Appendix D

Specialist Assessment Reports

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REPORT

KIWI POINT QUARRY PLAN CHANGE — ASSESSMENT OF OPTIONS: AIR QUALITY

Prepared for Wellington City Council

November 2016

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QUALITY STATEMENT

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Executive Summary

MWH New Zealand Limited (MWH) was commissioned by Wellington City Council (WCC) to undertake a preliminary air quality impact assessment for activities associated with the proposed expansion of the existing Kiwi Point Quarry located off Centennial Highway in Ngauranga, Wellington.

The purpose of the preliminary air quality impact assessment presented in this report is to determine the potential for dust nuisance effects in the surrounding community due to dust emissions at the project site. MWH has undertaken a qualitative (risk-based) assessment of the existing or proposed dust emissions at the site and their potential to cause dust nuisance effects beyond the site boundary based on the *'Alternatives Workshop Briefing Paper'* prepared by Incite Wellington 2012 Limited (Incite)[1] as part of the scoping work for a proposed plan change to enable the expansion of the quarry. A workshop was held on 3 November 2016 in Wellington to discuss the potential options associated with the proposed quarry expansion. Overall, four options were assessed in this report.

The potential dust impacts have been assessed separately for each activity for the following categories:

- Annoyance (or nuisance) due to dust soiling (deposition); and,
- The risk of health effects due to an increase in exposure to particles less than 10 microns in diameter (PM_{10}).

Dust Nuisance

The existing and proposed activities undertaken at the Kiwi Point Quarry are considered to have a *slight adverse* effect within the surrounding community. These potential effects are considered to be *no more than minor* and are based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the Ministry for the Environment's 24-hour mean trigger value for total suspended particles (TSP) of 100 micrograms per cubic metre ($\mu g/m^3$) will be exceeded beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of dust and particulate emissions at the quarry. The results of the qualitative assessment indicate that there are unlikely to be any dust nuisance effects beyond the Kiwi Point Quarry site boundary, provided that the mitigation measures recommended in MWH's report[2] dated July 2016 are implemented.

Furthermore, the results of the assessment indicate that the existing and proposed activities are of *low* risk, and that the most 'at-risk' receptors are existing residential properties located on Gurkha Crescent and Shastri Terrace, which are situated to the south-west of the site.

The existing businesses located on Tyers Road were assessed as being at *medium* risk and were considered to have the potential to experience a *slight adverse* effect due to dust emissions generated as a result of the proposed quarry expansion.

PM_{10}

Based on the results of the qualitative assessment for dust, MWH considers that it is unlikely that there will be any exceedances of the 24-hour mean National Environmental Standard (NES) for PM_{10} beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of PM_{10} emissions at the quarry, provided that the mitigation measures recommended in MWH's report[3] dated July 2016 are implemented.

1 Incite, 2016. Kiwi Point Quarry Expansion—Alternatives Workshop Briefing Paper, prepared for Wellington City Council, Incite, October 2016.

2 MWH, 2016. Kiwi Point Quarry Air Quality Assessment, prepared for Wellington City Council, MWH Global, 12 July 2016.

3 *Ibid*.

Wellington City Council

Kiwi Point Quarry Plan Change — Assessment of Options: Air Quality

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1 Introduction

1.1 Project Overview

MWH New Zealand Limited (MWH) was commissioned by Wellington City Council (WCC or the 'Council') to prepare an air quality impact assessment for activities undertaken at the existing Kiwi Point Quarry located off Centennial Highway/State Highway 1 (SH1) in Ngauranga, Wellington (the 'project site' or the 'quarry'). Kiwi Point Quarry is an established greywacke quarry located in the Ngauranga Gorge, involving ongoing extraction, processing, a cleanfill and rehabilitation, and is operated by Holcim New Zealand Limited (Holcim) under contract to WCC.

The aim of the air quality impact assessment is to determine the potential for dust nuisance effects beyond the boundary of the project site. In July 2016 MWH prepared an Air Quality Impact Assessment[4] in support of WCC's resource consent application to GWRC for discharges to air and other activities undertaken at the site with regards to WCC's proposed expansion of the existing quarry in the south-east corner of the site towards Tyers Road (hereafter the 'southern extension'). A copy of the Air Quality Assessment is attached as Appendix A.

The purpose of this report is to assess the actual and potential effects associated with the discharge of contaminants to air (predominantly dust/particulate matter) from site-wide activities, including:

- Soil/vegetation removal and overburden stripping and associated earthworks (including soil handling and storage). Overburden is disposed of in designated areas onsite;
- Drilling and blasting;
- Open-cast extraction and quarrying;
- Transfer of aggregate from the blast area(s) to crushing, screening and washing plant;
- Crushing, screening, and processing of aggregate;
- Stockpiling of aggregate products for retail; and,
- Transfer of aggregate products from stockpiles to customer's trucks via front-end loader for transport off site (product load-out).

This report examines the potential air quality effects that may arise during the operation of the quarry, including the proposed quarry expansion (southern extension), and the options identified in the *'Alternatives Workshop Briefing Paper'* prepared by Incite Wellington 2012 Limited (Incite)[5].

This preliminary report has been prepared as part of the first stage in the scoping work for a proposed plan change to enable the expansion of the quarry. This report contains an assessment of the actual and potential effects associated with the discharge of contaminants to air (predominantly dust) associated with the extraction (quarrying) and processing (crushing and screening) activities undertaken at the project site. It is envisaged that a more detailed (albeit qualitative) assessment will be undertaken on the preferred option, following the completion of the alternatives assessment by Incite and WCC.

1.2 Project Objectives

The rock resource within the site's existing quarry/extraction area (zoned 'Business 2' in the Wellington City District Plan) is nearing exhaustion due to physical constraints and technical factors at the quarry. If WCC were to seek a plan change to expand the existing quarry/extraction area into an area zoned Open Space B in the Wellington City District Plan, the operational life of the quarry would be extended.

The project objectives are set-out in Incite (2016).

[4] MWH, 2016. Kiwi Point Quarry Air Quality Assessment, prepared for Wellington City Council, MWH Global, 12 July 2016.

[5] Incite, 2016. Kiwi Point Quarry Expansion—Alternatives Workshop Briefing Paper, prepared for Wellington City Council, Incite, October 2016.

1.3 Study Overview

This report seeks to assess the potential air quality effects associated with the existing and proposed quarrying activities at the nearest identified sensitive receptors, and to make recommendations regarding the control of dust and particulate matter at the site, where required, as these are the principal contaminants of concern.

In order to determine the potential for dust nuisance effects in the surrounding community due to dust emissions at the project site, MWH has undertaken a qualitative (risk-based) assessment of the existing and proposed dust emissions on the site and their potential to cause dust nuisance effects beyond the site boundary.

The assessment undertaken in this report was carried out in accordance with the following national and international guidance documents:

- Ministry for the Environment's (MfE) 'Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions' (MfE, 2001).[6] This Good Practice Guide (GPG) is currently under review by the MfE;
- IAQM, 2014. 'Guidance on the assessment of dust from demolition and construction', Institute of Air Quality Management, February 2014; and,
- IAQM, 2016. 'Guidance on the assessment of mineral dust impacts for planning, Institute of Air Quality Management, May 2016 (version 1.1).

1.4 Project Site Location

The project site is located at 137 Centennial Highway/SH1 in the Ngauranga Gorge, Wellington and is legally described as Lots 1, 2 & 3 DP 72995, Lot 4 DP 72996, Lot 5 DP 72996, Lot 1 DP 34815, and Lot 6 DP 72996.

The site is situated on the western side of Ngauranga Gorge, within an industrial area, which is located at the base of a basin surrounded by high ridges. Residential areas are situated at the top of these ridges.

The site covers an area of approximately 44.92 hectares (ha) or 0.45 km^2, based on the map contained in Appendix 2 of the Wellington City District Plan, which is shown in Figure 1-1. The figure shows that there is a buffer area which is zoned 'Open Space B' in the Wellington City District Plan surrounding the existing quarry/extraction area, zoned 'Business 2' in the Wellington City District Plan. Restoration planting within the buffer zone will be undertaken in accordance with WCC's Quarry Management Plan (WCC, 2014).[7]

The centre of the project site is located at 315860 metres East, 5432680 metres North Universal Transverse Mercator (UTM) Zone 60 South (or latitude 41.236222 ºSouth, longitude 174.803046 ºEast). The project site is located approximately 4.5 km north-east of the Wellington central business district.

6 'Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions', Ministry for the Environment, September 2001 (MfE, 2001).

7 WCC, 2014. Kiwi Point Quarry Management Plan (QMP), Wellington City Council, 2014.

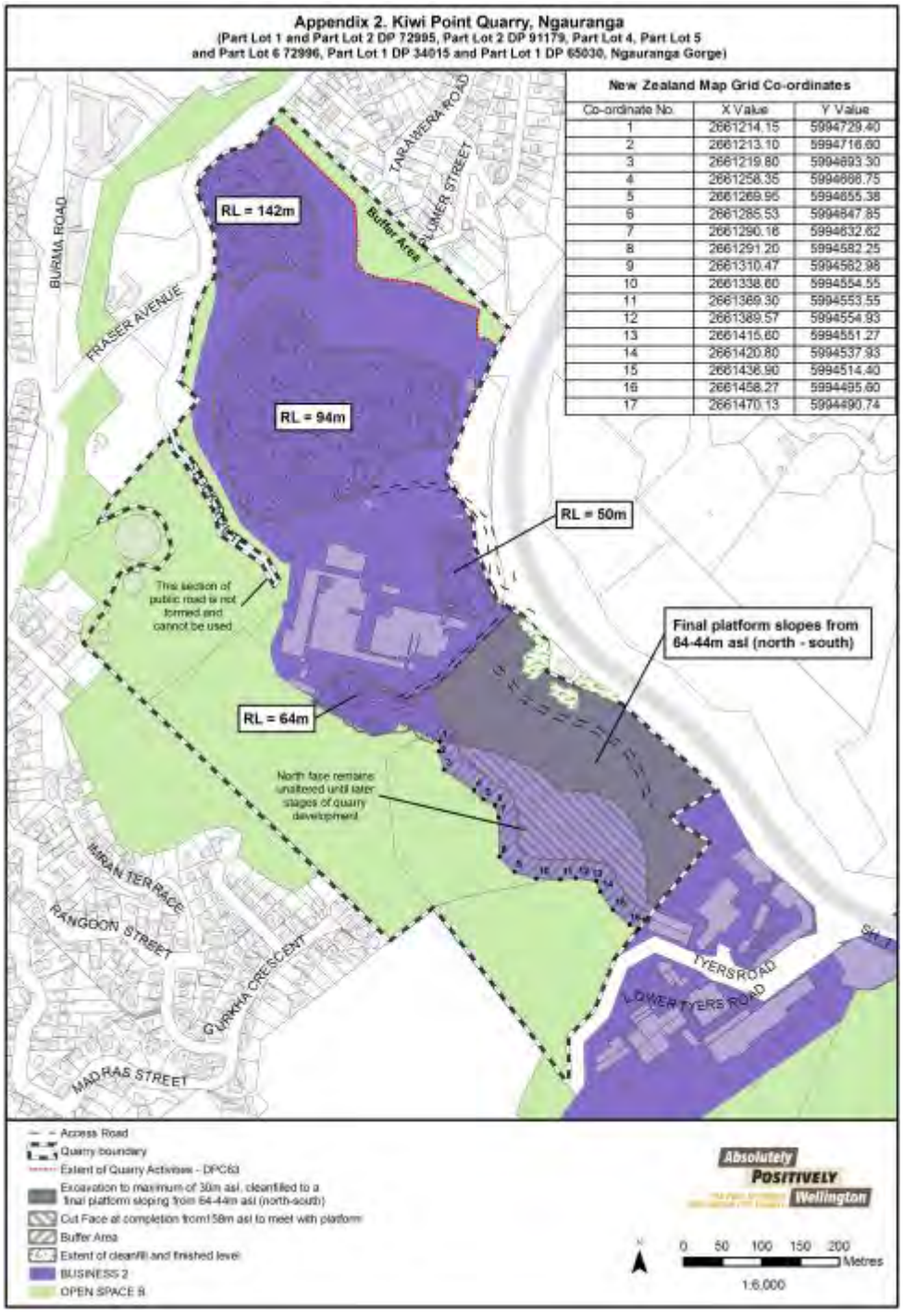

Figure 1-1: Location of the Kiwi Point Quarry

The location of the project site is shown in Figure 1-2. The figure was produced using OpenStreetMap (OSM) under the Open Database License. OSM has been used throughout this report and MWH has acknowledged OSM and its contributors, where relevant. The Open Database License can be read in full on the OSM website.[8]

Figure 1-2 shows the indicative Kiwi Point Quarry site boundary (solid red line), which is based on Figure 1-1, the area occupied by Taylor Preston Limited's abattoir and meat works (dashed red line) and the proposed southern extension area (dashed orange line).

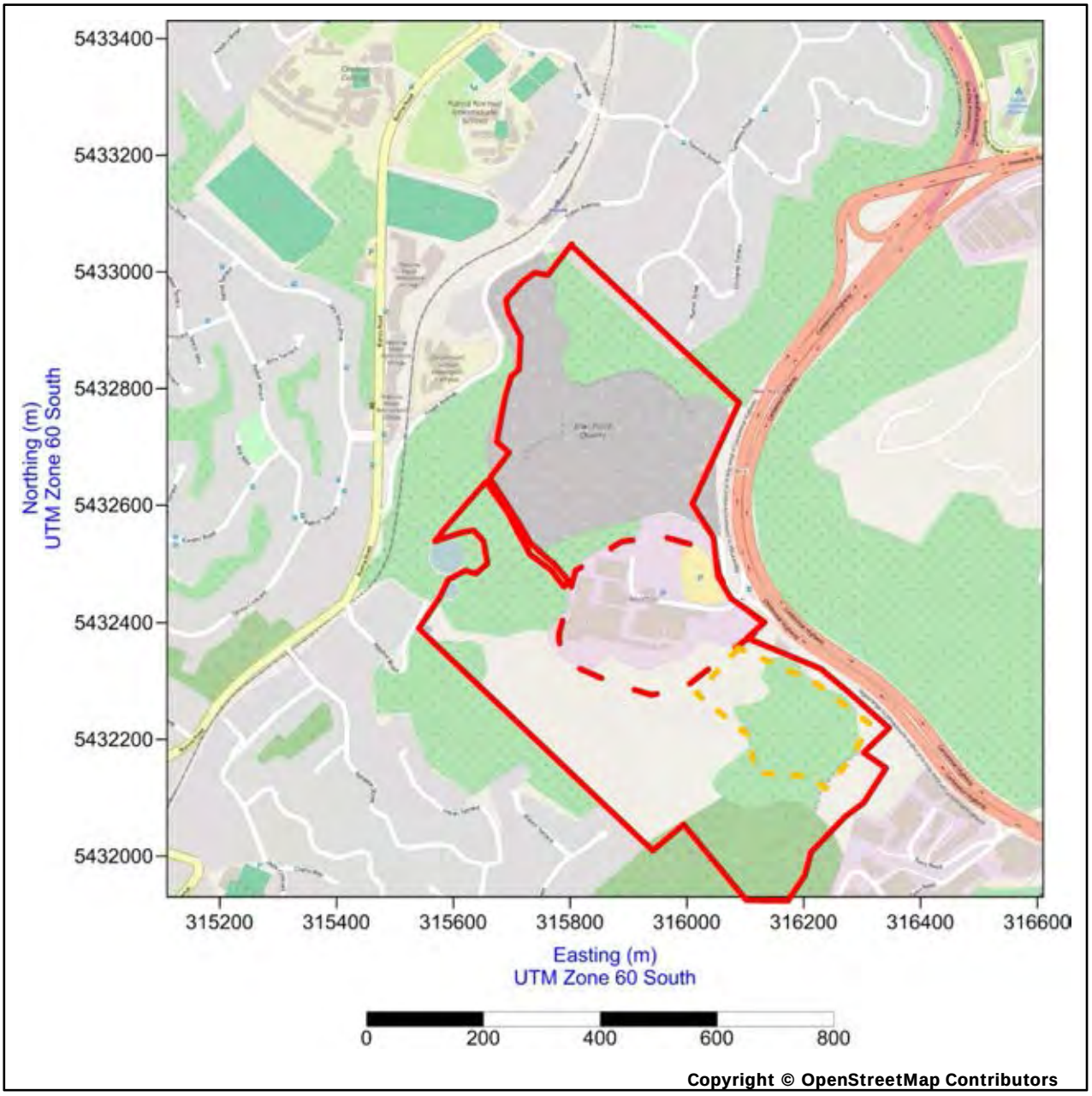

Figure 1-2: Location of the Kiwi Point Quarry Showing an OSM Basemap

8 http://opendatacommons.org/licenses/odbl/1.0/

1.5 Sensitive Receptors

In the context of this assessment, the term 'sensitive receptor' includes any persons, locations or ecosystems that may be susceptible to changes in airborne particulate concentrations and/or dust deposition as a result of dust emissions at Kiwi Point Quarry. An 'adverse effect' at a sensitive receptor may manifest itself as disamenity due to soiling (annoyance or nuisance), increased morbidity or mortality due to exposure to PM_{10}, or plant dieback due to reduced photosynthesis.

Typical locations for sensitive receptors include:

- Residential properties, including retirement villages;
- Hospitals or medical centres;
- Schools and libraries;
- Marae;
- Public outdoor locations (e.g. parks, reserves, sports fields, beaches); and,
- Ecological receptors (habitats that might be sensitive to dust).

A desk-study was undertaken to identify sensitive receptors within a radius of 1 km of the project site boundary. The nearest potentially affected sensitive receptors are shown in Table 1-1.

Table 1-1: Sensitive Receptor Locations

Ref.	Type	Address	UTM Zone 60 South		Direction from Boundary	Distance from Boundary (m)
			Easting (m)	Northing (m)		
R1	Residential	42 Gurkha Crescent	315927	5431995	SW	0
R2	Residential	44 Gurkha Crescent	315915	5432008	SW	0
R3	Residential	46 Gurkha Crescent	315904	5432024	SW	0
R4	Residential	39 Gurkha Crescent	315888	5432041	SW	0
R5	Residential	37 Gurkha Crescent	315870	5432057	SW	0
R6	Residential	18 Shastri Terrace	315735	5432126	SW	40
R7	Residential	26 Imran Terrace	315540	5432200	SW	120
R8	Residential	7 Maldive Street	315527	5432367	W	10
R9	Residential	94 Burma Road	315530	5432389	NW	20
R10	Residential	175 Fraser Avenue	315551	5432618	NW	50
R11	School	170 Fraser Avenue	315580	5432797	NW	80
R12	Business	130 Fraser Avenue	315636	5432963	NW	30
R13	Retirement Village	134 Burma Road	315503	5432943	WNW	160
R14	Park	159 Burma Road	315610	5433070	NW	110
R15	Residential	113 Fraser Avenue	315774	5433051	NE	0
R16	Residential	9 Plumer Street	315968	5432881	NE	0

The nearest sensitive receptors to the Kiwi Point quarry boundary are receptors R1 to R5, R15 and R16 and are all residential properties situated adjacent to the quarry boundary. Receptor R11 is the Westmount School located on Fraser Avenue, Receptor R12 is a business located on Fraser Avenue, while receptor R13 is the Malvina Major Retirement Village. Receptor R14 is the Raroa Park (area of public open space).

Figure 1-3 shows the location of the potentially affected sensitive receptors identified in this assessment (solid yellow circles), the indicative quarry site boundary (solid red line), the area occupied by Taylor Preston (dashed red line) and the southern extension area (dashed orange line) on a Bing aerial basemap.

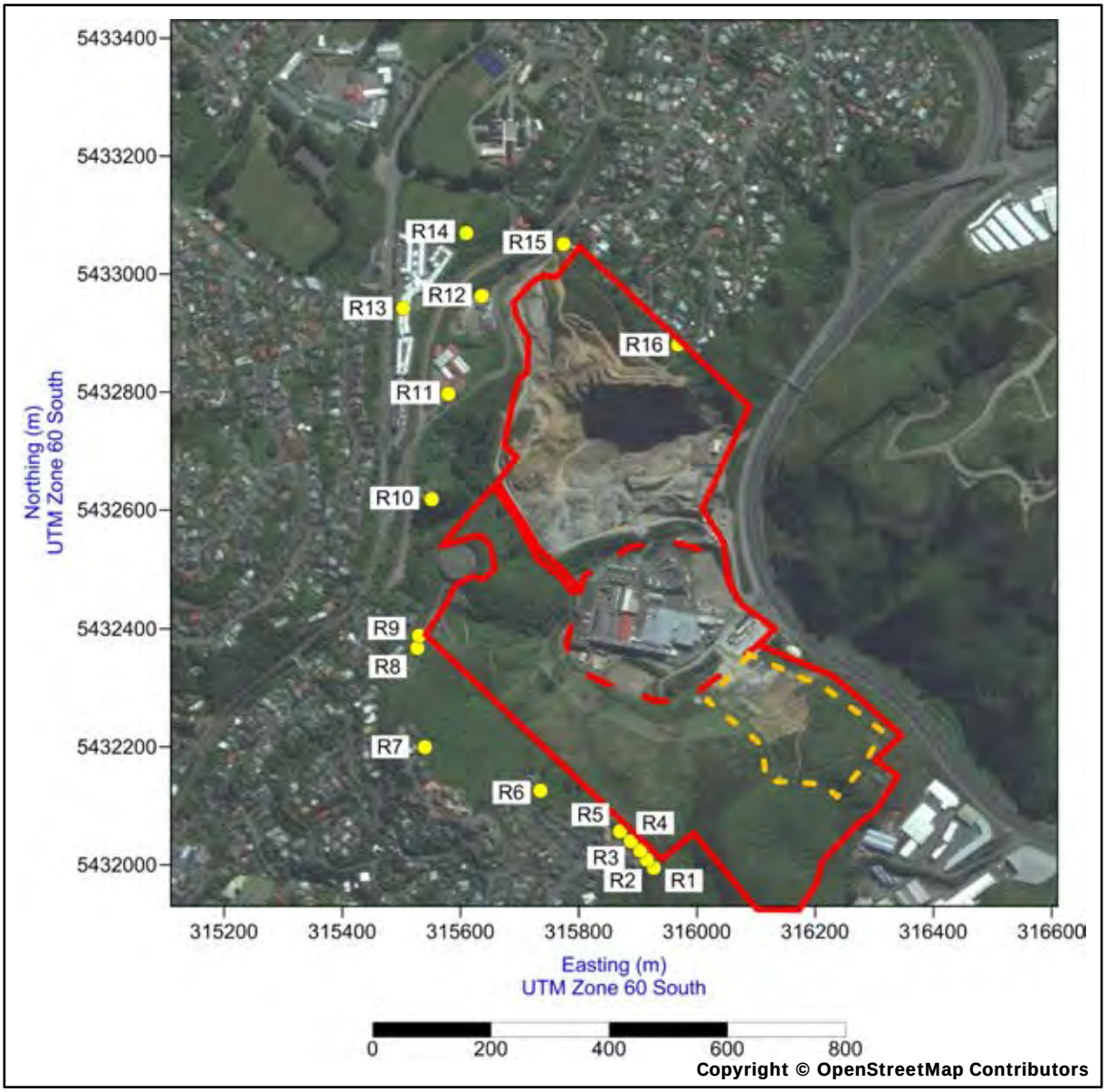

Figure 1-3: Sensitive Receptor Locations Showing a Bing Aerial Basemap

Whilst the existing businesses located on Tyers Road to the south-east of the quarry site boundary (and shown in Figure 1-3) have not been included as sensitive receptors in this report, a qualitative assessment has been undertaken in Section 3 to assess the potential risk at these properties as a result of dust emissions generated as a result of the proposed quarry extension.

Figure 1-4 shows the location of the potentially affected sensitive receptors identified in this assessment (solid yellow circles) and the other features shown in Figure 1-3 on an OSM basemap.

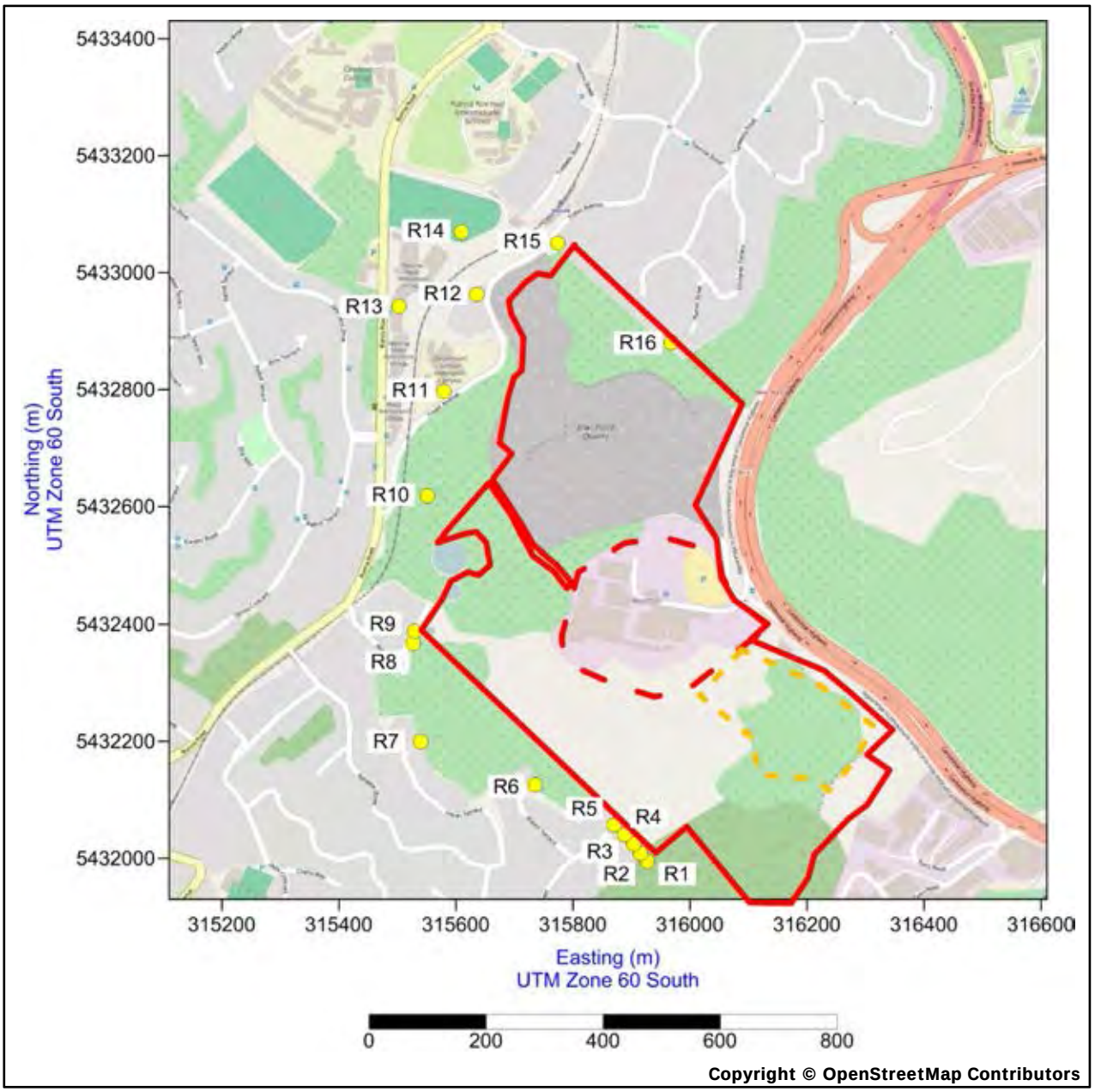

Figure 1-4: Sensitive Receptor Locations Showing an OSM Basemap

The receptors that are residential properties and the retirement village are considered to be of 'high' sensitivity[9] to potential dust emissions at Kiwi Point Quarry, for the reasons outlined below:

- The location of a person(s) who could reasonably be expected to enjoy a high level of amenity; or
- The appearance, aesthetics or value of a person's property could be diminished by soiling; and the people or property could reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.

Receptor R11 (school) and receptor R12 (business) are considered to be of 'moderate' sensitivity, while Receptor R14 (park) is of 'low' sensitivity to potential dust emissions at Kiwi Point Quarry.

[9] Other examples of high sensitivity receptors include, but are not limited to: marae, museums and other culturally important collections, medium- and long-term car parks (or parking areas used for work/residential) and car showrooms, electronics manufacturers, amenity areas and horticultural operations (e.g. salad or soft-fruit production). None of these types of receptors were identified from the desk-top study within the area immediately surrounding the quarry site boundary.

1.6 Options

In accordance with the *'Alternatives Workshop Briefing Paper'* prepared by Incite[10], the following options were assessed in this report:

- Option 1 Do Nothing (baseline option against which all other options will be assessed);
- Option 2 Permitted Activity Development (within the Business 2 zone, as per MWH, 2016);
- Option 3 Five Stage Development; and,
- Option 4 Area 2B Maximum Expansion.

Under Option 1 ('Do Nothing' or 'Baseline') it was assumed that all existing extraction, processing and associated activities undertaken at the quarry (primarily in the northern area) will cease, which is estimated to be in three to four years' time.

Under Option 2, it was assumed that the southern extension quarry activities will occur (i.e. rock will be extracted from the southern ridge situated in the south-eastern corner of the quarry, between Taylor Preston's site and Tyers Road). Refer to MWH (2016) and Ormiston (2016)[11] for further details.

Under Option 3, a five stage development of the quarry has been prepared by Ormiston Associates Limited on behalf of Holcim, and includes further extraction from the southern extension area towards the south-west (Gurkha Crescent). It is understood that the highest bench will be situated at an elevation of 190 m ASL and that there will be a minimum buffer distance of 100 m between the quarry activity area and the closest residential property boundary situated on Gurkha Crescent. The final stage (Stage 5) of the Option 3 quarry extension is shown in the site layout plan Figure 1-5, which was taken from Incite (2016). Refer to Incite (2016) for further details.

Under Option 4, a maximum expansion of the extraction area to the south-western corner of the quarry boundary (within an area called '2B'), resulting in a minimum buffer distance of 70 m between the quarry activity area and the closest residential property boundary situated on Gurkha Crescent.

[10] Incite, 2016. Kiwi Point Quarry Expansion—Alternatives Workshop Briefing Paper, prepared for Wellington City Council, Incite, October 2016.

[11] Ormiston, 2016. Report on the Proposed Development for the Business Centre Area South Ridge—Kiwi Point Quarry, prepared by Ormiston Associates Limited for Holcim New Zealand Limited, February, 2016.

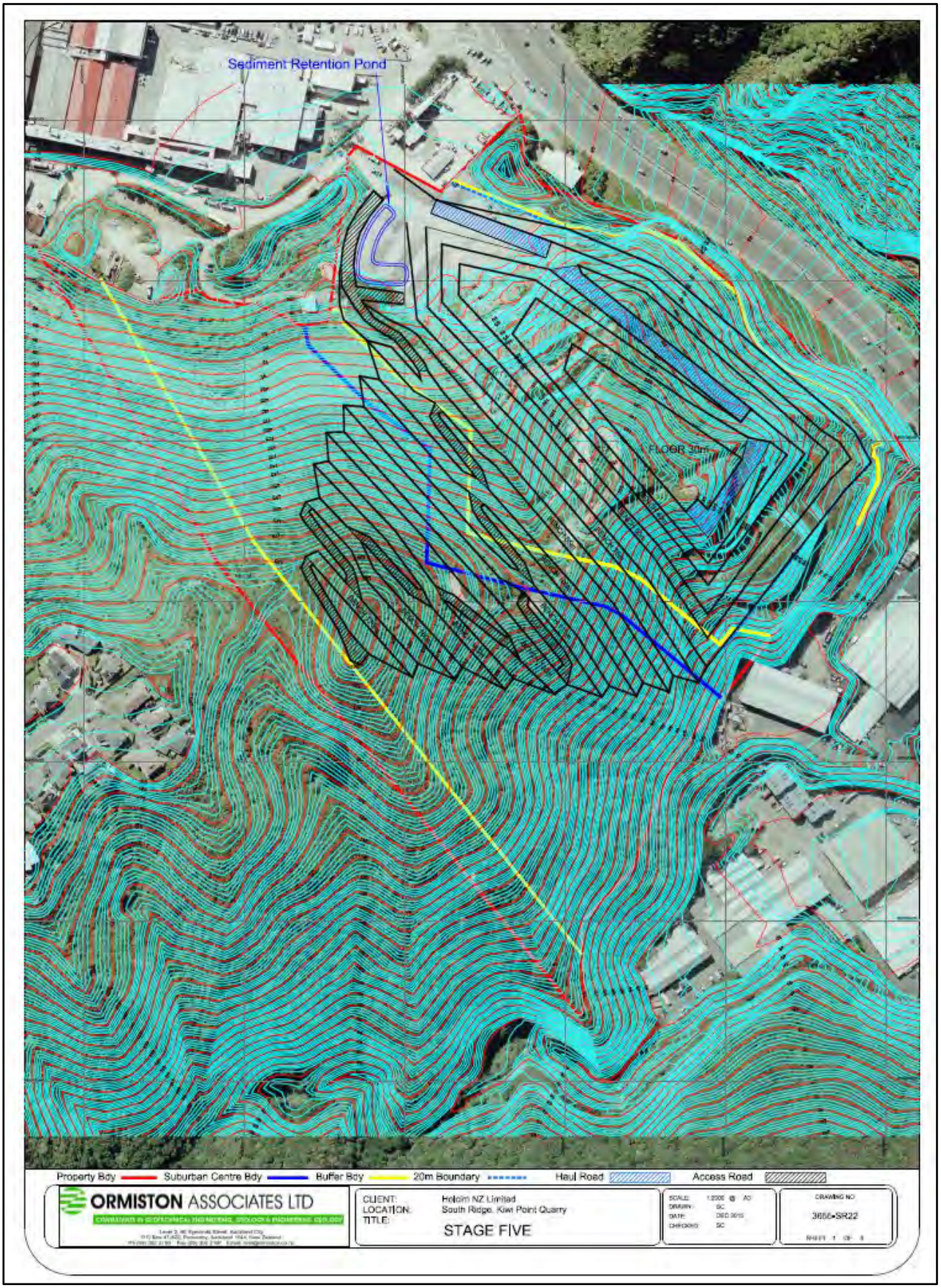

Figure 1-5: Site Layout Plan Showing the Option 3 Quarry Extension at Stage 5

2 Methodology and Local Meteorology

2.1 Methodology

In this report, MfE (2011), IAQM (2014)[12] and IAQM (2016)[13] were used to develop a qualitative (risk-based) assessment methodology to assess the potential effects arising from the dust-generating activities at the project site. The aim of the qualitative dust impact assessment is as follows:

- To determine the risk of dust emissions originating from the project site causing loss of amenity and/or health, cultural or ecological effects; and,
- To assess the magnitude (or scale) of the actual or potential effects beyond the site boundary.

