



ASSESSMENT OF AIR QUALITY EFFECTS

SOL Quarries –Yaldhurst Expansion

12 February 2019

ASSESSMENT OF AIR QUALITY EFFECTS

SOL Quarries –Yaldhurst Expansion

Contents

1	Introduction.....	4
1.1	Process description	5
1.2	Proposed hours of operation.....	6
1.3	Site plant	6
1.4	Water.....	6
2	Existing Environment	7
2.1	Meteorology	8
2.2	Surface Dryness	10
3	Relevant Regional Rules	11
3.1	Overall Status	12
4	Assessment Criteria.....	12
5	Identification of Sensitive Receptors	13
6	Discharges to Air	14
6.1	Vehicle Engine Emissions.....	14
6.2	Dust Emissions.....	14
6.2.1	Adverse effects associated with dust emissions from quarry operations	15
7	Proposed Mitigation to Reduce the Potential for Effects	16
7.1.1	Site Wide Mitigation Measures.....	16
7.2	Overburden/topsoil stripping and bund construction.....	18
7.3	Product excavation works	19
7.4	Product processing - screening/crushing.....	19
7.5	Loading and unloading trucks	21
7.6	Vehicle movements	21
7.7	Product stockpiles.....	22
7.8	Dust from exposed unconsolidated surfaces.....	23
7.9	Proposed Boundary Monitoring	23
8	Assessment of effects.....	24

NZ Air is an air quality consultancy specializing in expert evidence, air discharge consent applications, odour assessments, nuisance dust assessments, air quality monitoring and air dispersion modelling

8.1	Effects on unoccupied land	24
8.2	Particle Settling	25
8.3	Environment Canterbury Yaldhurst Quarry Zone Dust Monitoring Program	27
8.4	Documented Separation Distances.....	29
8.5	Complaints Assessment.....	29
9	FIDOL Assessment	30
9.1	Frequency	30
9.2	Intensity.....	31
9.3	Duration.....	31
9.4	Offensiveness	32
9.5	Location.....	32
9.6	Summary	32
10	Affected Party Consultation	33
11	Consent Term	33
12	Conclusion	33

1 Introduction

SOL Quarries Limited (**SOL**), require an air discharge consent for a proposed quarry extension at its existing quarry at 81 Conservators Road, Yaldhurst. The legal description of the land is Lot 1 DP 82891. The Current Quarry (referred to as **Stage 1**), located on Lot 2 DP 82891, is consented under CRC 184072, it is not proposed that any changes will occur to this currently consented activity. The proposed quarry (**Stage 2**) activities will occur at the completion of the consented Stage 1 quarry and essentially be undertaken as an extension of the current activities on the Stage 1 site. There will be a transition from Stage 1 to Stage 2. When excavation of Stage 2 commences the gravel will be processed and stockpiled on Stage 1; together with cleanfill & Site remediation works.

There will be no changes to the scale or intensity of the Quarry operation (i.e. no changes to the number of crushing plants, volume of aggregate produced, or truck movements).

The site location and Stage 1 (annotated as 'Existing Quarry') and Stage 2 (annotated as Stage 1 – Stage 3) are shown in **Figure 1**.

SOL have contracted NZ Air Limited (**NZ Air**) to undertake a qualitative assessment of environmental effects for discharges to air associated with the proposed Stage 2 quarry which is proposed to be separately consented to the Stage 1 quarry.

FIGURE 1 LOCATION OF EXISTING AND PROPOSED QUARRIES



Image sourced from Lands and Survey Ltd

1.1 Process description

It is proposed that Lot 1 DP 82891 will be subdivided (with boundaries being as depicted in **Figure 1**) With SOL owning the western portion of the lot and the current owner retaining the eastern portion of the lot.

The land associated with the expansion (Stage 2) is currently used by Readylawn Industries and involves a number of soil disturbance activities such as seeding and cultivating grass, harvesting grass and soil, and exposed soil awaiting seeding.

Bund will be constructed (as part of the Enabling Works) prior to any works occurring on Stage 2.

The owners of the Lot between the Stage 2 boundary and Conservators Road (Mr & Mrs Higgs) propose planting an evergreen shelter belt in Spring 2019 immediately adjacent to the bund – on the Conservators Road side of the boundary. It is predicted that the Stage 1 quarry has 5 – 10 years of material left and therefore the evergreen trees will be well established and will provide an effective screen to the activities occurring on-site. This will also have some positive effects from a dust control perspective, these are outlined further on in this report.

It is proposed that the Stage 2 quarry rates of aggregate extraction, processing and product storage will remain the same as that currently occurring in the Stage 1 quarry. It is proposed that the works on Stage 2 will simply be a continuation of the existing quarrying activity. Other than some site establishment works (bund formation and planting) it is not proposed that there will be any duplication of quarrying activities on both Stage 1 and Stage 2 (i.e. no potential cumulative effects).

SOL Quarries Ltd currently holds an Access Agreement with Alliance Group Ltd, providing a heavy vehicle access and egress from the Stage 1 property to Guys Road. Light vehicles access the site via Conservators Road. Currently a weigh bridge and site office is situated on the south eastern tip of the Stage 1 site (see **Figure 2**). It is proposed that the Stage 2 works will continue to use the existing heavy vehicle access and haul trucks will pass over the existing weigh bridge.

In general, the following process will occur (see **Figure 2** for site layout):

- Topsoil and overburden will be stripped from the surface of the staged cuts (generally not exceeding 2 hectares), this material will either be used to form a bund or stockpiled.
- Benched excavation of the aggregate will occur until the desired pit depth is reached (likely to be 10m below ground level).
- Excavated pit run will either be directly loaded to haul trucks, temporarily stockpiled for future load out, or put through the on-site aggregate processing plants to form primarily AP20, AP40, TNZM-40, and AP65.
- Haul trucks will enter the site via the heavy vehicle access point (either empty or carrying Cleanfill) and pass over the weighbridge.
- Then they will either dump the Cleanfill in the dedicated backfill area or proceed to the pit floor via the main haul road to collect a load of aggregate.
- Then they will then follow the main haul road back out of the site via the weighbridge.
- Once a section of the pit has been backfilled to the required final level, it will be rehabilitated with topsoil and re-grassed.

The existing Stage 1 quarry has a limit of 300 heavy vehicle movements per day. It is proposed that this will not increase in the Stage 2 quarry operations. In addition, there is a maximum of 30 light vehicle movements a day.

The current extraction rate equates to approximately 825,000 m³ per annum. While the future extraction rate will be subject to the demand for Pit Run and processed aggregate, the limited sources of quality raw gravel means there is no reason to expect that the future extraction rate will be any less.

SOL is proposing to conduct a staged quarrying operation, which is backfilled with Cleanfill and then progressively rehabilitated to grassed pasture.

The maximum proposed extraction and processing rate will be 600 t/hr.

It is proposed that there will be up to two aggregate processing and screening plants on-site. These will be located on the pit floor (likely to be between 7 and 10 m below natural ground level). Any product that is processed on-site will be primarily used to form Crusher dust, CAP20, CAP40, TNZ M4-40, and CAP65. It is proposed that stock piles, to a maximum of 15,000 m³ of each product, will be stored on site (in the Quarry Pit), at any one time.

1.2 Proposed hours of operation

- Site works will only occur between 0700 and 1800 Monday to Friday, and 0700 hours to 1200 on Saturday.
- There will be no site works on Sundays, and public holidays.

1.3 Site plant

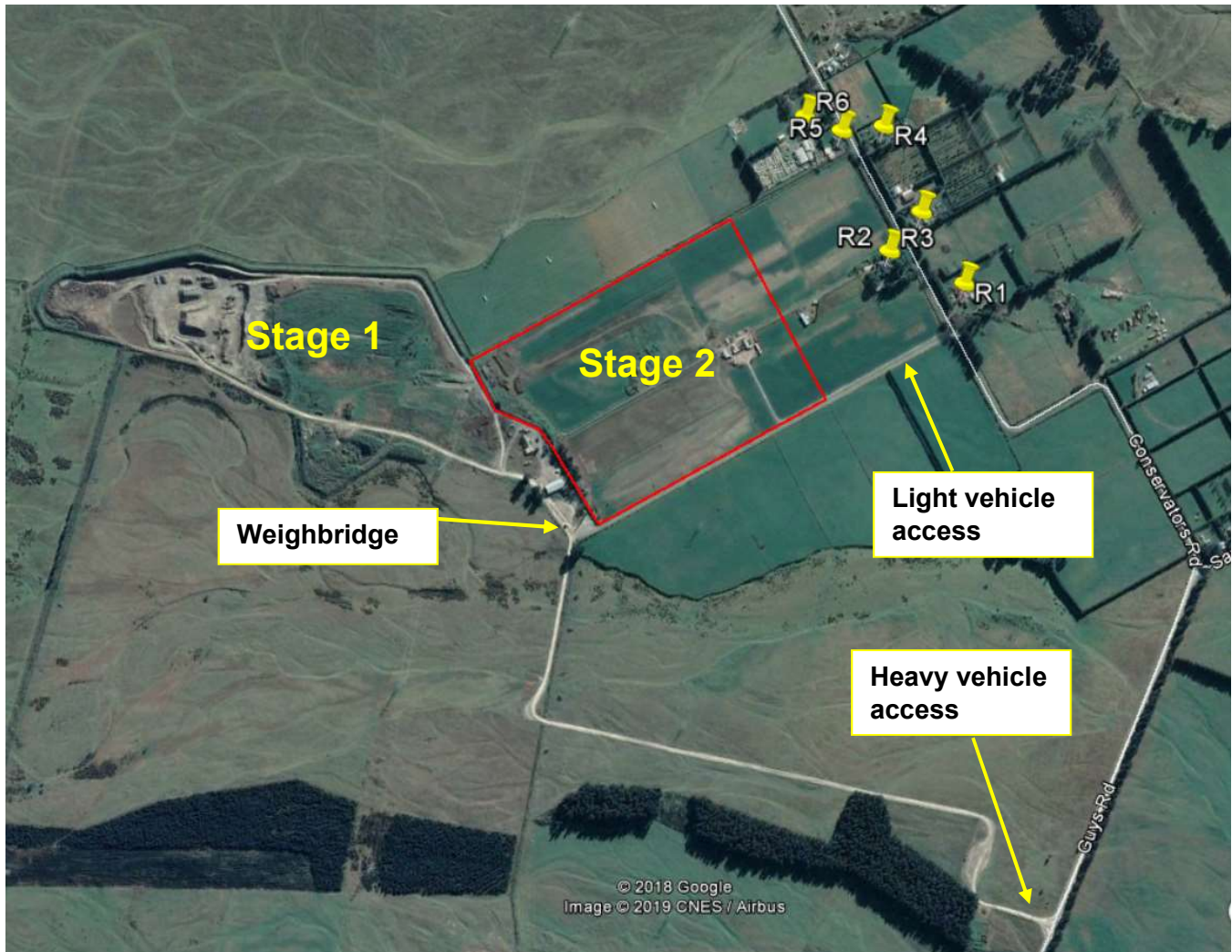
The following machinery is likely to be used on-site:

