Before the Hearing Panel appointed by Canterbury Regional Council and Selwyn District Council

IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Applications CRC192408, CRC192409, CRC192410, CRC192411, CRC192412, CRC192413 and CRC192414 by Fulton Hogan Limited for a suite of resource consents to establish a quarry operation

Section 42A Officer's Report

Report of Deborah Anne Ryan

EXECUTIVE SUMMARY

1. This report addresses the potential effects of the proposed Roydon Quarry on air quality. The principal issue associated with the proposal is the potential for dust from quarry construction and operation to have nuisance related effects on nearby properties. Dust impacts are proposed to be mitigated through the implementation of a set of management practices and monitoring of particulate matter concentrations in air. The monitoring is important because it provides a check on the sufficiency of the dust management being applied and is proposed to trigger the need for further measures if required to mitigate dust.

2. Health impacts of particulate matter are also of concern to many people who have submitted on the application. Discharges of particulate matter of a size and nature that are linked to health effects is not, however, expected to be significant. Consequently, adverse health effects associated with the quarry discharge impacts on related air contaminant levels will be no more than minor.

3. While adverse health effects related to the quarry are not expected, there is uncertainty relating to compliance with the National Environmental Standard for Air Quality for particulate matter smaller than ten microns (PM_{10}), in particular, Regulation 17(1), which relates to an allowable increase in the level of PM_{10} in a polluted airshed. Because it is not clear that this Regulation will be met, the Hearing Panel may need to consider whether off-sets for PM_{10} will need to be applied.

INTRODUCTION

4. Fulton Hogan Limited (the applicant) has applied for a suite of resource consents to establish a new aggregate quarry (known as 'Roydon Quarry') within the site bounded by Curraghs Road, Maddisons Road and Jones Road (the site).

5. My full name is Deborah Anne Ryan. I am employed by Pattle Delamore Partners Limited (PDP) as a Technical Director for Air Quality. I have prepared this report, which is supplementary to the overview Section 42A Report prepared by Ms Hannah Goslin for the resource consent application. Full details of the consent application by Fulton Hogan Limited are provided in that report.

6. I have a bachelor's degree in Biotechnology and Bioprocess Engineering from Massey University, Palmerston North (1991). I am a member of the Clean Air Society of Australia and New Zealand (CASANZ) and a Certified Air Quality Professional (CAQP) with CASANZ.

7. I have more than 25 years of experience in the air quality and resource management fields. I spent eight years as an Air Quality Specialist and Resource Consents Advisor with the Manawatu-Whanganui Regional Council and the Waikato Regional Council. I have been employed as an Air Quality Consultant in various roles since 2000, principally with Jacobs New Zealand Limited (formerly SKM), and currently with PDP. I have extensive experience in air pollution impact studies, in particular, preparing and reviewing a wide range of air quality effects assessments and in managing and reporting on air quality monitoring programmes. As an air quality specialist, I have been responsible for reporting and presenting specialist air quality advice to council resource consent hearings on multiple projects across all sectors.

8. My experience with effects of dust discharges includes involvement in effects assessment for consents, and/or monitoring, including for large scale construction projects such as for the Roads of National Significance (RoNS) Pūhoi to Warkworth, and Warkworth to Wellsford designation and consenting applications; and the air quality assessment for the Temaiku Land Reclamation Feasibility study. I have experience with dust-producing industries including lime extraction and processing (McDonalds Lime, King Country), hard rock quarries (Winstones Pokeno), mineral extraction processes (Waihi Gold Mine); coal mining (New Vale and Goodwin Mines, Southland, Solid Energy and Glencoal, Waikato) and landfill developments (AB Lime Ltd, Southland and Envirowaste Limited, Waikato).

9. I have advised on ambient air monitoring programmes to determine deposited and suspended particulate concentrations within and beyond quarry premises and identified mitigation measures necessary to minimise dust.

10. I have read the Code of Conduct for Expert Witnesses[1]. I agree to comply with that code when giving evidence to the Hearing Panel in this matter. All my evidence is within my expertise and I have considered and stated all material facts known to me which might alter or qualify the opinions I express.

11. In preparing my report I have reviewed the following information provided in the applicant's assessment of effects, the appendices and accompanying technical reports:

    a. Resource Consent Application to Establish 'Roydon Quarry', Templeton (November 2018);

    b. Appendix D Air Quality Assessment (and Draft Dust Management Plan), Fulton Hogan Limited, Assessment of Air Quality Effects - Proposed 'Roydon Quarry', Templeton, Golder Associates (NZ) Limited (November 2018) (the Air Quality Assessment).

    c. Roydon Quarry Proposal (Reference CRC192408-192414, RC185627) – Response to Request for Further Information, Golder Associates (NZ) Limited (March 2019), (the S92 Response); and

    d. Roydon Quarry Proposal (Reference CRC192408-192414, RC185627) – Response to additional Request for Further Information Golder Associates (NZ) Limited (August 2019), (the additional S92 Response)

[1] Environment Court Consolidated Practice Note 2014 – Expert Witness Code of Conduct.

APPLICATION AND REVIEW SCOPE

12. Fulton Hogan has applied for a discharge permit (CRC192410) to discharge contaminants into air from an industrial or trade premise, or process. Specifically, the discharge permit application relates to the discharge of contaminants from establishing and operating a proposed aggregate quarry, including discharges of dust and products of combustion. The application states that the extraction will be staged with an active quarry area restricted to 40 hectares at a time. In the Golder additional S92 Response (August 2019), Golder states that the applicant has revised the active area to a maximum of 26 hectares. Table 1 of the additional S92 Response summarises the activities included within the active area and this includes 5 hectares of excavation area.

13. My report provides information and advice related to the effects of the proposed activity on air quality. My report is set out as follows:

    a. A summary of the application, my review scope, and an overview of potential effects of air discharges;

    b. The air quality assessment framework;

    c. Review of the applicant's assessment of actual and potential effects;

    d. Response to submissions; and

    e. An assessment of any mitigation and monitoring proposed by the applicant.

14. My report has been prepared on behalf of Canterbury Regional Council (CRC) and specifically relates to my review of Fulton Hogan's air discharge permit application and the assessment of the effects on air quality prepared for the proposed Roydon Quarry application (Appendix D, or the Golder Air Quality Assessment).

15. I went on a site visit to the proposed location of the Royden Quarry on the 25th of June 2019. I also visited two operating Fulton Hogan quarries, one at Miners Road and one at Pound Road, on the same day.

Summary of activity and discharges

16. Section 2 of the Golder Air Quality Assessment describes the activities associated with quarrying in detail, potential sources of dust discharge from the operations include:

    a. Site preparation (eg. topsoil and overburden removal and bund construction to establish the quarry pit);

    b. Aggregate extraction, transfer and processing (fixed and mobile) and stockpiling;

    c. Haul roads;

    d. Aggregate loadout; and

    e. Backfilling, cleanfilling and site rehabilitation.

