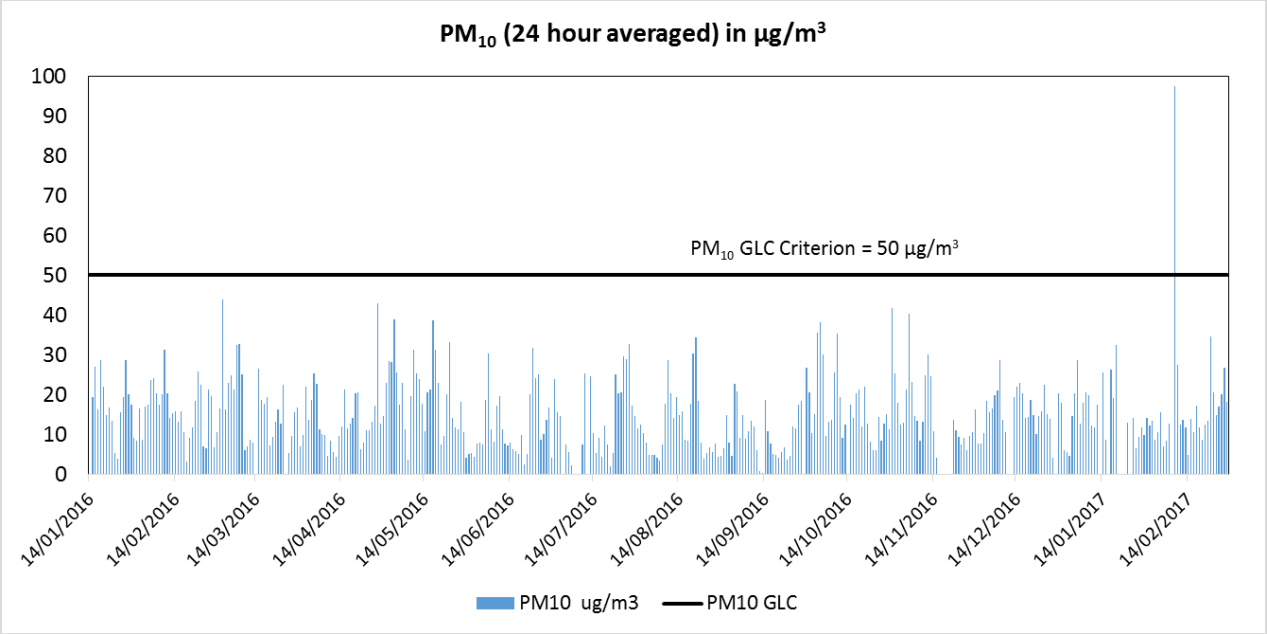

Figure 10 24-hour averaged PM_{10}

Particles ($PM_{2.5}$)

There have been no exceedances of the 24-hour ground level concentration criterion for $PM_{2.5}$ (25 µg/m^3) at Sellicks Beach during the monitoring period.