The risk of dust emissions from a particular project site causing loss of amenity and/or health, cultural or ecological effects is related to:

- The dust-generating activities being undertaken at the project site (e.g. drilling and blasting, quarrying, crushing and screening of aggregate (including stockpiling of material) and vehicle movements on unsealed roads);
- The frequency and duration (including phasing) of these dust-generating activities;
- The size of the project site and/or the size of the dust-generating activity area;
- The local terrain and meteorological conditions (e.g. wind speed, wind direction and rainfall);
- The proximity of sensitive receptors to the dust-generating activities;
- The sensitivity of the receptors to dust/particulate; and,
- The adequacy of the mitigation measures applied onsite to reduce or eliminate dust emissions.

The quantity of dust emitted from a particular project site will be related to the area of land where dust-generating activities occur, and the level of the activities (nature, magnitude and duration). Emissions from onsite vehicles passing over unsealed ground may be particularly important, and may be related to the silt content of the soil (if applicable), as well as the speed and weight of the vehicle, the surface moisture content, the distance covered and the frequency of vehicle movements. Soil has been defined by the US Environmental Protection Agency (US EPA) as particles smaller than 75 µm in diameter. Incidentally, British Standard 6069 defines ‘dust’ as particles up to 75 µm in diameter.

The wind direction, wind speed and rainfall, at the time when a dust-generating activity is taking place, will also influence whether there is likely to be a dust impact. Due to the variability of the weather, it is impossible to predict what the weather conditions will be when specific activities will be undertaken. However, the purpose of a dust impact assessment will be to determine the potential dust impacts for specific (e.g. worst-case) meteorological conditions.

Local terrain features coupled with wind speed and direction influence the propagation and dispersion of dust. This will also influence the frequency that a sensitive receptor is situated downwind of a dust-generating activity (emission source), and will depend on the distance and change in elevation between the source and receptor. Higher wind speeds in flat terrain and under dry meteorological (low moisture) conditions will result in the highest potential for the release of dust from a site. Buildings, structures and trees can also influence dispersion and the potential for offsite dust nuisance effects.

Adverse effects can occur in any direction from a project site. They are, however, more likely to occur downwind of the prevailing wind directions and/or close to the site (or dust emission source). It should be noted that the ‘prevailing’ wind direction is usually the most frequent direction over a long period such as a year; whereas a particular dust-generating activity may occur over a period of weeks or months (e.g. summer only) during which the most frequent wind direction might be quite different. The most frequent wind direction may also not be the direction from which the wind speeds are highest. The use of the annual mean prevailing wind direction in the assessment of risk is most useful, therefore, for activities of long duration, such as those undertaken at the Kiwi Point Quarry. However, as rainfall acts as a natural dust suppressant, the potential for dust impacts is greater during the drier summer months. Therefore, consideration should be given in this report to seasonal meteorological data (e.g. rainfall amount, wind direction and wind speed), where site-specific or local data are available.

[12] IAQM, 2014. ‘Guidance on the assessment of dust from demolition and construction’, Institute of Air Quality Management, February 2014.

[13] IAQM, 2016. ‘Guidance on the assessment of mineral dust impacts for planning, Institute of Air Quality Management, May 2016.

Local terrain and vegetation conditions also need to be taken into account. Topography and natural barriers (e.g. woodland and other vegetation) will reduce airborne particulate concentrations due to impaction. In addition, if the locality has a history of dust-generating activities, such as quarrying or abrasive blasting, a given level of additional dust may be more acceptable (i.e. more readily tolerated, than in a suburban residential area), as is the case at the Kiwi Point Quarry. Alternatively, impacts may be less acceptable where nearby residents have become sensitised to dust or have a history of complaining and may therefore be more likely to complain about a new dust source. Similarly, in rural areas agricultural activities may generate dust and this should be taken into account in the assessment of risk.

For PM_{10} and $PM_{2.5}$, local ambient air quality monitoring and/or atmospheric dispersion modelling data can be used to determine whether the 24-hour mean standards and guidelines are likely to be exceeded as a result of the proposed dust-generating activities. The risk of PM_{10} NES exceedances will be greatest at receptors very close to the site boundary (or dust emission source), especially if combined with PM_{10} from a major road (e.g. State Highway), or another PM_{10} emission source. However, a quantitative assessment is not considered to be required as part of this study, based on the results of the qualitative assessment presented in Section 3.

2.1.1 Qualitative Assessment

The qualitative (risk-based) assessment methodology outlined below is based on IAQM (2014) and IAQM (2016) and has been modified by MWH for the activities undertaken at the project site. The overall approach followed by MWH draws parallels with the FIDOL[14] method recommended in MfE (2001) and is consistent with MWH (2016).[15]

In accordance with IAQM (2014), the potential dust impacts have been assessed separately for each activity for the following categories:

1) Annoyance (or nuisance) due to dust soiling (deposition); and,
2) The risk of health effects due to an increase in exposure to PM_{10}.

It is noted that as no ecological or culturally sensitive receptors were identified from the desk-top study to be located within close proximity to the quarry site boundary, the potential impacts of dust-generating activities undertaken at the project site on these types of receptors are considered to be negligible and have not been considered further in this assessment.

The methodology follows the source-pathway-receptor (S-P-R) concept and represents the hypothetical relationship between the dust emission source (S), the pathway (P) by which nuisance or exposure might occur and the receptor (R) that could be adversely effected, and would apply equally to the human, cultural and ecological receptors.

The first step in the qualitative assessment is to determine the risk of dust arising in sufficient quantities to cause annoyance and/or health impacts (and/or cultural impacts and/or ecological impacts, where applicable) using four risk categories: 'negligible', 'low', 'medium' and 'high' risk. It first involves defining the site characteristics, onsite dust-generating activities and baseline environmental conditions (including meteorology, terrain, surrounding land use and ambient air quality).

A site is allocated a risk category based on two factors:

- The scale and nature of the dust-generating activities, which determines the potential dust emission magnitude as 'small', 'medium' or 'large' (Step 1); and,
- The sensitivity of the area to dust impacts (Step 2), which is defined as 'low', 'medium' or 'high' sensitivity (see Section 1.5), including the factors influencing the 'pathway' term, such as the position of receptors relative to the prevailing wind direction, distance between source and receptor, the topography, terrain and physical features (including vegetation cover and buildings). This step is also referred to as determining the pathway effectiveness.

These two factors (the 'source' term in Step 1 and the 'pathway' term in Step 2) are combined in Step 3 to determine the risk of dust impacts at each receptor location. The risk category assigned to the site can be different for individual site activities (e.g. drilling/blasting, quarrying, rock crushing and screening, material handling and storage (stockpiling) and vehicle movements). More than one of these activities may occur onsite at any one time.

[14] The Frequency (F), Intensity (I), Duration (D), Offensiveness (O) and Location (L) of the dust effect (nuisance).

[15] MWH, 2016. Kiwi Point Quarry Air Quality Assessment, prepared for Wellington City Council, MWH Global, 12 July 2016.

Where appropriate, the site can be divided into 'zones' for the dust risk assessment. This may result in different mitigation levels being applied to each zone. This could be where different parts of a large site are different distances from the nearest receptors, or where activities move away from or closer towards a receptor, during a new stage of the quarry development (e.g. during the proposed southern extension).

However, MWH recommends that on complex sites where activities are not easily segregated, the mitigation appropriate for the highest risk category should be applied. The aim is to ensure that it is clear what mitigation is supposed to be implemented on a site and to make auditing this simpler not only for regulatory authorities but also for onsite (operational) staff.

2.1.2 Step One – Estimate Dust Impact Risk and Potential Residual Emissions

The residual dust emission magnitude is based on the scale of the anticipated works and should be classified as 'imperceptible', 'small', 'medium', or 'large' after the 'designed-in' mitigation measures have been taken into account. For the purposes of this assessment, the 'designed-in' mitigation measures are assumed to be the existing mitigation measures employed onsite by Holcim (as opposed to the additional measures recommended in MWH, 2016). In addition, landscaping (including existing/proposed trees and vegetation cover), existing/proposed terrain elevations between dust emission sources and receptors and the site-specific / local meteorology (e.g. frequency of moderate to high wind speed conditions at the site and the propagation of dust by wind) should also be considered.

An 'imperceptible' impact magnitude is one where there is predicted to be *no discernible change* as a result of the scheme/activity. For example, there is predicted to be a variation in local ambient concentrations of TSP, PM_{10} or $PM_{2.5}$ of less than 1% of the relevant ambient air quality standards and guidelines. However, for simplicity, MWH has adopted the following classifications in this assessment: 'small', 'medium' and 'large'.

Examples of how the potential dust emission magnitude for different activities can be defined are shown in Table 2-1 and were based on the examples provided in IAQM (2016) for site preparation / restoration, mineral extraction, materials handling, onsite transportation, mineral processing, stockpiles / exposed surfaces and offsite transportation. Note that, in each case, not all the criteria need to be met, and that other criteria may be used if justified in the assessment. The 'medium' magnitude residual dust emissions would fall between the 'small' and 'large' categories.

Table 2-1: Determining Residual Source Emissions

Activity	'Small' Emissions	'Large' Emissions
Site Preparation / Restoration	• Small working area (<2.5 ha) • Low bunds (<4 m in height) • <20,000 m^3 material movement • <5 heavy plant simultaneously active • All bunds seeded • Material with a high moisture content (low dust potential)	• Large working area (>10 ha) • High bunds (>8 m in height) • >100,000 m^3 material movement • >10 heavy plant simultaneously active • All bunds un-seeded • Fine grained and friable material (high dust potential)
Mineral Extraction	• Small working area (<20 ha) • Low energy extraction methods (hydraulic excavator) • Material of low dust potential (e.g. coarse and/or high moisture content) • Low extraction rate (<200,000 tpa)	• Large working area (>100 ha) • High energy extraction methods (drilling and blasting frequently used) • Material of high dust potential (e.g. small particles and/or low moisture content) • High extraction rate (e.g. 1,000,000 tpa)
Materials Handling	• Low number of heavy plant (<5 plant more than 100 m from site boundary within quarry void or clean hardstanding) • Transferring material of low dust potential and/or high moisture content	• High number of heavy plant (>10 loading plant less than 50 m from site and/or on unconsolidated, surface with low moisture content) • Transferring material of high dust potential and/or low moisture content
Onsite Transportation	• Use of (covered) conveyors for majority of onsite material transportation • Paved haul roads • Road surface of low dust potential • Low number of HDV movements (<100 vehicle movements per day) and/or surface materials of compacted aggregate • Low total length of haul roads (<500 m in length) • Controlled (low) vehicle speed (<25 kmph)	• Use of unconsolidated haul roads for majority of onsite material transportation • Unpaved haul roads • Road surface of high dust potential • High number of HDV movements (>250 vehicle movements per day) and/or surface materials of compacted aggregate • High total length of haul roads (>2 km in length) • Uncontrolled vehicle speed
Mineral Processing	• Raw material of low dust potential and/or fixed screening plant with effective dust control • End product of low dust potential (high moisture e.g. wet sand/gravel) • Single process or	• Raw material of high dust potential and/or mobile crusher and screening plant with low dust control • End product of high dust potential (low moisture e.g. hard rock) • Complex or combination of

Activity	'Small' Emissions	'Large' Emissions
	product • Low volume material processed (<200,000 tpa)	processes • High volume material processed (>1,000,000 tpa)
Stockpiles / Exposed Surfaces	• Short-term stockpile (<1 month) and/or quarry production <200,000 tpa • Infrequent material transfers (weekly) • Material of low dust potential (high moisture content) • Ground surface hardstanding / clean • Stockpiles well within quarry void and more than 100 m from site boundary • Small areas of exposed surfaces (<2.5 ha) • Low wind speeds / high dust threshold	• Long-term stockpile (>12 months) and/or quarry production >1,000,000 tpa • Frequent material transfers (daily) • Material of high dust potential (low moisture content) • Ground surface unconsolidated / un-kept • Stockpiles or exposed surfaces within 50 m from site boundary • Large areas of exposed surfaces (>10 ha) • High wind speeds / low dust threshold
Offsite Transportation (trackout)	• Low number of HDV movements (<25 per day) • Paved (sealed) surface road and/or use of road sweeper (truck) or manual cleaning • Extensive vehicle cleaning facilities • Low total length of access road (<20 m)	• High number of HDV movements (>200 per day) • Unconsolidated access road and/or no road sweeper or manual cleaning • Limited or no vehicle cleaning facilities • High total length of access road (>50 m)

2.1.3 Step Two – Determine Receptor Sensitivity and Pathway Effectiveness

The determination of the sensitivity of the receptors identified in this assessment has taken the following factors into account:

- Specific sensitivities of receptors (see examples shown in Section 1.5). In this assessment, all residential properties (including the retirement village) were considered to be of 'high' sensitivity to potential dust emissions at the quarry. The school and business were considered to be of 'moderate' sensitivity, while the park was of 'low' sensitivity to dust emissions at the quarry;
- The level of amenity;
- The proximity and type of sensitive receptors (including frequency that receptors are situated downwind of dust-generating activities during prevailing wind directions);
- Where an assessment for PM_{10} is required, the local PM_{10} background concentration and compliance against the NES for PM_{10} (not applicable in this assessment); and,
- Site-specific factors, such as whether there are any man-made earth bunds, local terrain features (the latter are considered to be significant at Kiwi Point Quarry, as shown in MWH, 2016), or natural shelters, such as trees and other types of vegetation, to reduce the risk of wind-blown dust.

In accordance with IAQM (2016), the effectiveness of the pathway to each sensitive receptor location was determined by considering the distance and direction of the receptors relative to the prevailing wind directions (based on 5 years' wind speed and direction data for Kelburn AWS as shown in Section 2.2, in the absence of site-specific data), and the criteria used in this assessment are summarised in Table 2-2 and Table 2-3, respectively. However, the criteria shown in the tables do not consider the change in elevation between the dust emission source and receptor, and this limitation has the potential to lead to an over-prediction (more conservative assessment) of the potential impacts.

Table 2-2: Categorisation of Frequency of Potentially Dusty Winds

Frequency Category	Criteria*
Infrequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on all days are less than 5%
Moderately frequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on dry days are between 5% and 12%
Frequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on dry days are between 12% and 20%
Very frequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on dry days are greater than 20%

N.B. * For a worst-case assessment, include all days.

High-risk conditions for dust emissions at the site are associated with dry days with measured winds above moderate breeze (5.5 metres per second or 'm/s'). However, this assessment has not taken into account the potential for rainy days to reduce the frequency of potential 'high-risk' conditions. In other words, the frequency of 'potentially dusty winds' determined in Section 2.2 for the Kiwi Point Quarry is based on Table 2-2 and for 'all days' (including rainy days).

Given that the Kiwi Point Quarry is not situated within a polluted airshed and in the absence of actual site-specific or local (e.g. GWRC) ambient air quality monitoring data, it was assumed that the 24-hour mean background concentration of PM_{10} beyond the project site boundary was 28 µg/m^3. Reference should also be made to the New Zealand Transport Agency's interactive background air quality maps[16], which indicates that the existing 24-hour mean background concentration of PM_{10} within Raroa, Ngauranga West, Ngauranga East and Rangoon Heights is 28 µg/m^3.

[16] http://nzta.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=9ba0e52d1b3d4770ab031bb843d6198f

Table 2-3: Categorisation of Receptor Distance from Source

Frequency Category	Criteria*
Distant	Receptor is between 200 m and 400 m from the dust source
Intermediate	Receptor is between 100 m and 200 m from the dust source
Close	Receptor is less than 100 m from the dust source

N.B. * For a worst-case assessment, do not take into account changes in terrain elevations or the influence of vegetation cover and buildings.

The pathway effectiveness is determined from the outputs from Table 2-2 and Table 2-3 and using Table 2-4.

Table 2-4: Pathway Effectiveness

Receptor Distance	Frequency of Potentially Dusty Winds			
	Infrequent	Moderately Frequent	Frequent	Very Frequent
Close	Ineffective	Moderately Effective	Highly Effective	Highly Effective
Intermediate	Ineffective	Moderately Effective	Moderately Effective	Highly Effective
Distant	Ineffective	Ineffective	Moderately Effective	Moderately Effective

N.B. * For a worst-case assessment, do not take into account changes in terrain elevations or the influence of vegetation cover and buildings.

2.1.4 Step Three – Define the Potential Dust Impact Risk for Each Activity

The third step is to combine the residual source emissions (Step 1) and the pathway effectiveness (Step 2) to predict the dust impact risk for each dust-generating activity (and/or phase) and receptor as shown in Table 2-5.

Table 2-5: Dust Impact Risk Assessment Criteria

Pathway Effectiveness (Step 2)	Residual Source Emissions (Step 1)		
	Small	Medium	Large
Highly Effective Pathway	Low Risk	Medium Risk	High Risk
Moderately Effective Pathway	Negligible Risk	Low Risk	Medium Risk
Ineffective Pathway	Negligible Risk	Negligible Risk	Low Risk

The final step in the assessment is to determine the magnitude (scale) of the potential dust impact risks predicted at each receptor location. For complex sites it may be necessary to determine the risk for individual activities or phases and an overall assessment should be made based on the highest (worst-case) risk activity/phase. The dust impact magnitude criteria used in this assessment are shown in Table 2-6.

Table 2-6: Dust Impact Magnitude Criteria

Dust Impact Risk	Receptor Sensitivity		
	Low	Medium	High
High Risk	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Effect
Medium Risk	Negligible Effect	Slight Adverse Effect	Moderate Adverse Effect
Low Risk	Negligible Effect	Negligible Effect	Slight Adverse Effect
Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

2.2 Local Meteorology

The Kelburn Automatic Weather Station (AWS) is located 5.5 km south-west of the Kiwi Point Quarry and is operated by MetService (agent number 25354). Analysis of hourly wind speed and direction data for Kelburn Automatic Weather Station (AWS) between 2008 and 2012 indicates that winds from all directions are experienced at the monitoring site and are therefore likely to be experienced onsite.

The wind speed and direction frequencies are shown in Table 2-7 and in Figure 2-1.

Table 2-7: Wind Speed and Direction Frequencies at Kelburn AWS between 2008 and 2012

Wind Direction	Wind Speed (m/s)						
	0.5 to 1.5 (%)	1.5 to 3.0 (%)	3.0 to 5.5 (%)	5.5 to 8.0 (%)	8.0 to 10.5 (%)	>10.5 (%)	Total (%)
N	0.6	1.8	4.1	2.9	0.9	0.2	10.5
NNE	0.7	1.3	2.2	1.5	0.4	0.1	6.1
NE	0.6	0.9	0.6	0.3	0.1	0.0	2.5
ENE	0.6	0.7	0.4	0.1	0.0	0.0	1.8
E	0.5	0.6	0.5	0.2	0.1	0.0	1.9
ESE	0.4	0.5	0.8	0.4	0.2	0.0	2.5
SE	0.4	1.2	3.3	2.7	1.5	0.5	9.6
SSE	0.5	1.9	7.1	5.3	2.4	0.6	17.7
S	0.6	1.7	4.7	3.2	2.4	1.2	13.7
SSW	0.4	0.8	1.4	0.6	0.3	0.2	3.7
SW	0.3	0.5	0.6	0.2	0.0	0.0	1.7
WSW	0.5	0.7	0.3	0.1	0.0	0.0	1.5
W	0.8	1.1	0.5	0.2	0.1	0.0	2.8
WNW	0.7	0.7	1.3	1.4	0.9	0.6	5.6
NW	0.6	0.8	2.5	3.2	2.9	2.3	12.2
NNW	0.5	0.9	2.4	1.2	0.4	0.2	5.6
Sub-Total	**8.8**	**16.2**	**32.5**	**23.3**	**12.6**	**6.0**	**99.5**
Calms							**0.2**
Missing							**0.3**
Total							**100.0**

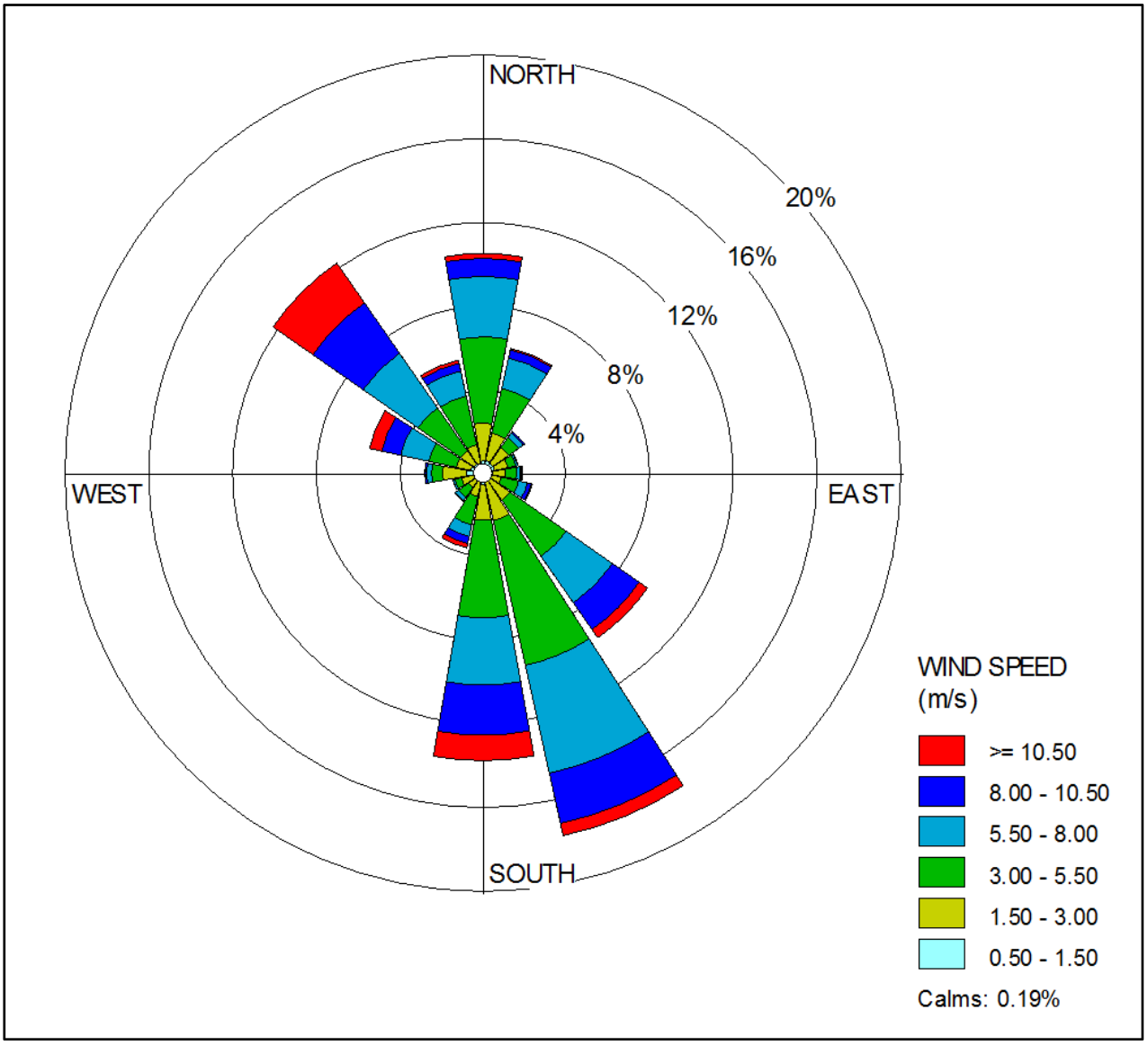

Figure 2-1: Wind Rose for Kelburn AWS for 2008 to 2012

The data shown in Table 2-7 and Figure 2-1 indicate that the predominant winds (63.8% in total) measured at the Kelburn AWS were from the south-south-east (SSE, 17.7%), south (S, 13.7%), north-west (NW, 12.2%), north (N, 10.5%) and south-east (SE, 9.6%).

The wind speed frequency distribution for Kelburn AWS for each year is shown in Figure 2-2. The figure indicates that 41.5% of the hourly mean wind speeds were above 5.5 m/s, which is significant as this has been adopted in this assessment as the threshold above which there is the potential for the propagation of dust in dry conditions, based on IAQM (2016). A 5.5 m/s mean wind speed corresponds to 19.8 km/hr or 'moderate breeze' (Beaufort 4) or 'moderate' winds, as defined by the MetService. Further analysis has been undertaken of the data to determine the percentage frequency that sensitive receptor locations are likely to be situated downwind of potentially dusty winds blowing over the quarry.

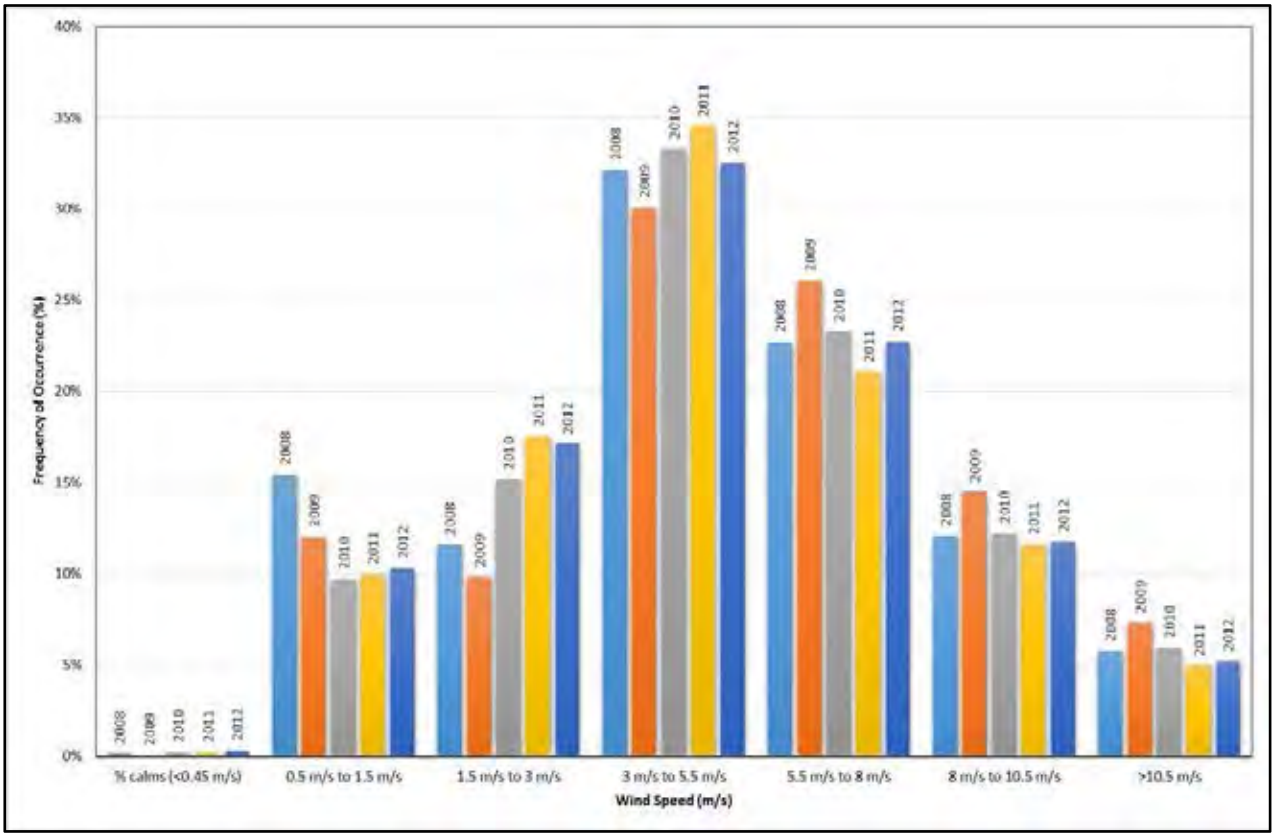

Figure 2-2: Wind Speed Frequency Distribution for Kelburn AWS for 2008 to 2012

The predominant winds above 5.5 m/s measured at the Kelburn AWS were from the NW (8.4%), SSE (8.3%), S (6.8%), SE (4.7%) and N (4%), which corresponds to 32.2% of the total winds above 5.5 m/s, as shown in Table 2-8 and in the wind rose shown in Figure 2-3.

Table 2-8: Moderate to High Wind Speed and Direction Frequencies at Kelburn AWS

Wind Direction	Wind Speed for 2008 to 2012 (m/s)			
	5.5 to 8.0 (%)	8.0 to 10.5 (%)	>10.5 (%)	Total (%)
N	2.9	0.9	0.2	4.0
NNE	1.5	0.4	0.1	2.0
NE	0.3	0.1	0.0	0.3
ENE	0.1	0.0	0.0	0.1
E	0.2	0.1	0.0	0.3
ESE	0.4	0.2	0.0	0.7
SE	2.7	1.5	0.5	4.7
SSE	5.3	2.4	0.6	8.3
S	3.2	2.4	1.2	6.8
SSW	0.6	0.3	0.2	1.1
SW	0.2	0.0	0.0	0.2
WSW	0.1	0.0	0.0	0.1
W	0.2	0.1	0.0	0.3
WNW	1.4	0.9	0.6	2.9
NW	3.2	2.9	2.3	8.4
NNW	1.2	0.4	0.2	1.8
Sub-Total	**23.3**	**12.6**	**6.0**	**42.0**
Calms				**0.2**
<5.5 m/s				**57.5**
Missing				**0.3**
Total				**100.0**

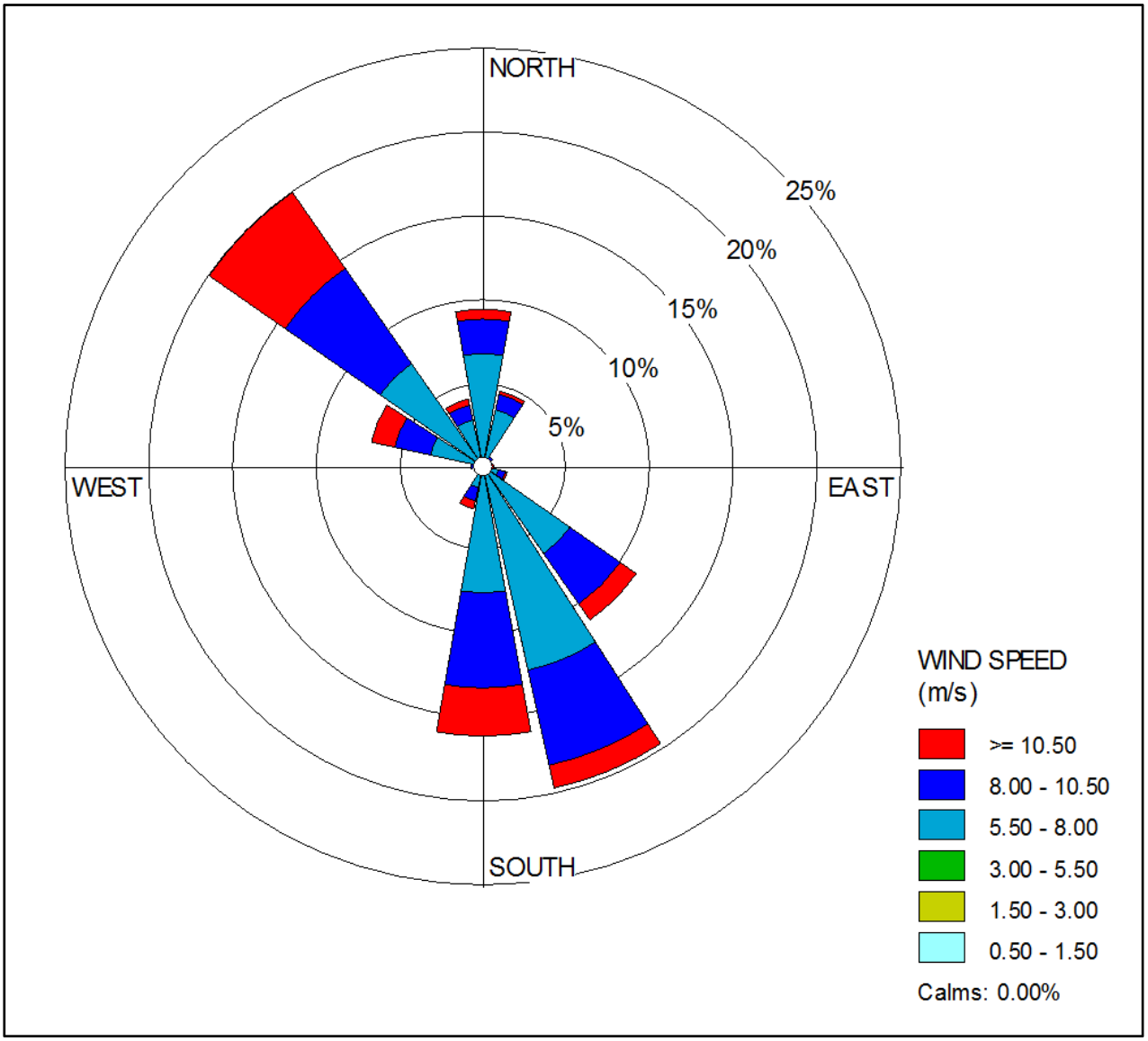

Figure 2-3: Wind Rose for Moderate to High Wind Speeds at Kelburn AWS for 2008 to 2012

2.3 Scoring

In accordance with the *'Alternatives Workshop Briefing Paper'* prepared by Incite[17], the options were assessed in this report as follows:

- +3 Significant positive (beneficial air quality impact);
- +2 Moderate positive (beneficial air quality impact);
- +1 Minor positive (beneficial air quality impact);
- 0 (zero) Neutral or *de minimus* (neither beneficial nor adverse air quality impact);
- -1 Minor negative (adverse air quality impact);
- -2 Moderate negative (adverse air quality impact); and,
- -3 Significant negative (adverse air quality impact).