- Up to five loaders.
- One excavator.
- One bulldozer.
- Crushing and screening will be undertaken by the plant (Jaw Crusher, Cone Crusher and Powerscreen). The actual setup of the plant will be determined by the processed aggregate specification.
- One water cart for dust suppression.

1.4 Water

SOL have access to 100 m³ of water per day for the purposes of dust suppression. In addition, a 100,000 litre storage tank is on-site as a backup for any peak water demands during particularly hot/dry weather conditions. The 100,000 litre storage tank is trickle fed and the dust suppression plant draws from the water tank, including filling the water truck.

FIGURE 2 SITE LAYOUT

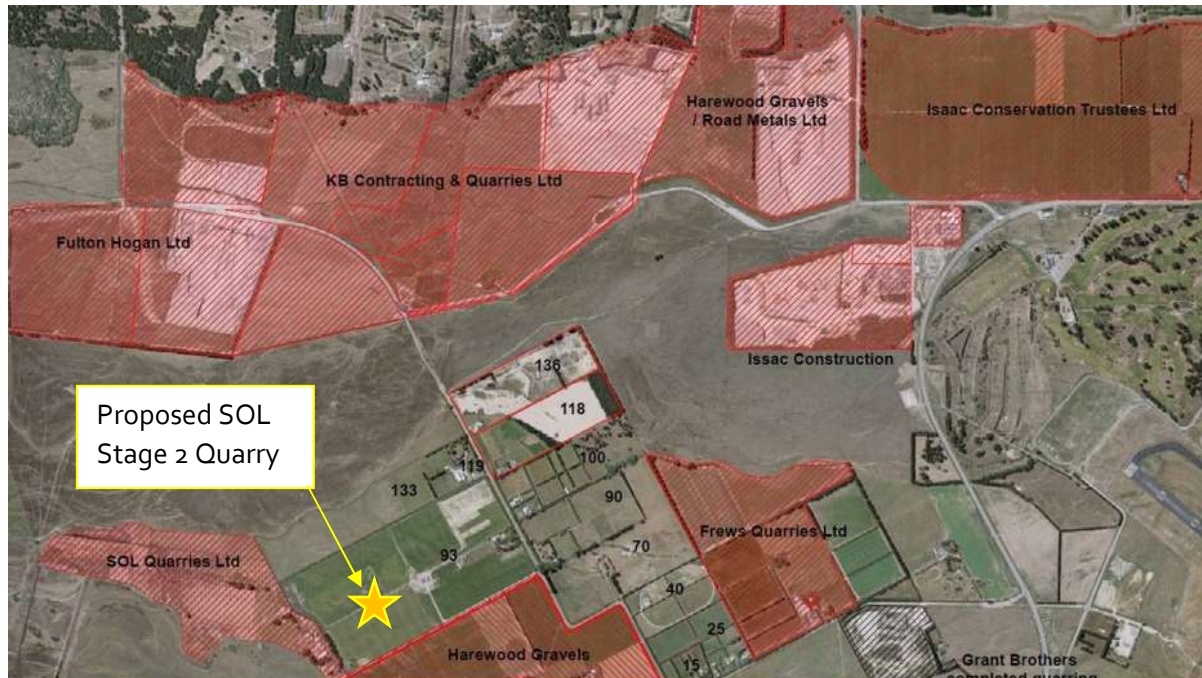


2 Existing Environment

The proposed Stage 2 quarry is situated on land zoned as Rural in the Christchurch District Plan. There are a number of rural residential lifestyle blocks to the northeast of the site. The remainder of the surrounding land is generally pasture used for sheep and beef grazing.

In the wider vicinity of the site there is a number of consented or proposed quarry operations (see **Figure 3**). Note that the proposed Harewood Gravels quarry directly south of the proposed Stage 2 quarry has recently been declined in a High Court decision. These quarry operations have a limited potential to result in cumulative effects for residential dwellings in the vicinity of the site. Many of these operations are situated significant distances (generally greater than 500m) from the nearest potentially effects parties to the proposed SOL Stage 2 quarry.

FIGURE 3 LOCATION OF OTHER QUARRIES SURROUNDING THE SITE



As mentioned earlier the land which is proposed to be converted into the Stage 2 quarry is currently used to produce ready lawn. This process involves a number of soil disturbance activities and at times exposing large areas of topsoil.

In a rural zoned area such as this, there is an expectation of ambient nuisance dust emissions from normal farming activities such as tilling fields, unsealed road/farm track use, crop dusting, etc. Dust from these sources is considered part of the existing environment and is generally accepted as the status quo by residents of rural environments.

2.1 Meteorology

Local meteorological conditions have a direct bearing on the potential for dust nuisance effects to occur at neighbouring properties, and need to be considered for an air discharge consent.

The Christchurch Aero weather station (located at the Christchurch airport) approximately 3 km east of the applicant's site. A wind rose for data collected at this site between 2010 and 2012 (inclusive) is presented in **Figure 4. Table 1** presents the wind frequency distribution data for the same period.

NZ Air considers that the wind patterns measured at the Christchurch Aero weather station are likely to be very similar to those experienced at the proposed SOL quarry site. There is little in the way of topographical features which would alter weather patterns between the two sites. Therefore, it is considered appropriate to rely on the high quality data available from the Christchurch Aero weather station for the purposes of determining likely scenarios at the application site.

FIGURE 4 CHRISTCHURCH AERO WINDROSE 2010 – 2012 (INCLUSIVE)

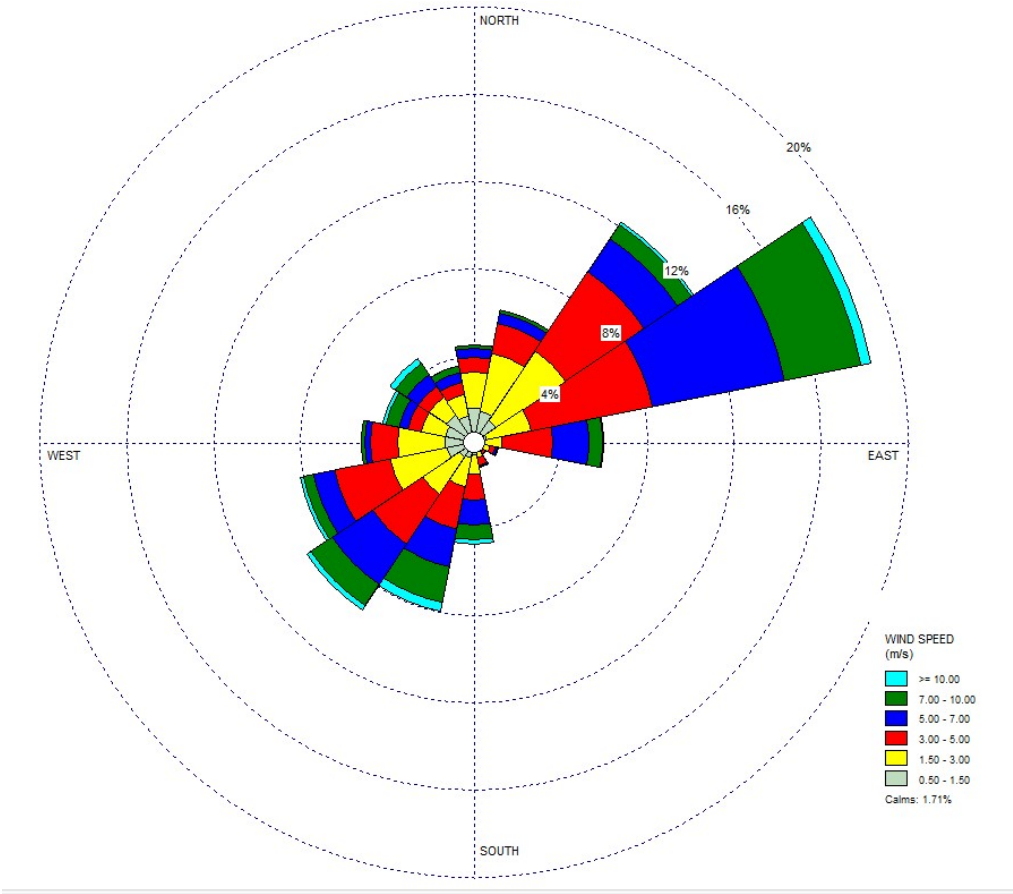


TABLE 1 CHRISTCHURCH AERO WIND FREQUENCY DISTRIBUTION PERCENTAGES

Wind Direction	Percentage of Winds from Wind Speed Bands						Total
	0.5 – 1.5 m/s	1.5 – 3.0 m/s	3.0 – 5.0 m/s	5.0 – 7.0 m/s	7.0 – 10.0 m/s	>10 m/s	
North	2.9%	3.3%	1.5%	0.8%	0.4%	0.0%	8.9%
Northeast	2.4%	6.8%	8.2%	5.2%	2.7%	0.4%	25.6%
East	0.8%	2.0%	5.2%	4.8%	2.5%	0.3%	15.5%
Southeast	0.7%	0.7%	0.3%	0.0%	0.0%	0.0%	1.7%
South	1.2%	1.6%	2.2%	2.0%	1.5%	0.4%	8.9%
Southwest	1.8%	4.1%	5.3%	3.9%	2.3%	0.5%	17.9%
West	2.6%	4.2%	2.8%	0.8%	0.5%	0.1%	11.1%
Northwest	2.9%	1.9%	1.1%	1.2%	1.2%	0.4%	8.7%
Sub Total	15.3%	24.6%	26.5%	18.8%	11.0%	2.1%	98.3%
Calms							1.7%
Missing Data							0.0%
Total							100.0%

The windrose demonstrates that wind patterns are dominated by winds from the north eastern and south western quadrants. Generally stronger wind speeds (greater than 10 m/s) are recorded as coming from the south, southwest, northeast, and northwest.