    I agree with the applicant's assessment that the principal contaminant discharge to air is dust (or particulate matter) from establishing and operating the quarry.

17. No processing capacities have been specified for the fixed or mobile crushing plant. Based on comments from the Fulton Hogan representative during my site visit, I understand that the Company is proposing for the processing capacity to be of a similar nature and scale to the activities at the Pound Road quarry.

18. In Section 3.1 of the Air Quality Assessment, Golder describes the factors influencing dust emissions being: surface disturbance e.g. traffic on haul roads; material processing; moisture content of exposed surfaces; exposed area; wind speed and particle size. I agree that these are key factors influencing the potential for dust from the quarry.

19. The nature of the potential effects of dust and particulate matter depend on the size and nature of the particles. In Sections 3.1.2 and 3.1.3 of the Air Quality Assessment, Golder describes both the nuisance (or amenity) and health effects potentially associated with particulate matter, which are related to particle size. I agree with Golder's summary of the potential effects on human health and amenity. From my experience, a key nuisance effect for neighbouring property owners is the potential for soiling of surfaces, which can result in additional cleaning and maintenance costs. Also, of concern are effects on plant life, that could occur from high dust deposition loadings. The potential effects on human health are generally associated with particulate matter smaller than 10 microns in diameter (PM_{10}), which can have effects on the cardiovascular and pulmonary systems. Particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$) is a subset of PM_{10}, for which there is more information emerging on the health effects linked directly to $PM_{2.5}$.

20. The Golder Air Quality Assessment identifies that there will be discharges of diesel combustion gases from machinery operating on the site. Machinery includes the mobile aggregate processing plant; site generators and mobile equipment such as diggers and loaders. Combustion gases from operating plant and machinery include, PM_{10}, oxides of nitrogen and carbon monoxide from fuel burning.

21. In Section 3.2 of the Air Quality Assessment, Golder originally assessed the diesel combustion sources on the basis that they were permitted activities. They described emissions from combustion and assesses that the effects of combustion gases will be negligible. From discussion with Ms Goslin, I now understand that a consent for a discretionary activity is needed for the proposed internal combustion sources, which could have a combined rating of up to 1.4 MW of electrical output. Given the separation distance of the processing plant to the boundary being at least 250 metres, I would expect that the concentrations of products of diesel combustion in air beyond the site boundary would be less than minor and I have not considered them further in this report.

AIR QUALITY ASESSMENT FRAMEWORK, MANAGEMENT AND ASSESSMENT CRITERIA

22. In this section of my report I outline the relevant assessment frameworks and criteria that are applicable to assessing the effects of the air discharges, including national guidelines and standards for air quality and other assessment criteria, and approaches, such as provided under the Canterbury Air Regional Plan (CARP).

23. The Air Quality Assessment notes that the Ministry for the Environment Dust Guide (MfE, 2016) recommends a dust nuisance trigger value for PM_{10} of 150 µg/m³ as a 1-hour average. The MfE trigger value is suggested for use to monitor and manage dust emissions, such as at quarries.

24. More recently in Canterbury, a lower 1-hour average trigger level for dust management has been adopted. An example is in the air discharge permit issued by CRC, CRC181274, for Road Metals Company Limited at Yaldhurst. This consent requires work to cease if the measured PM_{10} level exceeds 65 µg/m³ as a 1-hour average. This is a much lower, and therefore more conservative threshold than provided in the MfE guidance.

25. I note that Fulton Hogan's proposed trigger values for dust management, as set out in Section 7.3.2 of the Air Quality Assessment, are:

    a. 60 µg/m³ as a 1-hour average for taking immediate actions to investigate and reduce site dust emissions.

    b. 70 µg/m³ as a 1-hour average for ceasing all quarry activities (other than dust suppression activities) and taking immediate actions to investigate and reduce site dust emissions.

26. In the additional S92 Response (August 2019), Golder has provided a set of proposed conditions. Proposed condition 23 has trigger levels for dust monitoring that provide higher (less conservative) triggers to those in the Air Quality Assessment. As indicated in Ms Goslin's report, our reporting is based on the dust management triggers as proposed in the Air Quality Assessment. This is principally as no assessment was provided in relation to the proposed new triggers in condition 23 and they require further consideration. In my view the levels in paragraph 25 provide an appropriately conservative basis for managing dust to minimise the potential for adverse effects.

27. The New Zealand air quality standards and guidelines for particulate matter are set for PM_{10}. The National Environmental Standard for Air Quality (NESAQ) for PM_{10} is 50 µg/m³ as a 24-hour average. There is a National Ambient Air Quality Guideline (NAAQG) of 20 µg/m³ for PM_{10} as an annual average.

28. A monitoring guideline is also in place within the NAAQGs for particulate matter smaller than 2.5 microns in diameter ($PM_{2.5}$), which is a subset of PM_{10}, with more information emerging on the health effects linked to $PM_{2.5}$.

29. Respirable crystalline silica (RCS), more commonly quartz dust, is a subset of particulate matter that has been raised as a potential health issue related to quarry air discharge. The assessment criterion used for RCS is a Chronic Reference Exposure Level (CREL) of 3 µg/m³ as an annual average, which comes from the Californian Office of Environmental Health Hazard Assessment (OEHHA)[2].

30. The assessment criteria generally applied for nuisance and amenity effects of dust is set out in the MfE Dust Guide (2016) and is:

> *There shall be no noxious, dangerous, objectionable or offensive dust to the extent that it causes an adverse effect at or beyond the boundary of the site.*

31. The dust criterion is clearly subjective with enforcement, as described in the Dust Guide, being reliant on demonstrating that the effect would be considered "objectionable or offensive in the opinion of an ordinary reasonable person." This criterion is typically assessed by considering the FIDOL factors, which are frequency, intensity, duration, offensiveness and location. Each of these factors needs to be given weighting in assessing the potential for objectionable or offensive dust to result in adverse effects.

Canterbury Air Regional Plan

32. The CARP operative as at 31 October 2017, sets out objectives and policies for managing air quality in the Canterbury Region, which also provide matters for consideration in decision making relating to the application. In discussion with Ms Goslin, I have set out the key CARP objectives and policies relevant to the assessment of the proposed quarry as follows:

[2] https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary

- Objective 5.2 – Ambient air quality provides for the health and wellbeing of the people of Canterbury.
- Objective 5.3 - Competing demands for the use of the air resource of Canterbury are accommodated while unacceptable degradation of *ambient air* quality is avoided.
- Objective 5.4 – Degraded ambient air quality is improved over time and where ambient air quality is acceptable it is maintained.
- Objective 5.6 - Amenity values of the receiving environment are maintained.
- Objective 5.7 – Discharges from new activities are appropriately located to take account of adjacent land uses and sensitive activities

33. And the key CARP policies relevant to the assessment are:

- Policy 6.1 - Discharges of contaminants into air, either individually or in combination with other discharges, do not cause:
    a) adverse effects on human health and wellbeing; or
    b) adverse effects on the mauri and life supporting capacity of ecosystems, plants or animals; or
    c) significantly diminished visibility; or
    d) significant soiling or corrosion of structures or property.
- Policy 6.6 - Maintain ambient air quality in locations where the quality is acceptable when assessed against an ambient air quality standard set in a national ambient air quality standard or guideline.
- Policy 6.8 - Offensive and objectionable effects are unacceptable and actively managed by plan provisions and the implementation of management plans.
- Policy 6.9 - Discharges into air from new activities are appropriately located and adequately separated from *sensitive activities,* taking into account land use anticipated by a proposed or operative district plan and the sensitivity of the receiving environment.