In addition, if it is determined that an option should not proceed based on the Resource Management Act 1991 (RMA), or any other relevant legislation or statutory provisions, the option was given an "F" to indicate a fatal flaw.

[17] Incite, 2016. Kiwi Point Quarry Expansion—Alternatives Workshop Briefing Paper, prepared for Wellington City Council, Incite, October 2016.

3 Air Quality Impact Assessment

3.1 Site Visit

MWH undertook a site visit on the 31 October 2016. A photograph showing the southern ridge (Option 2) and proposed five stage quarry extension ridge (Option 3) is presented in Figure 3-1. The figure also shows the indicative boundary of the proposed option 3 quarry extension area (dashed yellow line) and the existing residential properties (sensitive receptors) located on Gurkha Crescent (top right corner).

Figure 3-1: Photograph of the Existing Quarry Pit (Area C) Southern Ridge Looking SSE

3.2 Option 1

Based on MWH (2016), the Do Nothing (baseline) option is likely to result in *slight adverse* air quality effects in the local community. These effects are considered to be *no more than minor* based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the MfE's 24-hour mean trigger value of 100 µg/m^3 will be exceeded beyond the Kiwi Point Quarry site

boundary or at any sensitive receptor location as a result of the baseline (existing) TSP/dust emissions at the quarry.

3.3 Option 2

Based on MWH (2016), the proposed southern extension is likely to result in *slight adverse* air quality effects in the local community. These effects are considered to be *no more than minor* based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the MfE's 24-hour mean trigger value of 100 µg/m^3 will be exceeded beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of TSP/dust emissions generated as a result of the southern extension at the quarry.

3.4 Option 3

3.4.1 Gurkha Crescent Receptor Locations

The most 'at-risk' receptors in the vicinity of the Option 3 quarry extension area (as shown in Figure 1-5 for Stage 5), based on the distance from the proposed dust-generating activities and each receptor, and the qualitative methodology outlined in Section 2, are the existing residential properties located on Gurkha Crescent.

Based on the Kelburn AWS wind speed and direction data for 2008 to 2012, the Gurkha Crescent receptors are likely to be *infrequently* exposed to potentially dusty winds (wind speeds above 5.5 m/s) and blowing from the NNE to the E (20ºN to 90ºN). Based on the AWS data, these receptors are only likely to be exposed to potentially dusty winds from the NNE to the E for 2.7% of the time (i.e. less than 5% of the time). As these receptors are residential properties they are considered to be of *high* sensitivity to potentially dusty winds from the quarry. However, they are situated at an *intermediate* distance downwind from the nearest proposed dust-generating activities (approximately 100 m) and the receptor pathway is *ineffective*.

Therefore, based on the qualitative assessment, the worst-case dust impact risk predicted at these locations (assuming *large* residual dust emissions) is considered to be *low*, while the expected dust impact risk at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.*

The worst-case dust impact magnitude predicted at these locations (assuming *large* residual dust emissions) is considered to be *slight adverse*, while the expected dust impact magnitude at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.* In other words, providing that the designed-in mitigation measures are implemented onsite (see Section 4), the air quality effects beyond the boundary of the quarry are predicted to be *no more than minor* as a result of the proposed Option 3 dust-generating activities.

3.4.2 Shastri Terrace Receptor Locations

Based on the Kelburn AWS data, the Shastri Terrace receptors are likely to be *infrequently* exposed to potentially dusty winds (wind speeds above 5.5 m/s) and blowing from the NE to the ESE (40ºN to 110ºN). Based on the AWS data, these receptors are only likely to be exposed to potentially dusty winds from the NE to the ESE for 1.4% of the time (i.e. less than 5% of the time). As these receptors are residential properties they are considered to be of *high* sensitivity to potentially dusty winds from the quarry. However, they are situated approximately 220 m downwind from the nearest proposed dust-generating activities and are therefore *distant*, while the receptor pathway is *ineffective*.

Therefore, based on the qualitative assessment, the worst-case dust impact risk predicted at these locations (assuming *large* residual dust emissions) is considered to be *low*, while the expected dust impact risk at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.*

The worst-case dust impact magnitude predicted at these locations (assuming *large* residual dust emissions) is considered to be *slight adverse*, while the expected dust impact magnitude at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.* In other words, providing that the designed-in mitigation measures are implemented onsite (see Section 4), the air quality effects beyond the boundary of the quarry are predicted to be *no more than minor* as a result of the proposed Option 3 dust-generating activities.

3.4.3 Tyers Road Receptor Locations

Whilst the existing businesses located on Tyers Road have not been included as sensitive receptors in this report, a qualitative assessment is provided below for completeness, to assess the potential risk associated with the proposed Option 3 dust-generating activities at these properties.

Based on the Kelburn AWS data, the Tyers Road businesses are likely to be *frequently* exposed to potentially dusty winds (wind speeds above 5.5 m/s) and blowing from the W to the NNE (270ºN to 15ºN). Based on the AWS data, these receptors are only likely to be exposed to potentially dusty winds from the W to the NNE for 19.4% of the time (i.e. between 12% and 20% of the time). As these receptors are commercial properties they are considered to be of *medium* sensitivity to potentially dusty winds from the quarry. However, they are situated in *close* proximity to the nearest proposed dust-generating activities (less than 100 m) and the receptor pathway is *highly effective*. However, it is noted that the assumption regarding the receptor pathway does not take into account the fact that the elevation at the south-eastern corner will be maintained at 70 m ASL (approximately 40 m above the proposed elevation of the floor at Stage 5), which indicates that there is the potential for the proposed batter slopes and benches to not only obstruct the wind flow during winds from the W to the NNE, but to also reduce the potential for the propagation of dust beyond the quarry boundary.

Given that the majority of the dust-generating activities will be undertaken within the low-lying parts of the quarry extension (the void) and in view of the residual dust emission magnitude criteria presented in Section 2, residual dust emissions are anticipated to be *medium*. Based on the qualitative assessment, the expected dust impact risk at these locations (assuming *medium* residual dust emissions) is considered to be *medium.* The expected dust impact magnitude at these locations (assuming *medium* residual dust emissions) is considered to be *slight adverse.* In other words, providing that the designed-in mitigation measures are implemented onsite (see Section 4), the air quality effects beyond the boundary of the quarry are predicted to be *no more than minor* as a result of the proposed Option 3 dust-generating activities.

3.4.4 Other Receptor Locations

The remaining sensitive receptor locations (as identified in Section 1.5) are situated at distances of more than 400 m from the proposed Option 3 dust-generating activities (i.e. they are situated at greater distances from the potential emissions sources, compared with the Gurkha Crescent, Shastri Terrace and Tyers Road receptors). Therefore, providing that the designed-in mitigation measures are implemented onsite, the air quality effects at these locations are predicted to be *no more than minor* as a result of the proposed Option 3 dust-generating activities, based on the qualitative assessment.

3.5 Option 4

3.5.1 Gurkha Crescent Receptor Locations

Based on the qualitative assessment, there is predicted to be *no discernible change* between Option 3 and Option 4 at the Gurkha Crescent receptors, despite the potential for there being dust-generating activities at a distance of 70 m from the nearest residential property boundary (i.e. in *close* proximity). Therefore, the worst-case dust impact risk predicted at these locations (assuming *large* residual dust emissions) is considered to be *low*, while the expected dust impact risk at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.*

The worst-case dust impact magnitude predicted at these locations (assuming *large* residual dust emissions) is considered to be *slight adverse*, while the expected dust impact magnitude at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.* In other words, providing that the designed-in mitigation measures are implemented onsite (see Section 4), the air quality effects beyond the boundary of the quarry are predicted to be *no more than minor* as a result of the proposed Option 4 dust-generating activities.

3.5.2 Shastri Terrace Receptor Locations

Based on the Kelburn AWS data, the Shastri Terrace receptors are likely to be *infrequently* exposed to potentially dusty winds (wind speeds above 5.5 m/s) and blowing from the NE to the ESE (40ºN to 110ºN). Based on the AWS data, these receptors are only likely to be exposed to potentially dusty winds from the NE to the ESE for 1.4% of the time (i.e. less than 5% of the time). As these receptors are

residential properties they are considered to be of *high* sensitivity to potentially dusty winds from the quarry. However, they are situated approximately 170 m downwind from the nearest proposed dust-generating activities and are therefore at an *intermediate* distance, while the receptor pathway is *ineffective*.

Therefore, based on the qualitative assessment, the worst-case dust impact risk predicted at these locations (assuming *large* residual dust emissions) is considered to be *low*, while the expected dust impact risk at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.*

The worst-case dust impact magnitude predicted at these locations (assuming *large* residual dust emissions) is considered to be *slight adverse*, while the expected dust impact magnitude at these locations (assuming *medium* residual dust emissions) is considered to be *negligible.* In other words, providing that the designed-in mitigation measures are implemented onsite (see Section 4), the air quality effects beyond the boundary of the quarry are predicted to be *no more than minor* as a result of the proposed Option 4 dust-generating activities.

3.5.3 Tyers Road Receptor Locations

Based on the qualitative assessment, there is predicted to be *no discernible change* between Option 3 and Option 4 at the Gurkha Crescent receptors, despite the potential for there being dust-generating activities at a distance of 70 m from the nearest residential property boundary (i.e. in *close* proximity). Therefore, the expected dust impact risk at these locations (assuming *medium* residual dust emissions) is considered to be *medium.* The expected dust impact magnitude at these locations (assuming *medium* residual dust emissions) is considered to be *slight adverse.*

In other words, providing that the designed-in mitigation measures are implemented onsite (see Section 4), the air quality effects beyond the boundary of the quarry are predicted to be *no more than minor* as a result of the proposed Option 4 dust-generating activities.

3.5.4 Other Receptor Locations

The remaining sensitive receptor locations (as identified in Section 1.5) are situated at distances of more than 400 m from the proposed Option 4 dust-generating activities (i.e. they are situated at greater distances from the potential emissions sources, compared with the Gurkha Crescent, Shastri Terrace and Tyers Road receptors). Therefore, providing that the designed-in mitigation measures are implemented onsite, the air quality effects at these locations are predicted to be *no more than minor* as a result of the proposed Option 4 dust-generating activities, based on the qualitative assessment.

3.6 Wind Environment

The proposed southern extension (Option 2), the proposed five stage development (Option 3) and the proposed maximum expansion into Area 2B (Option 4) have the potential to affect the wind microclimate within the project site and beyond the site boundary.

Based on the Kelburn AWS data for 2008 to 2012, winds from the SE, SSE and S occur approximately 41% of the time. As a result of the proposed removal of the southern ridge (Option 2) and the proposed extension towards Gurkha Crescent (Options 3 and 4), there is the potential for the existing sheltering effect experienced onsite during winds from the SE, SSE and S to cease. Given the high frequency of winds from these directions, there is the potential for a noticeable change in the wind microclimate both onsite and beyond the site boundary. Furthermore, the frequency of moderate to high wind speeds from these directions is 19.8%, and there is the potential for adverse wind effects (e.g. comfort and safety effects and/or vegetation damage) across certain parts of the site (e.g. proposed access road to the southern extension area) in the absence of mitigation. However, it is unlikely that there will be any significant adverse effects within the more sheltered parts of the site (e.g. below the ridgeline from Shastri Terrace and Maldive Street), or beyond the site boundary, as a result of Options 2 to 4. MWH recommends undertaking a more detailed assessment of the potential wind microclimate effects based on the preferred option, following the completion of the alternatives assessment by Incite and WCC.

4 Mitigation Measures

4.1.1 Mitigation Measures

A number of design and operational mitigation measures were recommended in MWH (2016). These measures are appropriate for the proposed options considered in this assessment and should be implemented onsite where possible and practicable to reduce the potential for dust nuisance effects in the local community.

4.1.2 Weather Station

It is recommended that an automatic weather station is established in a suitable location on the site to measure, as a minimum, the onsite wind speed and direction. Other parameters which could also be measured at little additional cost include: ambient temperature; relative humidity; atmospheric pressure; and rainfall. A possible location for the weather station could be on the ridge, in close proximity to the south-western boundary of the quarry and in line with the five stage quarry extension area (Option 3) and Gurkha Crescent, providing that an access track can be installed for maintenance purposes.

The weather station data should be reviewed by Holcim prior to blasting. For example, no blasting within the southern extension area (including the Option 3 Stage 5 extraction area) should occur when the wind speed exceeds 12 m/s and is blowing from the NE and NW (i.e. towards the residential properties located on Gurkha Crescent and Shastri Terrace, and the businesses on Tyers Road, respectively). In addition, all extraction, crushing and screening works should cease in the event that the onsite wind speed during NE and NW wind directions exceeds 12 m/s for a sustained period of time (e.g. >4 hours). The Quarry Manager should keep a record of all visual inspections undertaken on the site for visible dust emissions, all instances that the processing plant is shut-down to reduce dust emissions (e.g. when wind speeds exceed 12 m/s) and when dust mitigation measures are undertaken.

Prior to blasting, dust extraction equipment and filters should be used to control dust emissions from the drill rig. Any dusty material that has collected on the blast area during the drilling should be removed prior to detonation in order to reduce the potential for the generation of dust emissions. Prior warning should be given to the residents of Gurkha Crescent and Shastri Terrace before undertaking blasting.

The weather station should be positioned as far away from buildings and trees as possible, as these structures affect wind flow. The onsite meteorological data may be used for the following reasons:

- To manage the occasions when the propagation of dust occurs at the site. For example, it may be necessary to avoid undertaking drilling, blasting, quarrying (extraction) and processing (crushing and screening) activities under moderate to strong winds blowing towards the nearest sensitive receptors as these conditions may, in the absence of adequate mitigation, cause dust complaints;
- To corroborate (or contradict) any dust nuisance complaints that may arise during the continued operation of the quarry.

The weather station should be sited and operated in accordance with the MfE's 'Good Practice Guide for Air Quality Monitoring and Data Management' (MfE, 2009) and the following documents:

- US EPA, 2000. Meteorological Monitoring Guidance for Regulatory Modeling Applications, United States Environmental Protection Agency (US EPA), February, 2000;
- Australian/New Zealand Standard (AS/NZS) 3580.14:2014, Methods for Sampling and Analysis of Ambient Air—Meteorological Monitoring for Ambient Air Quality Monitoring Applications; and,
- WMO, 2008. Guide to Meteorological Instruments and Methods of Observation, World Meteorological Organization (WMO), WMO-No. 8, Geneva, Seventh Edition, 2008.

4.1.3 Ambient Monitoring

MWH recommends implementing a regular monitoring programme for dust emissions during this phase of the quarry works. This can range from visual inspections for visible dust plumes and dust deposition/flux monitoring, but could also include real-time PM_{10} continuous monitoring on the south-east boundary of the southern extension area and along the south-western boundary (in close proximity to Gurkha Crescent and Shastri Terrace).

The monitoring data could be used as a management tool to implement dust mitigation (suppression) measures, as required, particularly during dry conditions and under moderate to high wind speeds (>5.5 m/s) blowing from the W to the ESE (i.e. towards Gurkha Crescent, Shastri Terrace and Tyers Road).

5 Scoring

5.1 Option 1

Based on MWH (2016), a score of **-1** (i.e. minor negative, or *slight adverse* air quality effects in the local community) was determined for Option 1 (Do Nothing).

5.2 Option 2

Based on MWH (2016), a score of **-1** (i.e. minor negative, or *slight adverse* air quality effects in the local community) was determined for Option 2 (Permitted Activity Development – Southern Extension).

5.3 Option 3

A score of **-1** (i.e. minor negative, or *slight adverse* air quality effects in the local community) was determined for Option 3 (Five Stage Development).

5.4 Option 4

A score of **-1** (i.e. minor negative, or *slight adverse* air quality effects in the local community) was determined for Option 4 (Area 2B Maximum Expansion).

5.5 Summary

Whilst scores of **-1** (minor negative) were predicted for all four options, based on the fact that there are likely to be *slight adverse* effects in the local community for each option, it could be argued that there will be no discernible change between the various options, providing that appropriate mitigation measures are implemented.

6 Conclusions

MWH was commissioned by WCC to undertake a preliminary air quality impact assessment for activities associated with the proposed expansion of the existing Kiwi Point Quarry located off Centennial Highway in Ngauranga, Wellington.

The purpose of the preliminary air quality impact assessment presented in this report is to determine the potential for dust nuisance effects in the surrounding community due to dust emissions at the project site. MWH has undertaken a qualitative (risk-based) assessment of the existing or proposed dust emissions at the site and their potential to cause dust nuisance effects beyond the site boundary based on the *'Alternatives Workshop Briefing Paper'* prepared by Incite as part of the scoping work for a proposed plan change to enable the expansion of the quarry (Incite, 2016)[18]. A workshop was held on 3 November 2016 in Wellington to discuss the potential options associated with the proposed quarry expansion. Overall, four options were assessed in this report by MWH.

The potential dust impacts have been assessed separately for each activity for the following categories:

- Annoyance (or nuisance) due to dust soiling (deposition); and,
- The risk of health effects due to an increase in exposure to PM_{10}.

6.1 Dust Nuisance

The existing and proposed activities undertaken at the Kiwi Point Quarry are considered to have a *slight adverse* effect within the surrounding community. These potential effects are considered to be *no more than minor* and are based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the Ministry for the Environment's 24-hour mean trigger value of 100 micrograms per cubic metre for TSP will be exceeded beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of dust and particulate emissions at the quarry. The results of the qualitative assessment indicate that there are unlikely to be any dust nuisance effects beyond the Kiwi Point Quarry site boundary, provided that the mitigation measures recommended in MWH's report[19] dated July 2016 are implemented.

Furthermore, the results of the assessment indicate that the existing and proposed activities are of *low* risk, and that the most 'at-risk' receptors are existing residential properties located on Gurkha Crescent and Shastri Terrace, which are situated to the south-west of the site.

The existing businesses located on Tyers Road were assessed as being at *medium* risk and were considered to have the potential to experience a *slight adverse* effect due to dust emissions generated as a result of the proposed quarry expansion.

6.2 PM_{10}

Based on the results of the qualitative assessment for dust, MWH considers that it is unlikely that there will be any exceedances of the 24-hour mean National Environmental Standard (NES) for particles less than 10 microns in diameter (PM_{10}) beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of PM_{10} emissions at the quarry, provided that the mitigation measures recommended in MWH's report[20] dated July 2016 are implemented.

[18] Incite, 2016. Kiwi Point Quarry Expansion—Alternatives Workshop Briefing Paper, prepared for Wellington City Council, Incite, October 2016.

[19] MWH, 2016. Kiwi Point Quarry Air Quality Assessment, prepared for Wellington City Council, MWH Global, 12 July 2016.

[20] *Ibid*.

7 References

Australian/New Zealand Standard (AS/NZS) 3580.14:2014, Methods for Sampling and Analysis of Ambient Air—Meteorological Monitoring for Ambient Air Quality Monitoring Applications.

IAQM, 2014. Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management (IAQM), February 2014.

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US EPA, 2000. Meteorological Monitoring Guidance for Regulatory Modeling Applications, United States Environmental Protection Agency (US EPA), February, 2000.

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Appendix A Kiwi Point Quarry Air Quality Assessment

REPORT

KIWI POINT QUARRY AIR QUALITY ASSESSMENT

Prepared for Wellington City Council

12 July 2016

MWH

BUILDING A BETTER WORLD

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Executive Summary

MWH New Zealand Limited (MWH) was commissioned by Wellington City Council to undertake an air quality impact assessment for activities undertaken at the existing Kiwi Point Quarry located off Centennial Highway in Ngauranga, Wellington.

In order to determine the potential for dust nuisance effects in the surrounding community due to dust emissions at the project site, MWH has undertaken a qualitative (risk-based) assessment of the existing and proposed dust emissions on the site and their potential to cause dust nuisance effects beyond the site boundary. In addition, this assessment also involved undertaking a review of the project site's complaints record, in order to predict the level of impact that may be experienced in the surrounding community. According to the Greater Wellington Regional Council's complaints database, there have been three dust nuisance complaints relating to activities undertaken at the Kiwi Point Quarry. These complaints were made on 14 January 2009, 18 December 2009 and 20 December 2011.

Overall, the existing and proposed activities undertaken at the Kiwi Point Quarry are considered to have a slight adverse effect within the surrounding community.

These potential effects are considered to be no more than minor and are based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the Ministry for the Environment's 24-hour mean trigger value of 100 µg/m^3 will be exceeded beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of total suspended particles (TSP) or dust emissions at the quarry. The results of the qualitative assessment indicate that there are unlikely to be any dust nuisance effects beyond the Kiwi Point Quarry site boundary, provided that the mitigation measures recommended in this report are implemented and the existing measures are adhered to.

Furthermore, the results of the assessment indicate that the existing and proposed activities are of low risk, and that the most 'at-risk' receptors are as follows:

- R11 170 Fraser Avenue Medium residual emissions primarily from Areas A, B & C;
- R12 130 Fraser Avenue Small residual emissions primarily from Areas C, D & G;
- R13 134 Burma Road Medium residual emissions primarily from Areas A, B, C, D & G;
- R14 159 Burma Road Small residual emissions primarily from Areas D & G;
- R15 113 Fraser Avenue Small residual emissions primarily from Areas C, D & G; and,
- R16 9 Plumer Street Medium residual emissions primarily from Areas A, B & C.

Based on the results of the qualitative assessment for dust, MWH considers that it is unlikely that there will be any exceedances of the 24-hour mean National Environmental Standard (NES) for particles less than 10 microns in diameter (PM_{10}) beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of PM_{10} emissions at the quarry, provided that the mitigation measures recommended in this report are implemented.

Wellington City Council

Kiwi Point Quarry Air Quality Assessment

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1 Introduction

1.1 Project Overview

MWH New Zealand Limited (MWH) was commissioned by Wellington City Council (WCC or the 'Council') to undertake an air quality impact assessment for activities undertaken at the existing Kiwi Point Quarry located off Centennial Highway/State Highway 1 (SH1) in Ngauranga, Wellington (the 'project site' or the 'quarry'). Kiwi Point Quarry is an established greywacke quarry located in the Ngauranga Gorge, involving ongoing extraction, processing, a cleanfill and rehabilitation, and is operated by Holcim New Zealand Limited (Holcim) under contract to WCC.

The aim of the air quality impact assessment is to determine the potential for dust nuisance effects beyond the boundary of the project site. Resource consent number WGN050352 [24540] authorises the discharge to air of contaminants from a cleanfill located at the project site and was granted to WCC by Greater Wellington Regional Council (GWRC) on 6 July 2005. The consent will expire on 6 July 2020. A copy of the resource consent is contained in Appendix A. Note that there is currently no resource consent for the discharges to air from the quarrying (extraction) and processing (crushing and screening) activities undertaken on the project site.

MWH prepared an Assessment of Environmental Effects (AEE) report entitled *'Kiwi Point Quarry Southern Extension Assessment of Effects on the Environment'* in May 2016. The AEE was prepared in support of WCC's bundled resource consent application to GWRC for discharges to air and surface water and other activities undertaken at the site with regards to WCC's proposed expansion of the existing quarry in the south-east corner of the site towards Tyers Road (hereafter the 'southern extension'). Refer to the AEE for additional information.

The purpose of this report is to address the additional resource consent applications requested by GWRC under section 91 of the Resource Management Act (1991); one of which is a resource consent to discharge contaminants to air (predominantly dust/particulate matter) from site-wide activities, including:

- Soil/vegetation removal and overburden stripping and associated earthworks (including soil handling and storage). Overburden is disposed of in designated areas onsite;
- Drilling and blasting;
- Open-cast extraction and quarrying;
- Transfer of aggregate from the blast area(s) to crushing, screening and washing plant;
- Crushing, screening, and processing of aggregate;
- Stockpiling of aggregate products for retail; and,
- Transfer of aggregate products from stockpiles to customer's trucks via front-end loader for transport off site (product load-out).

This report examines the potential air quality effects that may arise during the operation of the quarry, including the proposed quarry expansion (southern extension). A number of mitigation measures are currently implemented onsite by Holcim to control dust emissions, however, a number of additional mitigation measures have been recommended by MWH in this report to further reduce the potential for dust nuisance effects in the surrounding community.

This report supports WCC's resource consent application to GWRC to discharge to air contaminants (predominantly dust) associated with the extraction (quarrying) and processing (crushing and screening) activities undertaken at the project site.

1.2 Study Overview

This report seeks to assess the potential air quality effects associated with the existing and proposed quarrying activities at the nearest identified sensitive receptors, and to make recommendations regarding the control of dust/particulate matter at the site, where required, as this is the principal contaminant of concern.

In order to determine the potential for dust nuisance effects in the surrounding community due to dust emissions at the project site, MWH has undertaken a qualitative (risk-based) assessment of the existing and proposed dust emissions on the site and their potential to cause dust nuisance effects beyond the

site boundary. In addition, this assessment also involved undertaking a review of the project site's complaints record, in order to predict the level of impact that may be experienced in the surrounding community (refer to Section 5 for further details).

The assessment undertaken in this report was carried out in accordance with the following national and international guidance documents:

- Ministry for the Environment's (MfE) 'Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions' (MfE, 2001).[1] This Good Practice Guide (GPG) is currently under review by the MfE;
- IAQM, 2014. 'Guidance on the assessment of dust from demolition and construction', Institute of Air Quality Management, February 2014; and,
- IAQM, 2016. 'Guidance on the assessment of mineral dust impacts for planning, Institute of Air Quality Management, May 2016.

1.3 Study Location

The project site is located at 137 Centennial Highway/SH1 in the Ngauranga Gorge, Wellington and is legally described as Lots 1, 2 & 3 DP 72995, Lot 4 DP 72996, Lot 5 DP 72996, Lot 1 DP 34815, and Lot 6 DP 72996.

The site is situated on the western side of Ngauranga Gorge, within an industrial area, which is located at the base of a basin surrounded by high ridges. Residential areas are situated at the top of these ridges.

The site covers an area of approximately 44.92 hectares (ha) or 0.45 km^2, based on the map contained in Appendix 2 of the Wellington City District Plan, which is shown in Figure 1-1. The figure shows that there is a buffer area which is zoned 'Open Space B' in the Wellington City District Plan surrounding the existing quarry/extraction area, zoned 'Business 2' in the Wellington City District Plan. Restoration planting within the buffer zone will be undertaken in accordance with WCC's Quarry Management Plan (WCC, 2014).[2]

The centre of the project site is located at 315860 metres East, 5432680 metres North Universal Transverse Mercator (UTM) Zone 60 South (or latitude 41.236222 ºSouth, longitude 174.803046 ºEast). The project site is located approximately 4.5 km north-east of the Wellington central business district.

1 'Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions', Ministry for the Environment, September 2001 (MfE, 2001).

2 WCC, 2014. Kiwi Point Quarry Management Plan (QMP), Wellington City Council, 2014.

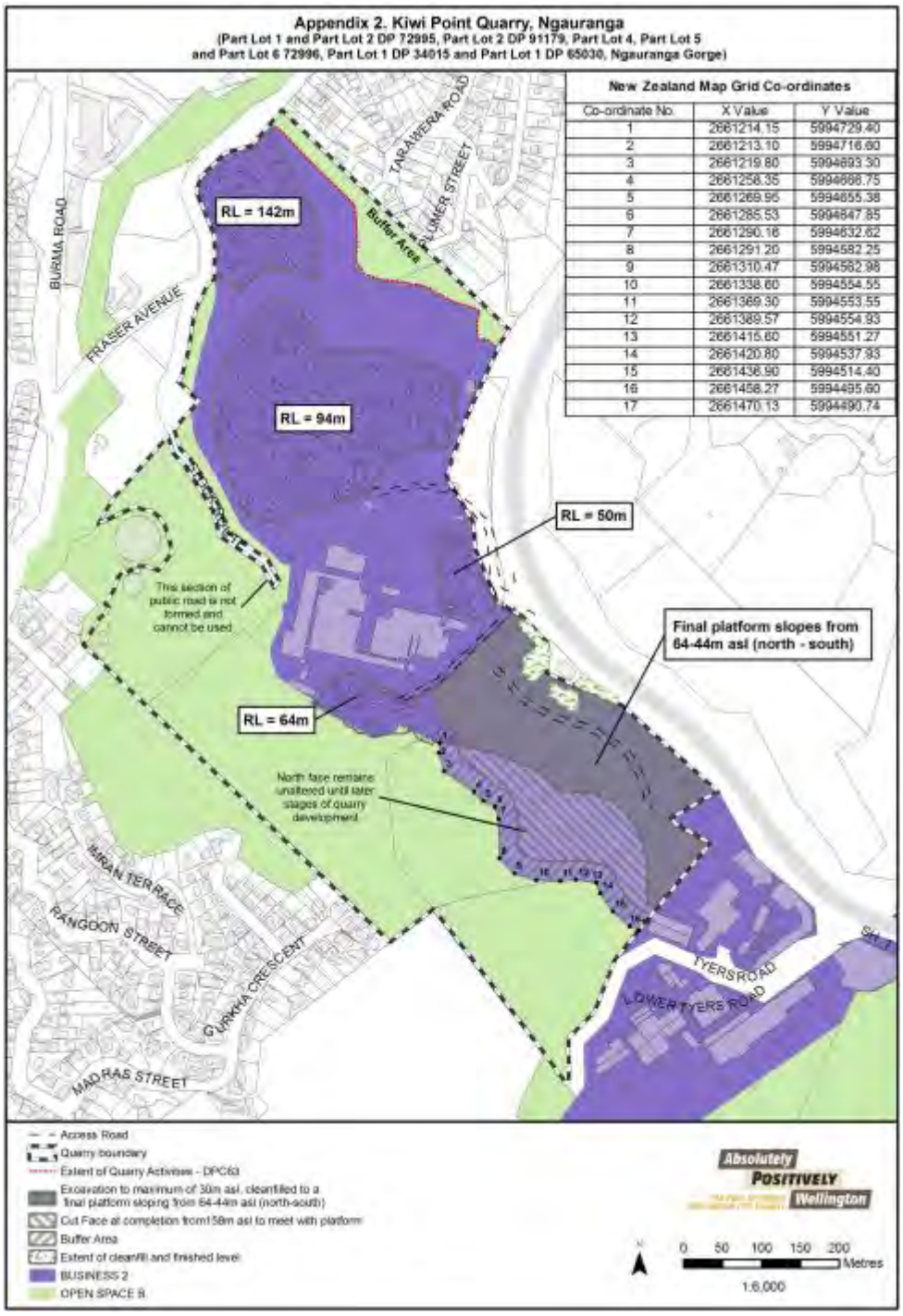

Figure 1-1: Location of the Kiwi Point Quarry

The location of the project site is shown in Figure 1-2. The figure was produced using OpenStreetMap (OSM) under the Open Database License. OSM has been used throughout this report and MWH has acknowledged OSM and its contributors, where relevant. The Open Database License can be read in full on the OSM website.[3]

Figure 1-2 shows the indicative Kiwi Point Quarry site boundary (solid red line), which is based on Figure 1-1, the area occupied by Taylor Preston Limited's abattoir and meat works (dashed red line) and the proposed southern extension area (dashed orange line).

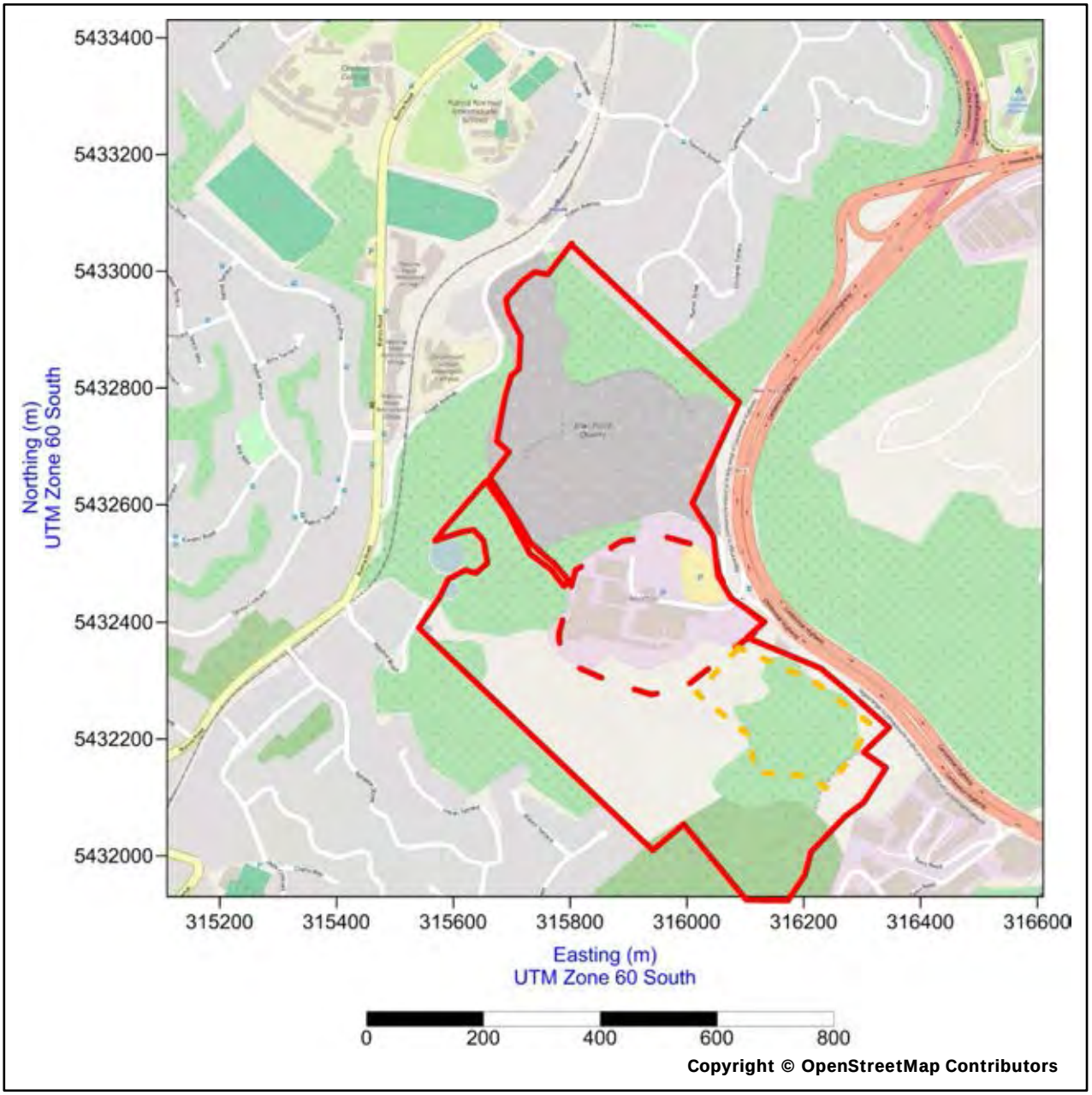

Figure 1-2: Location of the Kiwi Point Quarry Showing an OSM Basemap

[3] http://opendatacommons.org/licenses/odbl/1.0/

1.4 Existing and Proposed Activities

1.4.1 Site History

Kiwi Point Quarry began operating in the 1930s and is the last remaining quarry within the Wellington region. The quarry is an important provider of quarry products, producing approximately 350,000 tonnes of aggregate per annum (tpa), approximately 16 percent of the annual production for the region.