The data presented in **Table 1** also indicates that there is a relatively low percentage of the time when wind speeds¹ are greater than 5 m/s which is the speed at which dust from a disturbed surface can be carried a significant distance and very little time when wind speeds are greater than 10 m/s, which is the speed at which dust can be picked up from undisturbed surfaces.

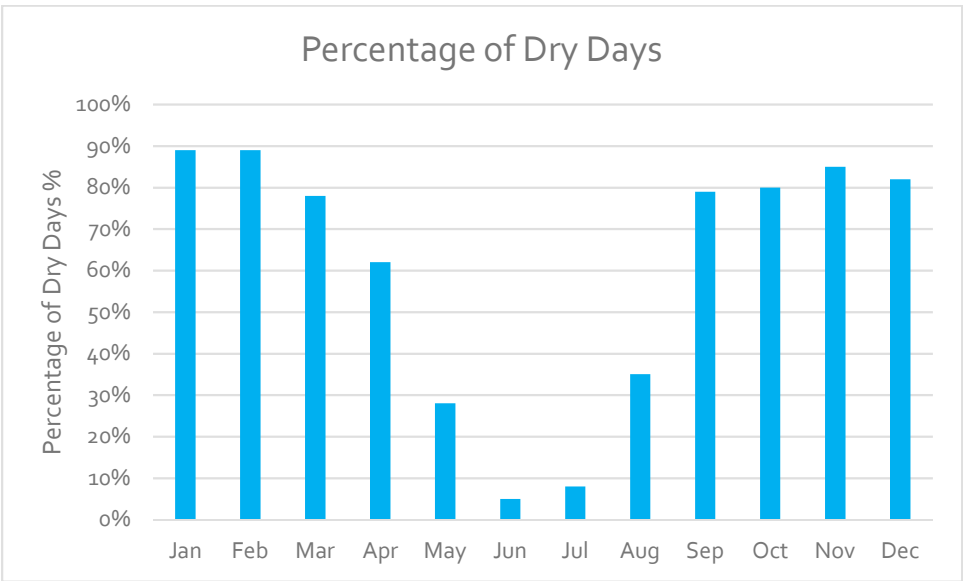
2.2 Surface Dryness

One of the factors influencing the potential for dust emissions from material disturbance activities is related to the moisture content of the dust containing material. When material containing fine particulate matter is damp, the potential for it to be aerosolised is greatly limited.

The dryness of the ground surface is related to the amount of rainfall and evapotranspiration rates (i.e. when there has been little rainfall and the evapotranspiration rates are high the surface moisture content in the soils/aggregates will be low).

To demonstrate the local surface dryness conditions at the proposed SOL quarry, rainfall and evapotranspiration rates measured at the Christchurch Airport between 2010 and 2014 have been analysed. A 'wet day' is considered to be a day where rainfall rates exceed the evapotranspiration conditions by more than 1 mm. A 'dry day' is considered to be a day that is not a 'wet day'. **Figure 5** presents the average percentage by month of dry days measured at Christchurch Airport between 2010 and 2014.

FIGURE 5 PERCENTAGE OF DRY DAYS MEASURED AT CHRISTCHURCH AIRPORT BETWEEN 2010 AND 2014



As is expected the highest percentage of dry days occurs between September and March. During these months the use of dust suppression and mitigation measures will be more critical for exposed surfaces and haul roads.

¹ These are wind speeds at 10 m above ground level, the height of the standard meteorological mast.

Much of the extracted and processed material in the quarry pit is damp (as it is extracted from a number of metres below ground level where moisture levels are more consistent) and therefore has a lower potential for dust discharges.

3 Relevant Regional Rules

Canterbury Regional Council (**CRC**) primarily deal with discharges to air across the region. The relevant rules in the Canterbury Air Regional Plan (**CARP**) which apply to the proposed activity are outlined below.

RULE 7.3

Rule 7.3: *The discharge of odour, dust or smoke into air that is not managed by any other rule in this Plan is a permitted activity provided the following conditions are met:*

1. *The discharge does not cause or is not likely to cause an adverse effect beyond the boundary of the property of origin; and*
2. *The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin when assessed in accordance with Schedule 2.*

Rule 7.3 addresses discharges of dust into air which produce an offensive or objectionable effect beyond the boundary of the property of origin when assessed in accordance with Schedule 2 of the plan. If an activity does result in an offensive or objectionable effect under this rule, it is a non-complying activity. The potential discharges of dust from the application site are assessed in **Sections 6 and 7** below. The conclusion of this assessment is that the potential dust discharges associated with the proposed quarry will not result in offensive or objectionable effects beyond the boundary of the site. Therefore, proposed discharges from this activity will not require consent under Rule 7.3 of the CARP.

RULE 7.35

Rule 7.35: *The discharge of contaminants into air from the handling of bulk solid materials is a permitted activity provided the following conditions are met:*

1. *The discharge of dust does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and*
2. *The handling occurs indoors, or where the handling occurs outdoors the rate of handling does not exceed 100t per hour; or*
3. *Where handling occurs outdoors on less than 21 days per calendar year, the rate of handling does not exceed 250t per hour; and*
4. *Where the handling occurs outdoors and the rate of handling exceeds 20t per hour, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and*
5. *The dust management plan is supplied to the CRC on request; and*
6. *The discharge does not occur within 200m of a sensitive activity, wāhi tapu, wāhi taonga or place of significance to Ngāi Tahu that is identified in an Iwi Management Plan; and*
7. *Notwithstanding condition 6, where the discharge is from production blasting at a quarry site the discharge does not occur within 500m of a sensitive activity wāhi tapu, wāhi tāonga or a place of significance to Ngāi Tahu that is identified in an Iwi Management Plan.*

Rule 7.35 provides for the permitted handling of bulk solid materials provided a number of conditions are met. However, the proposed Stage 2 quarry will extract and process bulk solid materials up to 300 tonnes per hour and will occur on more than 21 calendar days per year.

RULE 7.36

Rule 7.36: *The discharge of contaminants into air from the outdoor storage of bulk solid materials is a permitted activity provided the following conditions are met:*

1. *The discharge of dust does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2; and*
2. *The amount of material stored does not exceed 1000t when it has an average particle size of less than 3.5mm; and*
3. *Where the storage exceeds 200t, a dust management plan is prepared in accordance with Schedule 2 and implemented by the person responsible for the discharge into air; and*
4. *The dust management plan is supplied to the CRC on request; and*
5. *The discharge does not occur within 100m of a sensitive activity, wahi tapu, wahi taonga or place of significance to Ngai Tahu that is identified in an Iwi Management Plan.*

Rule 7.36 provides for the permitted outdoor storage of bulk materials provided a number of conditions are met. The proposed Stage 2 quarry operation will not comply with the conditions of this rule as:

- More than 1,000t of material with an average particle size of 3.5 mm (i.e. crusher dust and strippings) will be stored on-site.

Other than this, the proposed activity will comply with the remainder of the conditions of Rule 7.36.

3.1 Overall Status

As the activity will not meet all of the conditions in Rule 7.35 and Rule 7.36 it will be classed as Discretionary under Rule 7.63, which covers all other discharges to air from an industrial or trade premises not otherwise provided for by the permitted activity Rules.

The most restrictive classification for the proposed activity is Discretionary and therefore the overall activity status of the application is Discretionary.

4 Assessment Criteria

There is potential for some discharge to air of products of combustion associated with site vehicles, and vehicles travelling to and from the site, but due to the low traffic numbers, and surrounding land uses, these are unlikely to be discharged in quantities that are measurable above normal background concentrations in the area. Furthermore, it is proposed that the number of truck movements associated with SOL's activities will not increase from that currently occurring/consented.

The main potential discharge from the proposed quarry is nuisance dust. The dust rules in the CARP refer to the 'offensive or objectionable' threshold for nuisance beyond the boundary of the activity. Therefore, for the purposes of this assessment the assessment criteria is considered to be the 'offensive or objectionable' threshold.

The dust rules in the CARP refer to the criteria in Schedule 2 for assessing the nuisance effects.

The criteria involve undertaking an assessment using the FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) factors, which is a technique commonly used throughout New Zealand.

The criteria for assessing offensive and objectionable nuisance dust are described in Schedule 2 of the CARP and are reproduced below for convenience:

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

Schedule 2 also contains a list of tools to assist in FIDOL assessments, NZ Air has used a number of the relevant tools in this assessment.

5 Identification of Sensitive Receptors

A desktop study was undertaken to identify discrete receptors deemed sensitive to changes in air quality as a result of discharges from the Site. The potentially affected sensitive receptors within 320 m of the proposed quarry footprint are marked in **Figure 2** and are summarised in **Table 2**.