34. Schedule 2 of the CARP has information relevant to assessing compliance with the permitted activity conditions, resource consent conditions or Section 17(3)(a) of the RMA relating to objectionable of offensive effects of dust. For determining whether a dust discharge has caused an objectionable or offensive effect, the Regional Council will have regard to the following matters:

1. The frequency of dust events; and
2. The intensity of dust events, as indicated by dust quantity and the degree of effect; and
3. The duration of each dust event; and
4. The offensiveness of the discharge having regard to the nature of the dust, including soiling of materials or structures and any potential health effects; and
5. The location of the dust, having regard to the sensitivity of the receiving environment, including taking into account the relevant zone(s) and provisions in the relevant District Plan.

Separation Distances

35. Separation distance guidelines can also assist in managing the potential effects of activities discharging to air. The Air Assessment Report, Section 5.1.2, refers to

separation distances as a means to help mitigate nuisance effects when standard mitigation measures cannot be entirely effective citing when there are strong dry winds as an example.

36. Golder refers to the Victorian Environmental Protection Agency separation distance guidelines (EPA Victoria 2013) as a reference source used in New Zealand. The MfE Dust Guide also refers to the EPA Victoria guidelines as the most up-to-date source at the time of writing. The MfE Dust Guide notes that the basis of the recommended separation distance needs to be clearly understood. The EPA Victoria guidance notes that the distances are recommended as minimum distances to minimise off-site impacts arising from unintended industry generated dust.

37. For quarrying, crushing, screening, stockpiling and conveying of rock the recommended EPA Victoria separation distances to sensitive receptors, such as dwellings, are:

- without blasting 250 metres; and
- with Respirable Crystalline Silica (RCS) 500 metres.

38. In the S92 Response, Golder provided clarification on the applicability of the 500 metres separation distance to activities at Royden. I concur that the 500 metres separation distance for quarry activities is not needed to mitigate the effects of the discharge of RCS. This is principally based on the findings of the Yaldhurst monitoring for RCS as discussed later in my report.

ASSESSMENT OF ACTUAL AND POTENTIAL EFFECTS

39. In this section of the report, I consider the actual and potential effects of the air discharges on air quality, specifically in relation to the nature of the receiving environment, existing air quality, the potential for adverse effects from dust nuisance and effects of particulate matter on health.

Activity location within the receiving environment

40. The sensitivity of the receiving environment is a key consideration influencing the potential for adverse effects from dust. Separation of dust producing activities from sensitive locations does help to mitigate the potential effects because dust falls out of air with distance from the source.

41. Section 4.1 of the Air Quality Assessment describes the receiving environment and the locations of sensitive receptors around the proposed quarry. Golder identifies that there are 28 residential dwellings within 500 metres of the proposed quarry boundary, 15 of which are within 250 metres of the boundary. Golder also identifies that the proposed quarry site boundary is 700 metres to the west of Templeton township.

42. The applicant's entire site is proposed to be quarried except for boundary setbacks and areas around the two nearest dwellings. The quarry processing area is proposed to be established within the quarry pit at an indicative depth of up to 10 metres. Fulton Hogan is proposing both a fixed and a mobile processing plant. The proposed minimum setback distance for fixed plant (excluding conveyors) is 500 metres from the site boundary. While the mobile processing plant is proposed to be located at least 250 metres from the site boundaries and I understand would be operated as needed to meet demand.

43. The Air Quality Assessment identifies a dwelling that is located within 19 metres of the north-western quarry boundary at 319 Maddisons Road (Receptor 3 in the Air Quality Assessment); and another dwelling is within 90 metres of the boundary at

151 Curraghs Road (Receptor 11). Fulton Hogan is proposing an exclusion area be applied within 100 metres of these dwellings, where extraction will only be possible with the written approval of those neighbours.

44. A 20-metre strip is proposed along the site boundary for bunding and screen planting, which will provide a minimum separation from the active excavation areas to the site boundary.

45. Stockpiling for the fixed plant is proposed to be 400 metres from site boundaries, while smaller stockpiles associated with mobile plant are proposed to be at least 250 metres from the site boundaries.

46. Figure 2 of the Air Quality Assessment shows the locations of the sensitive receptors within 250 and 500 metres of the site boundary. Those receptors within a distance of 250 metres are more susceptible to the impacts of dust, particularly quarry establishment and construction activities that are proposed to occur close to the boundary. For fixed processing plant, separation distances are maximised by the proposed location of the plant within the centre of the site.

47. I consider that the location of the main quarry processing plant at the centre of the site, provides good separation to minimise the potential effects of dust, in conjunction with source controls. I understand the mobile plant will be used to supplement production, and it will still meet the minimum separation to the boundary of 250 metres, which is recommended by EPA Victoria.

48. Further consideration of the receiving environment sensitivity and the potential for adverse effects is provided starting at paragraph 58.

Background air quality

49. CRC, in collaboration with the Canterbury District Health Board (CDHB), commissioned an air quality monitoring programme around the quarries within the Yaldhurst area (Mote, 2018). The monitoring was designed to investigate the impacts of dust from the quarry operations in response to public concerns about exposure to dust; and to characterise short term particulate matter concentrations of PM_{10} and $PM_{2.5}$. The study included monitoring at the proposed Royden Quarry site, which was used to indicate the background air quality for the study as typical for a rural area on the fringe of Christchurch. Mr Steve Firth, CRC Regional Leader, Compliance Monitoring and Regional Support, has discussed the monitoring programme in his Memo, which is attached to Ms Goslin's report.

50. Neighbours to the Yaldhurst quarries had also raised concerns about RCS as being part of the dust they are exposed to, which is linked to the serious lung disease (silicosis). The air quality monitoring study specifically investigated ambient air concentrations of RCS.

51. In Section 4.2.1 of the Air Quality Assessment, Golder references the Yaldhurst particulate matter measurement study. Site 4 from the study was the Royden Quarry background site. The maximum measured concentration of PM_{10} at Site 4, using the standard method, beta attenuation monitor (BAM), was 45 $\mu g/m^3$ as a 24-hour average, which is compared with the NESAQ of 50 $\mu g/m^3$. On five days, over the 4-month monitoring programme, concentrations of PM_{10} were greater than 30 $\mu g/m^3$ as a 24-hour average. The overall 4-month average PM_{10} was 16 $\mu g/m^3$ at the Royden site.