1.4.2 Existing Activities

The current extraction area (the 'existing' or 'northern' quarry) is shown in Figure 1-3 as areas A, B, C and D.

The quarrying activity is undertaken in accordance with the Kiwi Point Quarry Management Plan (WCC, 2014).[4] The existing (northern) quarry has been excavated from south to north into a ridge at the northern boundary of the site, resulting in a batter slope rising steeply to the north. Greywacke rock is dry quarried through drilling and blasting and mechanical excavation. Material suitable for crushing is loaded on dump trucks and transported to the onsite crushing plant where it is crushed to reduce size, screened into various grades of aggregate and washed.

The following plant and machinery are present onsite:

- Three crushers (1 jaw crusher (primary), 1 cone crusher and 1 Barmac shaper (both secondary));
- Two screening plants (primary and secondary);
- One washing screening plant;
- Several conveyor belts for transporting finished products;
- Three front-end loaders (e.g. for transferring product, including product load-out);
- Three excavators;
- One bulldozer; and,
- One fork-lift truck (e.g. for moving conveyor belts).

The quarry's customers are predominantly contractors and access to the public is restricted: public trailer sales ceased in May 2014. Trucks vary in size from 3 tonne to 35 tonne capacities. Customer numbers vary per day and is dependent on their contractual requirements. The product sale hours are 57 hours per week and are currently as follows:

- Monday to Thursday 7:00 am – 5:00 pm;
- Friday 7:00 am – 4:00 pm; and,
- Saturday 7:00 am – 3:00 pm.

The quarry can operate 24 hours a day, 7 days a week, and the production volumes vary per hour and day as there are many variables. However, daily production can range from 1,500 to 2,600 tonnes per day. Approximately 10,000 to 16,000 tonnes of aggregate products are stored onsite. Currently, drilling and blasting occurs on a monthly basis but can occasionally occur twice a month. The blast times are restricted to the hours of 10:00 am to 2:00 pm.

The principal emissions to air associated with the above quarrying processes and activities include dust and particulate matter. There is also the potential for dust to be generated by site vehicles and customer (offsite) vehicles as they travel on the unsealed haul roads and across the quarry floor to the product stockpile areas. The unsealed haul roads are sprayed with water using a water truck, and the stockpile areas are also sprayed with water in order to control dust emissions. The sealed road has a sprinkler system for dust suppression.

An aerial photograph of the existing quarry areas A, B and C is shown Figure 1-4.

A photograph of the existing processing plant is shown in Figure 1-5.

[4] WCC, 2014. Kiwi Point Quarry Management Plan, Wellington City Council, 2014.

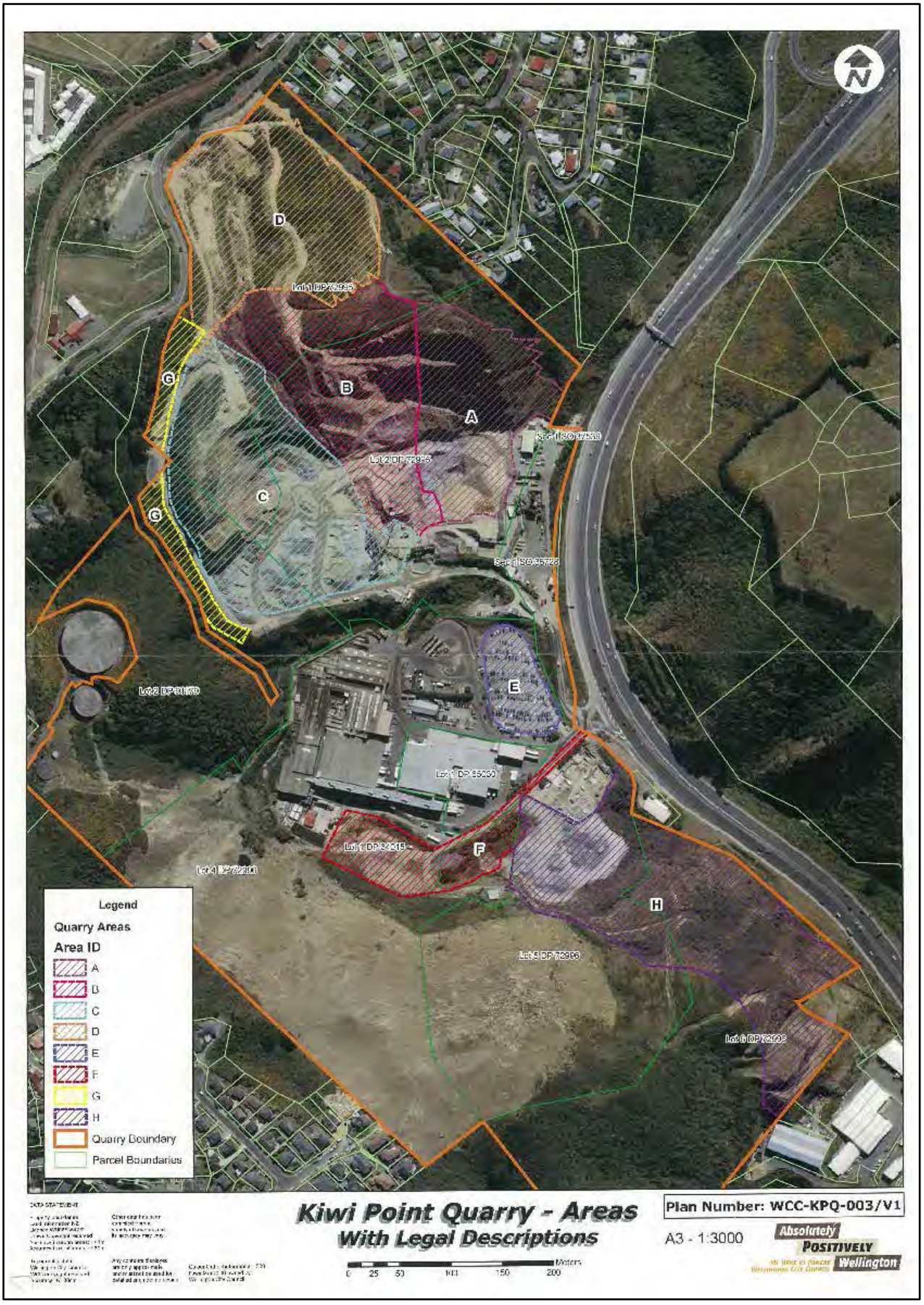

Figure 1-3: Plan of the Kiwi Point Quarry

Figure 1-4: Plan of the Kiwi Point Quarry Showing Areas A, B and C

Figure 1-5: Photograph of the Kiwi Point Quarry Processing Plant at its Existing Location

1.4.3 Proposed Activities

Ultimately the development of the site will include infilling the upper gully area from Fraser Avenue, down and through the quarry operation area, which will effectively provide further industrial land (Areas A, B, C, D and G in Figure 1-3). The Quarry Management Plan (QMP) includes a rehabilitation plan for both the existing (northern) quarry and the proposed quarry expansion into the southern ridge towards Tyers Road. In addition, Ormiston (2016) prepared a report as part of the QMP for the proposed southern extension.[5]

The proposed southern extension area is shown in Figure 1-3 as Area H and a photograph of the southern ridge is shown in Figure 1-6. The existing jaw crusher, one excavator and two loaders will be moved to the southern extension area along with 1 excavator and 1 to 2 loaders upon commencing the extraction of this resource.

The proposed activities also include:

- Soil stripping, vegetation clearance and overburden removal at both the existing quarry and in the southern extension area;
- Placement of cleanfill material (only in Areas A, B, C, D, F and H as shown in Figure 1-3);
- Taking of water from Ngauranga Stream to be used for dust suppression and aggregate washing in the southern extension area; and,
- Intermittent discharge of stormwater and washwater from the southern extension area to Ngauranga Stream.

Figure 1-6: Photograph of the Kiwi Point Quarry Southern Ridge Looking South

[5] Ormiston, 2016. Report on the Proposed Development for the Business Centre Area South Ridge—Kiwi Point Quarry, prepared by Ormiston Associated Limited for Holcim New Zealand Limited, February, 2016.

1.5 Surrounding Environment and Topography

1.5.1 Terrain

The surface elevation (terrain) data were taken from Lakes Environmental Software's website (www.webGIS.com), which was based on the Shuttle Radar Topography Mission (SRTM-1 Global Version 3) digital elevation model data (at approximately 30 m resolution) originally produced by NASA.

Figure 1-7 shows the location of the potentially affected sensitive receptors identified in Section 3.1 of this report (solid yellow circles), the indicative Kiwi Point Quarry site boundary (solid red line with red fill), the area occupied by Taylor Preston Limited's abattoir and meat works (dashed red line) and the southern extension area (dashed orange line with orange fill). Whilst it is noted that the contour lines (elevations) shown within the Kiwi Point Quarry site boundary are not accurate as they do not reflect the current or proposed final elevations, the figure does show that the quarry and proposed southern extension area are situated in much lower terrain than the nearest sensitive receptor locations.

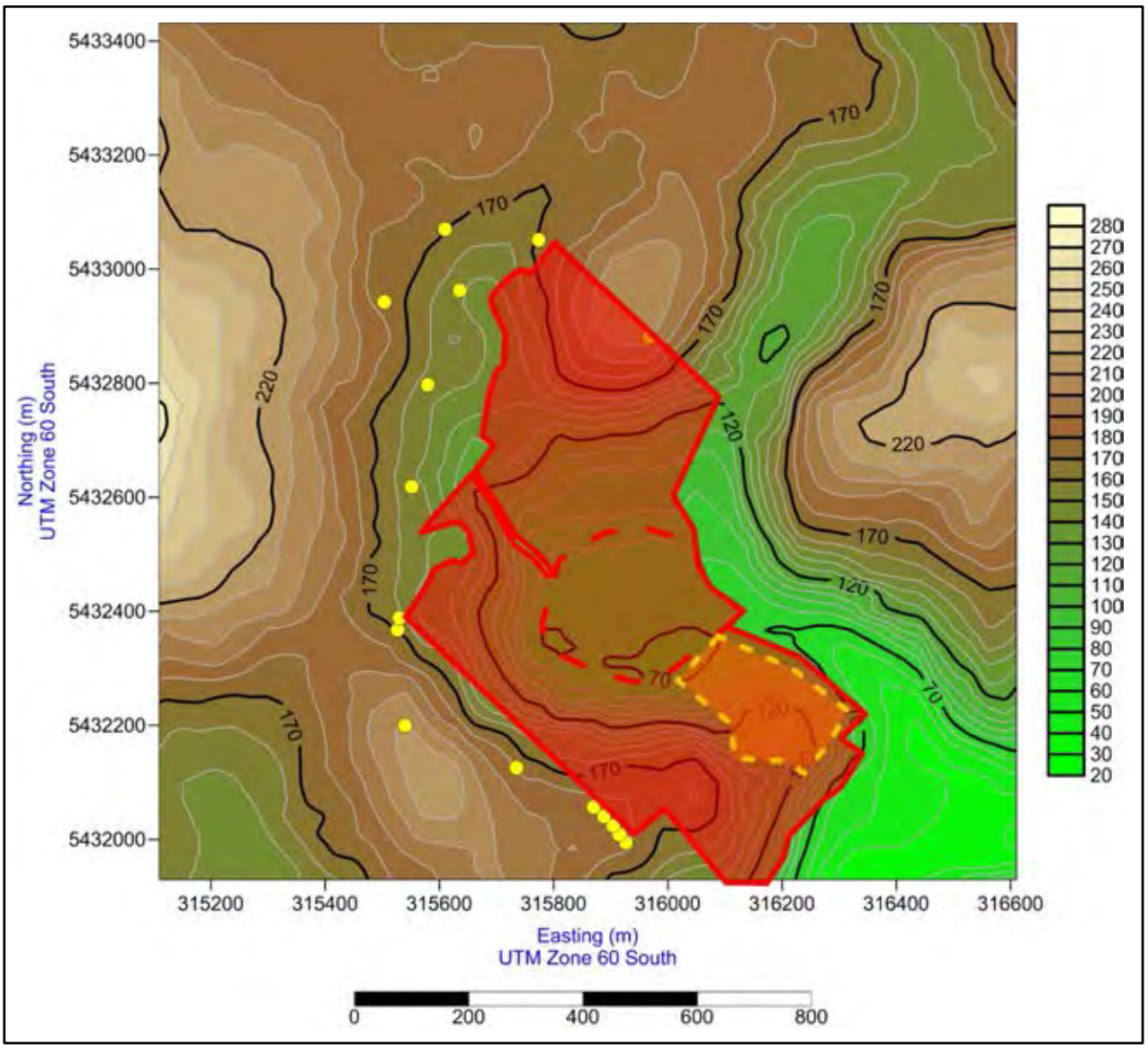

Figure 1-7: Location of the Kiwi Point Quarry Showing Terrain

1.5.2 Land Use

The potentially affected sensitive receptors identified in Section 3.1 of this report are situated within the 'Outer Residential' or 'Business 1' zones of the operative Wellington City District Plan (see Section 2.3), while the project site itself is situated within the 'Business 2 and 'Open Space B' zones of the Plan.

The Kiwi Point Quarry boundary surrounds the sites currently occupied by Taylor Preston Limited's abattoir and meat works (located at 131 Centennial Highway), the Downer Group's hot mix facility (also located on the quarry site at 137 Centennial Highway, approximately 60 m to the north-east of Taylor Preston) and Allied Concrete's concrete batching facility situated 40 m to the south-east of Taylor Preston). A water supply pumping station operated by Wellington Water is situated approximately 10 m to the north-north-east of the Kiwi Point Quarry boundary on Centennial Highway/SH1.

In other words, in addition to the potential for dust to be generated by activities undertaken at the Kiwi Point Quarry, there is also the potential for dust emissions to occur at the hot mix and concrete batching facilities. However, the cumulative PM_{10} concentrations beyond the boundary of the Kiwi Point Quarry are unlikely to exceed any national or regional ambient air quality standards or guidelines (see Section 5) and, therefore, the need for a detailed assessment involving dispersion modelling or ambient monitoring can be scoped out (excluded from) this study.

In addition, there are existing odour emissions from activities undertaken at Taylor Preston (see Section 1.7) and at the hot mix facility.

1.6 History of Complaints Due to Activities at the Kiwi Point Quarry

According to the GWRC's complaints database, there have been three dust nuisance complaints relating to activities undertaken at the Kiwi Point Quarry. These complaints are summarised in Table 1-1.

Table 1-1: History of Dust Complaints at Kiwi Point Quarry

Address	Date/Time	UTM Zone 60 South		Direction from Site Boundary	Distance from Site Boundary (m)
		Easting (m)	Northing (m)		
407 Burma Rd (Ref. C1)	14/01/2009 9:20 am	315504	5432975	WNW	200
134 Burma Rd (Ref. C2)	18/12/2009 9:10 am	315503	5432943	WNW	200
105 Fraser Ave (Ref. C3)	20/12/2011 9:40 am	315812	5433084	N	60

The location of the complainants' properties are shown in Figure 1-8 as solid yellow circles. The properties 'C1' and 'C2' are the Malvina Major Retirement Village, while property C3 is a private residential property. The figure also shows the indicative Kiwi Point Quarry site boundary (solid red line with red fill), the area occupied by Taylor Preston Limited's abattoir and meat works (dashed red line) and the southern extension area (dashed orange line with orange fill).

MWH understands that whilst these dust nuisance complaints were not verified by a GWRC enforcement officer, the file notes on the complaints database indicate that the incidents were relatively minor and of short duration. Given that these complaints occurred between 4.5 and 7.5 years ago, it is difficult to relate these complaints to actual activities that were undertaken at the quarry at the time. However, it is possible, given that the complaints occurred in the summer, that dry and windy conditions coupled with dust-generating activities taking place on the northern part of the quarry (towards Fraser Avenue) may have been the cause of the incidents.

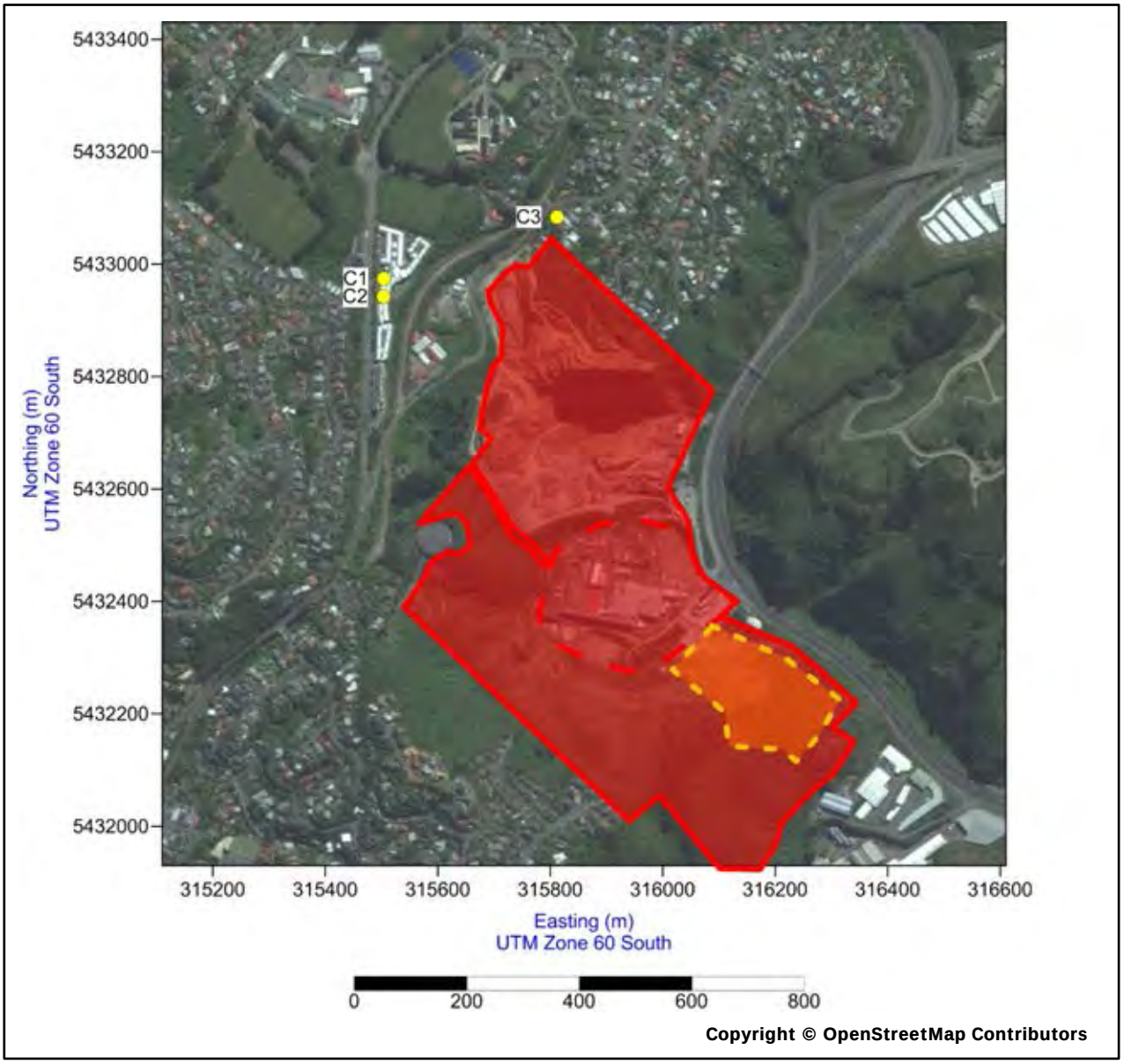

Figure 1-8: Location of the Complainants' Properties – Alleged Dust from Kiwi Point Quarry

1.7 History of Complaints Due to Activities at Taylor Preston

According to the GWRC's complaints database, there have been 20 odour nuisance complaints relating to activities undertaken at Taylor Preston's abattoir and meat works between 6 December 2014 and 7 June 2016. The location of the complainants' properties (which are all private residences) are summarised in Table 1-2 and are shown in Figure 1-9 as solid yellow circles. Note that the property located at 4 Jalna Avenue is not shown in the figure as it is situated beyond the map extents.

Analysis of the complaints indicates that whilst there have been 20 odour complaints, there have only been 10 complainants. With the exception of the complainant situated at 36 Gurkha Crescent (300 m to the south of the Taylor Preston site boundary), all the complainants have been located to the north-north-east, north-west, west-north-west, west or west-south-west of the Taylor Preston site boundary.

Based on the analysis of the local meteorological data shown in Section 4 and in view of the local terrain features (namely the Ngauranga Gorge and the quarry itself), the potential for further odour nuisance effects in the surrounding community due to odour discharges at Taylor Preston following the completion of the southern extension at the Kiwi Point Quarry is considered to be low.

Table 1-2: Location of Odour Complainants Properties (Odour Discharges at Taylor Preston)

Address	UTM Zone 60 South		Direction from Site Boundary	Distance from Site Boundary (m)
	Easting (m)	Northing (m)		
3 John Sims Drive	315402	5432724	NW	460
36 Gurkha Crescent	315882	5431977	S	300
27 Imran Terrace	315507	5432188	SW	310
4 Maldive Street	315431	5432363	W	340
7 Rangoon Street	315410	5432299	WSW	360
5 John Sims Drive	315395	5432741	NW	480
4 Jalna Avenue	315021	5432153	WSW	780
103 Burma Road	315430	5432533	WNW	370
18 Dominion Park Street	316215	5433251	NNE	750
92 Burma Road	315467	5432413	W	310

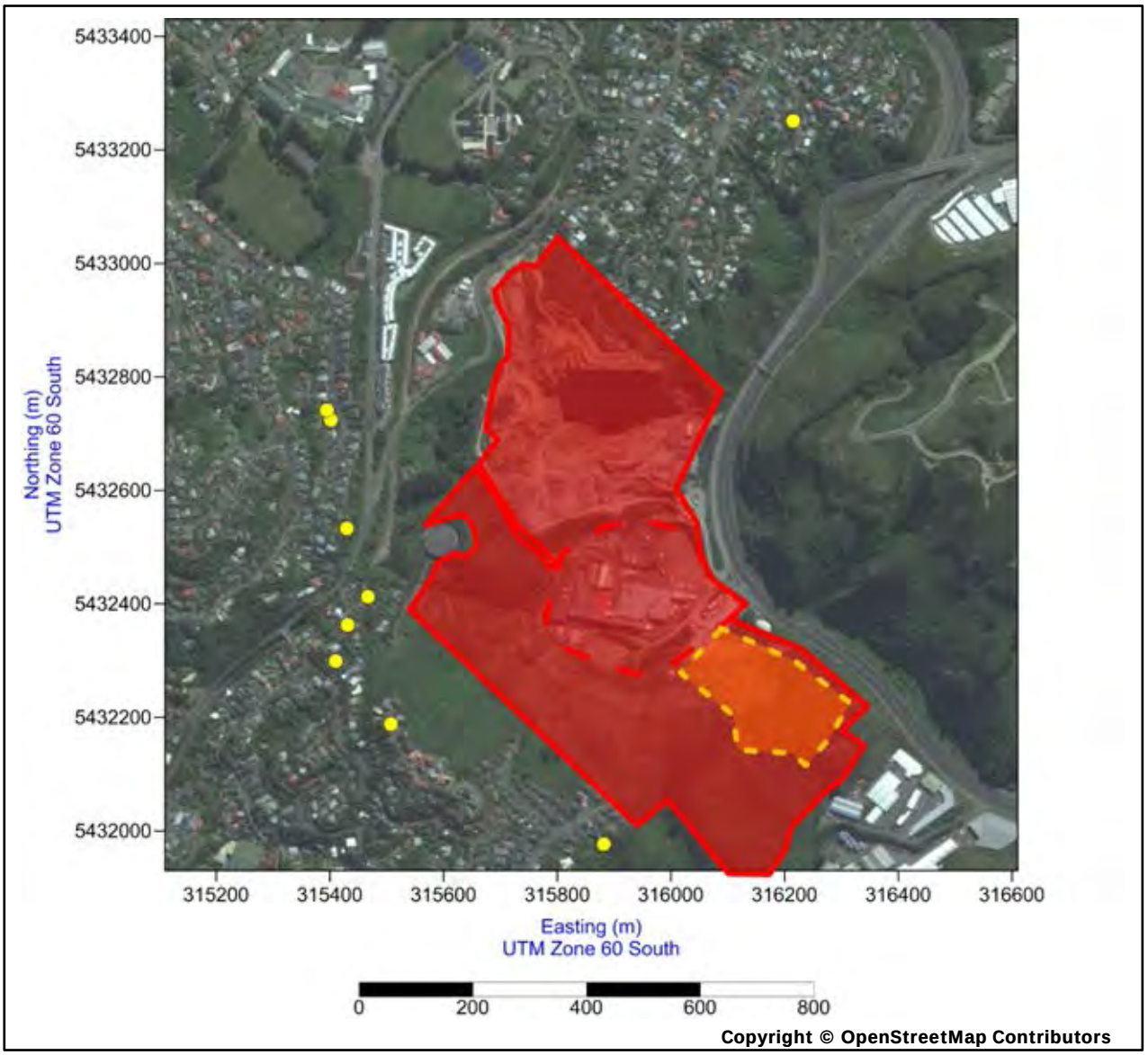

Figure 1-9: Location of the Complainants' Properties – Alleged Odour from Taylor Preston

1.8 Limitations

MWH has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of WCC and Holcim. No liability is accepted by this company or any employee or sub-consultant of this company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to GWRC and other persons for an application for permission or approval to fulfil a legal requirement.

This report is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

This report was prepared in July 2016 and is based on the conditions encountered and information reviewed at the time of preparation. MWH disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

2 Assessment Criteria

2.1 National Assessment Criteria

2.1.1 Resource Management Act 1991

Section 5(1) sets out the purpose of the RMA, which is "*to promote the sustainable management of natural and physical resources*".

Section 5(2)(c) provides for this to occur while "*avoiding, remedying, or mitigating any adverse effects of activities on the environment*".

Section 2 of the RMA defines *'environment'* and *'amenity values'* as follows:

> *"**Environment***
>
> *includes –*
>
> *(a) ecosystems and their constituent parts, including people and communities; and*
>
> *(b) all natural and physical resources; and*
>
> *(c) amenity values; and*
>
> *(d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.*
>
> ***Amenity values***
>
> *those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes."*

Since emissions of dust/particulate matter at quarries can be considered to cause potential effects on amenity values, people and communities, they should be managed under the RMA. Since dust is considered to be an air contaminant, its discharge to air is therefore controlled under section 15 of the RMA. Under section 15(1) of the RMA, discharges from industrial or trade premises are only allowed if they are authorised by a rule in a regional plan, a resource consent, or regulations. If the activity is prohibited under the plan, then no resource consent can be obtained.

Section 15 states:

> *1) "No person may discharge any:*
>
> *(a) contaminant or water into water; or*
>
> *(b) contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or*
>
> *(c) contaminant from any industrial or trade premises into air; or*
>
> *(d) contaminant from any industrial or trade premises onto or into land—*
>
> *unless the discharge is expressly allowed by a national environmental standard or other regulations, a rule in a regional plan as well as a rule in a proposed regional plan for the same region (if there is one), or a resource consent.*
>
> *2) No person may discharge a contaminant into the air, or into or onto land, from a place or any other source, whether moveable or not, in a manner that contravenes a national environmental standard unless the discharge:*
>
> *(a) is expressly allowed by other regulations; or*
>
> *(b) is expressly allowed by a resource consent; or*
>
> *(c) is an activity allowed by section 20A.*

(2A) No person may discharge a contaminant into the air, or into or onto land, from a place or any other source, whether moveable or not, in a manner that contravenes a regional rule unless the discharge:

(a) is expressly allowed by a national environmental standard or other regulations; or

(b) is expressly allowed by a resource consent; or

(c) is an activity allowed by section 20A.

3) This section shall not apply to anything to which section 15A or section 15B applies."

As mentioned earlier, WCC is currently authorised under resource consent number WGN050352 [24540] to discharge contaminants to air associated with the cleanfill and associated activities undertaken at the project site.

As part of this application, WCC is seeking a resource consent to discharge to air contaminants (predominantly dust) associated with the extraction (quarrying) and processing (crushing and screening) activities undertaken at the project site. Refer to Section 5 of this report for further details of the actual and potential environmental effects associated with these activities.

2.1.2 National Environmental Standards

The Ministry for the Environment (MfE) first promulgated the Resource Management (National Environmental Standards (NES) for Air Quality) Regulations on 6 September 2004 (the 'Regulations'). Since that time there have been a number of amendments to the NES, with the most recent amendment occurring in June 2011.

The Regulations set out a number of restrictions on certain activities that discharge contaminants to air, including prohibitions, performance requirements and ambient air quality standards. None of the prohibitions in Regulations 6 to 12 apply to the activities undertaken by WCC/Holcim at the project site.

Regulations 13 to 16 impose requirements on regional councils to meet ambient air quality standards for five air pollutants: fine and coarse particles that are less than 10 microns (µm) in diameter (as PM_{10}), carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3).

Regulations 22 to 27 apply to woodburners, domestic solid-fuel open fires and landfill gas flaring, and do not apply to the activities undertaken by WCC/Holcim.

While Regulations 17 to 19 apply to activities involving the discharge to air of fine and coarse particles (PM_{10}), Regulations 17A to 19 were revoked in June 2011. Regulation 20 applies to discharges to air of CO, oxides of nitrogen (NO_x) and volatile organic compounds (VOCs), while Regulation 21 applies to discharges to air of SO_2.

It is considered that Regulation 17(1) does not apply to this assessment as the principal emissions to air from the site will comprise of larger particles of more than 30 µm in diameter (e.g. total suspended particles or 'TSP') as opposed to PM_{10}. Furthermore, whilst WCC does not currently hold a resource consent for the existing and proposed extraction and processing activities at Kiwi Point Quarry, WCC/Holcim is not seeking to increase its existing production rates as part of the consent application and the Kiwi Point Quarry is not situated within a polluted airshed.[6] In view of the foregoing, Regulations 17 to 20 do not apply to the activities undertaken by WCC/Holcim.

Table 2-1 lists the ambient air quality NES for PM_{10}, CO, NO_2, SO_2 and O_3. The NES criteria for CO, NO_2, SO_2 and O_3 do not apply to this assessment. Whilst the NES for PM_{10} is the only criterion which applies to this assessment, it is noted that the principal emissions to air at the project site are larger particles (e.g. greater than 30 µm in diameter, including TSP). There are currently no NES criteria for larger particles, including TSP.

[6] Airsheds have been identified based on regional councils' knowledge of existing ambient air quality and the location of significant emission sources and factors that affect the dispersion of pollutants (such as local topography and meteorology). These airsheds have been published in the New Zealand Gazette. An airshed becomes a 'polluted airshed' in accordance with Regulation 17(4) of the Resource Management (National Environmental Standards for Air Quality) Regulations 2004.

Table 2-1: Ambient Air Quality National Environmental Standards

Contaminant	Threshold Concentration (µg/m³)	Averaging Period	Number of Exceedances Allowed Each Year
PM_{10}	50	24-hour	One 24-hour period
CO	10,000	8-hour	One 8-hour period
NO_2	200	1-hour	Nine 1-hour periods
SO_2	570 350	1-hour 1-hour	None Nine 1-hour periods
O_3	150	1-hour	None

Whilst the NES are not strictly assessment criteria, the Regulations require that any discharge of one of the NES contaminants must not result in a breach of the relevant Standard. Consequently, the NES must be considered as assessment criteria.

The Regulations place constraints on resource consents depending on the pollutant, the existing air quality of an airshed relative to the NES and the date of the application. A 'significant' discharge of PM_{10} is classified as a maximum 24-hour mean PM_{10} concentration beyond the site boundary of greater than or equal to 5% of the NES for PM_{10} (i.e. 2.5 µg/m³), in accordance with MfE (2011).[7]

2.1.3 National Ambient Air Quality Guidelines

The National Ambient Air Quality Guidelines (NAAQGs) were published by the MfE in 2002 following a comprehensive review of international and national research, and are widely accepted among New Zealand air quality practitioners. The NAAQG criteria provide the minimum requirements that ambient air quality should meet in order to protect human health and the environment.

Guideline levels for pollutants and averaging periods not covered by the NES criteria still apply. The NES criteria replace any previous guideline levels for that particular pollutant and averaging period. The NAAQG criteria set for the protection of human-health for PM_{10}, CO, NO_2, SO_2 and O_3 are presented in Table 2-2. The NAAQG for PM_{10} are the only criteria which apply to this assessment.