In the context of the assessment contained in this report, the term 'sensitive receptor' is defined as a location where a sensitive activity occurs (as defined in the CARP).

Sensitive activity means an activity undertaken in:

1. *the area within 20m of the façade of an occupied dwelling; or*
2. *a residential area or zone as defined in a district plan; or*
3. *a public amenity area, including those parts of any building and associated outdoor areas normally available for use by the general public, excluding any areas used for services or access areas; or*
4. *a place, outside of the Coastal Marine Area, of public assembly for recreation, education, worship, culture or deliberation purposes.*

Based on the desktop review and site visit undertaken by NZ Air the only sensitive receptors in the immediate vicinity of the proposed Stage 2 quarry are residential dwellings.

TABLE 2 NEAREST RECEPTORS TO THE PROJECT SITE (SEE FIGURE 2 LOCATION)

Receptor ID	Receptor Type	Approximate Distance from Site Boundary (m)	Direction Relative to the Site
R1	Residential	305	Northeast
R2	Residential	210	Northeast
R3	Residential	295	Northeast
R4	Residential	310	Northeast
R5	Residential	230	Northeast
R6	Residential	200	Northeast

Blue = affected party approval provided

The property owners/occupants of R2, R5 and R6 have provided affected party approval for the proposed Stage 2 quarry, therefore effects on these receptors have not been assessed. Therefore, the nearest potential receptors are all approximately 300 m from the site boundary.

Incidentally, during NZ Air's site visit it was observed that each of these properties has an established shelterbelt on their western boundaries. With the proposed boundary bund and shelter belt planting and the resident's shelterbelts there will be added protection to any residual dust emissions from the proposed SOL Stage 2 quarry.

6 Discharges to Air

6.1 Vehicle Engine Emissions

There will be engine combustion emissions associated with on-site vehicles and the trucks removing quarry product from the site.

In addition to this site based plant, there will be a low number of staff light vehicles (maximum of 30 movements a day). The proposed number of heavy vehicle movements associated with product removal from the site is predicted to be a maximum of 300 movements per day, excluding any movements of the water cart, for dust suppression purposes.

The increase in vehicle numbers on adjacent roads is well below the level at which the Ministry for the Environment² propose that an air quality assessment is required to assess vehicle engine emissions from projects that have a significant traffic component. The Ministry recommends that an air quality assessment is required for activities proposing an increase of more than 500 heavy vehicle movements per day, which is significantly more than the 300 movements proposed here.

In addition to this the majority of vehicle emissions are likely to occur on the main heavy vehicle access/haul road. Emissions of site vehicles primary occur within the pit which is generally central to the site. This increases the separation distances between the emission points and the nearest receptors.

For these reasons the potential effects of vehicle combustion emissions are considered to be minimal beyond the boundary of the site.

6.2 Dust Emissions

Nuisance dust generally consists of larger particle sizes (generally greater than 30 µm in diameter) otherwise known as Total Suspended Particulate (**TSP**). Generally, TSP does not travel further than 250 m from the discharge source in high wind conditions (considered to be greater than 10 m/s). Furthermore, when industry standard dust mitigation measures are employed TSP emissions generally don't travel further than 100 m from the emission point.

Rather than trying to quantify these emissions in any detail, NZ Air have used a qualitative approach, which is considered to be the most appropriate approach for this type of activity. The emphasis of this approach is on the mitigation measures that are proposed to control dust emissions.

Dust emissions can occur from nine main sources associated with the proposed quarry activities:

² Ministry for the Environment, Proposed Good Practice Guide on Assessing Discharges to Air from Land Transport, June 2006

- Overburden/topsoil stripping and bund construction;
- Product excavation works;
- Emissions from Cleanfill backfilling;
- Product processing (i.e. screening/crushing);
- Loading and unloading trucks;
- Vehicle movements (predominantly within the processing area and on the haul route out to Guys Road);
- Product stockpiles;
- Dust from the replacement of topsoil, formation of final level and rehabilitation works; and
- Dust from exposed unconsolidated surfaces.

There is a portion of quarry dust emissions which is smaller than 10 µm in diameter (referred to as **PM₁₀**). This fine particulate is mostly discharged from aggregate grinding or crushing activities which can occur in the product processing plants and haul roads (as a result of vehicle movements grinding the surface aggregates against each other). Additionally, there is potential for this fine particulate matter to contain respirable crystalline silica (**RCS**). These discharges are discussed further in **Section 6.2.1** below.

6.2.1 Adverse effects associated with dust emissions from quarry operations

HEALTH EFFECTS

Potential health effects associated with particulate emissions are dictated by the particulate size, concentration, and chemical composition. Particulates smaller than 10 µm (PM₁₀) have the ability to enter the alveoli in the lungs and cause respiratory health effects. There is good evidence of the effects of short term exposure to PM₁₀ on respiratory health, however elevated PM_{2.5} concentrations have a higher risk factor for long term exposure and mortality rates.

Both PM₁₀ and PM_{2.5} are primarily produced as a result of combustion activities. Particulate from combustion activities is correlated with higher health hazards due to the presence of black carbon and organics such as polyaromatic hydrocarbons (PAHs)³. As discussed above, the only combustion emissions associated with the proposed SOL quarry are vehicle emissions. Due to the relatively low number of vehicles associated with the project their potential offsite health effects from combustion emissions are negligible.

There is a small portion of dust emissions from quarry activities which is PM₁₀, however the bulk of dust emissions from quarry activities consists of TSP. Dust discharged from quarry activities is generally biologically inert, and of a large particulate size (~100 µm). Therefore, dust discharged from quarry operations has a much lower respiratory health risk than other particulate discharges. The exception to this is quarry activities which release elevated concentrations of RCS. Individuals exposed to excessive concentrations of RCS can develop silicosis, a serious respiratory illness which can lead to scarring of the lung tissue, reduced respiratory function and increase risk of tuberculosis, lung cancer, and chronic bronchitis.

Aggregate used in New Zealand is predominantly greywacke which can contain a small portion of quartz (generally in veins) which has a high silica content. Respirable silica is primarily released from

³ World Health Organisation 2013: *Health Effects of Particulate Matter*.

the cutting, crushing or processing of aggregates containing silica. As discussed in **Section 7.4** product crushing and processing on-site will be well separated from the nearest off-site receptors and have a number of mitigation measures employed to limit the emissions of dust and any respirable silica.

NUISANCE EFFECTS

Individual particles become visible at approximately 50 µm and particulate discharges in this size range (greater than 50 µm) are generally associated with nuisance effects rather than health effects.

Nuisance dust effects often relate to dust clouds obscuring visibility and soiling of clean surfaces such as cars, washing, outdoor furniture, etc. At times nuisance effects can extend to the contamination of rainwater collection systems and increased dust deposition inside houses (particularly when windows are left open in summer). These effects lead to additional cleaning requirements, reduced ability to enjoy outdoor living areas, and overall reduced amenity values.

Excessive dust emission and deposition can also have an effect on plant life. Effects include:

- Reduced photosynthesis.
- Increased incidence of plant pests and disease (as the dust can act as a medium for the growth of fungal diseases).
- Reduced effectiveness of pesticide sprays.
- Crop soiling effects can lead to rejection or downgrading of the quality of some horticultural crops.

7 Proposed Mitigation to Reduce the Potential for Effects

SOL has a good track record of undertaking its current quarry operation without resulting in offensive or objectionable dust impacts beyond the boundary. SOL have been operating the Stage 1 quarry for three years. The control measures used to date have been effective at controlling dust emissions from the current site activities. It is proposed that these control measures will continue to be used in the Stage 2 quarry.

7.1.1 Site Wide Mitigation Measures

Wind speed, wind direction and the distance from the site boundary are key factors when determining the potential for dust nuisance effects. As discussed earlier it is not anticipated that uncontrolled dust emissions from the site will travel further than 250 m from the emission point and with industry standard mitigation that dust will not travel further than 100 m from the site.

There are no sensitive receptors/potentially affected parties within these distances and therefore it is considered unlikely that the proposed Stage 2 quarry will result in adverse air quality effects.

Furthermore, most of the Stage 2 potential dust emitting activities will occur significantly further from the site boundary. For example, it is not anticipated that the product processing plants will be closer than 400 m from the nearest assessed receptors, and this will only occur towards the end of the quarry lifespan, most of the time this activity will be much further from the receptors. Additionally, the main haul road will come in from the southern corner of the site and drop into the pit below ground.

Therefore, any dust emissions associated with these vehicle movements will be well separated and less likely to be exposed to strong winds.

Material disturbance activities occurring close to the site boundary during elevated wind speeds towards neighbouring receptors are considered to produce the greatest risk for off-site effects. For this reason, mitigation measures are primarily focused on these activities during these conditions, however mitigation of dust emissions further from the boundary and from other sources is also proposed as an additional safety factor.