52. Measured $PM_{2.5}$ levels were low, with Figure 8 of the Mote report showing 24-hour average $PM_{2.5}$ at Royden as being around 10 $\mu g/m^3$ or less compared to the reporting guideline of 25 $\mu g/m^3$ as a 24-hour average.

53. RCS was not found to be at levels of concern in the vicinity of the Yaldhurst quarries, with most measurements being below detection limits. Where RCS was detected, the measured levels indicate concentrations would be well below the annual exposure criteria of 3 $\mu g/m^3$.

Meteorology

54. In Section 4.3 of the Air Quality Assessment, Golder describes the meteorology as it influences the potential for emissions of dust and the likely impacts of dust discharges.

55. Golder identifies that dry conditions and strong winds have the most potential to give rise to dust emissions. And that the direction of the prevailing winds will determine where impacts are most likely to occur. I agree that soil moisture levels and wind speed and direction are key considerations relating to the potential for impacts from dust and these have been appropriately accounted for in Golder's assessment.

56. Golder synthesised wind data for the site using measurements from nearby monitoring locations with the metrological model CALMET, and developed a wind rose for the Royden Quarry site. I agree with Golder's approach. The wind rose shown in Figure 10 of the Air Quality Assessment shows the strongest winds and prevailing winds are from the north-eastern quarter, with strong winds also from the southwestern quarter, and from the northwest. Sensitive receptors downwind of these directions will be susceptible to dust, particularly under strong winds and dry conditions.

57. As part of the application process for these consents, Fulton Hogan has collected wind data at the proposed quarry site. The results of the onsite monitoring as presented in Figure 12 of the Air Quality Assessment, indicate the CALMET windrose is representative of the actual conditions and I agree that the data is reliable for use in the assessment.

FIDOL Assessment

58. In Section 5.1 of the Air Quality Assessment, Golder considers the variables relevant to the FIDOL factors to assess the potential for dust nuisance. For example, the sensitivity of the receiving environment and separation distances are relevant in that they relate to the location factor. While wind direction, wind strength and on-site activities giving rise to dust are relevant to considering the frequency, intensity and duration factors. Separation distance also influences the potential intensity of dust impacts due to the fallout of dust with distance.

59. Golder has applied the FIDOL factors to assess if there is high, medium or low risk of dust impacts on neighbours in the vicinity of the quarry. I agree this is a reasonable approach and that this methodology helps to identify critical areas or activities that require additional or high level mitigation measures.

60. Golder, at Figure 15 of the Air Quality Assessment, indicated a relatively high frequency of dry days at Christchurch throughout most of the year, with the exceptions being May, June and July. This combined with wind direction and wind strength frequency was used to assess the dust risk. Extended dry weather and strong winds increase the risk that dust could cause impacts beyond the site boundaries.

61. Receptors 13 to 24, as shown in yellow on Figure 5 of the Air Quality Assessment, are located to the southwest of the site. These receptors are assessed as being downwind under the worst-case conditions of high wind speeds combined with dry conditions. Golder considers these locations to be rated as moderate to high risk due to the prevalence and strength of winds.

62. For Receptor 13, which is the Motor Caravan Association (the Association) park at 2/286 Jones Road, Golder notes the park as having moderate sensitivity to dust with a minimum of 290 metres to the quarry face. I note that the Association lodged a submission in opposition to the application, which stated that members may stay for up to 21-days in a 60-day period and undertake outdoor activities, such as barbeques. Therefore, the site could be considered as highly sensitive to dust, especially in summer.

63. Receptor 23 is a commercial activity at 10 Curraghs Road 110 metres to the quarry face, and Receptor 24 is dwelling at 5 Dawsons Road 140 metres from the quarry face and is considered by Golder as being sensitive to dust. The other receptors in this quarter are 270 metres or more away from the quarry face.

64. As set out in paragraph 43 above, Golder also identifies Receptor 3 and Receptor 11 as being at moderate to high risk due to that they are located less than 100 metres to the site boundary and has recommended setback for activities around these dwellings. I agree with the Golder assessment as to the most at risk properties for dust impacts based on the FIDOL assessment. The proposed mitigation measures to minimise the potential for adverse effects from dust are discussed elsewhere in my report.

Health Effects of Particulate Matter

65. In Section 6.2 of the Air Quality Assessment, Golder discusses the potential health effects of particulate matter including RCS. As discussed by Golder, the potential health effects of the particulate matter discharges depend on the size and nature of the particulate matter fractions. Health effects have been correlated with inhalable particulate matter in the PM_{10} and $PM_{2.5}$ fractions (MfE, 2016).

66. $PM_{2.5}$ is mainly associated with combustion sources, whereas dust such as from quarrying, is associated with the $PM_{2.5}$ to PM_{10} fraction or larger. The quarry will have minimal impact on $PM_{2.5}$ concentrations in air and there will be less than minor adverse health effects associated with $PM_{2.5}$.

67. Golder assesses that PM_{10} emissions will be minimised via dust controls, and state that "it is not expected that PM_{10} ambient off-site concentrations will approach or exceed health based standards" ie. the NESAQ for PM_{10}.

68. As discussed above, the monitoring for PM_{10} at the background Royden Quarry monitoring site, as part of the Yaldhurst study, measured a maximum PM_{10} of 45 $\mu g/m^3$ as a 24-hour average compared with the NESAQ of 50 $\mu g/m^3$. I therefore disagree with Golder's conclusion that ambient off-site concentrations are not expected to approach or exceed health based standards, because PM_{10} concentrations measured at Royden have already been shown to approach the NESAQ based on the background measurement. Further, I do not think there is enough information to be conclusive that the standard will not be exceeded. I do agree, however, that with a high level of dust control and management, in accordance with the trigger levels set out in paragraph 25 above, that any increase in PM_{10} as a result of the quarry will be minor, such that the effect on human health in the surrounding community will not be impacted to more than a minor extent.

69. Exposure to RCS, or quartz, has also been raised as an issue in relation to quarrying (WHO, 2000). The WHO reports environmental exposures to RCS, including quartz, can occur when ambient quartz is emitted into the air as a component of particulate emissions produced by natural, industrial, and farming activities. RCS has been studied due to exposure in occupational settings via inhalation. Ambient air studies for non-occupational exposures are more limited. But WHO reports that to date, there are no known adverse health effects associated with non-occupational exposure to quartz dust.

70. Because of concerns in the Yaldhurst communities, CRC commissioned the Yaldhurst monitoring study as described starting at paragraph 49 above. The monitoring study found no elevated health risk to the surrounding community, in particular, due to RCS exposure.

71. Based on the Yaldhurst monitoring data, and the similar nature of the proposed activities and underlying materials, I agree with Golder's assessment that RCS exposure will also not be an issue for people in the community around the Royden Quarry site.

