AECOM Imagine it. Delivered.

AECOM New Zealand Limited
8 Mahuhu Crescent
Auckland 1010
PO Box 4241
Auckland 1140
New Zealand
www.aecom.com

+64 9 967 9200 tel
+64 9 967 9201 fax

Memorandum

To	Ian Wallace	Page	1
CC			
Subject	Assessment of Off-site Effects associated with Overburden placement on the Pegram Block		
From	Andrew Curtis		
File/Ref No.		Date	25-Sep-2017

A number of submissions made on the Pegram Block Application for resource consent raised concerns about potential air quality effects associated with particulate emissions from the overburden placement. In particular there were concerns from the Northland District Health Board (NDHB) about the potential for effects associated with crystalline silica (quartz), and also concerns in other submissions about the potential for effects from “other toxic” compounds.

In this memo I have set out my response to these concerns, and my assessment of the potential for effects from the activity.

1.0 Presence of Toxic Substances

Based on my discussions with yourself and other GBC Winstone staff, my understanding is that the area where overburden will be removed from is in scrub, and has not been actively farmed. Consequently I did not consider it likely that there would be any compounds present in the overburden that might be considered “toxic”.

To confirm this, samples of the overburden topsoil have been collected and analysed by independent laboratories.

Pesticides/Herbicides

A sample of the topsoil was sent to RJ Hill Laboratories, a chemical testing laboratory based in Hamilton, and analysed to determine the presence of pesticides or herbicides. This analysis did not detect the presence of any pesticides or herbicides above the method detection limit. This indicates that it is extremely unlikely that any form of pesticide or herbicide has been used on the land, and consequently there is no potential for any form of effect related to these types of compounds from exposure to any dust that might be generated when the material is placed in the Pegram Block.

Biological Agents

A separate sample of the topsoil was collected and sent to Biodet Services Limited, a consulting microbiology laboratory based in Auckland, where the sample was cultured and then analysed for the presence five bacterial species. This analysis did not detect the presence of *Salmonella (*a bacteria found in the intestinal tract of many animals which can cause gastroenteritis) or *Staphylococcus aureus* (a bacteria primarily associated with humans), with *Aspergillus fumigatus* (a fungus which can be harmful to human health) also below the limit of detection.

The analysis did detect the presence of extremely low concentrations of *E coli* (an indicator of faecal contaminants) consistent with the presence of vermin and birds, as well as concentrations of other coliform bacteria consistent with normal biological activity in topsoil.

Overall the analysis was indicative of normal biological activity and no indication of any potential for human health effects.

Therefore there appears to be little to no potential for adverse effects associated with dust from overburden placement.

2.0 Quartz Assessment

The potential for there to be some form of health effects from exposure to quartz is well understood, and with recent publicity around the potential for public exposure to quartz in the area around gravel quarries in Christchurch, there has been a heightened concern about quartz exposure in other parts of the country as well.

Quartz is one of the two forms that silicon dioxide (commonly called silica), one of the most common minerals on earth, takes. The other form (amorphous silica) is relatively inert and is not implicated in any health effects as far as I am aware.

To result in any form of health effects the quartz particles need to be small enough to be respirable, that is, enter the lungs during normal breathing. This means that the particles need to be less than 10 microns (PM_{10}) in size[1]; and in addition, the published research indicates that the particles need to have freshly fractured surfaces.

In order to assess whether there is any potential for off-site effects from quartz associated with the overburden, Winstone has had samples of the overburden analysed. The overburden essentially comprises four layers:

- Clays, which represent approximately 5% of the overburden.
- Greensand, which represents approximately 70% of the overburden.
- Limestone, which represents approximately 20% of the overburden.
- Weathered greywacke, which represents <5% of the overburden.

The analysis of the clays indicated that there is approximately 20% quartz present amongst the other clay minerals. Given that this material is extremely well weathered, and the quartz does not exist as a discrete entity, it is extremely unlikely that this material would give rise to any quartz dust when it is placed. In addition, this material will be damp when excavated and is unlikely to generate dust during placement.