In addition to the activity specific mitigation measures proposed below, SOL propose to undertake a number of site wide industry standard mitigation measures, such as:

- In the event that visible dust is observed by site staff, traveling beyond the boundary of the site post mitigation measures, the activity generating the emissions is to cease immediately. It is the responsibility of every employee and contractor on the site to immediately notify the site manager so that dust mitigation measures can be implemented prior to the offending activity recommencing. These responsibilities will be documented in the Dust Management Plan (**DMP**) and be part of site inductions.
- SOL will continue to use the on-site weather station for the purposes of assessing wind speed and direction across the site. The weather station is sending real time alarms in the form of text messages and e-mails to the site supervisor. The following alarm trigger points are proposed to continue to be used in the Stage 2 quarry operations:
 - a. Wind speed above 10 m/s (as 10 minute average), cease potentially dusty activities such as:
 - i. Stripping of topsoil;
 - ii. Formation of bunds;
 - iii. Formation of soil stockpiles;
 - iv. Spreading of topsoil; and
 - v. Crushing and screening of aggregate in circumstances where fugitive dust is generated and no water or mist sprayers are used on the crushing and screening plants (due to specific product specifications).
 - b. Wind speed above 5 m/s (as 10 minute average) implement dust control measures such as:
 - i. Operating the watercart
 - ii. Operating the k-line sprinklers on the main haul road
- Minimising the areas of exposed ground;
- Regrassing or revegetating bare areas such as bunds, overburden stockpiles, and rehabilitated areas as soon as practicable;
- Carrying out land stripping and land restoration during favourable weather conditions and at times of least vulnerability to neighbouring properties;
- Taking wind conditions into account in planning and carrying out work to minimise dust dispersion;
- Using water and/or dust suppressants on all disturbed surfaces including extraction areas, roads and stockpiles when required;
- Applying a speed restriction on all internal and access roads of 15 kilometres per hour at all times;
- Minimising the material drop heights and not overloading trucks when transporting material;
- Maintaining internal roads on a regular basis so that they are free of pot holes and have a surface cover of clean chip containing minimal fine material;
- No more than two processing crushing and screening plants will be located on the site;
- The 250 m sealed portion of the access route from Guys Road as shown, shall be washed and swept each day to ensure the accumulation of dust is kept to a minimum.
- Using industry standard water or mist sprayers fixed on the crushing and screening plants when the processing of aggregate products generates fugitive dust, subject to the appropriateness of applying water or mist spray to the specific aggregate product. In circumstances where fugitive dust is generated and the use of water or mist sprayers is not appropriate for a specific aggregate product, production shall cease should the above wind speed trigger be exceeded.

7.2 Overburden/topsoil stripping and bund construction

Overburden stripping and bund construction is the activity considered to have the highest potential to generate off-site nuisance effects. The top soils and overburden (strippings) are likely to contain a greater proportion of fine material (soil, silts, sands, etc) with a higher dust generation potential than the gravels deeper in the ground profile. In addition, this top layer is often dryer (in summer months) than the gravels below due to its proximity to the surface. Therefore, SOL needs to apply greater levels of control to this activity, especially as this activity will not have the benefit of being conducted below ground level (which offers some protection from stronger wind speeds).

Overburden stripping will be undertaken with either an excavator or loader. Strippings will either be used to form a boundary bund or temporarily stockpiled until they are used to rehabilitate the completed quarry stage.

PROPOSED MITIGATION

As the initial bund formation on the north eastern boundary is the activity that is closest to the neighbouring receptors, where possible SOL will undertake these works during the winter months when soil moisture contents are much higher and evapotranspiration rates are lower. Therefore, potential emissions from this bund construction will be greatly reduced. Furthermore, with elevated rainfall during the winter months the potential for dust emissions from unconsolidated/exposed surfaces on the bund (prior to grass and shelter belt trees being established) will be lower.

The formation of these bunds during winter whilst the top soil is damp/wet will significantly reduce the likelihood of nuisance dust beyond the boundary of the site. However, as a backup measure, should visible dust emissions be observed by site staff traveling over the site boundary, a watercart equipped with a spray bar will be used to further dampen down the topsoil and control dust emissions.

The strippings from each new pit extension will be temporarily stockpiled in a central location to the site. These stockpiles will be seeded and vegetated to ensure that fugitive emissions do not occur from the surface of these stockpiles. An example of a vegetated strippings stockpile in the Stage 1 quarry is included in **Figure 6**.

FIGURE 6 VEGETATED STRIPPINGS STOCKPILE



As progressive stripping occurs, the resulting exposed ground will be watered to help form a 'crust' on the surface and prevent fugitive emissions from exposed surfaces. Where possible vehicle movements will be excluded from the exposed areas to minimise damaging this 'crust'.

SOL will cease all stripping and placing activities during wind speeds over 10 m/s (as discussed in **Section 7.1.1**).

7.3 Product excavation works

Product excavation is undertaken with loaders from a working face approximately 5 - 8 m high. This product is either transported directly to the processing plant(s), loaded into haul trucks, or temporarily stored as pit run.

SOL undertake a staged quarry plan, only a small portion of the available quarry is open at any one time. Excavation is staged so as to minimise the amount of unconsolidated surfaces at any one time and reduce the working area and excavation face.

All product excavation will occur after the north eastern boundary bund has been formed and vegetated with mature shelterbelt trees. The bund will form a partial wind break and product excavation and processing will be conducted below natural ground level where wind speeds will be lower than those at natural ground level.

Generally, the material is damp when it is excavated and therefore has a lower dust generation potential. In quarry operations of this type, the product extraction from the working face is generally not a major source of dust.

The product proposed to be excavated consists of mostly alluvial gravels which have a relatively low fines content. Therefore, the potential for nuisance dust emissions from this activity is low.

PROPOSED MITIGATION

The proposed mitigation measures to prevent potential dust emissions from these excavation works are as follows:

- Use of watercart in the immediate working area of the excavation works, during dry conditions;
- Works to be conducted below natural ground level and after bund is formed and vegetated;
- Minimising drop heights for all excavator bucket loads; and
- Limited working area (the quarry pit is usually not more than 2 hectares).

7.4 Product processing - screening/crushing

Product processing and stockpiling may occur on-site within the active quarry pit. Up to two processing plant will be used in the Stage 2 quarry, these are likely to consist of:

- A cone crusher;
- a jaw crusher;
- and a power screen.

Each plant has the ability to process up to 2,000 t/day. These processing plants will mostly be used to produce the following products:

- AP20

- AP40
- AP65
- TNZM-40
- Crusher dust

These products are often temporarily stored in the quarry pit prior to being hauled off-site. An example of the typical layout of the working quarry pit is illustrated in **Figure 7**.

In general, the product processing plants will be intentionally positioned to maximise the separation distance between this potential emission source and neighbouring receptors. The closest that the product processing plants will be to the nearest off-site receptors is expected to be 400 m, however, for the vast majority of the time this separation distance will be much greater.

FIGURE 7 QUARRY PIT



Product processing can have an elevated risk of nuisance dust emissions as the crushing plant reduces the material size and can generate elevated fine particulate emissions. In addition, as the product is being mixed and disturbed throughout this process there is more opportunity for the product to dry out and the fines in the product to become airborne.

PROPOSED MITIGATION

Proposed dust control measures associated with product processing include:

- Use of watercart during windy, dry conditions to keep working area damp;

- Spray or misting bars on the crushing/screening plants (where appropriate for the product being processed);
- Processing area is to be situated at the base of the pit (once formed), which is expected to be at approximately 10 metres below natural ground level; and
- Minimising drop heights for all loader/excavator bucket loads and conveyors.

7.5 Loading and unloading trucks

The type of material being loaded/unloaded will have a direct bearing on its ability to generate nuisance dust emissions i.e. the particle size distribution and moisture content. For example, dry friable topsoil or silts will have a much higher dust emission potential than damp aggregates (the raw product being extracted).

Trucks will be used to convey strippings and raw product around the site, deliver and dump cleanfill into the pit, and to convey final product from the site. These processes have the potential for dust emissions and it will be important for plant operators to be aware of the level of risk associated with the type of material they are loading/unloading (i.e. its moisture content and the proportion of fines in the product) and apply the appropriate mitigation to prevent dust emissions. A draft DMP is included in **Appendix A**, which outlines the site staff responsibilities with regards to dust control from this activity.

PROPOSED MITIGATION

The mitigation measures proposed rely on site personnel and visiting contractors being aware of the dust generation potential of the material being handled and applying the correct level of mitigation

The proposed measures to mitigate the potential discharges from this source include:

- Limiting drop heights for front end loaders loading trucks.
- Trucks delivering Cleanfill are to dump the Cleanfill in the dedicated backfill area and avoid tipping it over the face of the cut.
- Where possible loading and unloading of trucks is to occur in the pit where wind speeds are reduced (relative to those at ground level).
- Wetting down stockpiles/material prior to loading/unloading trucks when the material is dry and friable.

7.6 Vehicle movements

Poorly maintained unsealed roads can have a high dust generation potential. Despite the prevalence of unsealed roads in a rural environment such as this, it is incumbent on the applicant to minimise any nuisance dust effects from this activity.

The factors affecting dust generation from vehicle movements are; the particle size distribution on the surface of the road, the moisture content of the road base, and the speed of the vehicle. The distance of the vehicle movement from a potential sensitive receptor is another factor to consider given the dust settlement curves discussed in **Section 8.1**.

There will be a number of site vehicles which will operate within the site as described in **Section 1**. Most of these site vehicles will be operating within the pit, one or two vehicles may be operating on the surface during stripping or rehabilitation activities.

The primary vehicle movements will be the transport trucks (no more than 300 movements per day) removing and delivering material from/to the site via the main haul road. It is not proposed that there

will not be any increase in vehicle movements and therefore no increase in effect from the existing operation of the quarry.

Most vehicle movements will be confined to designated and maintained site/haul roads. The main haul road to and from the site will be approximately 1.7 km long as illustrated in **Figure 2**. To minimise potential effects on receptors close to the Guys Road site entrance the main haul route has been sealed for the first 250 m from the entrance (this is 150 m beyond that required in the existing consent for the Stage 1 quarry).

PROPOSED MITIGATION

Water will be applied to the haul roads at a rate of up to 1 mm per hour (see **Section 7.8** for more detail) such as to provide effective dust control.

Once again it is important that vehicle operators monitor and report any dust emissions occurring from haul roads, the draft DMP outlines proposed procedures for vehicle operators and site management to identify dust emissions from the haul road and apply mitigation measures.