72. I note that while the Yaldhurst monitoring study found that there were no serious public health risks from airborne dust around the quarries, nuisance dust was identified as an issue; which I understand has resulted in better dust management being required of quarry operators[3]. CRC has since initiated a programme of ongoing dust monitoring for all quarries in Canterbury where there is residential housing within 500 m of a quarry. I understand that this measure was initiated to ensure that dust management was improved across the quarry sector so that the effects of particulate matter are maintained at an acceptable level. Golder advised that the proposed Royden Quarry monitoring proposals will meet CRC 's requirements (refer to Section 3.2 of the Golder 92 Response dated March 2019).

Christchurch Airshed under the NESAQ for PM_{10}

73. The NESAQ for PM_{10} was set to provide a guaranteed level of protection for the health of all New Zealanders (MfE, 2011). In Section 8 of the Air Quality Assessment, Golder discusses the NESAQ Regulations as they apply to airshed management[4]. Figure 24, page 46 of the Air Quality Assessment shows that the proposed quarry site is immediately adjacent to the boundary of the Christchurch airshed. That airshed is deemed polluted for PM_{10} under the NESAQ Regulations with there being more than one high pollution day reported per year. A high pollution day is where the NESAQ threshold of 50 µg/m^3 for PM_{10} measured as a 24-hr average is exceeded.

74. Clause 17(1) of the Regulations requires that:

> *A consent authority must decline an application for a resource consent (the proposed consent) to discharge PM_{10} if the discharge to be expressly allowed by the consent would be likely, at any time, to increase the concentration of PM_{10} (calculated as a 24-hour mean under Schedule 1) by more than 2.5 micrograms per cubic metre in any part of a polluted airshed other than the site on which the consent would be exercised.*

75. There is a potential issue in that Regulation 17(1), refers to an increase in concentrations that is "likely, at any time". In my view, there is a possibility that PM_{10} concentrations could be impacted within the airshed to a level where the increase is more than the 2.5 µg/m³ as a 24-hour average allowable under the NESAQ, at least at sometime within the life of the consent. For example, an impact of this level, could conceivably occur when bund construction is occurring along the boundary with the airshed, particularly if a high wind event occurred during construction and bund materials dried out.

76. Regarding the impact of the proposed air discharges on the adjacent Christchurch airshed, Golder concludes that, given the nature of the discharges from quarry sites and the proposed management practices, the proposed Roydon Quarry is "very

[3] https://www.rmla.org.nz/2018/12/13/resolving-quarry-dust-issues-in-christchurch/

[4] Under the Regulations an airshed is effectively an air quality management area. Regional councils and unitary authorities gazette airsheds for managing air quality under the Regulations.

unlikely to contribute a more than negligible amount of PM_{10} to concentrations in the Christchurch airshed."

77. The applicant was requested to provide more information to support the statement in the Air Quality Assessment report about the potential increase in PM_{10} within the adjacent airshed, and specifically to assess whether the operation would be "likely at any time" to cause an increase above the 2.5 µg/m³ threshold value as a 24-hour average allowed for under the NESAQ.

78. Section 3.9 of the Golder Section 92 Response (March 2019) provides further information to support the assessment under Regulation 17(1). In particular, Golder provides information based on the Yaldhurst monitoring study, where PM_{10} data was gathered from 9 different locations around the Yaldhurst quarries.

79. Golder identifies that the airshed boundary is located to the east/northeast of the proposed Royden Quarry, meaning that southwesterly through to westerly winds would be of potential concern for causing increased levels of PM_{10} in the airshed.

80. Golder therefore assessed the data for monitoring sites 2 and 6 from the Yaldhurst monitoring, as being downwind relevant to the orientation at Royden. Data from these two sites was compared with data from upwind sites, taken to be sites 4 and 5, to assess the increase in PM_{10}. Golder reported that using the 95th percentile of the data, increases in PM_{10} concentrations of 13 to 25 µg/m³ as a 1-hour average were observed. Golder assessed that based on the hourly data the upper range suggests an increase of 10 µg/m³ as a 24-hour average. Golder also stated that the measured maximum increase in PM_{10} as a 24-hour average, when the southwesterly blew for 10 hours or more was 2 to 6 µg/m³. Based on these results, given the scale of the activities at Royden compared to Yaldhurst, Golder states "*it should be practical to control dust emissions such that increases in 24-hour PM_{10} within the adjacent gazetted airshed are less than 2.5* µg/m³".

81. I note from Table E-1 of the Yaldhurst monitoring report, that Site 2 is 190 metres to the nearest quarry boundary, and Site 6 is 160 metres to the nearest quarry boundary. Impacts closer to the site boundary would likely be higher. In my view, the monitoring data as analysed by Golder cannot be used as definitive support that Regulation 17(1) will be complied with.

82. I note, however, that Golder identifies in the S92 Response it is anticipated there will be a reduction in activity that would occur at the Fulton Hogan Pound Road processing site if the Royden Quarry is developed. I understand from discussions with a Fulton Hogan representative during my site visit on the 25th of June 2019, that Royden Quarry is essentially proposed as a replacement for Pound Road and represents a maintenance of supply rather than an expansion of activity. Given that Pound Road is directly within the Christchurch airshed, I agree that there is a potential for an overall net reduction in PM_{10} emissions in the airshed itself. This means that the reduction in activity at Pound Road, could be investigated for the purposes of an offset under the NESAQ Regulations if required.

Summary of Assessment of Effects

83. The key matters and conclusions arising from my review of the Air Quality Assessment are:

    a. The nearest residents to the quarry boundary, Receptor 3 (319 Maddisons Road) and Receptor 11 (151 Curraghs Road) are both less than 100 metres to the quarry boundary and are therefore at most risk of some increase in dust levels, particularly during bund the construction. In my view, a high level of dust control will be needed during construction to ensure that there is no offensive or objectionable dust to the extent that there is an adverse effect

on these properties. Measures should include pre-dampening materials and avoiding works in strong dry winds.

b. Considering the FIDOL factors, properties down wind of the worst case wind, assessed as properties to the south-west, are at most risk of increased dust from the ongoing quarry operations. For these properties (and others in other directions), if the monitoring trigger levels and management controls are complied with, then in my view, dust emissions will be adequately mitigated to ensure that: the amenity values associated with the area will be maintained; significant soiling will be avoided; and there will be no adverse effect on plants or animals. Given that Golder has identified that there are 15 dwellings, within 250 metres of the quarry boundary, which does not meet the minimum separation distance guidelines recommended from EPA Victoria, a high level of vigilance in applying dust controls will be needed. In my view, the particulate matter trigger monitoring and management responses will be important for ensuring the CARP objectives and policies can be met for this proposal.

c. The levels of $PM_{2.5}$ and RCS will not be increased to levels where ambient air quality will cause adverse effects on human health (or animal health) effects. And based on monitoring data from Yaldhurst, I do not consider that a 500 metre buffer as recommended by EPA Victoria is necessary to mitigate the effects of RCS.

d. In my view, there is uncertainty as to whether regulation 17(1) of the NESAQ Regulation for PM_{10} can be complied with, in which case some form of off-set condition would need to be considered. I am of the view that the potential cumulative effects of PM_{10} from the quarry with background cannot be assessed as "not expected to approach or exceed" the NESAQ of 50 $\mu g/m^3$ as a 24-hour average as assessed by Golder in the Air Quality Assessment, Section 6.2. But I agree given the dust controls proposed, that the level of increase will be minor, so that the community will not be impacted to a more than minor extent.