In reality this material is no different to the clays that underlie the area including Acacia Park.

The majority of the overburden is Greensand, which is a type of sandstone. The analysis indicates that quartz is present in relatively low concentrations (in the order of 12%). Again the quartz does not exist as separate strata, and therefore when it is placed in the overburden, it is unlikely that any discrete quartz dust will be generated.

Limestone represents approximately 20% of the overburden, and as there is no evidence from the analysis that it contains any quartz, its placement will not generate any quartz containing dust.

The weathered greywacke contains approximately 30% quartz, which is consistent with the underlying resource. However because of the weathering process, the excavation and placement of this material is unlikely to result in the generation of significant quantities of dust and any dust that is generated should not contain the fine highly fractured quartz particles that have been identified as having the greatest potential to result in health effects.

This last point is supported by a review of the occupational hygiene monitoring undertaken by GBC Winstone of workers in its Otaika Quarry, which is processing the underlying greywacke resource (which contains up to 40% quartz). Based on this monitoring, the quartz concentrations experienced by workers within the quarry, who arguably face the greatest risk of exposure are on average well less than 20% of the workplace exposure standard of 0.1 mg/m^3.

Given that these workers are regularly in very close proximity (less than 10 m) to activities such as crushing, that have the greatest potential to generate fine quartz particles and do not experience concentrations that could give rise to health effects, it is considered that there is negligible potential for these types of effect to occur on residents who will be located more than 100 m from the overburden and activities on it, which have significantly less potential to generate fine quartz particles.

---

[1] About a tenth of the size of a human hair

To put the above statement into context it is useful to consider in greater detail exactly what activities the two groups (GBC Winstone staff, and Acacia Park residents) will be expose to.

GBC Winstone staff who experienced the highest exposures, although still below the WES, are working in close proximity to the aggregate processing plant. At Otaika this means the greywacke goes through three stages of size reduction, (a primary (jaw) crusher, a secondary (cone) crusher as well as a Barmac through which some of the product passes), as well as vibrating screens (which separate out the different size fractions) and a wash plant. The high energy size reduction processes produce a range of size fractions for different construction and roading products, and invariably as a by-product of these processes, produce quantities of dust sized material (100 microns or less), including PM_{10} sized material some of which will be quartz.

Overburden placement does not involve any high energy size reduction processes. Material is excavated on the quarry site and then end tipped into the overburden. There may be some inadvertent site reduction as material is run over by machinery, but for the vast majority of the time this process will not generate PM_{10} sized material, or material that contains discrete quartz particles as quartz is not present as a discrete fraction within the majority of the overburden materials as set put above.

To provide further assurance to residents I have used a methodology developed by the United States Environmental Agency[2], to assess the potential for an increase in risk of effects from any crystalline silica that may be present. This methodology was based on a number of significant epidemiological studies of quarry workers.

I have used the data from the ambient monitoring that I have undertaken (set out in further detail below) and the data set out above on worst-case potential quartz concentrations in overburden. For the purposes of this assessment I have not considered the fact that works will be short term and that mitigation measures should significantly reduce the potential for dust emissions.

On the basis that there is a more than doubling of average measured PM_{10} concentrations to 16 $\mu g/m^3$ (static PM_{10} monitoring adjacent to the crusher undertaken for GBC Winstone had an average concentration of 25 $\mu g/m^3$) and that crystalline silica represents 30% of that PM_{10}, and that the works occur continually for 70 years, there would be a 0.04% increase in the risk of residents developing silicosis.

Given the levels of conservatism in these assumptions, the effective risk will be significantly less than this.

The fact that there is a high degree of conservatism in my assumptions is supported by the fact that the concentrations of crystalline silica experienced by quarry workers are well less than 20% of the respirable dust concentrations (which is essentially the same size fraction as PM_{10}). Given that this exposure is occurring in an environment which should give rise to the highest concentrations of crystalline silica (i.e. the unweathered greywacke has the highest percentage of crystalline silica and crushing has the greatest potential to generate the fine respirable particles) any exposure from overburden placement will be considerably less.