Proposed mitigation includes:

- Internal roads will be maintained regularly with fresh chip or rounds to reduce the amount of fine material on the surface and help prevent nuisance dust emissions from site vehicles.
- K-line sprinklers will be used on the main haul road on a timer to ensure the surface of the road remains damp in all weather conditions.
- Water carts will operate on all internal haul roads and working areas when wind speeds are over 5 m/s and no rainfall has fallen in the preceding two days, or when visible dust emissions are coming from vehicle movements.
- A water and sweeper truck will be operated on the heavy vehicle entrance to the quarry and along the immediately adjacent portions of Guys Road daily to prevent the build up of tracked material off-site on this heavy vehicle access point.

7.7 Product stockpiles

SOL do not intend to retain large amounts of end product on-site. Product stockpiles will not be more than 5 m in height and not contain more than 15,000 m³ at any one time. Any processed product stockpiled on-site will be stored within the quarry pit.

Potential for emissions from product stockpiles is influenced by a number of factors including:

- The age of the stockpile and whether it has been treated with water;
- The particle size distribution of the product stored;
- The angle of the batter;
- Exposure to wind; and
- Moisture content.

PROPOSED MITIGATION

As discussed above stockpiles will be positioned as far as possible from neighbouring receptors and below natural ground level to reduce wind shear effects.

To mitigate any surface erosion/fugitive emissions from the proposed stockpiles, SOL will undertake the following mitigation measures:

- Limiting the height of any stockpiles to 5 m;
- Locating the stockpiles in the base of the pit and as far as possible from neighbouring receptors;

- Where required, using a water cart with side spray bars once formed to wash surface fines deeper into the stockpile and form a surface crust on the stockpile. Water will be re-applied as necessary to keep stockpiles damp during windy, dry conditions; and
- Visual monitoring of stockpiles by site manager.

All these measures will limit potential dust discharges from this source.

7.8 Dust from exposed unconsolidated surfaces

Due to the staging of the proposed quarry, up to 9 ha will be open for active quarry activities at any one time; this excludes the heavy vehicle access road and light vehicle access road.

PROPOSED MITIGATION

Traffic access to exposed areas will be limited to the practical minimum, isolation bunds will be used where possible to prevent vehicle access to exposed areas. Exposed areas with no or low traffic access will be watered to form a crust over the surface and limit the amount of fines on the surface.

As surfaces which are exposed to regular traffic movements will have a much higher dust emission potential, SOL will prioritise watering and dust suppression measures on these areas. In Section 8.2 of the Ministry for the Environment (MFE) Dust Good Practice Guide (GPG)⁴ a conservative maximum water application rate for one litre per square metre per hour is recommended during dry conditions. This application rate is considered very conservative and most quarries in Canterbury achieve effective dust suppression with lower average water application rates.

Within each stage there will be approximately 2 ha (20,000 m²) within the 9 ha stage, of exposed active working area, where vehicles are operating and dust disturbance activities are actively occurring, at any one time. The haul road is estimated to be approximately 4 m wide and 1,700 m long (6,800 m²). Therefore, the total area which will be exposed to vehicle movements is approximately 26,800 m² and therefore SOL would require a maximum of 27 m³ of water per hour during peak dry conditions.

SOL have access to 100 m³ per day of water where required for the purposes of dust suppression at their proposed Stage 2 quarry. In addition, SOL have a 100,000 L buffer tank on-site, this enables sufficient supply for peak water requirements. This water supply has been sufficient to effectively run the k-line sprinklers and water truck on-site over the last three years and it is anticipated that this will also be the case for the requirements of the Stage 2 quarry (in fact the haul roads are expected to be shorter for the Stage 2 quarry operation and therefore less water will be required).

SOL will have a 10,000 litre water cart on-site which has the ability to apply water at a rate of one litre per square metre to approximately 15,000 square metres per hour. When wind speeds exceed 5 m/s as a one hour average the water cart will be operated to damp down any unconsolidated surfaces during hot/dry conditions.

To limit after hour emissions from exposed surfaces, it is recommended that the watercart is operated at end of day to form a crust on any exposed unconsolidated surfaces, this will limit after hour emissions from these sources.

7.9 Proposed Boundary Monitoring

SOL intend to undertake monthly dust monitoring (PM₁₀ and TSP) on the north eastern site boundary to demonstrate that the above control measures are being effective. The details of the proposed monitoring equipment, methodology and frequency are included in the draft DMP.

⁴ Ministry for the Environment: Good practice guide for assessing and managing dust. 2016

It is proposed that the monitoring results will be compared against the nuisance criteria in the MfE dust GPG. Where a monitoring result exceeds these trigger points SOL will investigate the cause of the exceedance and modify the site activities which resulted in the dust discharges.

The modified control measures will be incorporated into the DMP and all site staff will be notified of the new site procedures.

Additional monitoring rounds will be conducted to confirm the effectiveness of the amended dust mitigation measures/site procedures.

8 Assessment of effects

The proposed quarry has the potential to generate dust emissions from activities associated with the quarry operations. There is a potential for both health and nuisance based effects.

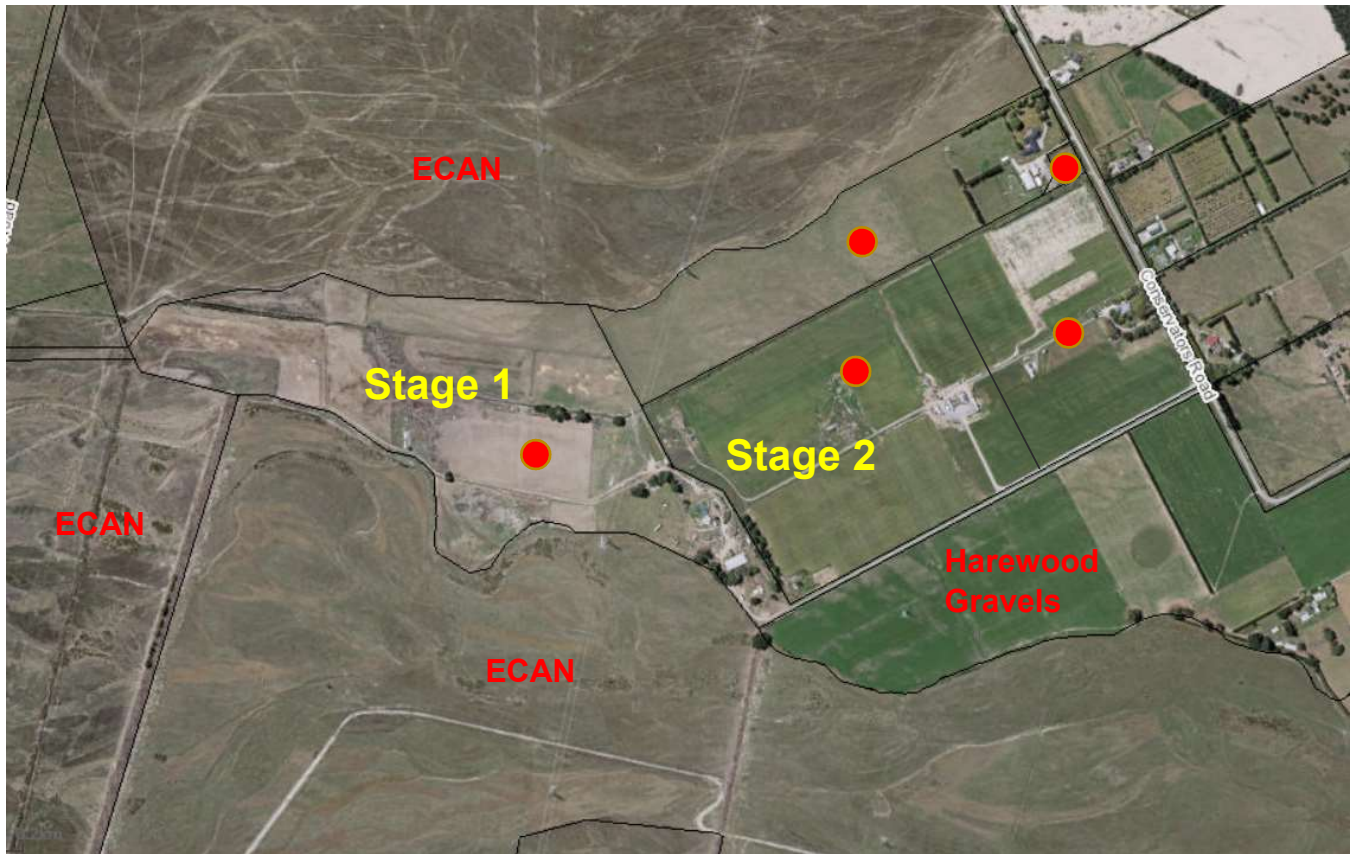
It is in SOL's best interests to minimise dust emissions, as dust emissions can result in on-site health and safety concerns, wear on vehicles and machinery, and reduced amenity values both on-site and off-site. For these reasons, SOL is looking to implement industry standard dust control practices on-site for the safety of their staff members and to be a good neighbour.

8.1 Effects on unoccupied land

Much of the directly adjacent land is owned by SOL or persons whom have provided affected party approval (see red dots on **Figure 8**).

The amount of deposited dust that is required to generate effects on plant life (such as those listed in **Section 6.2.1**) is significant, generally a visible layer of dust on the surface of the leaves is required. This magnitude of effect is generally associated with larger particulate sizes which deposit out of the air stream close to the emission point (mostly not more than 50 m from the emission source). Furthermore, the dust emitted from quarry activities such as proposed by SOL is biologically inert and comes from a natural source. Therefore, the potential for effects on adjacent plant life beyond the properties which have provided affected party approvals is very limited.