RESPONSE TO SUBMISSIONS/MATTERS RAISED

84. Submissions in opposition to the proposed quarry raised concerns about a range of potential effects on air quality including:

a. Stock grazing affected by pasture being covered in dust

b. Effects on human health such as on people with asthma, bronchial issues, chronic sinusitis and respiratory disease

c. Effects of dust on animals including horses and alpacas e.g. detrimental effects on breathing

d. Effects of dust on rainwater tanks

e. Dust nuisance effects on washing, solar panels, windows and in homes and effects on gardens and vegetables

f. Exposure to RCS

g. The volume of water required for dust suppression

85. The MfE Dust Guide (2016) identifies that if dust deposition is excessive it can have effects on plant life. Dust can affect the palatability of pasture and reduced plant, yield which may adversely affect people's gardens.

86. The applicant is proposing a set of dust mitigation measures that I discuss starting at paragraph 103 below. Continuous monitoring of PM_{10} using the trigger levels set out in paragraph 25 of my report will, in my view, provide a basis for proactive management to ensure the level of dust control across the site is adequate. Given Fulton Hogan's proposed mitigation measures, I consider the proposed quarry can be managed in a way that more than minor adverse effects on vegetation, including pasture and gardens in the surrounding area will be avoided.

87. The potential effects of particulate matter on the health of humans and animals are managed by achieving compliance with the NESAQ for PM_{10}. The NESAQ is set for the protection of the health of all New Zealanders including the infirm. The PM_{10} guidelines and standards are predominantly based on epidemiology of human population exposures for public health protection (WHO, 2005). The New Zealand NAAQGs states that "animals are likely to be protected from guidelines established to protect human health but the possibility of extremely sensitive species being adversely affected at such levels cannot be ruled out" (MfE, 2002).

88. The background PM_{10} measured for the proposed Royden Quarry site, Site 4 in the Yaldhurst monitoring study, was typically below 30 µg/m³ as a 24-hour average, with a maximum measurement of 45 µg/m³ as a 24-hour average.

89. As discussed in paragraph 68 of my report, in my view, there is not enough data to be conclusive about the cumulative effect of the quarry plus background PM_{10}. With a high level of dust control, however, any increase in PM_{10} experienced in the community is likely to be low, so that the effect on human health and animals will not be impacted to more than a minor extent.

90. As set out above, however, the quarry may not be able to comply with Regulation 17(1) relating to the limit of 2.5 µg/m³ increase in concentrations of PM_{10} on the Christchurch (polluted) airshed.

91. $PM_{2.5}$ has emerged as a concern for human health effects. As discussed elsewhere in my report, $PM_{2.5}$ is not a major component of particulate matter generated from quarries. In the S92 response dated March 2019, Golder provided references relating to the particle size fractions as discussed in Section 3.1.1 of the Air Discharge Assessment, which states that $PM_{2.5}$ is not typically generated by mechanical processes associated with quarrying. I agree $PM_{2.5}$ concentrations in air around the quarry will not be impacted by the quarry operation so that the effect on human health will be less than minor.

92. Effects of dust on roof rainwater could be of concern if the dust contained toxic contaminants. Provided that any potentially contaminated materials are appropriately managed and contained, if excavated, the majority of the dust emissions from the quarry will be relatively inert. Golder was asked to provide further information on dust impacts on roof water supplies in the S92 request. The S92 Response (March 2019) stated that measures to reduce dust nuisance effects to an acceptable level will be sufficient to minimise dust effects on water supplies. I agree with Golder that the potential effect on water supply is more of a nuisance issue than a health concern. If dust controls did fail, additional dust loadings from the quarry operation could add additional cleaning costs, such as frequency of changing filters or cleaning out tanks.

93. As indicated above, for effects on vegetation and pasture, proposed mitigation and continuous monitoring of PM_{10} mean that the proposed quarry operations can be managed in a way that will avoid more than minor adverse effects on vegetation and pasture from dust deposition beyond the site. Similarly, issues such as soiling of washing, windows, solar panels and general deposition can be mitigated to the extent that more than minor adverse effects can be avoided.

94. As discussed in paragraph 69 of my report, general population exposure to RCS has not been found at levels of concern based on literature and data from the Yaldhurst monitoring study. Golder states in Section 4.2 of the Air Quality Assessment, that they consider the findings of the Yaldhurst study are applicable to Royden, I agree, and I expect RCS levels will remain below levels of concern in ambient air around the Royden Quarry.

95. Inadequate water for dust suppression is a potential issue, because if water supplies are inadequate, dust control measures could be compromised. How much water is needed depends on the overall design and operation, and the mix of measures adopted. As an example, sealing of site access and internal roads would reduce water demand as compared to unsealed roads. Likewise, using a vacuum sweeper truck rather than a water truck, or using chemical suppressant rather than water sprinklers would reduce the amount of water needed for dust suppression. To provide assurance that dust control will not be compromised, I consider that Fulton Hogan should demonstrate that the amount of water available will meet requirements for dust control. Further information was requested by CRC relating to on-site water use for dust suppression and water availability. The Golder additional S92 Response (August 2019) did provide some information on the expected maximum rate indicated for dust suppression of 1,400 m^3 per day. It would be useful if Golder could clarify how they have determined the adequacy of the amount of water needed for dust suppression.

96. Submitters requested specific mitigation measures, and/or specific conditions relating to air discharges and their management and monitoring as follows:

    a. spray or mist systems around perimeter, water carts not to be relied on as primary mitigation
    b. no dust to cross boundary of quarry at any time
    c. monitoring around quarry boundary, located 500 metres from any residential property boundary edge
    d. all trucks to be covered
    e. water spray for dust control 24 hours, not just when quarry operating
    f. all roads within the site paved
    g. all operations stop if dust goes beyond quarry boundary
    h. watering system on top of bunds for dust suppression
    i. sufficient planting to mitigate dust
    j. dust monitoring on properties near the quarry
    k. wheel wash for trucks
    l. dust monitoring results available online and in real time
    m. automatic sprinklers on all four boundaries operating all of the time
    n. dust monitors tested, maintained and calibrated regularly.