3.0 PM_{10} Monitoring

As well as the TSP monitoring undertaken adjacent to the Pegram Block which shows that the existing 24 hour average are less than 35 $\mu g/m^3$concentrations, I have also undertaken a more limited quantity of PM_{10} monitoring. I have attached as Figure 1, some of the available data.

This monitoring indicates that the existing average 24 hour average PM_{10} concentrations are less than 8 $\mu g/m^3$, which is consistently below the concentrations measured at Robert Street in central Whangarei.

There would therefore need to be a more than five fold increase in PM_{10} concentrations for ambient levels to approach the NES AQ PM_{10} value of 50 $\mu g/m^3$ as a 24 hour average. Based on my experience at other sites this level of increase is considered highly unlikely to occur.

[2] US EPA, Ambient Levels and Noncancer Health Effects of Inhaled Crystalline and Amorphous Silica, EPA/600/R-95/115

Figure 1 Otaika PM_{10} Monitoring

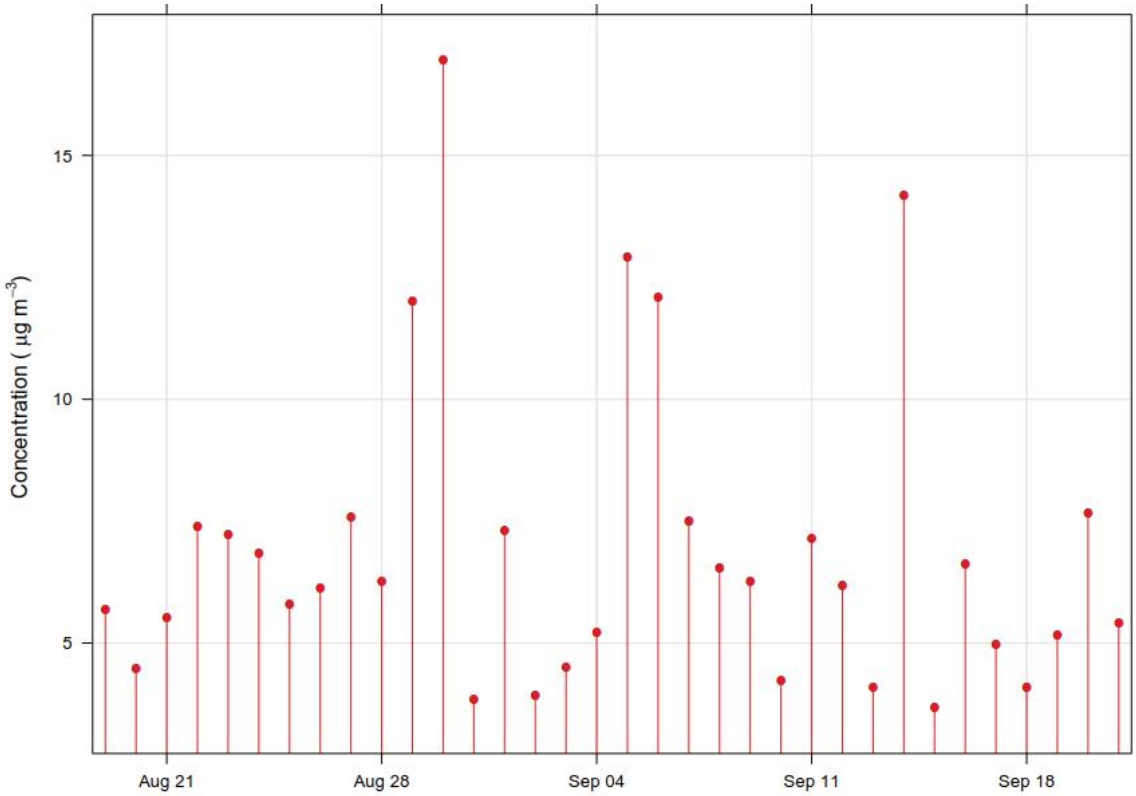
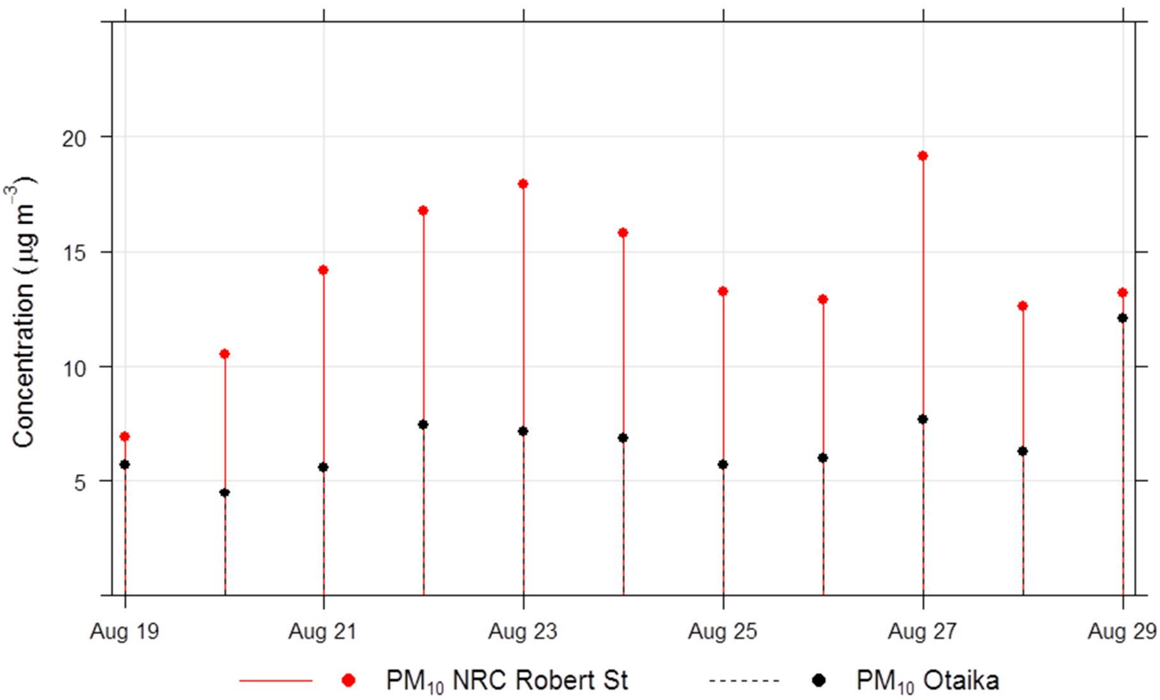