FIGURE 8 LAND PARCELS WHICH HAVE PROVIDED AFFECTED PARTY APPROVALS AND LOCATION OF OTHER LAND OWNERS

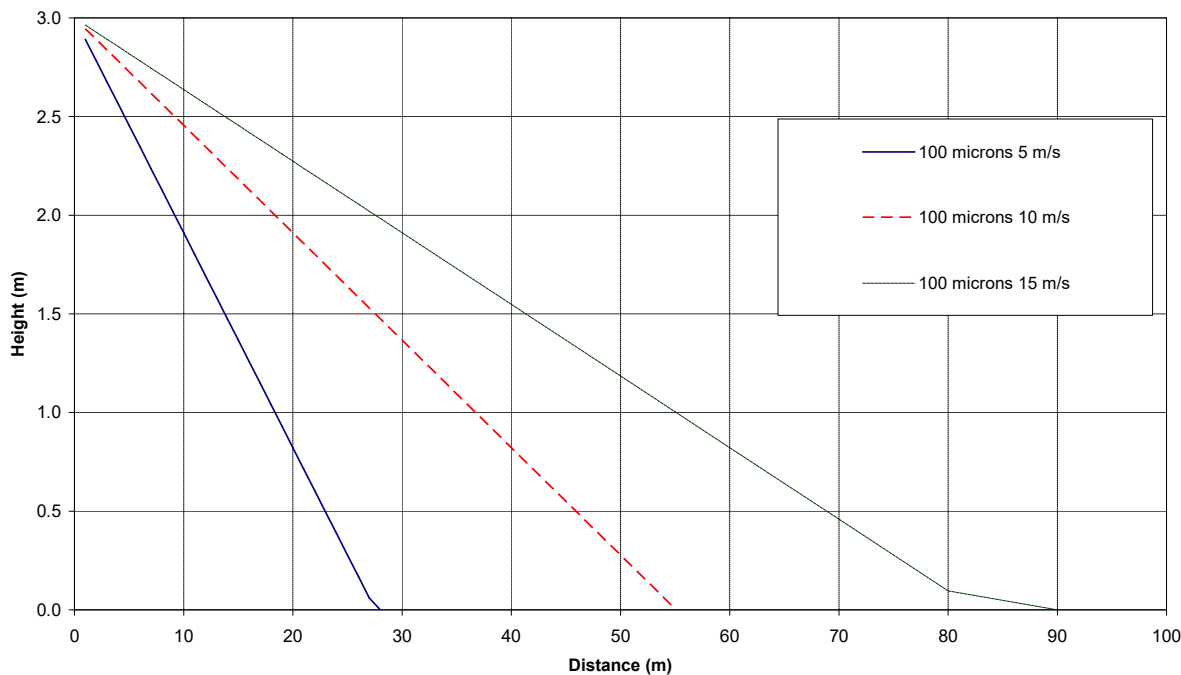


8.2 Particle Settling

The potential for nuisance dust emissions to travel beyond the boundary of the site is dependent on a number of factors including, the distance between the discharge point and the site boundary, the size of the particulates, the release height of the emission, and the wind speed.

Figure 9 illustrates the generic dust settling curves for suspended particulates with a diameter of 100 μm , based on Stokes Law calculations. When the wind speed is 10 m/s, suspended particulates 100 μm in diameter, when released at a height of 3 m (approximate truck loading heights), will settle out at a distance of 55 m from the source.

FIGURE 9 GENERIC DUST SETTLING CURVES (STOKES LAW)



There will be a portion of dust emitted from the quarry activities which is smaller than 100 μm and therefore will travel further than the distances indicated in **Figure 9**. For this reason, it is important the SOL apply effective mitigation measures, especially when handling products with a higher proportion of fines (top soils and overburden containing silts), in close proximity to neighbouring residential receptors, on dry windy days.

In NZ Air’s experience, nuisance dust effects do not generally occur beyond 250 m of quarrying activities, and with good controls don’t occur beyond 100 m. Whilst the nearest sensitive receptors whom have not provided affected party approval are greater than 290 m from the site boundary, it is proposed that there will be vegetated boundary bund which will increase the separation distances (presented in **Table 2**) by approximately another 20 m.

Figure 10 illustrates these separation distances from the site boundary.

FIGURE 10 SEPERATION DISTANCES



8.3 Environment Canterbury Yaldhurst Quarry Zone Dust Monitoring Program

Recently a detailed dust monitoring program was undertaken by Environment Canterbury of the Yaldhurst Quarry Zone (Mote 2018⁵). This study focused on potential health effects of dust discharges (i.e. monitoring for PM₁₀, PM_{2.5}, and RCS).

The monitoring program studied the air quality surrounding the Yaldhurst Quarry Zone over a period of four months during the 2017/2018 summer (December 2017 to April 2018). This quarry zone is a large site comprised of multiple dust producing activities including multiple large screening and crushing plants, concrete crushing and recycling, demolition waste screening, asphalt plants, and concrete batching plants. These dust generating activities are occurring both above and below ground level.

The combined area of active quarrying and filling operations in the Yaldhurst Quarry Zone exceeds 250 hectares, while in comparison the proposed SOL Stage 2 quarry will have an operational area of not exceeding 9 hectares (with approximately 2 hectares of unconsolidated 'cleanfill area').

⁵ Mote 2018. Yaldhurst Air Quality Monitoring. Summary Report 22 December 2017 – 21 April 2018. Prepared by Mote Limited for Environment Canterbury. 19 June 2018.

Many of the quarry operations are much larger than the proposed Stage 2 SOL quarry operation. The overall Yaldhurst Quarry Zone has much higher material handling rates, and therefore a higher potential to generate off-site discharges of dust than the proposed Stage 2 SOL quarry.

Some of the main consented activities within the Yaldhurst Quarry Zone are as follows:

- Winstone Aggregates:
 - 700 tonnes per hour concrete crushing, storage of 15,000 m³ of crushed concrete,
 - Unlimited rate of extraction, screening, crushing and stockpiling of aggregates from 233 Old West Coast Road, and
 - ~400,000 m³ of aggregate extraction from 4 hectares located at 199 Old West Coast Road.
- KB Quarries Ltd:
 - Unlimited rate of extraction, storage, screening, crushing, loading and transportation at Crn Kettlewell Drv and Miners Rd.
- Blackstone Quarries Ltd
 - Unlimited rate of extraction, storage, screening, crushing, loading and transportation at 325 Old West Coast Road, and
 - Screening, sorting and stockpiling of demolition waste with up to 80,000 m³ on-site.
- Fulton Hogan:
 - Unlimited rate of extraction, storage, screening, crushing, loading and transportation at 26 and 35 Miners Rd, and
 - Asphalt plant.
- Road Metals:
 - Unlimited rate of extraction, storage, screening, crushing, loading and transportation at 394 West Coast Road,
 - Concrete batching plant, and
 - Additional extraction from 290, 316 and 350 West Coast Road.

The Yaldhurst study showed that in general the concentrations of PM₁₀ 190 m from the downwind edge of the zone were comparable to background concentrations at a location 4,800 m from the zone. However, short term events did occur and concentrations in excess of the MfE suggested PM₁₀ nuisance dust trigger level (150 mg/m³ as a 1 hour average) did occur. These exceedances were generally limited to within 80 m of the zone, however on one event (strong north westerly winds) the levels exceeded the trigger level 600 m from the zone.

Airborne dust concentrations migrating from an emission source tends to reduce exponentially with distance from the source, both due to settling and dispersion of the dust plume (this was demonstrated in the transect monitoring results presented in the Mote 2018 report). Large diameter particulates (i.e. nuisance dust) are expected to travel shorter distances from the source than respirable dust (PM₁₀) since it settles from the air at greater rates.

The air quality monitoring undertaken by Mote in 2018 concluded that there were no measured concentrations of PM₁₀, PM_{2.5}, or RCS that exceeded the relevant health based criteria. RCS was only detected at very low levels on two samples (out of 21 collected). Both were at a site 50 m from the zone and well below the relevant criteria. Therefore, there is limited potential health effects from large scale quarrying activities such as that undertaken within the Yaldhurst Quarry zone.

However, in frequent nuisance effects can occur within 80 m of the zone boundary and up to 600 m from the boundary in exceptional weather conditions. For this reason, SOL is proposing to have wind speed triggers which will limit on-site activities during high wind conditions, this will limit the potential for nuisance conditions to occur at distance from the site.

The nearest assessed sensitive receptors to the proposed SOL Stage 2 quarry are all approximately 300 m from the site boundary, the Mote monitoring program demonstrated that, even from a much larger quarry operation, the effects on air quality at this distance from the boundary were minimal.

Given the scale differences between the Yaldhurst Quarry zone and the proposed SOL Stage 2 quarry operation, it is considered very conservative to compare the monitoring results of this monitoring study with SOL's proposed operation. Nonetheless, SOL is proposing a high level of mitigation to ensure that its operation will not result in adverse effects beyond the boundary. Furthermore, SOL intend to use boundary monitoring to confirm that the mitigation measures are being effective.

8.4 Documented Separation Distances

Whilst documented separation distances are a good guide as to the potential for effects from a particular industry, they are mostly used by district councils to ensure that noncompatible land uses are not placed too close together. They are generally conservative in nature. Should sensitive receptors/land uses occur within these conservative separation distances an activity specific assessment needs to be undertaken.

For the purpose of providing perspective, the following documented separation distances are considered appropriate to the proposed SOL quarry:

- Auckland Council recommends a separation distance of **200 m** from a dwelling (it's a controlled activity to establish a quarry within 200 m of a dwelling in the Auckland Unitary Plan).
- The Victoria Environmental Protection Agency (Vic EPA) recommends a separation distance of **250 m** for a quarry which does not involve blasting⁶.
- The South Australia EPA recommends a separation distance of **300 m** for extractive industries with no blasting⁷.

8.5 Complaints Assessment

NZ Air have been supplied a copy of the CRC complaint record for SOL's Stage 1 quarry operation. A total of 31 complaints have been reviewed.

Although there has been a number of complaints made about the current quarry operation, in all the information reviewed from both the CCC and CRC records, there has not been a confirmed noxious, offensive, or objectionable dust effect beyond the boundary of the SOL site.