97. Fulton Hogan has supplied a Draft Dust Management Plan (DMP) as an attachment to the Air Quality Assessment. The draft DMP sets out many of the aspects of dust management and monitoring sought by the submitters, at least to some degree. Dust management, however, relies on a combination of factors with multiple control points. What is appropriate will vary in time and space depending on conditions and activities. Dust management is typically adaptive of the prevailing conditions, hence the use of management plans rather than prescription of measures, which may not be practicable or necessary at all times.

98. I discuss the applicant's mitigation and monitoring proposals starting at paragraph 103 below. There is uncertainty as to how well the range of measures will be applied in practice, with many of the measures relying on human judgement. Based on experience elsewhere, neighbours are rightly concerned that controls could fail at times, such as was found to be the case from the monitoring around the Yaldhurst quarries.

99. I understand from CRC monitoring staff (Steve Firth) and the Mote report findings, that the community around the Yaldhurst quarries did experience dust nuisance impacts, and that this triggered CRC to require continuous dust monitoring around all the sites where there are residences within 500 meters. Consequently, I understand that dust management practices have generally been improved and that there has been some improvement in the dust levels experienced from the quarries in the local environment at Yaldhurst.

100. I support the use of continuous dust monitoring around the Royden Quarry, which will allow real-time dust management, trigger additional dust controls, and reduce the subjective human judgement element as to if controls are adequate. Continuous monitoring also provides for the site to be managed if needed outside of hours of operation. If trigger levels are exceeded, automated systems can be activated and/or staff made available to investigate and take action.

101. In my view, the proposed trigger levels for 1-hour average dust are sufficiently conservative, that if appropriately responded to, will assist in avoiding more than minor adverse effects from dust. Achieving this will require a good deal of vigilance, particularly when activities are in close proximity to the boundaries and dwellings are nearby such as for 319 Maddisons Road (Receptor 3) and 153 Curraghs Road (Receptor 11).

102. I am in overall agreement with the applicant's proposed set of mitigation measures, that if applied as indicated, will avoid more than minor adverse effects from dust deposition at neighbouring properties. In particular, when considering proposed mitigation, the activity will be in accordance with the CARP policy 6.8, in that objectionable or offensive effects will be managed.

MITIGATION AND MONITORING

103. Details of the applicant's proposed mitigation and monitoring are set out in Section 7 of the Air Quality Assessment and at Appendix B of the Air Quality Assessment, the draft DMP. In the Section 92 request the applicant was asked to substantiate comments made in the Air Quality Assessment that the proposal represents "good practice". In the Section 92 Response, Golder provided a table summary as Appendix B setting out good industry practice for dust control measures and provided a comparison against the proposed dust mitigation for Roydon Quarry. Golder used as a primary reference the Institute of Air Quality Management (IAQM) *Guidance on the Assessment of Mineral Dust Impacts for Planning* (2016), which provides a list of good practice mitigation. I agree that the IAQM reference sets an appropriate benchmark for identifying good practice within the quarry industry, and that Golder's analysis demonstrates that the proposal meets accepted good practice for dust management.

104. Measures identified in the Air Quality Assessment to mitigate dust at the proposed quarry include:

    a. Water carts or fixed sprays on haul roads e.g. roads bringing in cleanfill.

    b. Water sprays on active working areas.

c. A high-pressure water-misting system over the fixed processing areas and stockpile areas.

d. Water dust suppression for mobile processing plant and operation of processing plant restricted where sensitive locations are within 250 m and the wind is blowing in that direction.

e. Applying setbacks and limiting activities near site boundaries (or sensitive receptors).

f. Stockpile heights to be below the level of the bunds with a minimum setback of 250 m from the site boundaries.

g. Using conveyors by preference to transport of materials from extraction areas to processing plant, and processing plant to stockpiles.

h. Limiting vehicle speeds on haul roads to 15 km per hour (during dry conditions).

i. Maintenance of an aggregate base on haul roads with limited fines.

j. Minimising drop heights when loading trucks and conveyors (misting of conveyor drop points to the crushing plant).

k. Retaining existing shelter belting and enhance planting where there are gaps.

l. Monitoring trigger levels for dust as set out in paragraph 25 of my report.

m. Minimising exposed areas – with an active quarry area to be less than 40 ha, Exposed areas where they won't be disturbed for a prescribed period of time to have surface treatment to minimise dust (eg. chemical suppressants, pea gravel, or misting).

n. Sealed accessway, wheel washes and rumble strips to avoid tracking of dust off-site.

105. I note that for part m. above the "prescribed period of time" does not appear to be stated anywhere. It would be useful if the applicant provided some certainty about the length of time envisaged before exposed areas will be treated.

106. From discussions with the Fulton Hogan representative during the site visit, it was apparent the design was still be finalised, but that additional measures could include:

a. The site access and loop road fully sealed with road sweeping (rather than a wheel wash);

b. A reduced footprint for the fixed processing plant and stockpiles; and

c. A reduced active quarry area.

107. Although these additional mitigation measures have not been proposed by the applicant at this stage, I agree that all such measures ultimately reduce the potential for dust discharges. In my view, the sealing of roadways would be a significant improvement on historical operations and would lessen dust generated from vehicle movements on roads and lower the risk of tracking dust and dirt out of the site, which can have significant impacts from dust deposition locally.

108. I consider that site preparation e.g. topsoil and overburden removal, and bund construction to establish the quarry pit, are high risk activities associated with the quarry development, particularly for dwellings at Receptor 3 and Receptor 11, and those receptors located in the Receptor 13 to Receptor 24 quadrant, downwind of the prevailing northeasterly wind. These activities have the least separation to site boundaries, particularly, in the case of bund construction. Soils may be low in

moisture or dry out rapidly and contain fines that have the potential to become airborne if there is a high wind event.

109. The Air Quality Assessment indicates that dampening, crust formation and grassing of bunds will be needed to control dust. The Air Quality Assessment also states that chemical dust suppressants must be available and in exceptional circumstances if bund formation does take place during very dry weather, suppressants may also be applied as necessary to prevent dust emissions.

110. The Air Quality Assessment also recommends pre-planning for bund construction to avoid these works when strong winds are expected and when the ground surface is particularly dry.

111. I agree that strict management of these works will be needed to avoid adverse effects from dust nuisance, in particular, ensuring materials are damp and avoiding unfavourable wind conditions.

112. In my experience, the processing plant and aggregate loadout operations lend themselves to fixed water spray control and dust potential can therefore be readily managed.

113. Other measures identified in the Air Quality Assessment include that processing plant is to be no higher than the top of the bunds, with setback distances of 250 metres to mobile plant and 500 metres to fixed plant.

114. I agree that using conveyors for transfer of material from the extraction area to the processing plant/s will significantly lower the potential for dust emissions through a reduced requirement for truck movements within the site. I understand that any unsealed haul roads will likely be associated with the excavation and fill areas and will still be a potential source of dust due to vehicle movements bringing in material for backfilling, and therefore will require careful monitoring and dust control.