Table 2-2: National Ambient Air Quality Guidelines

Contaminant	Threshold Concentration (µg/m³)	Averaging Period	Key Health Effects
PM_{10}	50 20	24-hour Annual	Mortality, morbidity, hospitalisation, work-affected days, increased use of medication
CO	30,000 10,000	1-hour 8-hour	Reduced birth weight (non-smoking mothers), decreased work capacity, increased duration of angina (for those with ischaemic heart disease), decrease in visual perception, decreased manual dexterity, and decreased ability to learn
NO_2	200 100	1-hour 24-hour	Apparent contribution to morbidity and mortality, especially in susceptible subgroups, including young children, asthmatics and those with chronic inflammatory airway disease.
SO_2	350 120	1-hour 24-hour	Daily mortality, hospital admissions and emergency room attendances for respiratory and cardiovascular disease, increases in respiratory symptoms and decreases in lung function

[7] MfE 2011. 'Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy to Meet the PM10 Standard' (August, 2011; referred to hereafter as the 'NAQCS for PM10' or 'MfE, 2011').

Contaminant	Threshold Concentration (µg/m^3)	Averaging Period	Key Health Effects
O_3	150 100	1-hour 8-hour	Increased daily mortality, respiratory and cardiovascular disease; decreases in lung function; increases in hospitalisations, and in respiratory illnesses such as cough, phlegm and wheeze

In addition to the health-based NAAQGs reviewed above, the MfE has recommended a set of trigger levels for deposited and suspended particulate. These trigger levels for deposited dust and TSP are summarised in Table 2-3 and were taken from MfE (2001).[8]

Table 2-3: MfE Trigger Levels for Deposited Dust and TSP

Contaminant	Trigger Level	Preferred Monitoring Method
Deposited dust	4 g/m^2/30 days (above background)	ISO DIS-4222.2
TSP	80 µg/m^3 (24-hour mean) — sensitive area **100 µg/m^3 (24-hour mean)** — moderately sensitive area 120 µg/m^3 (24-hour mean) — non-sensitive area	AS-3580.9.6:2015

A 'sensitive area' is defined in MfE (2001)[9] as being a site surrounded by '*significant residential development*', whereas a non-sensitive area could be defined as '*a sparsely populated rural area … [which is] relatively insensitive to some discharges*'.

A 'non-sensitive area' could also be described as a 'low sensitive area', and would apply to a site located in, for example, a 'heavy industrial' zone (provided that there are no industrial activities sensitive to dust/particulate, such as vehicle showrooms, food manufacturers, electronics manufacturers, or other sensitive receptors in the surrounding community).

The project site is considered in this assessment to be situated in a *'moderately sensitive area'* given that it is within the 'Business 2' zone of the Wellington City District Plan, and given that there are very few residential properties located within 400 m of the existing and proposed extraction and processing areas (see Section 3). MWH considers that the MfE's trigger value for TSP of 100 µg/m^3 (as a 24-hour mean concentration) applies in this assessment. This is in accordance with Section 3 which contains a more detailed discussion on the sensitivity of the surrounding environment.

2.2 Regional Assessment Criteria

2.2.1 Operative Regional Air Quality Management Plan

The Wellington Regional Air Quality Management Plan (RAQMP or the 'Regional Plan') became operative on 8 May 2000. Change 1 to the RAQMP was made operative on 1 September 2003.

The RAQMP applies to discharges to air in the whole of the Wellington region, except for the coastal marine area. Discharges to air in the coastal marine area (CMA) are covered in the Regional Coastal Plan (RQP), which became operative on 19 June 2000. The CMA is situated approximately 1 km to the

8 'Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions', Ministry for the Environment, September 2001 (MfE, 2001).

9 *Ibid*.

south-east of the project site boundary and, in the absence of adequate dust mitigation, there is the potential for the propagation of dust beyond the site boundary and towards the CMA under certain meteorological conditions. However, for the reasons outlined in Sections 3, 4 and 5, it is considered unlikely that there will be any adverse effects within the CMA. Therefore, the objectives, policies and rules of the RAQMP have been considered in this report, rather than those stated in the RQP. Incidentally, the Commercial Port Area (CPA) is situated approximately 2 km to the south-west of the project site boundary.

The RAQMP identifies issues to be addressed so that air can be sustainably managed. Objectives, policies, and rules have been adopted to address these issues.

Rule 10 of the RAQMP (as amended 2003) covers the extraction (quarrying) and processing (size reduction and screening) of minerals and states that *"the extraction, quarrying [and mining of minerals and the size reduction and screening of wood products and minerals]"* is a permitted activity provided that it complies with the following conditions (emphasis added as **bold** text):

- *"For the area shown as the Operational Port Area, included within the Wellington City District Plan, any discharge shall not result in odour, dust, gas or vapour which is noxious, dangerous, offensive or objectionable to such an extent that it has, or is likely to have, an adverse effect on the environment outside the Operational Port Area; and*
- *For all other areas, any discharge **shall not** result in **dust**, odour, gas or vapour, which is **noxious, dangerous, offensive or objectionable at or beyond the boundary of the property**."*

In other words, the existing and proposed quarrying and processing activities undertaken at the Kiwi Point Quarry are permitted under Rule 10 provided that there are no *"noxious, dangerous, offensive or objectionable"* effects associated with the discharges to air from the site beyond the site boundary.

The RAQMP also contains a set of regional ambient air quality guidelines (RAAQGs) for particulate matter (not specifically 'PM_{10}' and assumed herein as TSP), CO, NO_2, SO_2, O_3 and a number of other pollutants. The RAAQGs for particulate matter (as TSP), CO, NO_2, SO_2, O_3 are presented in Table 2-4**.**

Table 2-4: Regional Ambient Air Quality Guidelines

Contaminant	Maximum Desirable Concentration ($\mu g/m^3$)	Maximum Acceptable Concentration ($\mu g/m^3$)	Averaging Period
Particulate (as TSP)	70 40	120 40	24-hour Annual
CO	6,000	10,000	8-hour
NO_2	95 30	300 100	1-hour 24-hour
SO_2	None	500 350 125 50	10-minute 1-hour 24-hour Annual
O_3	100	150 100	1-hour 8-hour

The NES, NAAQGs and MfE trigger level for TSP adopted in this assessment are more stringent than the RAAQGs shown above.

The term 'cleanfill' is defined in the RAAQP as follows:

> *"materials such as clay, soil, rock, concrete, or brick, that are free of combustible or putrescible components or hazardous substances or materials likely to create a hazardous leachate by means of biological or chemical breakdown."*

The term 'landfill' is defined in the RAAQP as follows (emphasis added as **bold** text):

> *"a waste disposal site of any size used for the controlled deposit of solid wastes onto or into land, **but not including deposition associated with a quarry** or other cleanfill material."*

The term 'dust' is defined in the RAAQP as follows:

> *"… small particulates containing metallic elements, organic and other materials including, but not limited to, fertilisers, cement, coal, coke, soot, carbon tars, wood, fibres, and pathogens."*

2.2.2 Proposed Natural Resources Plan for the Wellington Region

In recent years, GWRC has been working to review the existing regional plans for the Wellington region. As a result of this review, the Proposed Natural Resources Plan for the Wellington Region (PNRP or the 'Proposed Regional Plan') was developed. The Proposed Regional Plan was approved by Council for public notification on 31 July 2015. It combines coastal and regional plans, as well as incorporating regulatory and non-regulatory methods (rules).

Rule R27 of the PNRP provides for the handling of aggregate and is very similar to Rule 10 of the operative RAQMP (as amended 2003). Rule R27 of the PNRP states that (emphasis added as **bold** text):

> *"The discharge of contaminants into air from the handling of aggregate (rock, sand and shingle) including blasting, extraction, crushing, screening, processing, stockpiling, handling, conveyance and storage is a permitted activity, provided the following condition is met:*
>
> *(a) the discharge **shall not** cause **noxious, dangerous, offensive or objectionable odour, dust, particulate, smoke, vapours, droplets or ash beyond the boundary of the property**."*

In other words, and as per the operative Rule 10 of the RAQMP, existing and proposed quarrying and processing activities undertaken at the Kiwi Point Quarry are permitted under Rule R27 of the PNRP provided that there are no *"noxious, dangerous, offensive or objectionable"* effects associated with the discharges to air from the site beyond the site boundary.

Objective O41 of the PNRP states (emphasis added as **bold** text):

> *"The adverse effects of odour, smoke and **dust** on amenity values and people's well-being are reduced."*

Policy P55 of the PNRP is entitled 'managing air amenity and states (emphasis added as **bold** text):

> *"Air quality amenity in urban, rural and the coastal marine areas shall be managed to minimise offensive or objectionable odour, smoke and **particulate matter**, fumes, ash and visible emissions."*

Policy P58 of the PNRP covers industrial point source discharges and fugitive emissions and states:

> *"Industrial point source discharges and fugitive emissions into air will be minimised by using good management practices."*

Policy P61 of the PNRP covers discharges to air within polluted airsheds. This policy does not apply as the Kiwi Point Quarry is not situated within a polluted airshed.

The PNRP contains a set of regional ambient air quality targets (RAAQTs) for PM_{10}, $PM_{2.5}$, CO, NO_2, SO_2, O_3 and a number of other pollutants. The RAAQTs for PM_{10}, particles less than 2.5 µm in diameter ($PM_{2.5}$ or fine particles), CO, NO_2, SO_2 and O_3 are presented in Table 2-5 and are based on the NAAQGs, as outlined below:

- **Action** Exceeds the NAAQG value. Exceedances of the NAAQG are a cause for concern and warrant action if they occur on a regular basis.
- **Alert** Between 66% and 100% of the NAAQG value. This is a warning level, which can lead to exceedances if trends are not curbed.
- **Acceptable** Between 33% and 66% of the NAAQG value. This is a broad category, where maximum values might be of concern in some locations, but are generally at a level that does not warrant action.
- **Good** Between 10% and 33% of the NAAQG value. Peak measurements in this range are unlikely to affect air quality.
- **Excellent** Less than 10% of the NAAQG value Values are of little concern. If maximum values are less than a tenth of the guideline, average values are likely to be much less.

Table 2-5: Regional Ambient Air Quality Targets

Contaminant	Concentration ($\mu g/m^3$) 'Excellent'	'Good'	'Acceptable'	'Alert'	Averaging Period
PM_{10}	No targets	17 7	33 13	50 20	24-hour Annual
$PM_{2.5}$	No targets	8 3	17 7	25 10	24-hour Annual
CO	3,000 1,000	10,000 3,000	20,000 7,000	30,000 10,000	1-hour 8-hour
NO_2	20 10	66 33	132 66	200 100	1-hour 24-hour
SO_2	35 12	115 40	231 79	350 120	1-hour 24-hour
O_3	15 10	50 33	99 66	150 100	1-hour 8-hour

The 'alert' level RAAQTs are the same as the NAAQGs, except that the latter do not contain a guideline for $PM_{2.5}$.

2.2.3 Operative Regional Policy Statement

The Wellington Regional Policy Statement (RPS) became operative in 1995 and sets out the framework and priorities for resource management in the Wellington region. The RMA requires all regional councils to produce an RPS for their region and to review it every 10 years.

The second generation Regional Policy Statement for the Wellington region (RPS) was made operative on 24 April 2013. The RPS identifies the regionally significant issues around the management of the region's natural and physical resources and sets out what needs to be achieved (objectives) and the way in which the objectives will be achieved (policies and methods).

It is stated in the operative RPS that (emphasis added as **bold** text):

> *"Odours, smoke and **dust** from people's activities can reduce the amenity of an area, affect people's health and social and cultural wellbeing, create annoyance, and sometimes cause poor visibility."*

Air Quality Objective 1 of the RPS states (emphasis added as **bold** text):

> *"Odour, smoke and **dust** affect amenity values and people's wellbeing. These effects are generally localised and result from the following activities or land uses:*
> *(a) odour from activities – such as, rendering, spray painting and solvent use, landfills,*
> *(b) sewage treatment plants, silage feeding and effluent spreading*
> *(c) smoke from domestic fires and backyard burning*
> *(d) dust from land uses or activities – such as, earthworks, **quarries**, and land clearance."*

2.2.4 Existing Resource Consent

Resource consent number WGN050352 [24540] authorises the discharge to air of contaminants from a cleanfill located at the project site and was granted to WCC by GWRC on 6 July 2005. The consent will expire on 6 July 2020.

A copy of the resource consent is contained in Appendix A.

As mentioned earlier, WCC currently does not hold a resource consent for the existing or proposed extraction and processing activities.

The main conditions seeking to control dust emissions from the operation of the cleanfill are as follows:

(4) "Only material such as clay, soil, rock, concrete or brick that are free of combustible or putrescible components or hazardous substances or materials likely to create leachate by means of biological breakdown, shall be deposited within the cleanfill site.

Materials considered to meet the above definition are outlined in Table 4.1 of the publication A Guide to the Management of Cleanfills by the Ministry for the Environment (2002).

(5) Cleanfill shall only be deposited in Areas A, B, C and D identified on the aerial photo attached to the application as Appendix One.

(6) The permit holder shall ensure that there shall be no discharges to air resulting from the exercise of this consent that are noxious, dangerous, offensive or objectionable at or beyond the legal boundary of the property where the activity is to be carried out, being Lots 1, 2 & 3 DP 72995.

(7) All work areas associated with the operation of the cleanfill are to be managed in such a way as to keep fugitive dust emissions to a minimum. This includes but not be limited to wetting unsealed areas with sufficient water as required.

(9) Upon achieving the desired completion levels (as identified in the rehabilitation plan), cleanfilled areas shall be topsoiled and planted upon completion. The topsoil shall be of sufficient depth such that no concrete or other rubble is visible. Vegetation shall be established as soon as practical after topsoiling.

(11) Depositing of cleanfill shall be supervised by Kiwi Point Quarry Staff at all times.

(12) The permit holder shall record details of each load of material that is deposited within the cleanfill, including:

- *(a) the date and time of receipt of material at the cleanfill site;*
- *(b) quantity;*
- *(c) source;*
- *(d) description of material deposited (e.g. soil, concrete, bricks);*
- *(e) name of the contractor depositing the material.*

This information shall be forwarded to the Manager, Consents Management, Wellington Regional Council at periods ending 31 March and 30 September each year, and shall be made available for inspection when requested.

(13) The permit holder will keep a permanent record of any complaints received alleging adverse effects from the permit holder's operations. The complaints record shall contain the following where practicable:

- *(a) the name and address of the complainant, if supplied;*
- *(b) identification of the nature of the complaint;*
- *(c) date and time of the complaint and alleged event;*
- *(d) weather conditions at the time of the alleged event;*
- *(e) results of the permit holder's investigations; and,*

(f) any mitigation measures adopted.

The complaints records shall be made available to the Wellington Regional Council on request.

(14) The permit holder shall keep a record of any incident that has or could have resulted in a condition of this permit being contravened. The incident record shall be made available to the Wellington Regional Council upon request.

The permit holder shall notify the Manager, Consents Management, Wellington Regional Council of any such incident, within 24 hours of the incident being brought to the attention of the permit holder, or the next working day."

2.3 Wellington City District Plan

The Kiwi Point Quarry is situated within the Business 2 and Open Space B zones of the Wellington City District Plan (WCDP or the 'Plan'), which became operative in July 2000 and was amended in November 2014. The quarry is subject to specific rules recognising its economic importance to Wellington City and the wider region as well as to other relevant rules applying elsewhere in Business Areas to mitigate adverse effects.

Business 2 is defined in the WCDP as *"traditional business areas where a range of industrial activities including warehousing, manufacturing and commercial services can occur."*

It is stated in the WCDP that *"the Business 2 Areas generally have lower amenity values than other areas of the City and are, by and large, more utilitarian in character. Business 2 Areas provide a place where industry can locate without having to compete for land and without interference from non-industrial activities requiring higher amenity standards."*

Rule 33.2.2.7 of the WCDP provides for the *"development and site rehabilitation of the Kiwi Point Quarry to the extent specified in the Plan in a way that avoids, mitigates or remedies adverse effects"* and states that (emphasis added as **bold** text):

"Kiwi Point Quarry is an established quarry located in the Ngauranga Gorge, involving ongoing extraction, processing, cleanfilling and rehabilitation. As the continuing availability of aggregate and other quarry materials is economically important for the City and wider region, the Plan makes specific provision for the ongoing use and development of the quarry. For both the older and newer areas of the quarry, specific rules and a development plan are incorporated. These provisions provide for the ***avoidance or mitigation of adverse effects from the quarry activity*** *and the long-term mitigation of effects on landscape and landform following quarrying. It is the Council's intention that cut faces should be designed to yield a relatively natural landform in the long term and that rehabilitation of cut faces should begin as early as practicable. The staging of quarry development, and the day to day management of quarry activities are further detailed and controlled through the application of a quarry management plan.*

A quarry management plan shall be prepared and regularly updated by Council, which sets out:

- *intended staging of the excavation and cleanfilling activities*
- *the means of management of surface and groundwater*
- *management of on-site traffic*
- *provision for any onsite processing and temporary storage of quarry material*
- *any specific provisions relating to onsite management of noise,* ***dust****, vibration, visual impact, water quality*
- *a procedure for addressing any* ***complaints***
- *objectives and principles for the rehabilitation of the site, including:*
  - *a timetable for the rehabilitation of prominent quarry faces*
  - *measures to create soil conditions which will support plant growth*
  - *measures to create a variety of site conditions to support a range of species*

  - *means of controlling runoff to avoid erosion*
  - *means of control of plant and animal pests*
  - *measures to avoid fire risks*
  - *means to assist native vegetation to regenerate on grazing land*
  - *rehabilitation which is compatible with Open Space strategy for adjacent areas of land*
- *management of buffer areas*
- *practices and methods that will be adopted to ensure that all permitted activity conditions applying to the activities will be met.*

The quarry management plan will complement the other rules applying to the quarry activity and will provide additional management details. It will be reviewed by Council at least every five years and any necessary adjustments will be made.

The progressive rehabilitation of the area is an important aspect of quarry management, and accordingly the Quarry Management Plan includes rehabilitation provisions. As quarrying and cleanfilling activities are completed on the site, an implementation plan shall be prepared annually by the consent holder in accordance with the Quarry Management Plan.

The requirement that regular monitoring is undertaken and regular progress reports are completed and submitted to the Council is a key element. This requirement is included because successful rehabilitation of any disturbed area requires constant monitoring as site conditions vary considerably and evolve over time. Regular observation and recording of results is an essential part of managing the process.

A vegetated buffer area is included within the area as part of the development of the southern part of the quarry. At the northern end, the necessary buffer area is within the Open Space B Area.

It is important also that rehabilitation of the quarry area should recognise and in the longer term be able to be integrated as appropriate with the Open Space strategy developed by the Council for the adjacent areas of land. Current Council policy is for the creation of further Green Belt areas on the steep hill sides of the Ngauranga Gorge and, for instance, it may be possible to allow continuation or linking of proposed walkways.

Overall, the environmental result will be the availability of quarry materials for the City and wider region in the short and medium term, and long-term achievement of well-vegetated quarry faces with the appearance of natural landforms which will be integrated with Council development of Open Space areas in this vicinity."

Rule 34.6.1.10 of the WCDP states (emphasis added as **bold** text):

"34.6.1.10.1

*Activities must not create a dust nuisance. A **dust nuisance** will occur if:*

- *there is visible evidence of suspended solids in the air beyond the site boundary; or*
- *there is visible evidence of suspended solids traceable from a dust source settling on the ground, building or structure on a neighbouring site, or water.*

34.6.1.10.2

With regard to the above provisions, where sites are contiguous and are held under the same ownership then any dust nuisance shall be measured at the periphery of the land holding within the District Plan area."

2.4 Assessment Criteria Adopted in this Report

Table 2-6 lists the assessment criteria adopted in this report. Note that only assessment criteria for particulate matter (as $PM_{2.5}$, PM_{10}, and TSP) apply in this assessment.

Table 2-6: Assessment Criteria Adopted in this Report

Contaminant	Assessment Criteria ($\mu g/m^3$)	Averaging Period	Reference
TSP	100	24-hour	MfE (2001)
PM_{10}	50 20	24-hour Annual	NES / NAAQG / RAAQT NAAQG / RAAQT
$PM_{2.5}$	25 10	24-hour Annual	RAAQT RAAQT

In light of the dust-generating activities undertaken on the project site (see Section 1), the reasons outlined in Section 3.2 and the existing dust mitigation measures employed onsite (see Section 5), the principal assessment criteria adopted in this assessment are as follows:

- 100 $\mu g/m^3$ for TSP (MfE's 24-hour mean trigger value); and,
- 50 $\mu g/m^3$ for PM_{10} (24-hour mean NES).

3 Assessment Methodology

3.1 Sensitive Receptors

In the context of this assessment, the term 'sensitive receptor' includes any persons, locations or ecosystems that may be susceptible to changes in airborne particulate concentrations and/or dust deposition as a result of dust emissions at Kiwi Point Quarry. An 'adverse effect' at a sensitive receptor may manifest itself as disamenity due to soiling (annoyance or nuisance), increased morbidity or mortality due to exposure to PM_{10}, or plant dieback due to reduced photosynthesis. Typical locations for sensitive receptors include:

- Residential properties, including retirement villages;
- Hospitals or medical centres;
- Schools and libraries;
- Marae;
- Public outdoor locations (e.g. parks, reserves, sports fields, beaches); and,
- Ecological receptors (habitats that might be sensitive to dust).

A desk-study was undertaken to identify sensitive receptors within a radius of 1 km of the project site boundary. The nearest potentially affected sensitive receptors are shown in Table 3-1.

Table 3-1: Sensitive Receptor Locations

Ref.	Type	Address	UTM Zone 60 South		Direction from Boundary	Distance from Boundary (m)
			Easting (m)	Northing (m)		
R1	Residential	42 Gurkha Crescent	315927	5431995	SW	0
R2	Residential	44 Gurkha Crescent	315915	5432008	SW	0
R3	Residential	46 Gurkha Crescent	315904	5432024	SW	0
R4	Residential	39 Gurkha Crescent	315888	5432041	SW	0
R5	Residential	37 Gurkha Crescent	315870	5432057	SW	0
R6	Residential	18 Shastri Terrace	315735	5432126	SW	40
R7	Residential	26 Imran Terrace	315540	5432200	SW	120
R8	Residential	7 Maldive Street	315527	5432367	W	10
R9	Residential	94 Burma Road	315530	5432389	NW	20
R10	Residential	175 Fraser Avenue	315551	5432618	NW	50
R11	School	170 Fraser Avenue	315580	5432797	NW	80
R12	Business	130 Fraser Avenue	315636	5432963	NW	30
R13	Retirement Village	134 Burma Road	315503	5432943	WNW	160
R14	Park	159 Burma Road	315610	5433070	NW	110
R15	Residential	113 Fraser Avenue	315774	5433051	NE	0
R16	Residential	9 Plumer Street	315968	5432881	NE	0

The nearest sensitive receptors to the Kiwi Point quarry boundary are receptors R1 to R5, R15 and R16 and are all residential properties situated adjacent to the quarry boundary. Receptor R11 is the Westmount School located on Fraser Avenue, Receptor R12 is a business located on Fraser Avenue, while receptor R13 is the Malvina Major Retirement Village. Receptor R14 is the Raroa Park (area of public open space).

Figure 3-1 shows the location of the potentially affected sensitive receptors identified in this assessment (solid yellow circles), the indicative quarry site boundary (solid red line), the area occupied by Taylor Preston (dashed red line) and the southern extension area (dashed orange line) on a Bing aerial basemap.

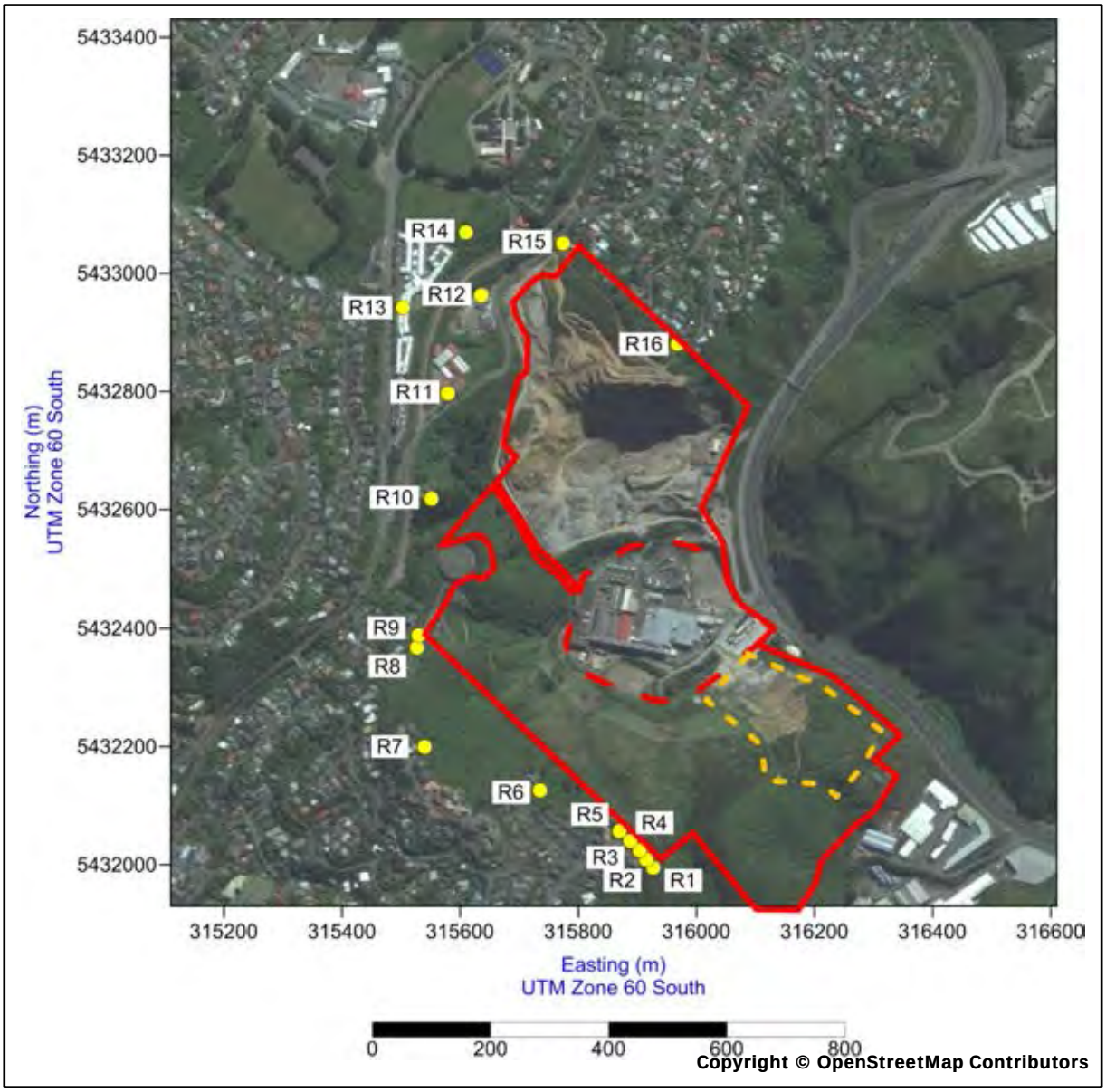

Figure 3-1: Sensitive Receptor Locations Showing a Bing Aerial Basemap

Whilst the existing businesses located on Tyers Road to the south-east of the quarry site boundary (and shown in Figure 3-1) have not been included as sensitive receptors in this report, a qualitative assessment has been undertaken in Section 5 to assess the potential risk at these properties as a result of dust emissions generated during the proposed southern extension works.

Figure 3-2 shows the location of the potentially affected sensitive receptors identified in this assessment (solid yellow circles) and the other features shown in Figure 3-1 on an OSM basemap.

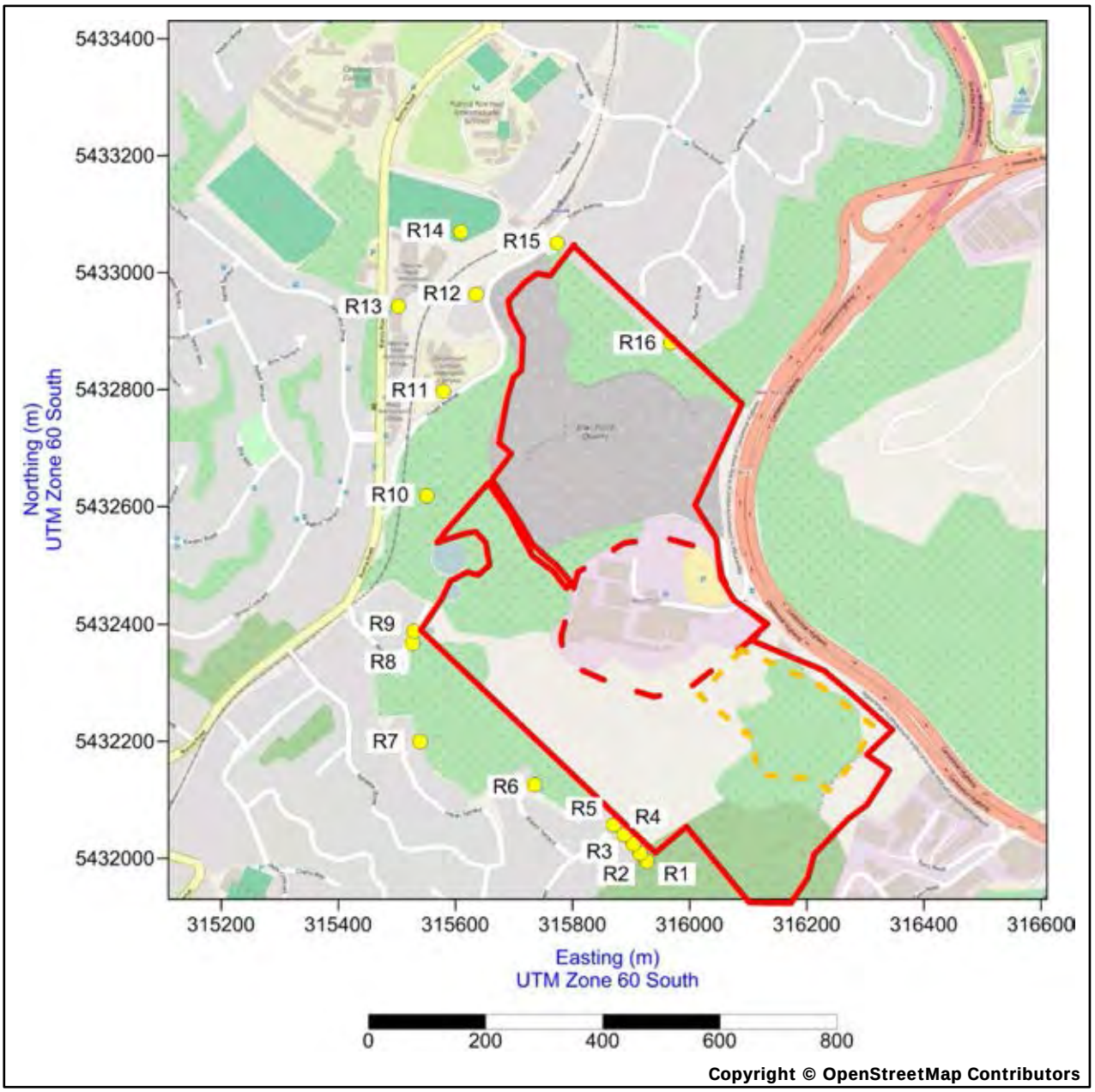

Figure 3-2: Sensitive Receptor Locations Showing an OSM Basemap

The receptors that are residential properties and the retirement village are considered to be of 'high' sensitivity[10] to potential dust emissions at Kiwi Point Quarry, for the reasons outlined below:

- The location of a person(s) who could reasonably be expected to enjoy a high level of amenity; or
- The appearance, aesthetics or value of a person's property could be diminished by soiling; and the people or property could reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.

Receptor R11 (school) and receptor R12 (business) are considered to be of 'moderate' sensitivity, while Receptor R14 (park) is of 'low' sensitivity to potential dust emissions at Kiwi Point Quarry.

[10] Other examples of high sensitivity receptors include, but are not limited to: marae, museums and other culturally important collections, medium- and long-term car parks (or parking areas used for work/residential) and car showrooms, electronics manufacturers, amenity areas and horticultural operations (e.g. salad or soft-fruit production). None of these types of receptors were identified from the desk-top study within the area immediately surrounding the quarry site boundary.

3.2 Dust and its Potential to Cause Nuisance

Dust has been defined in IAQM (2016) as follows:

> *"Solid particles that are suspended in air, or have settled out onto a surface after having been suspended in air. The terms dust and particulate matter (PM) are often used fairly interchangeably, although in some contexts one term tends to be used in preference to the other … the term 'dust' has been used to include the particles that give rise to soiling and to human health and ecological effects.*

The above definition has been adopted in this assessment. Dust emissions arising from drilling and blasting, quarrying (extraction), rock crushing and processing (screening), and the movement of vehicles on unsealed haul roads have the potential to cause nuisance both within and beyond the Kiwi Point Quarry site boundary, in the absence of appropriate mitigation measures. Within the site boundary, dust has the potential to cause mechanical or electrical faults to equipment, such as computers and printers, and could increase abrasion of moving parts in plant and machinery, and clogging of filters. In the surrounding environment, dust/particulate has the potential to cause annoyance to neighbours by the soiling of property, in particular, windows, cars and also of washed clothes that have been hung out to dry.

Table 3-2 summarises the potential effects of dust/particulate on people and the environment associated with dust nuisance, as opposed to health-related effects associated with dust particles getting into eyes and mouth, or falling onto skin, hair and lips, or fine particles ($PM_{2.5}$) and coarse particles ($PM_{2.5-10}$) getting into the respiratory tract.

The focus of this air quality impact assessment is on the larger particles, usually termed dust or TSP, which tend to settle out of the air quickly, and their potential to cause offsite dust nuisance effects.

The UK's Minerals Policy Statement 2 (MPS2)[11] states that:

> *"Large dust particles (greater than 30 µm), which make up the greatest proportion of dust emitted from mineral workings, will largely deposit within 100 m of sources. Intermediate-sized particles (10–30 µm) are likely to travel up to 200–500 m. Smaller particles (less than 10 µm) which make up a small proportion of the dust emitted from most mineral workings, are only deposited slowly but may travel 1000 m or more. Concentrations decrease rapidly on moving away from the source, due to dispersion and dilution. Large- and intermediate-sized particles are often referred to as nuisance dust, while small particles (PM_{10}) are associated with effects on human health."*

As MPS2 suggests, any larger dust particles (e.g. greater than 30 µm in diameter) released during the activities undertaken onsite are likely to settle within 100 m of the source over flat terrain (e.g. map distance). IAQM (2016) states that larger particles (such as TSP) are unlikely to travel more than 400 m downwind of a dust source on a minerals site, even at the most dusty quarries, based on monitoring data presented in the report.