Figure 2 Comparison of Otaika and Roberts Street PM_{10} Monitoring



4.0 Wind Speed Monitoring

NDHB indicated in its submission that AECOM should have used meteorological data collected at Otaika Quarry for assessing the potential off-site effects of dust, to ensure that local wind directions and speeds were taken into account. AECOM agrees that ideally this is the best approach. However when we were first engaged to assist with this project we identified the fact that the Otaika weather station was not suitably located (see Figure 3) to provide representative data and Winstones subsequently relocated the weather station to a more suitable location (see Figure 4).

Figure 3 Initial Location of Otaika Weather Station

Figure 4 New Location of Otaika Weather Station

However in order to undertake the assessment we required a long record of meteorological data and selected the Portland site because of its proximity. We compared the Portland data (Figure 5) to that from Whangarei Airport (Figure 6) and see a high degree of similarity, and therefore consider that Portland data is reasonably representative of the wider area.

AECOM Imagine it. Delivered.

Figure 5 Portland Windrose

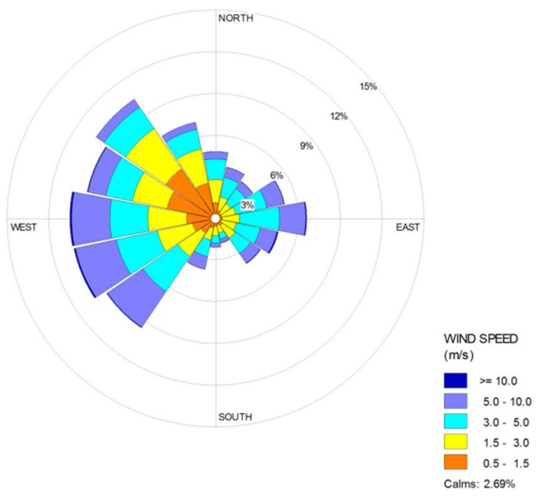
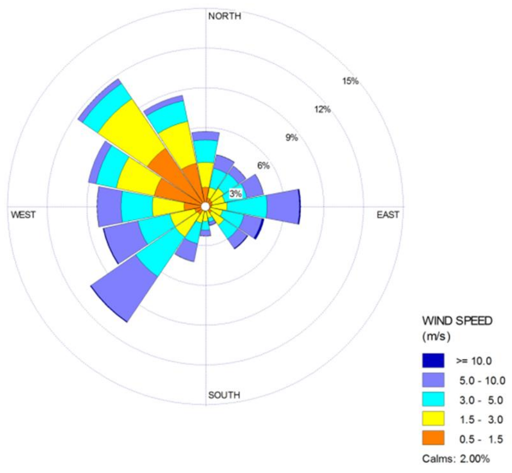
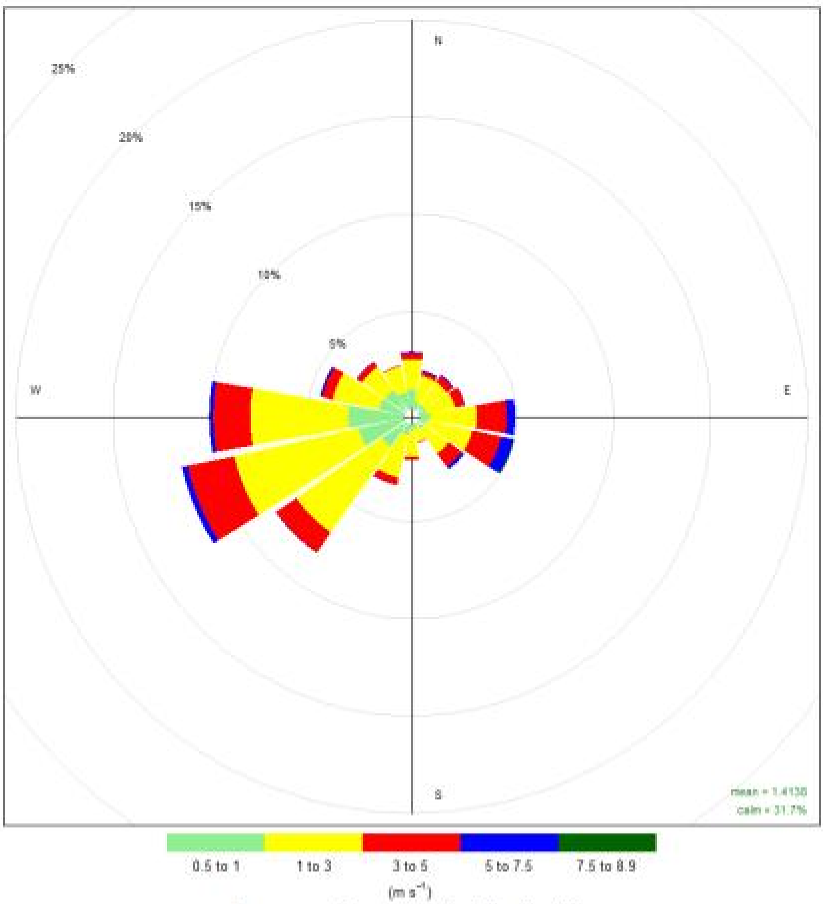


Figure 6 Whangarei Windrose



There is now approximately nine months of data available from the Otaika station (see Figure 7), and we have compared it with that from Portland. In general the data looks similar to that from Portland.

Figure 7 Otaika Windrose December 2016 to August 2017



As can be seen in Figure 8, there is good agreement on the wind directions, and therefore we have not underestimated the percentage of times that winds might blow towards neighbouring residences.