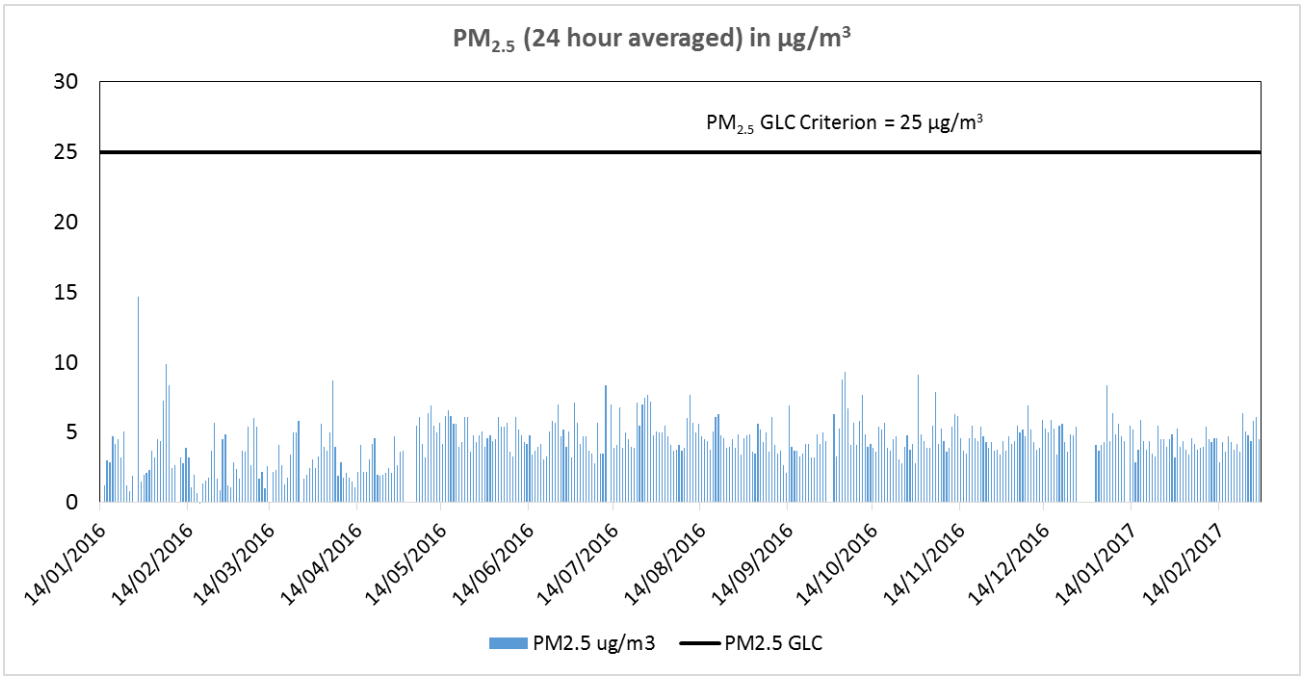

Figure 11 24-hour averaged $PM_{2.5}$

PM_{10} data comparison with other monitoring sites

PM_{10} data from Sellicks Beach, Christies Beach and Netley stations are presented in the graph (Figure 12). PM_{10} levels at all three stations have exhibited a similar trend during this monitoring period. Overall, Sellicks Beach PM_{10} concentrations were somewhat higher than those at the urban stations, most likely because of local sources or activities in the Sellicks Beach/Sellicks Hill area. However, the levels were generally below state ground level concentration criteria (except on 9 February 2017). It is important to note that there are no South Australian criteria for nuisance dust measured as TSP.