The residual emissions to air (after the implementation of mitigation measures) of coarse particles ($PM_{2.5-10}$) and fine particles ($PM_{2.5}$) as a result of activities undertaken on the project site are not likely to be significant.

[11] Minerals Policy Statement 2 (MPS2), Annex 1: Dust, Office of the Deputy Prime Minister, 2005.

Table 3-2: Potential Nuisance Effects of Particles on People and the Environment

People or Resources Affected	Potential Effects
People: People at home, workplaces, community facilities, schools, hospitals etc.	Nuisance through surface soiling
Environmental resources: Landscape and nature conservation	• Loss of visual amenity through deposition • Covering of the leaf surface, resulting in shading and consequently reduction in net photosynthesis, altered pigment levels and/or reduced productivity • Blocking of stomatal pores to prevent them from fully functioning • Alteration of leaf surface chemistry that may affect disease resistance • Addition of nutrients from the dust that may lead to increased growth and/or deficiencies • Changes in pH levels over time if the dust has different pH conditions to surrounding soils • Soil pollution via deposition from the air or water run-off • Creation of a surface film on still water bodies
Environmental resources: Water quality	Increase in suspended and dissolved material in water courses with knock-on effects on aquatic ecology
Environmental resources: Air quality	Increased ambient concentrations of particulate
Environmental resources: Cultural heritage	Surface soiling and damage during cleaning

3.3 Qualitative Risk Assessment for Dust

In this report, MfE (2011), IAQM (2014)[12] and IAQM (2016)[13] were used to develop a qualitative (risk-based) assessment methodology to assess the potential effects arising from the dust-generating activities at the project site. The aim of the qualitative dust impact assessment is as follows:

- To determine the risk of dust emissions originating from the project site causing loss of amenity and/or health, cultural or ecological effects; and,
- To assess the magnitude (or scale) of the actual or potential effects beyond the site boundary.

The risk of dust emissions from a particular project site causing loss of amenity and/or health, cultural or ecological effects is related to:

- The dust-generating activities being undertaken at the project site (e.g. drilling and blasting, quarrying, crushing and screening of aggregate (including stockpiling of material) and vehicle movements on unsealed roads);
- The frequency and duration (including phasing) of these dust-generating activities;
- The size of the project site and/or the size of the dust-generating activity area;
- The local terrain and meteorological conditions (e.g. wind speed, wind direction and rainfall);
- The proximity of sensitive receptors to the dust-generating activities;
- The sensitivity of the receptors to dust/particulate; and,
- The adequacy of the mitigation measures applied onsite to reduce or eliminate dust emissions.

[12] IAQM, 2014. 'Guidance on the assessment of dust from demolition and construction', Institute of Air Quality Management, February 2014.

[13] IAQM, 2016. 'Guidance on the assessment of mineral dust impacts for planning, Institute of Air Quality Management, May 2016.

The quantity of dust emitted from a particular project site will be related to the area of land where dust-generating activities occur, and the level of the activities (nature, magnitude and duration). Emissions from onsite vehicles passing over unsealed ground may be particularly important, and may be related to the silt content of the soil (if applicable), as well as the speed and weight of the vehicle, the surface moisture content, the distance covered and the frequency of vehicle movements. Soil has been defined by the US Environmental Protection Agency (US EPA) as particles smaller than 75 µm in diameter. Incidentally, British Standard 6069 defines 'dust' as particles up to 75 µm in diameter.

The wind direction, wind speed and rainfall, at the time when a dust-generating activity is taking place, will also influence whether there is likely to be a dust impact. Due to the variability of the weather, it is impossible to predict what the weather conditions will be when specific activities will be undertaken. However, the purpose of a dust impact assessment will be to determine the potential dust impacts for specific (e.g. worst-case) meteorological conditions.

Local terrain features coupled with wind speed and direction influence the propagation and dispersion of dust. This will also influence the frequency that a sensitive receptor is situated downwind of a dust-generating activity (emission source), and will depend on the distance and change in elevation between the source and receptor. Higher wind speeds in flat terrain and under dry meteorological (low moisture) conditions will result in the highest potential for the release of dust from a site. Buildings, structures and trees can also influence dispersion and the potential for offsite dust nuisance effects.

Adverse effects can occur in any direction from a project site. They are, however, more likely to occur downwind of the prevailing wind directions and/or close to the site (or dust emission source). It should be noted that the 'prevailing' wind direction is usually the most frequent direction over a long period such as a year; whereas a particular dust-generating activity may occur over a period of weeks or months (e.g. summer only) during which the most frequent wind direction might be quite different. The most frequent wind direction may also not be the direction from which the wind speeds are highest. The use of the annual mean prevailing wind direction in the assessment of risk is most useful, therefore, for activities of long duration, such as those undertaken at the Kiwi Point Quarry. However, as rainfall acts as a natural dust suppressant, the potential for dust impacts is greater during the drier summer months. Therefore, consideration should be given in this report to seasonal meteorological data (e.g. rainfall amount, wind direction and wind speed), where site-specific or local data are available.

Local terrain and vegetation conditions also need to be taken into account. Topography and natural barriers (e.g. woodland and other vegetation) will reduce airborne particulate concentrations due to impaction. In addition, if the locality has a history of dust-generating activities, such as quarrying or abrasive blasting, a given level of additional dust may be more acceptable (i.e. more readily tolerated, than in a suburban residential area), as is the case at the Kiwi Point Quarry. Alternatively, impacts may be less acceptable where nearby residents have become sensitised to dust or have a history of complaining and may therefore be more likely to complain about a new dust source. Similarly, in rural areas agricultural activities may generate dust and this should be taken into account in the assessment of risk.

For PM_{10} and $PM_{2.5}$, local ambient air quality monitoring and/or atmospheric dispersion modelling data can be used to determine whether the 24-hour mean standards and guidelines are likely to be exceeded as a result of the proposed dust-generating activities. The risk of PM_{10} NES exceedances will be greatest at receptors very close to the site boundary (or dust emission source), especially if combined with PM_{10} from a major road (e.g. State Highway), or another PM_{10} emission source. However, a quantitative assessment is not considered to be required as part of this study, based on the results of the qualitative assessment presented in Section 5.

3.4 Methodology

The qualitative (risk-based) assessment methodology outlined below is based IAQM (2014) and IAQM (2016) and has been modified by MWH for the activities undertaken at the project site. The overall approach followed by MWH draws parallels with the FIDOL[14] method recommended in MfE (2001).

In accordance with IAQM (2014), the potential dust impacts have been assessed separately for each activity for the following categories:

1) Annoyance (or nuisance) due to dust soiling (deposition); and,
2) The risk of health effects due to an increase in exposure to PM_{10}.

It is noted that as no ecological or culturally sensitive receptors were identified from the desk-top study to be located within close proximity to the quarry site boundary, the potential impacts of dust-generating activities undertaken at the project site on these types of receptors are considered to be negligible and have not been considered further in this assessment.

The methodology follows the source-pathway-receptor (S-P-R) concept and represents the hypothetical relationship between the dust emission source (S), the pathway (P) by which nuisance or exposure might occur and the receptor (R) that could be adversely effected, and would apply equally to the human, cultural and ecological receptors.

The first step in the qualitative assessment is to determine the risk of dust arising in sufficient quantities to cause annoyance and/or health impacts (and/or cultural impacts and/or ecological impacts, where applicable) using four risk categories: 'negligible', 'low', 'medium' and 'high' risk. It first involves defining the site characteristics, onsite dust-generating activities and baseline environmental conditions (including meteorology, terrain, surrounding land use and ambient air quality).

A site is allocated a risk category based on two factors:

- The scale and nature of the dust-generating activities, which determines the potential dust emission magnitude as 'small', 'medium' or 'large' (Step 1); and,
- The sensitivity of the area to dust impacts (Step 2), which is defined as 'low', 'medium' or 'high' sensitivity (see Section 3.1), including the factors influencing the 'pathway' term, such as the position of receptors relative to the prevailing wind direction, distance between source and receptor, the topography, terrain and physical features (including vegetation cover and buildings). This step is also referred to as determining the pathway effectiveness.

These two factors (the 'source' term in Step 1 and the 'pathway' term in Step 2) are combined in Step 3 to determine the risk of dust impacts at each receptor location. The risk category assigned to the site can be different for individual site activities (e.g. drilling/blasting, quarrying, rock crushing and screening, material handling and storage (stockpiling) and vehicle movements). More than one of these activities may occur onsite at any one time.

Where appropriate, the site can be divided into 'zones' for the dust risk assessment. This may result in different mitigation levels being applied to each zone. This could be where different parts of a large site are different distances from the nearest receptors, or where activities move away from or closer towards a receptor, during a new stage of the quarry development (e.g. during the proposed southern extension).

However, MWH recommends that on complex sites where activities are not easily segregated, the mitigation appropriate for the highest risk category should be applied. The aim is to ensure that it is clear what mitigation is supposed to be implemented on a site and to make auditing this simpler not only for regulatory authorities but also for onsite (operational) staff.

3.4.1 Step One – Estimate Dust Impact Risk and Potential Residual Emissions

The residual dust emission magnitude is based on the scale of the anticipated works and should be classified as 'imperceptible', 'small', 'medium', or 'large' after the 'designed-in' mitigation measures have been taken into account. For the purposes of this assessment, the 'designed-in' mitigation measures are assumed to be the existing mitigation measures employed onsite by Holcim (as opposed to the additional measures recommended in Section 6). In addition, landscaping (including existing/proposed trees and vegetation cover), existing/proposed terrain elevations between dust emission sources and

[14] The Frequency (F), Intensity (I), Duration (D), Offensiveness (O) and Location (L) of the dust effect (nuisance).

receptors and the site-specific / local meteorology (e.g. frequency of moderate to high wind speed conditions at the site and the propagation of dust by wind) should also be considered.

An ‘imperceptible’ impact magnitude is one where there is predicted to be no discernible change as a result of the scheme/activity. For example, there is predicted to be a variation in local ambient concentrations of TSP, PM_{10} or $PM_{2.5}$ of less than 1% of the relevant ambient air quality standards and guidelines. However, for simplicity, MWH has adopted the following classifications in this assessment: ‘small’, ‘medium’ and ‘large’.

Examples of how the potential dust emission magnitude for different activities can be defined are shown in Table 3-3 and were based on the examples provided in IAQM (2016) for site preparation / restoration, mineral extraction, materials handling, onsite transportation, mineral processing, stockpiles / exposed surfaces and offsite transportation. Note that, in each case, not all the criteria need to be met, and that other criteria may be used if justified in the assessment. The ‘medium’ magnitude residual dust emissions would fall between the ‘small’ and ‘large’ categories.

Table 3-3: Determining Residual Source Emissions

Activity	'Small' Emissions	'Large' Emissions
Site Preparation / Restoration	• Small working area (<2.5 ha) • Low bunds (<4 m in height) • <20,000 m^3 material movement • <5 heavy plant simultaneously active • All bunds seeded • Material with a high moisture content (low dust potential)	• Large working area (>10 ha) • High bunds (>8 m in height) • >100,000 m^3 material movement • >10 heavy plant simultaneously active • All bunds un-seeded • Fine grained and friable material (high dust potential)
Mineral Extraction	• Small working area (<20 ha) • Low energy extraction methods (hydraulic excavator) • Material of low dust potential (e.g. coarse and/or high moisture content) • Low extraction rate (<200,000 tpa)	• Large working area (>100 ha) • High energy extraction methods (drilling and blasting frequently used) • Material of high dust potential (e.g. small particles and/or low moisture content) • High extraction rate (e.g. 1,000,000 tpa)
Materials Handling	• Low number of heavy plant (<5 plant more than 100 m from site boundary within quarry void or clean hardstanding) • Transferring material of low dust potential and/or high moisture content	• High number of heavy plant (>10 loading plant less than 50 m from site and/or on unconsolidated, surface with low moisture content) • Transferring material of high dust potential and/or low moisture content
Onsite Transportation	• Use of (covered) conveyors for majority of onsite material transportation • Paved haul roads • Road surface of low dust potential • Low number of HDV movements (<100 vehicle movements per day) and/or surface materials of compacted aggregate • Low total length of haul roads (<500 m in length) • Controlled (low) vehicle speed (<25 kph)	• Use of unconsolidated haul roads for majority of onsite material transportation • Unpaved haul roads • Road surface of high dust potential • High number of HDV movements (>250 vehicle movements per day) and/or surface materials of compacted aggregate • High total length of haul roads (>2 km in length) • Uncontrolled vehicle speed
Mineral Processing	• Raw material of low dust potential and/or fixed screening plant with effective dust control • End product of low dust potential (high moisture e.g. wet sand/gravel)	• Raw material of high dust potential and/or mobile crusher and screening plant with low dust control • End product of high dust potential (low moisture e.g. hard rock)

Activity	'Small' Emissions	'Large' Emissions
	• Single process or product • Low volume material processed (<200,000 tpa)	• Complex or combination of processes • High volume material processed (>1,000,000 tpa)
Stockpiles / Exposed Surfaces	• Short-term stockpile (<1 month) and/or quarry production <200,000 tpa • Infrequent material transfers (weekly) • Material of low dust potential (high moisture content) • Ground surface hardstanding / clean • Stockpiles well within quarry void and more than 100 m from site boundary • Small areas of exposed surfaces (<2.5 ha) • Low wind speeds / high dust threshold	• Long-term stockpile (>12 months) and/or quarry production >1,000,000 tpa • Frequent material transfers (daily) • Material of high dust potential (low moisture content) • Ground surface unconsolidated / un-kept • Stockpiles or exposed surfaces within 50 m from site boundary • Large areas of exposed surfaces (>10 ha) • High wind speeds / low dust threshold
Offsite Transportation (trackout)	• Low number of HDV movements (<25 per day) • Paved (sealed) surface road and/or use of road sweeper (truck) or manual cleaning • Extensive vehicle cleaning facilities • Low total length of access road (<20 m)	• High number of HDV movements (>200 per day) • Unconsolidated access road and/or no road sweeper or manual cleaning • Limited or no vehicle cleaning facilities • High total length of access road (>50 m)

3.4.2 Step Two – Determine Receptor Sensitivity and Pathway Effectiveness

The sensitivity of the receptors identified in this assessment has taken the following factors into account:

- Specific sensitivities of receptors (see examples shown in Section 3.1). In this assessment, all residential properties (including the retirement village) were considered to be of 'high' sensitivity to potential dust emissions at the quarry. The school and business were considered to be of 'moderate' sensitivity, while the park was of 'low' sensitivity to dust emissions at the quarry;
- The level of amenity;
- The proximity and type of sensitive receptors (including frequency that receptors are situated downwind of dust-generating activities during prevailing wind directions);
- Where an assessment for PM_{10} is required, the local PM_{10} background concentration and compliance against the NES for PM_{10} (not applicable in this assessment); and,
- Site-specific factors, such as whether there are any man-made earth bunds, local terrain features (the latter are considered to be significant at Kiwi Point Quarry, as shown in Section 1.5), or natural shelters, such as trees and other types of vegetation, to reduce the risk of wind-blown dust.

In accordance with IAQM (2016), the effectiveness of the pathway to each sensitive receptor location was determined by considering the distance and direction of the receptors relative to the prevailing wind directions (based on 5 years' wind speed and direction data for Kelburn AWS as shown in Section 4, in the absence of site-specific data), and the criteria used in this assessment are summarised in Table 3-4 and Table 3-5, respectively. However, the criteria shown in the tables do not consider the change in elevation between the dust emission source and receptor, and this limitation has the potential to lead to an over-prediction (more conservative assessment) of the potential impacts.

Table 3-4: Categorisation of Frequency of Potentially Dusty Winds

Frequency Category	Criteria*
Infrequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on all days are less than 5%
Moderately frequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on dry days are between 5% and 12%
Frequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on dry days are between 12% and 20%
Very frequent	Frequency of winds (>5.5 m/s) from the direction of the dust source on dry days are greater than 20%

N.B. * For a worst-case assessment, include all days.

High-risk conditions for dust emissions at the site are associated with dry days with measured winds above moderate breeze (5.5 m/s). However, this assessment has not taken into account the potential for rainy days to reduce the frequency of potential 'high-risk' conditions. In other words, the frequency of 'potentially dusty winds' determined in Section 4 for the Kiwi Point Quarry is based on Table 3-4 and for 'all days' (including rainy days).

Given that the Kiwi Point Quarry is not situated within a polluted airshed and in the absence of actual site-specific or local (e.g. GWRC) ambient air quality monitoring data, it was assumed that the 24-hour mean background concentration of PM_{10} beyond the project site boundary was 28 µg/m^3. Reference should also be made to the New Zealand Transport Agency's interactive background air quality maps[15], which indicates that the existing 24-hour mean background concentration of PM_{10} within Raroa, Ngauranga West, Ngauranga East and Rangoon Heights is 28 µg/m^3.

[15] http://nzta.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=9ba0e52d1b3d4770ab031bb843d6198f

Table 3-5: Categorisation of Receptor Distance from Source

Frequency Category	Criteria*
Distant	Receptor is between 200 m and 400 m from the dust source
Intermediate	Receptor is between 100 m and 200 m from the dust source
Close	Receptor is less than 100 m from the dust source

N.B. * For a worst-case assessment, do not take into account changes in terrain elevations or the influence of vegetation cover and buildings.

The pathway effectiveness is determined from the outputs from Table 3-4 and Table 3-5 and using Table 3-6.

Table 3-6: Pathway Effectiveness

Receptor Distance	Frequency of Potentially Dusty Winds			
	Infrequent	Moderately Frequent	Frequent	Very Frequent
Close	Ineffective	Moderately Effective	Highly Effective	Highly Effective
Intermediate	Ineffective	Moderately Effective	Moderately Effective	Highly Effective
Distant	Ineffective	Ineffective	Moderately Effective	Moderately Effective

N.B. * For a worst-case assessment, do not take into account changes in terrain elevations or the influence of vegetation cover and buildings.

3.4.3 Step Three – Define the Potential Dust Impact Risk for Each Activity

The third step is to combine the residual source emissions (Step 1) and the pathway effectiveness (Step 2) to predict the dust impact risk for each dust-generating activity (and/or phase) and receptor as shown in Table 3-7.

Table 3-7: Dust Impact Risk Assessment Criteria

Pathway Effectiveness (Step 2)	Residual Source Emissions (Step 1)		
	Small	Medium	Large
Highly Effective Pathway	Low Risk	Medium Risk	High Risk
Moderately Effective Pathway	Negligible Risk	Low Risk	Medium Risk
Ineffective Pathway	Negligible Risk	Negligible Risk	Low Risk

The final step in the assessment is to determine the magnitude (scale) of the potential dust impact risks predicted at each receptor location. For complex sites it may be necessary to determine the risk for individual activities or phases and an overall assessment should be made based on the highest (worst-case) risk activity/phase. The dust impact magnitude criteria used in this assessment are shown in Table 3-8.

Table 3-8: Dust Impact Magnitude Criteria

Dust Impact Risk	Receptor Sensitivity		
	Low	Medium	High
High Risk	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Effect
Medium Risk	Negligible Effect	Slight Adverse Effect	Moderate Adverse Effect
Low Risk	Negligible Effect	Negligible Effect	Slight Adverse Effect
Negligible Risk	Negligible Effect	Negligible Effect	Negligible Effect

4 Local Meteorological Conditions

4.1 Wind Speed and Direction

The nearest automated weather stations (AWS) to Kiwi Point Quarry are the Kaukau Top and Kelburn AWS sites. The details of these surface meteorological stations, which are all included in the national climate database (CliFlo) maintained by NIWA, are summarised in Table 4-1.

Table 4-1: Nearest Weather Stations to the Project Site

Name	Agent Number	Operator	UTM Zone 60 South		Distance (km) and Direction from Site Boundary	
			Easting (m)	Northing (m)		
Kaukau Top	03375	NIWA	313702	5432772	1.9	WNW
Kelburn AWS	25354	MetService	313119	5427300	5.5	SW

The Kaukau Top weather station site is situated at an elevation of 425 m above mean sea level (MSL), which indicates that whilst it is closer to the site than the Kelburn AWS, it is likely to experience higher wind speed conditions than at Kelburn or at the Kiwi Point Quarry. The Kelburn AWS site is situated at an elevation of 125 m above MSL, compared with the proposed final elevations within the void (floor) of the existing quarry (Area A) and the proposed southern extension (Area H) of 50 m and 55 m above MSL, respectively. However, it is noted that the elevations along the ridgelines surrounding the quarry upon which the nearest sensitive receptors are located are situated at elevations of between approximately 150 m and 210 m and in the absence of any site-specific or more local meteorological data, it is considered appropriate in this assessment to use the data from the Kelburn AWS.

Hourly wind speed and direction data for these two meteorological stations between 1 January 2008 and 31 December 2012 (i.e. over a 5 year period) were analysed. The data availability at both AWS sites over the 5-year period was excellent at 99.5% (Kaukau Top) and 99.7% (Kelburn AWS). The data availability for each year is shown in Table 4-2.

Table 4-2: Data Availability at Kaukau Top and Kelburn AWS between 2008 and 2012

Year	Kaukau Top		Kelburn AWS	
	Number of Missing Data Hours	Percentage of Missing Data Hours (%)	Number of Missing Data Hours	Percentage of Missing Data Hours (%)
2008	123	1.4	72	0.8
2009	10	0.1	29	0.3
2010	12	0.1	4	0.1
2011	36	0.4	8	0.1
2012	28	0.3	19	0.2

The percentage calms (or winds less than 0.45 m/s) and the annual mean wind speed measured at both sites for each year is shown in Table 4-3. As expected, the annual mean wind speeds measured at Kelburn AWS were significantly lower than at Kaukau Top, however, the percentage of calms was somewhat unexpectedly lower at Kelburn AWS than at Kaukau Top.

Table 4-3: Frequency of Calms and Annual Mean Wind Speeds between 2008 and 2012

Year	Kaukau Top		Kelburn AWS	
	Percentage of Calm Hours (%)	Annual Mean Wind Speed (m/s)	Percentage of Calm Hours (%)	Annual Mean Wind Speed (m/s)
2008	1.5	11.1	0.2	5.1
2009	1.1	11.8	0.1	5.6
2010	2.3	11.3	0.2	5.3
2011	2.1	10.8	0.2	5.1
2012	2.1	10.8	0.3	5.1

Analysis of hourly wind speed and direction data for these two meteorological stations between 2008 and 2012 indicates that winds from all directions are experienced at each monitoring site, and are therefore likely to be experienced at Kiwi Point Quarry.

The predominant winds (63.8% in total) measured at the Kelburn AWS were from the south-south-east (SSE, 17.7%), south (S, 13.7%), north-west (NW, 12.2%), north (N, 10.5%) and south-east (SE, 9.6%), as shown in Table 4-4 and in the wind rose shown in Figure 4-1.

Table 4-4: Wind Speed and Direction Frequencies at Kelburn AWS between 2008 and 2012

Wind Direction	Wind Speed (m/s)						
	0.5 to 1.5 (%)	1.5 to 3.0 (%)	3.0 to 5.5 (%)	5.5 to 8.0 (%)	8.0 to 10.5 (%)	>10.5 (%)	Total (%)
N	0.6	1.8	4.1	2.9	0.9	0.2	10.5
NNE	0.7	1.3	2.2	1.5	0.4	0.1	6.1
NE	0.6	0.9	0.6	0.3	0.1	0.0	2.5
ENE	0.6	0.7	0.4	0.1	0.0	0.0	1.8
E	0.5	0.6	0.5	0.2	0.1	0.0	1.9
ESE	0.4	0.5	0.8	0.4	0.2	0.0	2.5
SE	0.4	1.2	3.3	2.7	1.5	0.5	9.6
SSE	0.5	1.9	7.1	5.3	2.4	0.6	17.7
S	0.6	1.7	4.7	3.2	2.4	1.2	13.7
SSW	0.4	0.8	1.4	0.6	0.3	0.2	3.7
SW	0.3	0.5	0.6	0.2	0.0	0.0	1.7
WSW	0.5	0.7	0.3	0.1	0.0	0.0	1.5
W	0.8	1.1	0.5	0.2	0.1	0.0	2.8
WNW	0.7	0.7	1.3	1.4	0.9	0.6	5.6
NW	0.6	0.8	2.5	3.2	2.9	2.3	12.2
NNW	0.5	0.9	2.4	1.2	0.4	0.2	5.6
Sub-Total	**8.8**	**16.2**	**32.5**	**23.3**	**12.6**	**6.0**	**99.5**
Calms							**0.2**
Missing							**0.3**
Total							**100.0**

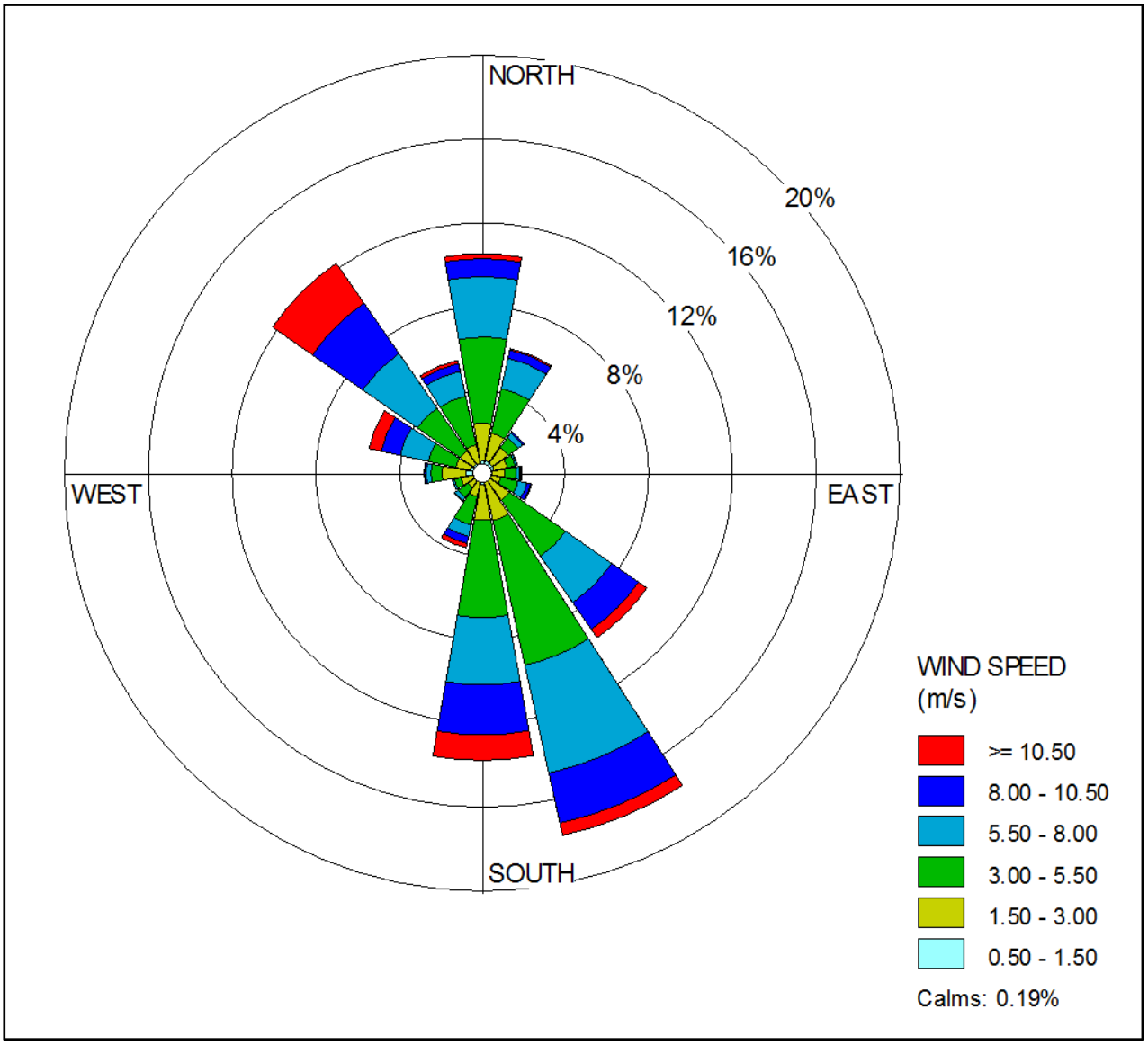

Figure 4-1: Wind Rose for Kelburn AWS for 2008 to 2012

The wind speed frequency distribution for Kelburn AWS for each year is shown in Figure 4-2. The figure indicates that 41.5% of the hourly mean wind speeds were above 5.5 m/s, which is significant as this has been adopted in this assessment as the threshold above which there is the potential for the propagation of dust in dry conditions, based on IAQM (2016). A 5.5 m/s mean wind speed corresponds to 19.8 km/hr or 'moderate breeze' (Beaufort 4) or 'moderate' winds, as defined by the MetService. Further analysis has been undertaken of the data to determine the percentage frequency that sensitive receptor locations are likely to be situated downwind of potentially dusty winds blowing over the quarry (refer Section 3).

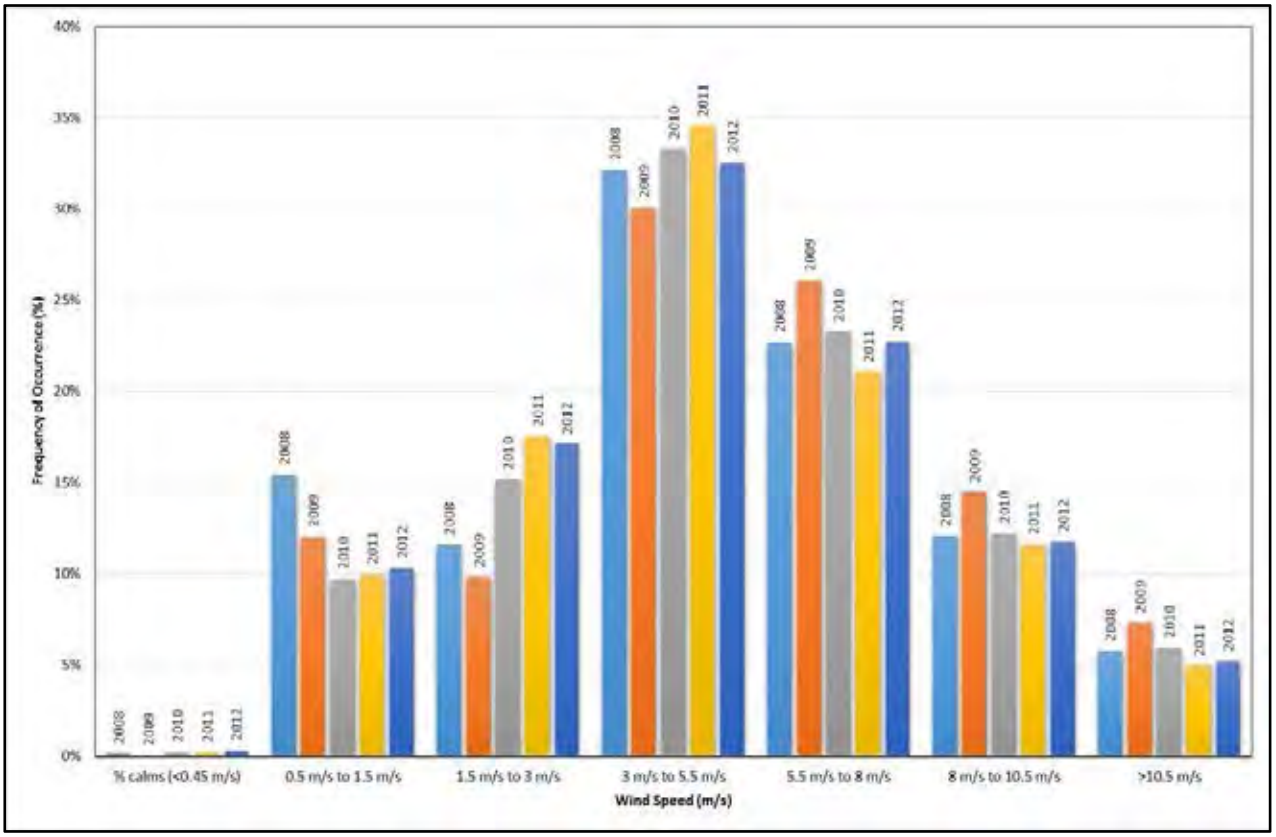

Figure 4-2: Wind Speed Frequency Distribution for Kelburn AWS for 2008 to 2012

The predominant winds above 5.5 m/s measured at the Kelburn AWS were from the NW (8.4%), SSE (8.3%), S (6.8%), SE (4.7%) and N (4%), which corresponds to 32.2% of the total winds above 5.5 m/s, as shown in Table 4-5 and in the wind rose shown in Figure 4-3.