There are distinctly lower wind speeds measured at Otaika (see Figure 9). These lower wind speeds are probably due to the fact that the anemometer height at Otaika is lower than at Portland, but may also be due to local factors.

However as we have used the Portland data in our analysis we have likely overestimate the percentage of strong winds and therefore our assessment is conservative.

We are there comfortable with the approach we have taken to assessing off-site dust effects.

Figure 8 Comparison of Otaika and Portland Wind Directions

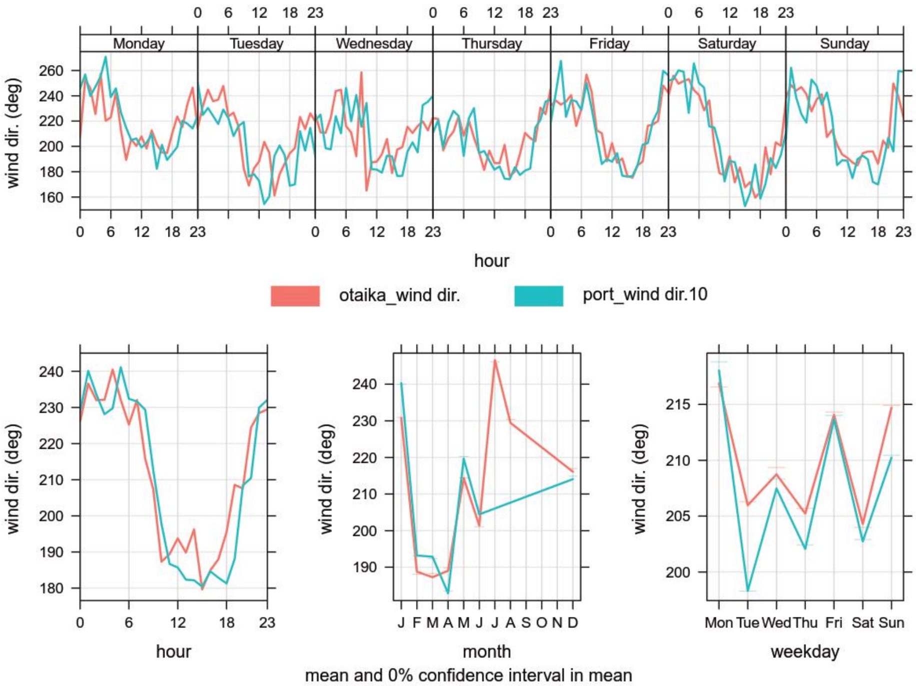
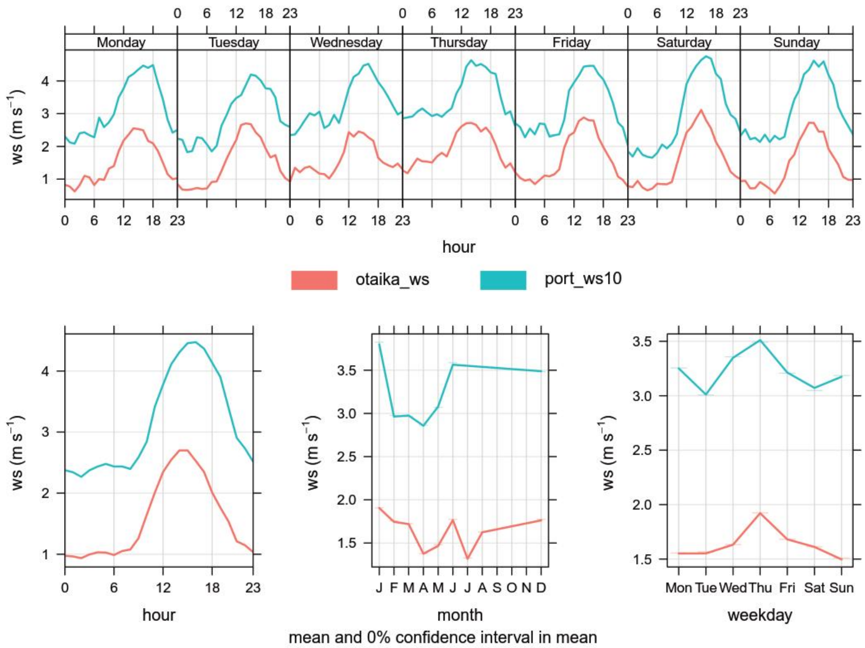


Figure 9 Comparison of Otaika and Portland Wind Speeds



AECOM Imagine it. Delivered.