115. As I indicated above, many of the proposed management measures require judgement from operators, for example, frequency of water cart use, drop height minimisation and limiting vehicle speeds during dry conditions. Therefore, the effectiveness of the measures is linked to staff training and buy-in; and support from company and site management, particularly when there are time and cost constraints that may impact the priority assigned for dust control. It needs to be acknowledged that management plans do not control dust, rather automated systems and ultimately people do. Policies on staff training and responsibilities for dust management measures and monitoring are typically set through the DMP.

116. A failure of controls will not always result in adverse effects because there are other dependencies, but the more system failures there are, the higher the risk of off-site adverse effects occurring.

117. The applicant is proposing permanent-continuous monitoring for dust at site boundaries. Golder has stated in the S92 Response dated March 2019 that the monitoring is in-line with CRC's stated requirement for boundary monitoring where there are residential dwellings within 500 metres of a quarry. As indicated above, the CRC requirement has arisen as a result of findings from the Yaldhurst quarry monitoring, where CRC concluded that monitoring showed the presence of dust nuisance was linked to inadequate application of dust management measures at the quarries.

118. The applicant also proposes monitoring for wind and rainfall as described in Section 7.1.10 of the Air Assessment. This data would be used on site to help plan and manage activities to lower the risk of dust impacts.

119. Section 7.3.2 of the Air Quality Assessment sets out the Golder recommendations for continuous dust monitoring for PM_{10}. Golder's recommendations are that:

> *"Continuous monitoring is undertaken for PM_{10}, whenever the staging of activities means that quarrying occurs within 250 m of residences along the south-eastern or north-western site boundary (i.e., Stages 1 and 5 as illustrated in Figure 2). Two monitors are to be situated at separate locations just within the boundary during stripping and bund formation or on top of the bunds at all other times."*

120. Golder also recommends with that for the nearest receptors:

> *"when operating within 250 m of either Receptors 3 or 11, an additional monitor should be situated at the site boundary nearest to each receptor."*

121. I agree with CRC (and Golder) that continuous monitoring is desirable as a management measure. In my view, continuous monitoring should encourage a more proactive and preventative approach is taken to applying dust management measures. To ensure good management it will be important that dust monitors are appropriately located relative to activities and receptors. I agree with the additional monitoring proposed by Golder for dwellings at Receptors 3 and 11.

122. Golder recommends that the monitors be fitted with automated alarms with set trigger levels with notification to an appropriate person for taking immediate action to reduce dust. I agree with the proposed trigger levels and actions in response to monitoring. I consider that the proposed trigger levels are appropriately conservative to achieve proactive management for avoiding dust nuisance effects on amenity[5].

123. I agree that the monitoring will provide a check on the adequacy of dust controls and a trigger for investigation where dust levels are starting to be elevated. This will include times when people are not present at the site, so that dust management measures will be triggered when needed outside of working hours.

124. I agree with the proposal for onsite monitoring and logging of wind direction, wind speed and rainfall, which will assist in management of activities on-site to reduce the potential for dust and assist with any investigations.

125. The proposed approach to developing and updating a site DMP as described in Section 7.4 of the Air Quality Assessment is consistent with good practice, with the purpose of the DMP being" to provide a framework for managing dust emissions at the proposed Roydon Quarry so that potential adverse effects at or beyond the site boundary are avoided or mitigated".

CONCLUSIONS

126. The Royden Quarry proposal complies with good practice management, control, and monitoring for dust discharges at quarries. Separation distances are maximised as far as practicable by locating fixed plant within the centre of the site and other activities are proposed to be managed to maximise separation where practicable.

127. The critical locations where dust risk is assessed as high have been identified in the Air Quality Assessment. I agree that avoiding work when the winds are blowing towards these properties is good practice, the minimal separation, in particular, for the dwellings at Receptors 3 and 11, mean that due care will be needed to avoid adverse effects from dust, when working in the vicinity of the two receptors.

[5] As noted in paragraph 25 this is based on the trigger levels set out in the Air Quality Assessment, not the new trigger levels proposed in the additional s92 Response.

128. There are many judgements needed as part of the proposed dust management and mitigation, which rely on an operator taking a proactive and preventative approach to minimising dust. Where additional time and money is needed for dust control operators will need clear support from management in order to apply the measures to minimise dust and prevent off site effects. As noted above the responsibilities for compliance and implementation of dust controls will be as set out in the DMP. In my view, the use of the proposed dust monitoring trigger levels will reduce the subjectivity associated with determining if the level of dust control is adequate.

129. RCS was not found in air at concentrations of concern for human health in the vicinity of the Yaldhurst quarries, and I expect that this will also be the case for the Royden Quarry. Therefore, unacceptable exposure to RCS, i.e. exceedance of the assessment criteria around the quarry will not occur as a result of the proposal.

130. There is a potential that Regulation 17(1) of the NESAQ, relating to an increase in PM_{10} in a polluted airshed, may not be complied with, or at least it is not possible to be conclusive about this. There may be offsets available for the Royden Quarry PM_{10} emissions from a possible reduction in activity at Pound Road. If this does occur it should result in a net reduction in emissions in the Christchurch airshed, although at the time of writing I understand that the applicant has not committed to or demonstrated how such an offset would be achieved to the extent required by the NESAQ.

131. Overall, subject to mitigation, the discharges of dust from the proposed Roydon Quarry are not expected to result in more than minor impacts on amenity or nuisance from dust deposition. Air quality is expected to be maintained at acceptable levels for health effects relative to applicable air quality guidelines and standards for RCS and $PM_{2.5}$. PM_{10} will be minimised through the proposed mitigation for dust control and monitoring with dust trigger levels, which are expected to be conservative. Any increased exposure to PM_{10} from the quarry operation in the surrounding community is generally expected to be low, so that any effects on human health in the population will be no more than minor. Continuous monitoring for PM_{10} and wind monitoring, linked to management actions, such as ceasing dust generating activities, will be critical to ensuring the activity is managed to avoid adverse effects.

Signed:  Date: 28th August 2019

Name: Deborah Ryan
Technical Director – Air Quality, Pattle Delamore Partners

REFERENCES

Environment Canterbury, *Resource Consent CRC181274, Road Metals Company Limited to discharge contaminants to air*, 2019

MinEx Health & Safety Council, *Guidelines for the Control of Dust and Associated Hazards in Surface Mines and Quarries*, March 2008

Ministry for the Environment, *Ambient Air Quality Guidelines*, 2002

Ministry for the Environment, *Good Practice Guide for Assessing and Managing Dust*, 2016

Ministry for the Environment, *Users' Guide to the Revised National Environmental Standards for Air Quality*, 2011

Mote Limited, *Yaldhurst Air Quality Monitoring Summary Report*, June 2018

Environmental Protection Authority Victoria, *Recommended separation distances for industrial residual air emissions*. Publication number 1518, March 2013

WHO, *Concise International Chemical Assessment Document 24, Crystalline Silica, Quartz*, 2000

WHO, *Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update*, 2005