Table 4-5: Moderate to High Wind Speed and Direction Frequencies at Kelburn AWS

Wind Direction	Wind Speed for 2008 to 2012 (m/s)			
	5.5 to 8.0 (%)	8.0 to 10.5 (%)	>10.5 (%)	Total (%)
N	2.9	0.9	0.2	4.0
NNE	1.5	0.4	0.1	2.0
NE	0.3	0.1	0.0	0.3
ENE	0.1	0.0	0.0	0.1
E	0.2	0.1	0.0	0.3
ESE	0.4	0.2	0.0	0.7
SE	2.7	1.5	0.5	4.7
SSE	5.3	2.4	0.6	8.3
S	3.2	2.4	1.2	6.8
SSW	0.6	0.3	0.2	1.1
SW	0.2	0.0	0.0	0.2
WSW	0.1	0.0	0.0	0.1
W	0.2	0.1	0.0	0.3
WNW	1.4	0.9	0.6	2.9
NW	3.2	2.9	2.3	8.4
NNW	1.2	0.4	0.2	1.8
Sub-Total	**23.3**	**12.6**	**6.0**	**42.0**
Calms				**0.2**
<5.5 m/s				**57.5**
Missing				**0.3**
Total				**100.0**

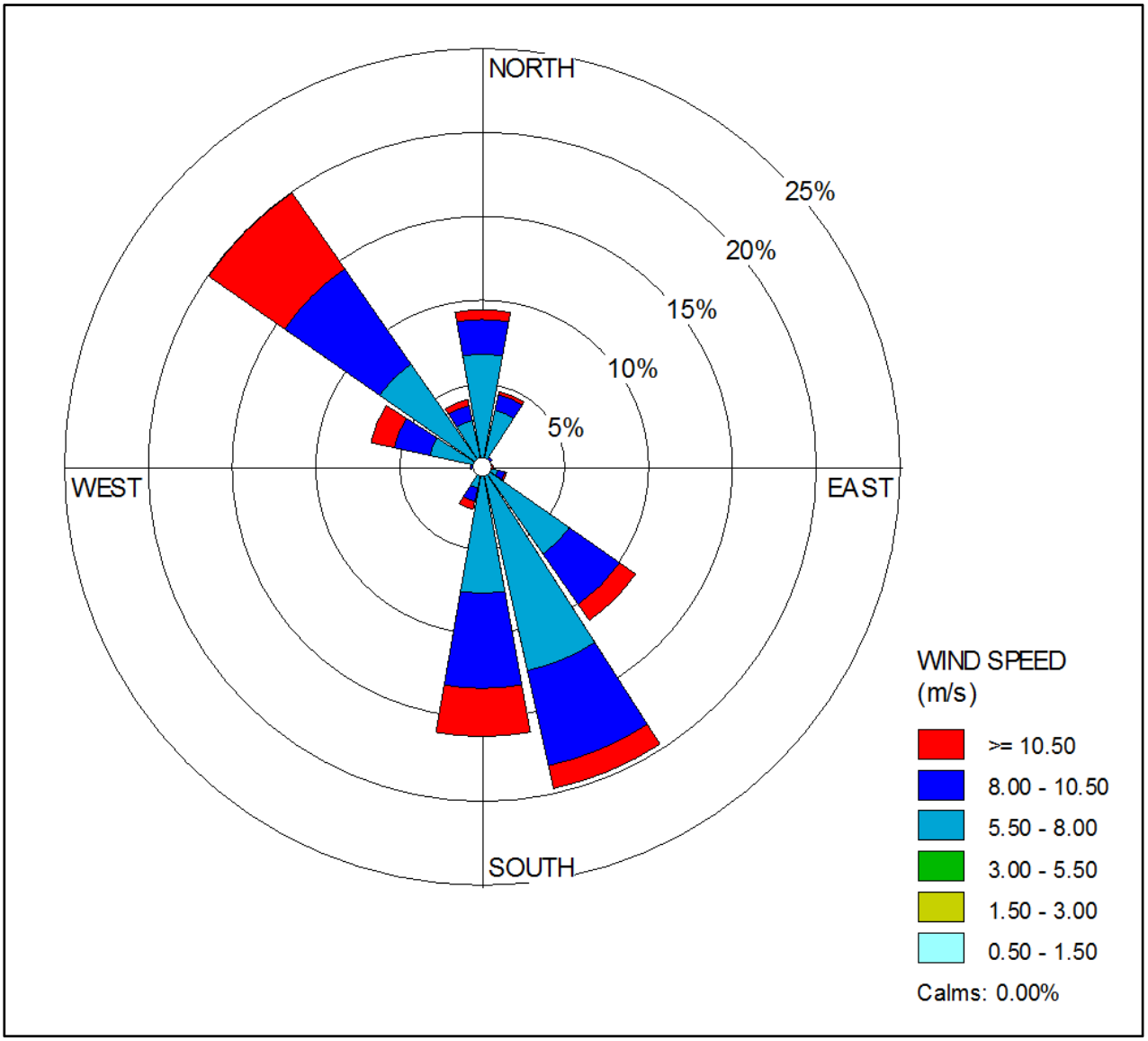

Figure 4-3: Wind Rose for Moderate to High Wind Speeds at Kelburn AWS for 2008 to 2012

The frequency of wind speeds above 5.5 m/s (moderate to high wind conditions or potentially dusty winds) are shown in Table 4-6, along with the distance of each sensitive receptor relative to the direction from the nearest potential dust emission source(s) up to a maximum map-distance of 400 m, in accordance with IAQM (2016). The pathway effectiveness (Step 2 of the methodology) is also shown for each receptor. It is noted that no further analysis of the wind speed and direction data has been undertaken to exclude rainy days, in order to allow for a robust (conservative) assessment.

Table 4-6: Frequency of Potentially Dusty Winds and Receptor Pathway Effectiveness

ID	Receptor Address	Direction From Nearest Dust Source to Receptor	Total Wind Speeds >5.5 m/s (%)	Freq. of Potential Dusty Winds	Receptor Distance and Description from Source (m)	Pathway Effectiveness
R1	42 Gurkha Crescent	NNE to E	2.7	Infrequent	230 / Distant	Ineffective
R2	44 Gurkha Crescent	NNE to E	2.7	Infrequent	230 / Distant	Ineffective
R3	46 Gurkha Crescent	NNE to E	2.7	Infrequent	250 / Distant	Ineffective
R4	39 Gurkha Crescent	NNE to E	2.7	Infrequent	260 / Distant	Ineffective
R5	37 Gurkha Crescent	NNE to E	2.7	Infrequent	260 / Distant	Ineffective
R6	18 Shastri Terrace	NNE to E	2.7	Infrequent	300 / Distant	Ineffective
R7	26 Imran Terrace	NNE to E	2.7	Infrequent	380 / Distant	Ineffective
R8	7 Maldive Street	NNE to ENE	2.4	Infrequent	270 / Distant	Ineffective
R9	94 Burma Road	NNE to ENE	2.4	Infrequent	240 / Distant	Ineffective
R10	175 Fraser Avenue	NE to ESE	1.4	Infrequent	120 / Intermediate	Ineffective
R11	170 Fraser Avenue	NE to SE	6.1	Moderately Frequent	100 / Intermediate	Moderately Effective
R12	130 Fraser Avenue	ENE to S	20.9	Very Frequent	50 / Close	Highly Effective
R13	134 Burma Road	E to SSE	14.0	Frequent	200 / Distant	Moderately Effective
R14	159 Burma Road	ESE to S	20.5	Very Frequent	120 / Intermediate	Highly Effective
R15	113 Fraser Avenue	SE to SW	21.2	Very Frequent	100 / Intermediate	Highly Effective
R16	9 Plumer Street	SSE to W	16.9	Frequent	160 / Intermediate	Moderately Effective

4.2 Rainfall

Chappell (2014)[16] indicates that average annual rainfall within the Wellington region is highly variable due to topographical effects which influence airflows and thus the patterns of precipitation.

The monthly and annual rainfall normals (in mm) for Wellington Airport (Site A) and Gracefield, Lower Hutt (Site B), which are the two closest weather stations to the project site where rainfall measurements are undertaken by NIWA, are shown in Table 4-7.

Table 4-7: Monthly and Annual Rainfall Normals for Wellington and Gracefield for 1981 to 2010

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
A	58	61	67	68	86	101	113	93	75	95	75	65	957
B	44	55	60	50	70	84	87	76	59	67	62	55	767

The percentage of annual rainfall totals for each month for Wellington Airport (Site A) and Gracefield, Lower Hutt (Site B), are shown in Table 4-8.

Table 4-8: Percentage of Annual Rainfall Totals for Each Month for Wellington and Gracefield

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
A	6	6	7	7	9	11	12	10	8	10	8	7	-
B	4	6	9	5	13	11	14	8	8	7	8	8	-

The rainfall data for Wellington Airport and Gracefield indicate that rainfall is highest at these locations, as expected, during the winter months (June to August) and is lowest during the summer months (December to February). Whilst there is a higher potential for high-risk conditions for dust emissions at the site to occur during summer (e.g. dry days with measured winds above moderate breeze (5.5 m/s)), the rainfall data indicate that there is still a moderate to high potential for rainy days to occur at this time of year, which will dampen down unsealed surfaces and stockpiles at the quarry, thus reducing the potential for wind-blown dust at the site.

[16] Chappell, P.R., 2014. The Climate and Weather of Wellington, Second Edition, NIWA Science and Technology Series Number 65, 2014.

5 Air Quality Impact Assessment

5.1 Existing Dust Mitigation Measures

Existing dust mitigation measures implemented onsite by Holcim include:

- **Visual inspection (monitoring) for dust**. Quarry staff undertake regular visual inspections for dust emissions on the site, and implement control measures (e.g. sprinklers, water cart) as required;
- **Mineral Processing and Materials handling**. The crushing and screening plant and aggregate product stockpiles are located within a low-lying part of the site (the quarry floor or void) which reduces the potential for propagation by wind erosion and weathering. In addition, overburden extracted on site will be used to construct noise/visual bunds around the perimeter of the site (along the boundary with SH1). There is the potential for these bunds to be planted with native vegetation which, in addition to the other vegetation located around the perimeter of the site, in addition to the terrain elevations, will significantly reduce the potential for dust to be picked and carried by the wind from the sources located on the quarry floor; and,
- **Dampening surfaces and stockpiles using water**. The unsealed haul roads are sprayed with water using a water truck, and the stockpiles area is also sprayed in order to control dust emissions. The sealed road has a sprinkler system for dust suppression.

Reference should be made to the QMP for additional information regarding existing dust control.

5.2 Impact Assessment

5.2.1 Dust Emissions

Emissions of dust/particulate to air at the project site during the continuation of the existing quarrying operation and during the proposed southern extension have the potential to occur during extraction (quarrying) and processing (crushing and screening) and associated activities, such as vehicle movements and aggregate handling and stockpiling. Emissions are likely to vary substantially from day to day, depending on the level of activity, the specific operations being undertaken, the weather conditions and the location of the activity (e.g. quarrying/overburden placement within the existing (northern) quarry or the southern extension area).

A large proportion of the emissions are likely to result from the quarrying and rock crushing and screening plant, aggregate stockpiles and from road vehicles moving over unsealed site roads and yard surfaces. The scale of the impacts associated with these activities depends on the dust suppression and other mitigation measures applied by Holcim (as discussed in Section 5.1).

While there is the potential for some dust and particulate emissions to arise during the operation of the crushers and screening plant and from the product stockpiles, these sources are located within low-lying parts of the quarry (quarry floor, or Area A as shown in Figure 1-4), away from the site boundary and will be surrounded by noise/visual bunds (along the boundary with SH1) and native vegetation, which offer protection from the wind. It is also noted that Holcim uses a water cart to dampen down the quarry-floor area and sprinklers to control dust emissions from the crushing and screening plant, unsealed surfaces and stockpiles, as required during dry and windy meteorological conditions. The crushers and screening plant are shut-down during strong winds in order to reduce the dust emissions from the plant. Furthermore, the soil/overburden removal areas and stockpiles or bunds will continue to be hydroseeded and watered regularly by Holcim, in order to control the potential dust emissions from these sources.

A meteorological station is not currently situated on the site (although one is recommended in Section 6 to be installed onsite). It is therefore acknowledged that Holcim currently puts dust suppression measures into action based on visual inspections around the site (i.e. if there are visible emissions of dust). A meteorological station could be used to record wind speed, wind direction, temperature and rainfall, and the data could be reviewed prior to undertaking blasting within the southern extension area.

5.2.2 Actual and Potential Air Quality Effects

The main air quality impacts that may arise during quarrying (including drilling and blasting), aggregate processing and associated activities are as follows:

1) Dust deposition, resulting in the soiling of surfaces; and,
2) Elevated PM_{10} concentrations, as a result of dust generating activities onsite.

It is noted that visible dust plumes, which are evidence of dust emissions, may also occur from time to time, in the absence of adequate mitigation (dust suppression).

Dust soiling has the potential to arise from the deposition of dust in all size fractions. The ambient dust/particulate relevant to health outcomes will be that measured as PM_{10} and $PM_{2.5}$ although most of this will be in the coarse ($PM_{2.5-10}$) fraction, rather than the fine ($PM_{2.5}$) fraction. Research undertaken in the USA suggests that 85% to 90% by weight of the fugitive dust emissions of PM_{10} from construction sites are $PM_{2.5-10}$ and 10% to 15% are in the $PM_{2.5}$ fraction. Consequently, the potential for elevated $PM_{2.5}$ concentrations as a result of dust-generating activities on the project site is considered to be extremely low, and has not been considered further in this assessment.

Experience of assessing the exhaust emissions from onsite non-road mobile machinery (NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. Consequently, the potential for elevated concentrations of NO_2, CO and PM_{10} as a result of exhaust emissions from onsite plant on the project site is considered to be extremely low, and has not been considered further in this assessment.

MWH has determined the potential residual dust emission magnitudes for the existing and proposed activities to be undertaken on the project site by Holcim (Step 1 of the methodology). The residual dust emission magnitudes and the predicted dust impacts at each receptor are summarised in Table 5-1.

Overall, the existing and proposed activities undertaken at the Kiwi Point Quarry are considered to have a slight adverse effect within the surrounding community. These potential effects are considered to be no more than minor and are based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects.

Whilst the results of the assessment indicate that the designed-in (existing) operational mitigation measures are considered appropriate to mitigate the potential effects on the surrounding area, a number of additional mitigation measures have been recommended in the following section, which take into account current best practice. The results indicate that there are unlikely to be any dust nuisance effects beyond the Kiwi Point Quarry site boundary.

Table 5-1: Summary of Predicted Dust Impacts

ID	Receptor Type and Address	Nearest Dust Source	Residual Source Emissions	Pathway Effective-ness	Dust Impact Risk	Receptor Sensitivity	Magnitude of Dust Effect
R1	Residential 42 Gurkha Crescent	Southern Extension Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R2	Residential 44 Gurkha Crescent	Southern Extension Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R3	Residential 46 Gurkha Crescent	Southern Extension Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R4	Residential 39 Gurkha Crescent	Southern Extension Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R5	Residential 37 Gurkha Crescent	Southern Extension Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R6	Residential 18 Shastri Terrace	Southern Extension Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R7	Residential 26 Imran Terrace	Existing Quarry Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R8	Residential 7 Maldive Street	Existing Quarry Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R9	Residential 94 Burma Road	Existing Quarry Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R10	Residential 175 Fraser Avenue	Existing Quarry Works	Medium	Ineffective	Negligible Risk	High	Negligible Effect
R11	School 170 Fraser Avenue	Existing Quarry Works	Medium	Moderately Effective	Low Risk	Medium	Negligible Effect
R12	Business 130 Fraser Avenue	Existing Quarry Works	Small	Highly Effective	Low Risk	Medium	Negligible Effect
R13	Retirement Village 134 Burma Road	Existing Quarry Works	Medium	Moderately Effective	Low Risk	High	Slight Adverse Effect
R14	Park 159 Burma Road	Existing Quarry Works	Small	Highly Effective	Low Risk	Low	Negligible Effect
R15	Residential 113 Fraser Avenue	Existing Quarry Works	Small	Highly Effective	Low Risk	High	Slight Adverse Effect
R16	Residential 9 Plumer Street	Existing Quarry Works	Medium	Moderately Effective	Low Risk	High	Slight Adverse Effect

Figure 5-1 shows the predicted dust impacts at each receptor (solid circles), the indicative Kiwi Point Quarry site boundary (solid red line), the area occupied by Taylor Preston (dashed red line), the southern extension area (dashed orange line) and the wind rose for Kelburn AWS (2008 to 2012) for wind speeds greater than 5.5 m/s (i.e. moderate to high wind speeds or 'potentially dusty winds'). The figure indicates that slight adverse effects were predicted at receptors R13, R15 and R16 and negligible effects were predicted at the remaining receptors. It is noted that restoration planting within the buffer zone (area zoned Open Space B in the WCDP as shown in Figure 1-1) will be undertaken in accordance with the QMP, and this will reduce the potential for adverse effects at receptors R13, R15 and R16.

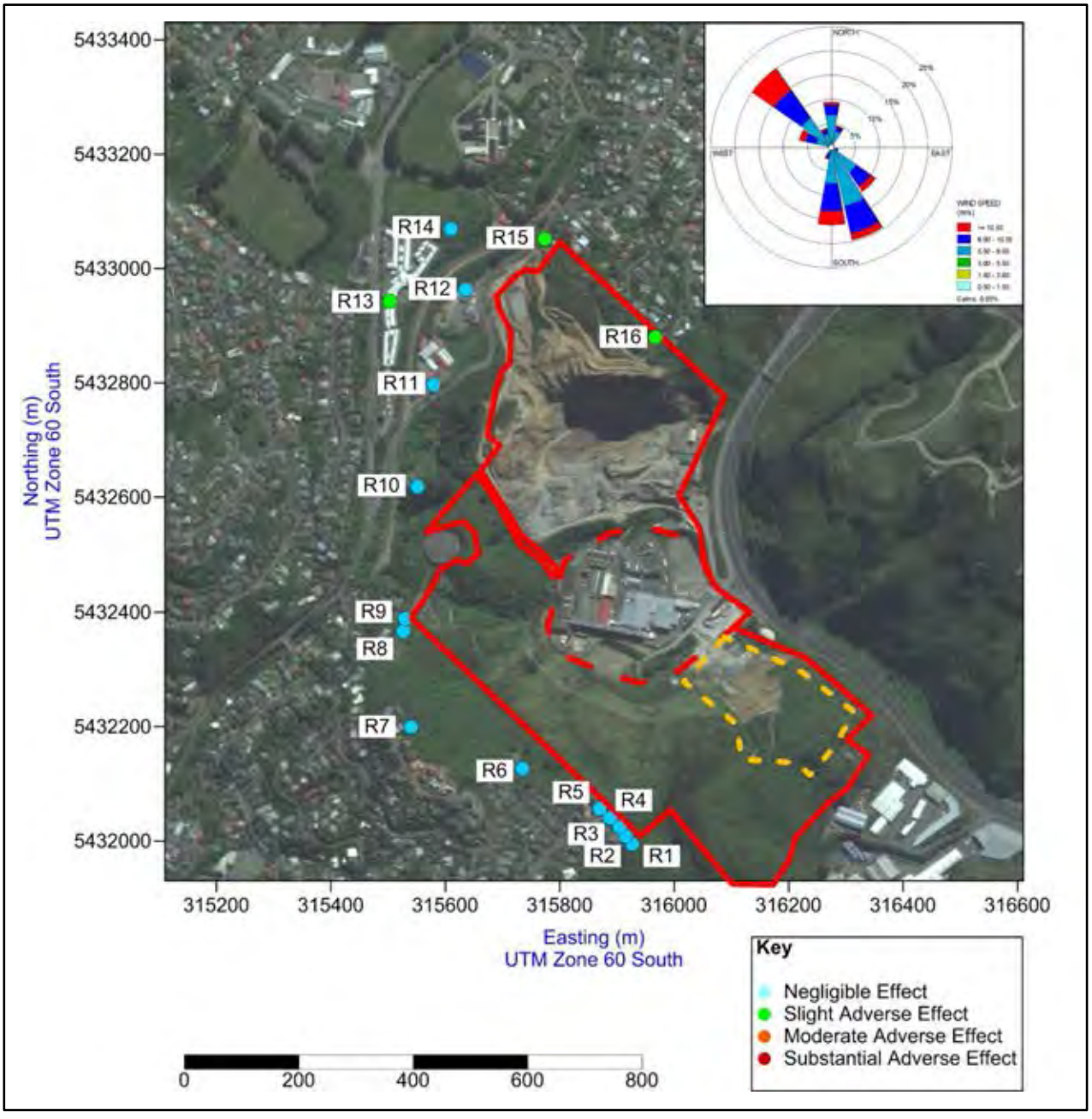

Figure 5-1: Summary of Predicted Dust Impacts

5.3 Impact Summary

5.3.1 24-hour Mean Concentrations of TSP (Dust)

Overall, the existing and proposed activities undertaken at the Kiwi Point Quarry are considered to have a slight adverse effect within the surrounding community.

These potential effects are considered to be no more than minor and are based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the MfE's 24-hour mean trigger value of 100 µg/m^3 will be exceeded beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of TSP/dust emissions at the quarry. The results of the qualitative assessment indicate that there are unlikely to be any dust nuisance effects beyond the Kiwi Point Quarry site boundary.

Furthermore, the results of the assessment indicate that the existing and proposed activities are of low risk, and that the most 'at-risk' receptors are as follows:

- R11 170 Fraser Avenue Medium residual emissions primarily from Areas A, B & C;
- R12 130 Fraser Avenue Small residual emissions primarily from Areas C, D & G;
- R13 134 Burma Road Medium residual emissions primarily from Areas A, B, C, D & G;
- R14 159 Burma Road Small residual emissions primarily from Areas D & G;
- R15 113 Fraser Avenue Small residual emissions primarily from Areas C, D & G; and,
- R16 9 Plumer Street Medium residual emissions primarily from Areas A, B & C.

The results of the assessment indicate that the designed-in (existing) operational mitigation measures are considered appropriate to mitigate the potential effects on the surrounding area. This is corroborated by the fact that there have only been three dust nuisance complaints relating to dust-generating activities undertaken at the quarry and these complaints occurred between 4.5 and 7.5 years ago (see Section 1.6).

Whilst the existing businesses located on Tyers Road have not been included as sensitive receptors in this report, a qualitative assessment is provided below for completeness, to assess the potential risk associated with the proposed southern extension works at these properties.

In accordance with IAQM (2016), the properties are considered to be of 'medium' sensitivity to potential dust emissions generated during the proposed southern extension works. This is based on the principle that users would expect to enjoy a reasonable level of amenity but would not be reasonably expected to enjoy the same level of amenity as they would in their home. Whilst the appearance, aesthetics or value of their properties could potentially be diminished by soiling, MWH understands that no dust-sensitive activities (e.g. electronics manufacturing, food production or car showrooms) are undertaken at these properties. In addition, these properties are a place of work and it would be reasonable to assume that people will only be present at these locations for up to 8 hours a day.

Based on the qualitative (risk-based) methodology presented in this report, the Tyers Road businesses were determined to be of 'low' risk to dust emissions generated during the proposed southern extension and the potential effects are predicted to be 'negligible' based on the following assumptions:

- Based on the Kelburn AWS wind speed and direction data for 2008 to 2012, the receptors are likely to be 'frequently' exposed to potentially dusty winds (wind speeds above 5.5 m/s and blowing from the W to the WNW (towards the receptors) occur 13.4% of the time);
- The receptors are of 'medium' sensitivity and are situated 110 m to the SE of the proposed southern extension area (i.e. they are an 'intermediate' distance downwind of a dust source);
- The receptor pathway is 'moderately effective'; and,
- The residual dust emissions will be 'medium', based on the designed-in mitigation measures (see below). However, the additional mitigation measures recommended in Section 6 will further reduce the potential for dust emissions to occur, particularly during the drilling and blasting operations.

The existing elevations (terrain heights) along a transect through the centre of the southern extraction area and on a heading of 130 degrees from north (i.e. from the north-west boundary of the extraction area towards the south-east / Tyers Road) increases from 70 m ASL to 140 m ASL (over a map distance of 170 m and a ground distance of 180 m). The south-east ridge (at 140 m ASL) is situated approximately 80 m north-west of the Tyers Road businesses. The existing terrain profile from the north-

west boundary of the southern extension area towards the south-east / Tyers Road (on a heading of 130 degrees from north) is shown in Figure 5-2, and is based on terrain data presented in Figure 1-7.

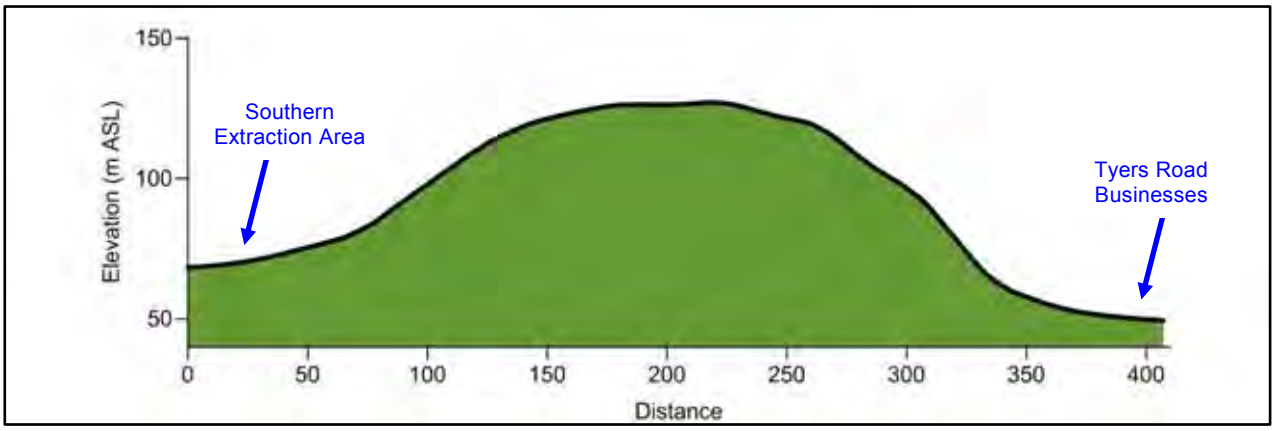

Figure 5-2: Terrain Profile of the Southern Extension Area from the North-West to the South-East

The proposed southern extension extraction works, as stated in Ormiston (2016), will be undertaken in two stages. Stage 1 will involve extending the quarry towards the south-east (i.e. Tyers Road) and then, under Stage 2, towards the south-west.

The batter slope profiles will be constructed at between 45 and 55 degrees and the floor of the quarry upon completion of both stages with be 55 m ASL. Upon completion of Stage 1, the elevation at the top of the batter slope is anticipated to be between 140 m and 145 m ASL. Therefore, the greatest risk of offsite dust nuisance effects is likely to be during the mid to latter phases of Stage 2, as more of the resource on the south-east boundary (the closest boundary to the Tyers Road receptors) of the extraction area is removed.

The terrain height (elevation) at the south-east boundary of the southern extension area is expected to be at least 70 m ASL upon completion of Stage 2. Therefore, given that the majority of the dust-generating activities will be undertaken within the low-lying parts of the quarry extension and in view of the residual dust emission magnitude criteria presented in Section 3, residual dust emissions are anticipated to be 'medium', as outlined below:

- **Site Preparation / Restoration**: the southern extension working area is approximately 3.8 ha and is therefore of 'medium' size, the bunds will be constructed to a height of 2 m and will therefore be 'small', all bunds will be seeded and up to 5 heavy plant will be operational at any one time. The worst-case residual dust emissions from this activity are therefore considered to be 'medium';
- **Mineral Extraction**: the southern extension working area is approximately 3.8 ha and is a 'small' extraction area. However, as the resource is hard rock and drilling and blasting will be undertaken on a monthly basis, and there is the potential for material of high dust potential to be extracted and handled at a medium extraction rate, the overall residual dust emissions from this activity are considered to be 'medium';
- **Materials Handling**: there is the potential for material of medium dust potential to be handled, although this will be mostly within low-lying parts of the extraction area, and more than 300 m from the nearest offsite sensitive receptors. The overall residual dust emissions from this activity are considered to be 'medium';
- **Onsite Transportation**: while there is the potential for dust to be generated by onsite vehicles travelling on unsealed quarry surfaces and haul roads within the southern extraction area, the total length of the haul routes and area of the quarry floor surface is considered to be small. Therefore, the residual dust emissions from this activity are considered to be 'small';
- **Mineral Processing**: while there is the potential for dust to be generated from the jaw crusher, it will be situated within a low-lying part of the quarry or will be sheltered from the wind by a 2 m bund, thus the emissions are considered to be small. Therefore, the residual dust emissions from this activity are typically likely to be 'small', or 'moderate' as a worst-case;
- **Stockpiles / Exposed Surfaces**: all stockpiles and exposed surfaces will be dampened down as required and will be situated within a low-lying part of the quarry or will be sheltered from the wind by a 2 m bund and be located more than 100 m from the quarry site boundary, thus the emissions

are considered to be small. Therefore, the residual dust emissions from this activity are considered to be 'small'; and,

- **Offsite Transportation**: there will be a low number of HDV movements each day (e.g. <25 movements per day) and the length of the access routes within the southern area will be short (<20 m), thus the emissions are considered to be small. Therefore, the residual dust emissions from this activity are considered to be 'small'.
- Overall, the worst-case residual emissions are considered to be 'medium'.

Based on the qualitative assessment, there are predicted to be negligible dust effects at the Tyers Road receptors, providing that the dust mitigation measures are implemented. MWH recommends implementing a regular monitoring programme for dust emissions during this phase of the quarry works. This can range from visual inspections for visible dust plumes and dust deposition/flux monitoring, but could also include real-time PM_{10} continuous monitoring on the SE boundary of the southern extension area, particularly during Stage 2. The monitoring data could be used as a management tool to implement dust mitigation (dust suppression) measures, as required, particularly during dry conditions and under moderate to high wind speeds (>5.5 m/s) blowing from the W to the WNW (i.e. towards Tyers Road).

5.3.2 24-hour Mean Concentrations of PM_{10}

The 24-hour mean background concentration of PM_{10} beyond the Kiwi Point Quarry site boundary was assumed in this assessment to be 28 µg/m^3, based on the New Zealand Transport Agency's interactive background air quality maps[17].

Whilst there is the potential for coarse ($PM_{2.5-10}$) and fine ($PM_{2.5}$) particles to travel up to 400 m from the dust emission source, the majority of the wind-blown dust (including TSP and PM_{10}) will travel a relatively short distance onsite from its source (e.g. <100 m) and mostly within low-lying parts of the quarry (voids).

In view of the foregoing, and taking into account the distance from the nearest dust emission source to the site boundary and offsite sensitive receptors, and the findings of the qualitative assessment for dust, MWH considers that it is unlikely that there will be any exceedances of the 24-hour mean NES for PM_{10} beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of PM_{10} emissions at the quarry.

[17] http://nzta.maps.arcgis.com/apps/OnePane/basicviewer/index.html?appid=9ba0e52d1b3d4770ab031bb843d6198f

6 Additional Mitigation Measures

6.1 Dust Mitigation Measures

The following additional mitigation measures should be implemented onsite where possible and practicable to reduce the potential for dust nuisance effects in the surrounding community.

MWH has split these mitigation measures into 'design' controls (Table 6-1) and 'operational' controls (Table 6-2).

Table 6-1: Design Mitigation Measures

Activity	Description
Phasing of extraction activities (including Stage 1 and Stage 2 of the proposed southern extension works)	Consideration should be given to the relationship of site activities to sensitive receptor locations beyond the site boundary. As far as practicable, dust-generating activities should be located away from high and medium sensitive receptors (as identified in this report). It is important that the minimisation of dust through site design is addressed for each phase of the works operation.
Design and location of dust-generating activities	Dust-generating activities should, where possible, be located where maximum protection can be obtained from topography, trees and vegetation cover or other sheltering features. Stockpiles, haul roads, tips and mounds, and exposed areas should be located as far away as possible from sensitive receptors. Where practicable, they should not be located directly upwind of sensitive receptors with respect to the potentially dusty wind directions determined in this report.
Provision for dust-mitigation measures	For longer periods of activity, perimeter screening bunds (ideally vegetated) or semi-permeable fences, and over shorter periods netting screens may be effective. If adequate protection is not provided by requirements for landscaping works, then consideration should be given to the need for a zone adjacent to the perimeter within which works are not conducted (i.e. create a "sensitive zone", which might also be known as a standoff distance, separation zone or buffer zone). Planning and design of the scheme should make provision for water supply to meet the site demand for mitigation and damping.
Equipment and vehicles	The site should be designed to minimise haul route distances and to locate haul routes away from sensitive receptors. Consideration should be given to the installation of a wheel or vehicle washing facility, where feasible, and the construction of a sealed (paved) road after the vehicle washing facility in order to reduce trackout beyond the site boundary and onto the Centennial Highway. A separate sealed (paved) parking area for offsite vehicles, such as staff cars, with no access to the working areas, can also help to prevent trackout of mud onto the public highway.
Planting	Refer to QMP for further details of the rehabilitation planting within the buffer area. Existing trees and vegetation cover along site boundaries (where applicable) should be retained where possible. Advance planting of native trees and shrubs should be considered.

Table 6-2: Operational Mitigation Measures

Activity / Item	Description
Management	A Dust Management Plan (DMP) should be produced and adhered to. The DMP could be incorporated into the existing Kiwi Point Quarry QMP. Effective site management practices are critical to demonstrate the willingness of the operator to control dust emissions and provides a mechanism for auditing of site operations. Such management procedures should be outlined within the DMP. Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
Training	Provide training to the site personnel on dust mitigation and visual inspections for dust. Training should also cover 'emergency preparedness plans' to react quickly in case of any failure of the planned dust mitigation.
Monitoring	Implement an appropriate monitoring scheme. This can range from visual inspections, dust deposition/flux monitoring, to real-time PM_{10} continuous monitoring locations. Undertake daily onsite and offsite inspections, audit the monitoring programme: carry out regular site inspections to monitor compliance with the DMP and adjust the frequency of site inspections according to dust risk (higher frequency in dry and windy conditions).
Communication	Maintain good communication to help alleviate anxieties between the operators and the surrounding communities. Set up regular, accessible liaison arrangements and providing information as freely as possible.
Planning of Activities	Some activities should ideally be planned only during favourable weather conditions. Where possible, particularly dusty activities should be avoided during extended periods of dry and windy conditions.
Vehicle Movements	Standard good practices for site haulage include: • avoiding abrupt changes in direction; • regular clearing, grading and maintenance of haul routes; • setting appropriate site speed limits. If practicable, set site-specific and enforceable speed limits (e.g. 25 kph on unmade routes). Where not practicable, the Quarry Manager should set speed limits according to operating conditions at the time; • fitting heavy plant with upswept exhausts and radiator fan shields; • evenly loading vehicles to avoid spillages; • regular application of water, whether by bowser or by fixed sprays, in dry conditions; • use sealed (paved) roads where practicable, ensure mobile plant has upward directing exhausts and radiator fan shields. It is also important to avoid trackout from offsite transportation. Clean heavy duty vehicles used to transport minerals before they leave the site using an effective wheel- or vehicle-washing facility.
Soil and Overburden Handling	Site stripping and reinstatement operations, and overburden handling activities should be avoided during dry and windy conditions. Soil handling is generally a short-lived seasonal activity and there is considerable flexibility as to its timing. Overburden can usually be worked at higher moisture contents than soils which can reduce the risk of unacceptable dust emissions. Use of soil scrapers is effective in minimising soil handling where the sites are flat, and permit their use. In case of sites with complex topography, use of bulldozers, loaders and dump trucks may be effective and practical to remove soils.