5.0 TSP Monitoring

NDHB also raised questions about the level of TSP in the local area based on the monitoring I had initiated. I have attached in Figures 10 and 11 updates of the data for 1 24 hour averages respectively.

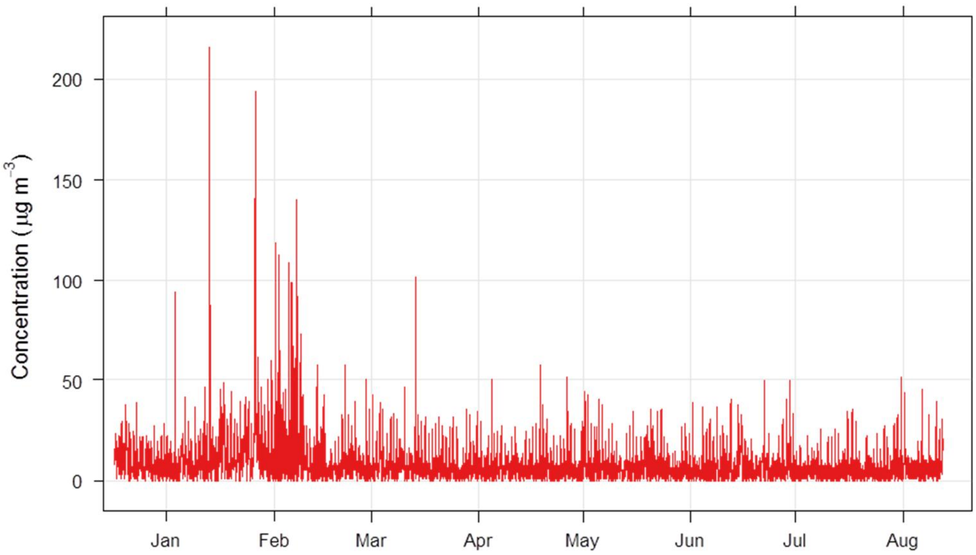
As can be seen in these figures the peak short-term (1 hour) concentrations (Figure 10) are typically well less than 100 µg/m^3 and the average 24 hour average concentrations (Figure 11) are typically well less than 35 µg/m^3.

With the exception of one of the hourly measurements, the measured concentrations are typically less than the recommended MfE guidelines for monitoring in a high sensitivity area. When I looked further at this data I identified that for both of the hours with the highest concentrations, there were light winds blowing from the north. This means that the wind was from within the Acacia Park subdivision and was most likely associated with the construction of a building platform at 5-7 Grove Lane, approximately 50 metres from the location of the monitor.

The 24 hour average TSP concentrations that have been measured are typical of those that I have either measured or seen reported for other rural locations in New Zealand that might be considered background sites for air quality.

Therefore while my monitoring has indicated that winds from the direction of the Otaki Quarry are a source of dust at the monitoring station (see Figure 12), there is no evidence from the data that existing activities associated with Otaika Quarry are causing dust nuisance effects in the local area.

Figure 10 One hour Average TSP Concentrations



AECOM Imagine it. Delivered.