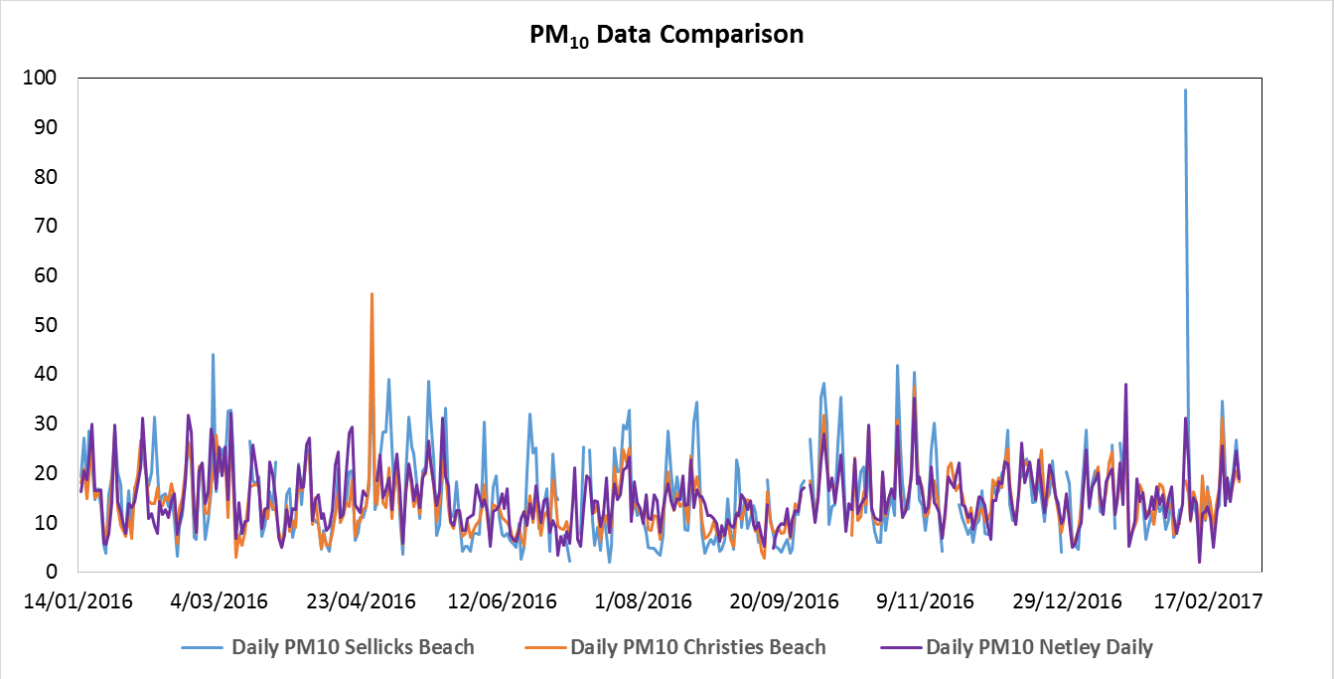

Figure 12 24-hour averaged PM_{10} comparison chart

Summary

- The EPA undertook a thorough analysis of wind patterns in the local area before selecting the location for monitoring.
- Most TSP events were associated with relatively low to moderate wind speeds.
- There was a significant contribution to dust levels (TSP and PM_{10}) associated with wind blowing from west of the monitoring station. It is suggested that sea salt may have contributed significantly to recorded particle levels in the Sellicks Beach/Sellicks Hill area, noting this phenomenon is quite common for coastal areas in other states.
- Both PM10 and PM2.5 generally remained below the ground level concentration criteria and exhibited similar trends to those observed at other monitoring locations in the Adelaide metropolitan region.
- 24-hour averaged PM10 concentrations in Sellicks Beach were persistently slightly higher than those at the other locations; however the levels were largely below the ground level concentration criterion.
- It is recognised that there are no criteria for nuisance dust (measured as TSP). The monitoring data suggests that Sellicks Beach may occasionally get affected by short-term TSP event(s) originating from multiple directions. The complaints received from the community in the area are likely due to localised dust events in the area.

Regulation

- Southern Quarries are undertaking regulatory monitoring at the boundaries of the quarry as part of their dust management plan (DMP). The location of boundary air quality monitors were decided based on the understanding of local wind patterns.
- This monitoring is critical in ensuring that remedial measures are implemented immediately in response to any increased dust levels and there are no offsite dust impacts on nearby properties or the Sellicks Beach/Sellicks Hill community.
- The dust management plan (DMP) also required Southern Quarries to effectively engage with the local community to inform local residents about steps being undertaken to manage offsite dust impacts.
- The EPA will continue to work with Southern Quarries through licensing to ensure that all reasonable and practicable measures are undertaken to minimise offsite dust impacts from its Sellicks Hill operations.

Further information

Legislation

Online legislation is freely available. Copies of legislation are available for purchase from:

Service SA Government Legislation Outlet
Adelaide Service SA Centre
108 North Terrace
Adelaide SA 5000

Telephone: 13 23 24
Facsimile: (08) 8204 1909
Website: <shop.service.sa.gov.au>
Email: <ServiceSAcustomerservice@sa.gov.au>

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