Many of the complaints are related to truck movements on the main haul road between the site office and Guys road or material being tracked onto Guys road. Since these complaints were made in 2017/2018 SOL have undertaken additional mitigation to address the issues raised by the complainants. An additional 150 m of the main haul road has been sealed from Guys Road (making the total sealed portion 250 m). SOL have extended the k-line sprinklers operating on this haul road so that they cover the majority of the haul road going through ECAN land. A water/sweeper truck is used 5 days a week to keep the entranceway and adjacent sections of Guys road free of dust and tracked material.

These measures have been effective at reducing dust levels at the Guys road entrance way.

In April 2018 SOL applied to modify some consent conditions which were ambiguous and not consistent with the original consent application assessments. From this point on SOL have been compliant with the consent conditions.

⁶ Victoria EPA, 2013: 'Recommended separation distances for industrial residual air emissions' Publication number 1518

⁷ South Australia EPA, 2007: 'Guidelines for separation distances'

SOL have worked proactively with CRC and CCC to address any complaints made and ensure that its operation is compliant with the consent conditions.

9 FIDOL Assessment

NZ Air have undertaken a qualitative assessment of dust emissions using the FIDOL factors discussed earlier. This form of assessment is consistent with the CARP Schedule 2 requirements and the Ministry for the Environment recommendations.

Although the FIDOL assessment below is focused on residential dwellings surrounding the site, as these are considered the most sensitive receptors, it is acknowledged that there is potential for effects on pasture or crop growth on neighbouring properties. However, the controls which are proposed to mitigate potential effects at the residential dwellings will also be effective at reducing potential impacts on neighbouring plant life (see **Section 8.1**).

9.1 Frequency

SOL has proposed that:

- Site works will only occur between 0630 and 1800 Monday to Friday, and 0700 hours to 1200 on Saturday.
- There will be no site works on Sundays, and public holidays.

So potential dust emissions from the various sources with these activities will be limited to occurring between these hours of operation.

Also, as the proposed quarry is staged some neighbouring receptors may have elevated frequencies of potential effects during one or two stages, but in other stages they will be quite removed from the operation and potential effects will be negligible.

The nearest residential receptor downwind of the strong dry north westerly winds which often generate very dusty conditions across the Canterbury plains is more than 470 m from the nearest point of the proposed Stage 2 quarry.

Receptors R1, R3 and R4 are all downwind from the proposed quarry operations during south westerly winds.

The wind speed at which significant dust pick up can occur from unconsolidated surfaces is generally considered to be 5 m/s or greater⁸. At a wind speed of 10 m/s or greater dust emissions can occur from consolidated surfaces and the distance that the dust travels is significantly increased (see **Figure 9**).

Overall the meteorological data presented in **Figure 4** and **Table 1** indicates that 2.1% of the time wind speeds are over 10 m/s and 31.9% of the time they are over 5 m/s. However, winds from the south west above 5 m/s only occur 6.7% of the time.

Nuisance dust emissions from quarry operations generally only occur during the summer months (conservatively assumed to be September to March, for the purposes of this assessment), when evapotranspiration rates exceed the rainfall rates leading to the material being disturbed by the quarry operation becoming dry and friable. Looking at this subset of wind conditions (winds from the southwest during summer months) further reduces the percentage of time one or more neighbouring residential

⁸Section 8.2, Ministry for the Environment *Good Practise Guide for Assessment and Managing the Environmental Effects of Dust Emissions* 2001

receptor could be exposed to these conditions. Only 0.3% of the time are wind speeds above 10 m/s and only 3.6% of the time wind speeds are above 5 m/s.

Despite the above, the percentage of time when dust generating activities occur close to the site boundary and winds are blowing towards a neighbouring receptor will be much less than those quoted above.

SOL have proposed a very comprehensive set of industry standard mitigation measures which will reduce the potential for dust emissions in the first place. These controls are aimed at no visible emissions being observed beyond the boundary of the site. Furthermore, there are backup measures in place should the primary measures be insufficient. For this reason, NZ Air considers that the potential frequency of offensive or objectionable nuisance dust effects is greatly reduced and the residual risk, post control measures, is very low.

9.2 Intensity

The intensity of dust emissions is generally related to the scale of operations in a quarry such as this. SOL is only proposing to operate one or two mobile processing plant and a limited number of site vehicles. Furthermore, as there will generally be a maximum of 9 ha open at any one time and a maximum of 300 heavy vehicle movements per day, this is considered to be a medium sized quarry operation.

The majority of dust producing activities will occur below natural ground level, therefore the dust settling potential increases as the dust approaches the pit sides. Additionally, a mature shelter belt on top of a 3m high bund will be situated on the boundary between the proposed quarry and the nearest neighbouring receptors. Furthermore, the neighbouring receptors all have an additional mature shelterbelt between their properties and the proposed Stage 2 quarry.

The intensity of any dust emissions from the site will be higher the closer you get to the site due to progressive deposition of suspended particles. Product processing, stockpiles, and haul roads have been intentionally situated to increase the separation distance from neighbouring receptors.

Receptors R1, R3 and R4 are approximately 300 m from the site boundary and will be substantially further from most of the potential dust producing activities. This separation distance is generally beyond that which conservative documented separation distances recommend. It is also beyond the effects perimeter usually observed around other quarries in New Zealand (which was supported by the Yaldhurst Quarry study). Therefore, any dust that is emitted from the quarry and does manage to travel greater than 300 m for the site is likely to be of a low intensity.

As discussed above the likelihood of emissions beyond the boundary given the controls proposed and the separation distances between the majority of dust producing activities and neighbouring receptors is low. Any residual emissions from the site are likely to be of a low intensity and rare.

9.3 Duration

In general, many of the potential dust generating activities are proposed to occur throughout the hours of operation, however some of those with higher risk factors (those involving displacement of over burden and top soil) will have limited durations (i.e. at the start and end of each stage).

In general, should an activity be producing visible dust, the site staff and management have mitigation measures which will be implemented to control the discharge at the discharge point, it is anticipated that the response time to implement these controls will be short (unlikely to be more than 10 minutes in most cases). Furthermore, the wind direction and wind speeds that may carry any dust emitted from the site towards a neighbouring receptor are likely to change which will result in any emission either not

travelling towards a receptor or not travelling the distance between the emission point and the receptor. Therefore, if all these conditions do occur then they will not occur for very long and the duration of any air discharge will be short lived.

The site manager has a number of mitigation measures and backup measures to control dust emissions (documented in the DMP) and ultimately will cease works if they cannot be controlled. These measures will greatly reduce the duration of any discharges from the site.

9.4 Offensiveness

All dust emissions from the proposed quarry activities are of a natural origin and consistent with the dusts that occur naturally in the area. All Cleanfill sent to site will be compliant with the MfE Cleanfill criteria⁹, and therefore not contain hazardous or toxic elements. As the residual concentrations predicted at nearby residences are likely to be very low, it is unlikely they will cause offence.

Generally, to meet the offensive and objectionable threshold nuisance dust effects need to be visible in the air and/or leave deposits on exposed surfaces. Given the assessment above and the conclusions drawn it is not considered that this will occur at neighbouring residences.

9.5 Location

Given the high demand for aggregates in Canterbury it is difficult for quarry operators to find new sites. This site has been chosen as the preferred site by SOL after considering resource quality, market proximity and proximity to neighbouring properties. One of the selection criteria for a new site is potential for nuisance dust effects.

The extension of the current SOL quarry is considered to have a lower impact than the development of a new quarry. Neighbouring properties are already aware of the existing quarry, there will be no additional dust discharged associated with the extension of the quarry. Although some activities will occur closer to some neighbouring properties, SOL have obtained affected party approvals from the directly adjacent neighbours and intentionally maintained good separation distances between the activity and other neighbouring dwellings. This assessment predicts that this will not result in additional effects, as the separation distances and controls will be sufficient to control potential nuisance or health effects beyond the boundary.

The receiving environment is less sensitive to minor nuisance dust impacts due to its rural character and the existence of natural dust sources (as compared with a residential zone).

The proposed quarry is situated within the CCC 'rural' zone. The surrounding land is sparsely populated to the north, south and west of the site.

For all of these reasons, the location of the proposed Stage 2 quarry is considered appropriate.

9.6 Summary

Each of the FIDOL factors presents the activity as a low risk activity post mitigation measures, with a low potential for off-site nuisance effects. Therefore, overall NZ Air considers the potential for nuisance dust effects beyond the boundary of the proposed SOL quarry is low.

It is considered that the proposed operation of the SOL Stage 2 Quarry will not generate offensive or objectionable effects beyond the site boundary or at neighbouring properties.

⁹ Ministry for the Environment. 2002. A guide to management of Cleanfills. Ministry for the Environment, Wellington.

10 Affected Party Consultation

SOL have consulted with the nearest adjoining neighbours and sought their affected party consent. The properties indicated by red dots in **Figure 5** have provided written approvals (these are attached as **Appendix B**).

11 Consent Term

SOL is seeking an 8-year lapse period (enabling works are expected to commence in 5 – 7 years' time) and a Consent duration of 20-years from the date of grant of Consent.

12 Conclusion

NZ Air have qualitatively assessed the potential emissions from the proposed SOL Stage 2 quarry at 81 Conservators Road. Potential effects on neighbouring properties within 320m of the proposed site were assessed.

The applicant has proposed a number of mitigation measures which are consistent with industry standard dust control measures to reduce the potential of dust emission beyond the boundary of the site. A FIDOL assessment of potential nuisance dust emissions from the site was conducted and concluded that there is a low possibility that neighbouring receptors will be adversely affected.

SOL propose to take all practical steps to reduce impacts on neighbouring properties.

APPENDIX A – DRAFT DUST MANAGEMENT PLAN

APPENDIX B – AFFECTED PARTY APPROVALS