Figure 11 24 Hour Average TSP Concentrations

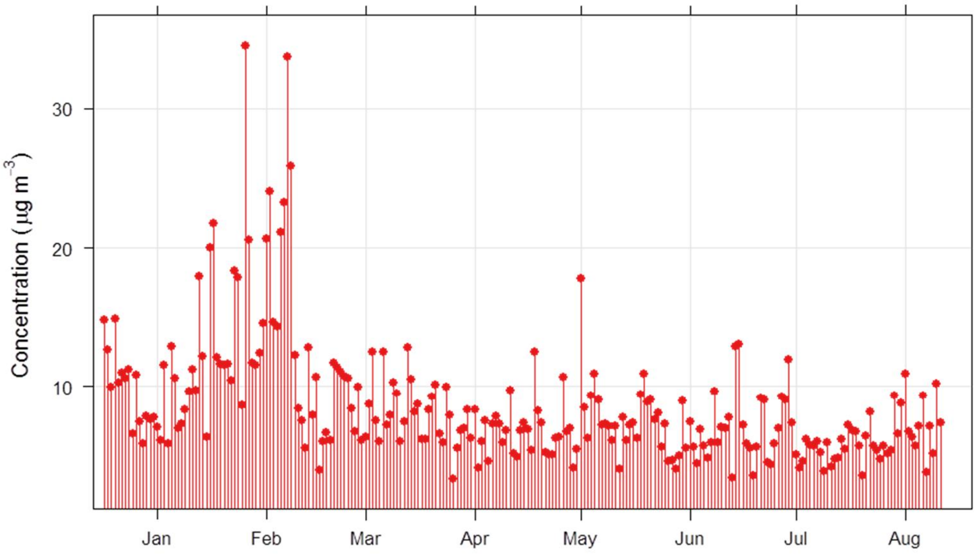
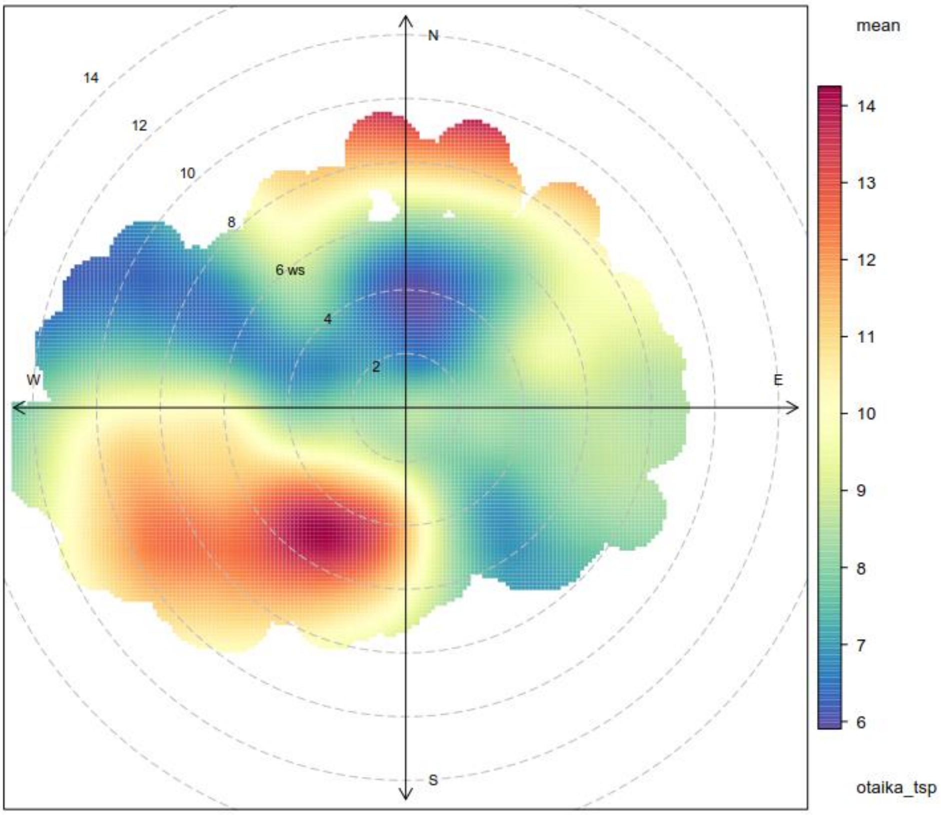


Figure 12 Otaika TSP Polar Plot



Andrew Curtis
Technical Director Air Quality
andrew.curtis@aecom.com

Mobile: +64 29 355 1390
Direct Dial: +64 9 967 9126