Activity / Item	Description
	For all mineral handling it is appropriate to minimise handling and reduce drop heights.
Mineral Extraction (including drilling and blasting)	Blasting may be avoided if appropriate alternatives can be employed, for example modern hydraulic excavators and breakers. Equipment used for abrasive blasting should be fitted with dust extraction systems.
Mineral Processing (crushing and screening)	Wherever practicable, crushing and screening should take place within fully enclosed structures, or where this is not possible (e.g. in the case of mobile plant) mineral processing should take place within a sheltered part of the quarry, away from boundaries with offsite sensitive receptors. The following measures are considered to be effective in minimising dust emissions during mineral processing: • dampen material, for example, wetting down of rock stockpiles prior to crushing operation; • protect equipment (for example, conveyors, process plant) by partial or complete enclosure within housing; • use crushing and screening plant within its design capacity; and, • maintain good standards of all plant and equipment.
Materials Handling	Enclose transfer points and conveyor discharges where visible dust emissions occur. As a general provision, other potential impacts should be mitigated wherever practicable by: • installation on an even alignment with no abrupt changes in grade; • return belt cleaners, with arisings collected into a bin or cleaned up; • maintenance of the structures and rollers to minimise spillages; • shrouding of feed hoppers, transfer points and discharges; • fixed sprays where required; • clearance of any spillages to minimise accumulations of loose dry material around the structures; • minimisation of drop heights at feed hoppers and discharges; • control and restrict the duration of the site activities where practicable; • storing material under cover, and protecting material from wind; • screening material to remove dusty fractions prior to external storage; • dampen material using sprays, mists, microfoam or foam; • spray exposed surfaces with chemical binders (after consultation with GWRC) and spray exposed surfaces of mounds regularly to maintain surface moisture (unless mound surface has formed a crust after rainfall or is grassed); • design hopper load systems to ensure a good match with truck size, and enclose fully on all sides • vegetate exposed surfaces, e.g. overburden mounds, with quick growing plants; • filtration equipment may be used to remove silty wastes from waste slurries, and the resulting 'cake' can then be disposed while it is wet.

MWH recommends that WCC/Holcim should consider installing a meteorological station onsite and should review the meteorological data prior to blasting. For example, no blasting within the southern extension area should occur when the wind speed exceeds 12 m/s and is blowing from the NE and NW (i.e. towards the residential properties located on Gurkha Crescent and Shastri Terrace, and the businesses on Tyers Road, respectively). In addition, all extraction, crushing and screening works should cease in the event that the onsite wind speed during NE and NW wind directions exceeds 12 m/s for a sustained period of time (e.g. >4 hours). The Quarry Manager should keep a record of all visual inspections undertaken on the site for visible dust emissions, all instances that the processing plant is shut-down to reduce dust emissions (e.g. when wind speeds exceed 12 m/s) and when dust mitigation measures are undertaken.

Prior to blasting, dust extraction equipment and filters should be used to control dust emissions from the drill rig. Any dusty material that has collected on the blast area during the drilling should be removed

prior to detonation in order to reduce the potential for the generation of dust emissions. Prior warning should be given to the residents of Gurkha Crescent and Shastri Terrace before undertaking blasting.

6.2 Monitoring

Based on the qualitative assessment presented in Section 5, there are predicted to be negligible dust effects at the Tyers Road receptors, providing that the existing and proposed (additional) mitigation measures are implemented.

MWH recommends implementing a regular monitoring programme for dust emissions during this phase of the quarry works. This can range from visual inspections for visible dust plumes and dust deposition/flux monitoring, but could also include real-time PM_{10} continuous monitoring on the south-east boundary of the southern extension area. The monitoring data could be used as a management tool to implement dust mitigation (suppression) measures, as required, particularly during dry conditions and under moderate to high wind speeds (>5.5 m/s) blowing from the W to the WNW (i.e. towards Tyers Road).

6.3 Weather Station

It is recommended that an automatic weather station is established in a suitable location on the site to measure, as a minimum, the onsite wind speed and direction. Other parameters which could also be measured at little additional cost include: ambient temperature; relative humidity; atmospheric pressure; and rainfall.

The weather station should be positioned as far away from buildings and trees as possible, as these structures affect wind flow. The onsite meteorological data may be used for the following reasons:

- To manage the occasions when the propagation of dust occurs at the site. For example, it may be necessary to avoid undertaking drilling, blasting, quarrying (extraction) and processing (crushing and screening) activities under moderate to strong winds blowing towards the nearest sensitive receptors as these conditions may, in the absence of adequate mitigation, cause dust complaints;
- To corroborate (or contradict) any dust nuisance complaints that may arise during the continued operation of the quarry.

The weather station should be sited and operated in accordance with the MfE's *'Good Practice Guide for Air Quality Monitoring and Data Management'* (MfE, 2009) and the following documents:

- US EPA, 2000. Meteorological Monitoring Guidance for Regulatory Modeling Applications, United States Environmental Protection Agency (US EPA), February, 2000;
- Australian/New Zealand Standard (AS/NZS) 3580.14:2014, Methods for Sampling and Analysis of Ambient Air—Meteorological Monitoring for Ambient Air Quality Monitoring Applications; and,
- WMO, 2008. Guide to Meteorological Instruments and Methods of Observation, World Meteorological Organization (WMO), WMO-No. 8, Geneva, Seventh Edition, 2008.

7 Conclusions

MWH was commissioned by WCC to undertake an air quality impact assessment for activities undertaken at the existing Kiwi Point Quarry located off Centennial Highway/SH1 in Ngauranga, Wellington. Kiwi Point Quarry is an established greywacke quarry located in the Ngauranga Gorge, involving ongoing extraction, processing, a cleanfill and rehabilitation, and is operated by Holcim under contract to WCC.

In order to determine the potential for dust nuisance effects in the surrounding community due to dust emissions at the project site, MWH has undertaken a qualitative (risk-based) assessment of the existing and proposed dust emissions on the site and their potential to cause dust nuisance effects beyond the site boundary. In addition, this assessment also involved undertaking a review of the project site's complaints record, in order to predict the level of impact that may be experienced in the surrounding community. According to the GWRC's complaints database, there have been three dust nuisance complaints relating to activities undertaken at the Kiwi Point Quarry. These complaints were made on 14 January 2009, 18 December 2009 and 20 December 2011.

Overall, the existing and proposed activities undertaken at the Kiwi Point Quarry are considered to have a slight adverse effect within the surrounding community.

These potential effects are considered to be no more than minor and are based on a consideration of the different magnitude of effects at individual receptor locations, and the sensitivity and type of receptor that would potentially experience these effects. MWH considers that it is unlikely that the MfE's 24-hour mean trigger value of 100 µg/m^3 will be exceeded beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of TSP/dust emissions at the quarry. The results of the qualitative assessment indicate that there are unlikely to be any dust nuisance effects beyond the Kiwi Point Quarry site boundary, provided that the mitigation measures recommended in Section 6 are implemented. This is corroborated by the fact that there have only been three dust nuisance complaints relating to dust-generating activities undertaken at the quarry and that these complaints occurred between 4.5 and 7.5 years ago.

Furthermore, the results of the assessment indicate that the existing and proposed activities are of low risk, and that the most 'at-risk' receptors are as follows:

- R11 170 Fraser Avenue Medium residual emissions primarily from Areas A, B & C;
- R12 130 Fraser Avenue Small residual emissions primarily from Areas C, D & G;
- R13 134 Burma Road Medium residual emissions primarily from Areas A, B, C, D & G;
- R14 159 Burma Road Small residual emissions primarily from Areas D & G;
- R15 113 Fraser Avenue Small residual emissions primarily from Areas C, D & G; and,
- R16 9 Plumer Street Medium residual emissions primarily from Areas A, B & C.

Based on the results of the qualitative assessment for dust, MWH considers that it is unlikely that there will be any exceedances of the 24-hour mean NES for PM_{10} beyond the Kiwi Point Quarry site boundary or at any sensitive receptor location as a result of PM_{10} emissions at the quarry, provided that the mitigation measures recommended in Section 6 are implemented.

8 References

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IAQM, 2014. Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management (IAQM), February 2014.

IAQM, 2016. Guidance on the assessment of mineral dust impacts for planning, Institute of Air Quality Management (IAQM), May 2016.

MfE, 2001. Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions, Ministry for the Environment (MfE), September 2001.

MfE, 2009. Good Practice Guide for Air Quality Monitoring and Data Management, Ministry for the Environment (MfE), April 2009.

MfE, 2011. Clean Healthy Air for All New Zealanders: The National Air Quality Compliance Strategy to Meet the PM_{10} Standard, Ministry for the Environment (MfE), August, 2011.

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WCC, 2014. Kiwi Point Quarry Management Plan (QMP), Wellington City Council, 2014.

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Appendix A Existing Resource Consent

Quality for Life

greater WELLINGTON
THE REGIONAL COUNCIL

Consent No. WGN050352 [24540] Category: Discharge permit

Pursuant to sections 104B and 108, and subject to all the relevant provisions of the Resource Management Act 1991 and any regulations made thereunder, a consent in respect of a natural resource is hereby granted to:

Name	Kiwi Point Quarry Business Unit, Wellington City Council	
Address	P O Box 2199, Wellington	
Term of consent	Effective: 6 July 2005	Expires: 6 July 2020
Purpose for which right is granted	To discharge contaminants to air from the operation of a cleanfill.	
Location	Kiwi Point Quarry, Centennial Highway, Ngauranga at or about map reference NZMS 260: R27;611.951	
Legal description of land	Lots 1, 2 and 3 DP 72995	
Volume/quantity/rate	NA	
Conditions	1-15 as attached	

For and on behalf of
WELLINGTON REGIONAL COUNCIL

Manager, Consents Management

Date: 6 July 2005

Conditions to Resource Consent WGN050352 [24540]

(1) The location, design, implementation and operation of the works shall be in accordance with the consent application and its associated plans and documents lodged with the Wellington Regional Council on 2 June 2005, and amendments received by fax on 28 June 2005.

(2) The permit holder shall pass a copy of this consent including any relevant site plans and attachments to the operator undertaking the works.

(3) The Manager, Consent Management shall be given a minimum of 48 hours notice prior to works commencing.

(4) Only material such as clay, soil, rock, concrete, or brick, that are free of combustible or putrescible components or hazardous substances or materials likely to create a hazardous leachate by means of biological breakdown, shall be deposited within the cleanfill site.

Materials considered to meet the above definition are outlined in Table 4.1 of the publication A Guide to the Management of Cleanfills by Ministry for the Environment (2002).

(5) Cleanfill shall only be deposited in Areas A, B, C and D identified on the aerial photo attached to the application as Appendix One.

(6) The permit holder shall ensure that there shall be no discharges to air resulting from the exercise of this consent that are noxious, dangerous, offensive or objectionable at or beyond the legal boundary of the property where the activity is to be carried out, being Lots 1, 2 & 3 DP 72995.

(7) All work areas associated with the operation of the cleanfill are to be managed in such a way as to keep fugitive dust emissions to a minimum. This shall include, but not be limited to wetting unsealed areas with sufficient water as required.

(8) The permit holder shall operate the cleanfill in accordance with Kiwi Point Quarry Quality Procedures, subject to any changes required to meet the conditions of this consent. A copy of this document shall be forwarded to the Manager, Consents Management within two months of commencement of the activity authorised by this permit.

(9) Upon achieving the desired completion levels (as identified in the rehabilitation plan) cleanfilled areas shall be topsoiled and planted upon completion. The topsoil shall be of sufficient depth such that no concrete or other rubble is visible. Vegetation shall be established as soon as practical after topsoiling.

(10) The permit holder shall supply a copy of the comprehensive rehabilitation plan to the Manager, Consents Management, within six months of commencement of the activity authorised by this permit. This plan should include details of the final levels of rehabilitated areas and details of the proposed plantings to occur and timeframes from completion.

(11) Depositing of cleanfill shall be supervised by Kiwi Point Quarry Staff at all times.

(12) The permit holder shall record details of each load of material that is deposited within the cleanfill, including:

(a) the date and time of receipt of the material at the cleanfill site;
(b) quantity;
(c) source;
(d) description of material deposited (e.g. soil, concrete, bricks);
(e) name of the contractor depositing the material;

6/7/05

This information shall be forwarded to the Manager, Consents Management, Wellington Regional Council at periods ending 31 March and 30 September each year, and shall be made available for inspection when requested.

(13) The permit holder shall keep a permanent record of any complaints received alleging adverse effects from the permit holder's operations. The complaints record shall contain the following where practicable:

(a) the name and address of the complainant, if supplied;
(b) identification of the nature of the complaint;
(c) date and time of the complaint and alleged event;
(d) weather conditions at the time of the alleged event;
(e) results of the permit holder's investigations; and,
(f) any mitigation measures adopted.

The complaints' record shall be made available to the Wellington Regional Council on request.

The permit holder shall notify the Manager, Consents Management, Wellington Regional Council, of any complaints received, which relate to the exercise of this permit, within 24 hours of being received, or the next working day.

(14) The permit holder shall keep a record of any incident that has or could have resulted in a condition of this permit being contravened. The incident record shall be made available to the Wellington Regional Council upon request.

The permit holder shall notify the Manager, Consents Management, Wellington Regional Council of any such incident, within twenty four hours of the incident being brought to the attention of the permit holder, or the next working day.

(15) The Wellington Regional Council may review any or all conditions of this permit by giving notice of its intention to do so pursuant to section 128 of the Resource Management Act 1991, at any time within three months of the first, third, fifth, seventh, ninth, eleventh and thirteenth anniversaries of the date of the granting of this permit for any of the following purposes:

(a) To deal with any adverse effects on the environment which may arise from the exercise of this permit, and which are appropriate to deal with at a later stage.

(b) To review the adequacy of any plans and/or monitoring requirements prepared for this consent so as to incorporate into the permit any modification which may become necessary to deal with any adverse effects on the environment arising from the exercise of this permit.

(c) The Wellington Regional Council shall be entitled to recover from the permit holder the actual and reasonable costs of the conduct of any review, calculated in accordance with, and limited to, that council's scale of charges in-force and applicable at that time pursuant to Section 36 of the Resource Management Act 1991.

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KIWI POINT QUARRY EXPANSION - ALTERNATIVES WORKSHOP

TERRESTRIAL ECOLOGY REPORT

Prepared by Myfanwy Emeny, Team Leader Urban Ecology, Wellington City Council

10 November 2016

INTRODUCTION

This report provides an assessment of terrestrial ecological effects for identified potential alternative options[1] for the expansion of the existing Kiwi Point Quarry.

Following a briefing on 5 October 2016, a rapid ecological assessment was carried out on the proposed expansion site for the Kiwi Point Quarry. A precautionary approach has been taken pending a more thorough ecological assessment.

PROPOSED WORK

Potential options range from a 'do nothing' scenario through to a maximum expansion option that would require the removal of the section of ridgeline on the south east face between Prestons Meat works and Tyers Rd back along the ridge line towards Ghurka Crescent. This contains a large component of significant coastal forest habitat (Fig 1).

[1] As included in the '*Kiwi Point Quarry Expansion Alternatives Workshop Briefing Paper'*, dated October 2016 as prepared by Incite.

Figure 1. Significant Natural Area[2]

TERRESTRIAL ECOLOGY ASSESSMENT

VEGETATION

Currently there is contiguous coastal forest from Tyers Stream Reserve, covering the southern faces on Tyers Road through to the end of the ridgeline leading down towards Centennial Highway. The ridgeline leading up to the highpoints on the northern side of the fence line comprises a mix of lowland pasture grass and broom, darwin's barberry and gorse. Within the grassland, *Melicytus crassifolius* clings to rock faces. The broom covering much of the highpoint and some of the northern faces is at a stage of breaking up allowing the native vegetation to grow through. Currently there is native seedling growth within the broom cover. On the saddle area the native coastal vegetation has grown over the ridgeline onto the northern faces (Fig 2).

The portion of ridgeline running down to Centennial Highway has a remnant population of *Hebe parviflora, Olearia paniculata* and *Kunzea robusta*. The vegetation in this section runs

[2] This site was identified through a preliminary assessment by Wildlands Consultants as part of a review of Significant Natural Areas in Wellington. The assessment was carried out in accordance with the significance criteria in Our Natural Capital – Wellington's Biodiversity Strategy and Action Plan (2015) and Policy 23 of the Regional Policy Statement for the Wellington region.

down a very steep face and except for the bulldozed tracks through this section is contiguous with the rest of the forested area (Fig 3).

Sophora microphylla, kowhai, is found further down the ridge on the northern area above Centennial Highway. Very few naturally occurring kowhai exist in the Wellington forest as much of this type of forest has been modified or removed.

The coastal forest with complete canopy closure is estimated to be at least 60 – 100 years of age, the forest on the saddle is nearer 10 - 30 years of age. The forest within the deeper gullies is likely to contain remnant specimens.

Figure 2. Saddle with coastal forest

The vegetation on the steep faces on the northeastern side of Ngauranga Gorge forms a near continuous green backdrop. This area contains the largest section of remnant population of *Griselinia lucida*, *Olearia paniculata*, *Kunzea robusta* and *Melicope ternata*. Further up the slopes, *Knightea excelsa* are now above the canopy. The cliff faces in Tyers Stream hold some of the few remaining original *Sophora microphylla, Melicope ternata* and *Alectryon excelsus subsp. excelsus*.

Aside from this section of forest within and surrounding Tyers Stream Reserve, there is not much of this forest type remaining within Wellington. It is found in small sections along the Hutt motorway, within one location in Miramar and in fragments within Trelissick Park.

Figure 3. Ridgeline running back up to Ghurka Crescent, coastal vegetation in foreground

OTHER BIODIVERSITY

There has not been sufficient time to conclusively determine the presence of native fauna within the area proposed for quarrying.

However, 5 minute bird counts have been carried out with Tyers Stream reserve over the last 5 years, and it can be reasonably assumed that due to the contiguous nature of the forest, these species are also found within the proposed quarrying site. Observations have also been taken from public reporting of bird species

Species detected within this area are tui, fantail, grey warbler, kereru, kaka, kakariki and karearea. Kaka, kakariki and karearea all have a current threat classification. All other species are considered locally significant.

In addition, due to the similarity in vegetation type and aspect between this area and nearby sites where surveys have been carried out, it is suspected that the Melicytus/grassland habitat and the coastal and lowland forest would contain the following lizard species: Ngahere gecko, Raukawa gecko, Ornate skink, Northern grass skink, Glossy brown skink and Copper skink. The Ornate skink has a current national threat status. All other species are considered regionally threatened or locally significant.

ASSESSMENT OF EXISTING QUARRY PLANS WITH REGARD TO TERRESTRIAL ECOLOGY

KIWI POINT QUARRY MANAGEMENT PLAN (2009) AND THE KIWI POINT QUARRY PROGRESSIVE REHABILITATION PLAN (2005)

These management plans allow for a slow rehabilitation of the quarry, approx. 50 – 100 years, followed by years of maintenance, with a view to incorporating the grazing areas, Ngauranga Gorge Stream (Waitohi) and buffer areas of the north and south quarry faces. The gorge area will follow the vision of Ngauranga Gorge as part of the City's inner green belt network, focusing on re-establishing native vegetation.

Prior planning, landscape and ecological assessments and consultation have identified the five general rehabilitation principles:

1. To promote Wellington's indigenous biodiversity and rehabilitate natural processes within the site
2. To conduct rehabilitation concurrently with quarry operations, coordinating progressive competition with rehabilitation
3. To finish the quarry faces to resemble the steep bluff landforms that would have occurred naturally in the Ngauranga Gorge
4. To conduct rehabilitation in a manner that encourages rapid vegetation of the slopes, reducing the duration of adverse visual impacts
5. To revegetate the quarry in a way that supports the vision of the City's Inner Green Belts.

The Kiwi Point Quarry Management Plan (2009); outlines:

Section 7.5.2, Vegetation Protection, prior to commencement of operations, to identify areas of vegetation as these are important to the long term rehabilitation of the area as they form part of the natural seed dispersal. These areas to be clearly marked and not removed.

Section 7.5.8, Hydroseeding, suggested that this be the technique for stabilising the rock faces and steep battered slopes. That new hydroseeding techniques be initiated and trialled. *So far no progress has been made in trialling native seed within the hydroseeding technology. The suggestion that this be carried out this season as a trial has met with resistance for providing the funding to initiate some trials.*

Section 7.5.9, Natural Regeneration, this is perhaps the most successful method of establishing any growth at KPQ, the site needs to be left in a state that will encourage this growth, allowing suitable runoff, a reasonable substrate and retaining a good seed source. The site will take many years to naturally regenerate as the climatic conditions at the site are extreme

Appendix 7 of this plan outlines a budget that has not been followed to date. The budget was through to 2018/19, from animal pest control to providing budget for hydroseeding, planting and fencing, in sections A, B and C. A different area has been planted instead which has been successful but is hampered by lack of finance to continue the work.

KPQ Progressive Rehabilitation Plan (2005)

The principles of this document are reflected in the 2009 plan. It does not imply that the restoration of the site will be to its former state as the rehabilitation process allows for the modified environment. This plan acknowledges that this area has harsh conditions which will delay the natural regeneration of plant cover by decades. Some of these harsh conditions can be alleviated slightly by:

a. Not over steepening the slopes, by blasting, creating screes or suitable planting sites
b. Adding in organic matter
c. Providing microenvironments
d. Planting appropriate species
e. Good animal and plant pest control

The proposed schedule within this document suggests a northern facing aspect to take up to 80 + years and with intervention of planting to reach a mature second growth forest, and without intervention 150 + years.

RELEVANCE TO QUARRY EXTENSION PROPOSAL

The proposed south face extension options (Options 3 and 4) differ from the original proposal outlined in the restoration plan (serving as the Option 2 Permitted Activity Development), with cut faces that extend well back along the ridgeline.

Getting any vegetation to take on this face will be challenging as the northeast aspect is hot, dry and windy, very poor conditions for any survival. Furthermore, extending back into the existing slopes will further deteriorate any chance of successful vegetation cover.

The shelved areas of Ngauranga gorge (Fig 4) on the southern side have little native vegetation. These areas were cut in the 1960's when the road was widened from four to six lanes. This area has taken a significant length of time to slowly recover, and is still largely exotic vegetation. By creating this type of disturbance, with the very slow growth experienced in these types of conditions, benches on the northern side are going to take many decades to recover.

Figure 4. Benches showing mostly exotic cover

Evaluation of options

Option 1 - Do nothing

If all quarrying activity in this area is ceased, and the current rehabilitation plan is followed, the gradual rehabilitation of this area and its surrounds will have a positive effect on the terrestrial ecology. It would also ensure that the current remnant forest would remain intact. However, in line with typical practise, this option in forming as the existing environment is rated **0**.

Option 2 – Permitted activity development

This option would entail the removal of established coastal forest within the gullies on the northeastern face (as seen in Fig 1). Only 0.2% of Wellington City still has this type of coastal forest cover. This option should not affect the wind throw into the remnant forest on the northeastern side of Ngauranga Gorge and should not affect the regenerating vegetation within the grassland at the top of the ridge.

Due to the scarcity of this forest type remaining in Wellington, this option is scored as **-2**, having moderate effects on the terrestrial ecological values. The potential for onsite mitigation options is limited due to the previously noted challenging environmental conditions. There is very little area around the quarry operations which has the same sheltered aspect and conditions as the area proposed for removal, and which could result in

the same forest type being restored. Therefore any onsite mitigation is unlikely to improve the option score of -2 with regard to terrestrial ecology.

If good practise offsite mitigation was followed (in accordance with the Guidance on Good Practice Biodiversity Offsetting in New Zealand 2014 - Section 4.4), this option would be scored as **-1**. It would still have minor effects due to the difficulties of recreating this type of coastal forest in another location.

OPTION 3 – FIVE STAGE DEVELOPMENT

This option would remove the coastal forest on the front faces as well as remove part of the contiguous forest on the northeastern side of Ngauranga Gorge. The prime forest remnant consists of tawa, rewarewa, and kohekohe with porokaiwhiri, mamaku, lancewood and mapou. The remnant is surrounded by diverse secondary low forest of mahoe, kanuka, mapou, kohuhu, fivefinger, akiraho ngaio, lancewood hinau, mamaku and fuchsia.

There is more lowland forest left within Wellington City than coastal forest; however the remaining areas still cover only 3.2% of the city. This increases the significance of these areas within the Wellington context. There are also threatened bird and lizard species suspected to inhabit this area.

This option would also compromise the regenerating grassland habitat on the other side of the ridgeline. While vegetation values in this area are not yet significant, this would remove habitat for native lizard species. Naturally allowing the cover of broom to aid the restoration process on an arid wind swept hillside is the best option for rehabilitating this area.

The proposed quarry extension (with required benches for stabilising the area) will leave only a 20m setback to the Tyers Stream Reserve boundary on the top ridge line. This could have an effect on wind patterns into this area. If this area is opened up to stronger winds it is highly likely to have detrimental consequences for the vegetation in Tyers Reserve. This vegetation is currently sheltered from the drying northerly wind. This option is scored as **-3**, having significant negative effects.

As with option 2, the potential for onsite mitigation options is limited due to the previously noted challenging environmental conditions. With the removal of a larger section of existing forest, there is no area around the quarry operations which has the same amount of sheltered aspect and conditions as the areas proposed for removal, and which could result in the same forest type being restored. Therefore any onsite mitigation is unlikely to improve the option score of -3 with regard to terrestrial ecology.

If best practise offsite mitigation was followed (in accordance with the Guidance on Good Practice Biodiversity Offsetting in New Zealand 2014 - section 4.4), this option would be scored as **-2**. Effects would still be moderate. As with option 2 the issue is finding the land

on which to restore this forest type, the length of time this would take and the potential effects on the remaining remnant within Tyers Stream Reserve.

Option 4 – Area 2B Maximum Expansion

This option intensifies the issues noted for option 3. The operation extends to the boundary of Tyers Stream reserve and all impacts on the existing bush remnant, the coastal forest and the regenerating grassland habitat would be exacerbated. This option also further encroaches into the gully system where the more significant vegetation is typically found. This option is also scored as **-3**, having significant negative effects on the vegetation being removed and the fauna found in this area, in addition to the vegetation left on site and the existing bush remnant within Tyers Stream reserve. As with option 3 the effects could be reduced to moderate (**-2**) if best practise offsite mitigation (in accordance with the Guidance on Good Practice Biodiversity Offsetting in New Zealand 2014 - section 4.4) was carried out.

Conclusion

Coastal forest and lowland forest area is underrepresented in Wellington. Currently, there is potential to build on the existing forest by restoring species to the steep hillsides of the gorge.

Removing the ridgeline will have a significant effect on the remaining vegetation as this is likely to change the wind throw within the forested area, including Tyers Stream Reserve. As has been shown in other areas of Wellington, removing wind protection and changing the impact caused by wind on vegetation causes long term damage within a forest.

Vegetation in this area will take many years to recover as the soils are very sparse and the weather conditions extreme, with both southerly and northerly winds affecting the slopes and arid conditions in the summer months.

By removing and disturbing this section of hillside it is estimated that it will be 50 – 100 years (or more) before any significant rehabilitation of the site will be seen, and it may have unintended consequences on the adjoining forest remnant.

If a plan change process is to be furthered for an expansion option in the south face area it is recommended that a more thorough ecological assessment is undertaken. This would need to include a detailed vegetation survey, surveys for birds and lizards and an assessment on the effects of wind on the forest remnant.

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MEMORANDUM

To Logan Logeswaran (WCC), Aaron Edwards (Incite)

From Sandy Ormiston, Ormiston Associates Limited.

Date 14/11/2016

Subject KIWI POINT QUARRY SOUTHERN RIDGE- GEOTECHNICAL SPECIALIST SCORES

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1. Introduction

1. Following the Kiwi Point Quarry workshop held at Wellington City Council on Thursday 3rd November, we provide a summary report in support of the allocated scores for geotechnical considerations for the proposed Kiwi Point Quarry Southern Ridge quarry development.
2. We have assessed the geotechnical considerations based on the Options 1 to 4 as provided at the workshop.

Option 1 (Do Nothing)

3. Option 1 comprises doing nothing and maintaining the existing situation. We do not consider this option to be neutral as indicated on the score sheet provided by Wellington City Council officers as there are considerable geotechnical risks. However this review is of the effects from the proposed KPQ southern ridge development compared to the existing situation.
4. The existing natural slopes rise very steeply over an elevation of approximately 100metres to the south from the edge of the motorway up to the first main spur at an overall slope angle of approximately 40° (approx. 1V:1.2H). There are steeper sections of slope close to the motorway. The existing slope exhibits evidence for previous slope failures and includes overhangs. No motorway Rockfall protection measures have been installed. These risks are further increased under earthquake conditions.
5. The do nothing option poses an existing significant risk to major infrastructure and also to the general public.

6. In addition to instability risks to the motorway, the existing natural and quarry batter slopes descending from the Southern Ridge east to the Tyers Road commercial buildings are also very steep. These slopes are a mixture of natural and quarry batter slopes which exhibit evidence of previous and recent slope failures. Some of the existing factory units at Tyers Rd have been constructed on platforms immediately adjacent to the slope toe without any protection should there be rock falls or soil slope failure. The risk of slope failure poses a significant risk to the buildings and personnel at Tyers Rd.

Option 2 (Permitted Activity Area)

7. We recommend a geotechnical score of **+2.5 for Option 2** within the permitted activity area option. Development of the permitted activity area provides a significant geotechnical improvement in terms of reduced risk to the motorway and lessor improvement for the Tyers Road industrial area. The geotechnical improvement provided includes,
    - Reduction in the height of existing slopes located immediately adjacent to the motorway and,
    - Reduction in the height of part of the existing slopes adjacent to the commercial buildings located at the slope toe at Tyers Rd.
8. Development of Option 2 also moves the quarry batter slope away from the motorway providing a buffer zone and catch area in the event of a major slope failure within the quarry batter slope highwall.

Option 3 (Five Stage Development)

9. We recommend a geotechnical score of **+3 for the five stage option**. The geotechnical score is more than the permitted activity area quarry development because,
    - Although the western batter slope crest is closer to Gurkha Crescent properties located behind the batter slope crest, a significant separation of approximately 100metres between the batter crest and property boundaries is provided.

- The ultimate batter height increases from the permitted activity option of approximately 60metres to 120metres.
- There is a significant positive geotechnical benefit for the Tyers Road commercial buildings through a significant reduction in natural and old quarry batter slope heights at the rear of the buildings.

The above Option 3 assessment is based on the ultimate development (Stage 5), the maximum batter slope angle of 55° and backfilling of the pit to approximately RL70m.

Option 4 (Area 2B Maximum Expansion)

10. We recommend a geotechnical score of **+2 for the Area 2B** maximum expansion option with a batter slope angle of 55° and backfilling of the pit to approximately RL70m. The geotechnical score is less than the geotechnical score for Option 3 having a mix of positive and negative outcomes.
    - The western batter slope crest is moved approximately 30metres closer to Gurkha Crescent reducing the separation to approximately 70metres.
    - The batter height reduces to approximately 105metres (RL70m to RL175m) which is beneficial with respect to geotechnical considerations.
    - There is an additional positive geotechnical benefit for Tyers Road commercial buildings through a reduction in natural slope heights at the rear of the buildings at the western end.

2. Conclusions

Our conclusions are summarised in the table below.

Geotechnical Score Summary Table

Specialist Assessment	Option 1 Do Nothing	Option 2 PA Development	Option 3 5 Stage Development	Option 4 Area 2B Maximum Expansion
Geotechnical	0	+2.5	+3	+2

Ormiston Associates Limited

Sandy Ormiston
MSc Engineering Geology
Director

Date: 11th November 2016

Kiwi Point Quarry Expansion - Alternatives

isthmus
landscape architecture | urban design

To:	Aaron Edwards	**Date:**	Monday 14th Nov 2016
Company:	Incite	**Project:**	Kiwi Point Quarry Expansion
From:	Lisa Rimmer	**Job No:**	3706

URBAN DESIGN AND LANDSCAPE REPORT

Introduction

Isthmus has been asked to provide specialist landscape and urban design assessment to help inform the multi criteria analysis for the short list of options [1] proposed for the Kiwi Point Quarry Expansion along the south face, Area 2:

- **Option 1** - defines a do nothing scenario, forming as the existing environment against which all other options are to be assessed.
- **Option 2** - defines the Permitted Activity works in the Business Zone between the Taylor Preston abattoir and the Tyers Road Business Park.
- **Option 3** – defines a Five Stage Development scenario that extends up into the Area 2B (currently zoned as Open Space B) including the 190m peak, to within 100m of Gurkha Cres houses.
- **Option 4** – defines the Area 2B Maximum Expansion, up and out from the 5 Stage Development to provide a greater total yield and more blue greywacke; the most valuable rock type. This expansion would extend up to the quarry boundary with the cut face aligned away from and approximately 70m from the nearest house.

This appraisal follows on from Isthmus' input to the options scoping workshop (23rd June 2016) and initial appraisal of urban and landscape values, potential effects and design matters to consider (memo 26th June 2016).

Draft Project Objectives

As set out in the briefing paper and following specialist input at the options scoping workshop:

1. To enable extraction activity to provide for forecast regional aggregate demand.
2. To manage and develop the Quarry in a safe manner that meets all statutory and non-statutory requirements.
3. To plan and co-ordinate effective rehabilitation of the site post-quarry activity to enable identified long-term land-use options
4. To internalise effects of the quarry operation to within the site and to manage the immediate and long-term cultural, social, land-use and other environmental impacts of the Project on the surrounding area by so far as practicable avoiding, remedying or mitigating any such effects
5. To recognise landscape values in the context of the gateway experience and to minimise landscape impacts as far as practicable.

[1] As set out in the alternatives Workshop Briefing Paper – Incite October 2016.

Methodology

- Review background documents[2] provided by Incite and WCC.
- Preliminary review of relevant urban design and landscape national, regional and district policy matters
- Visit surrounding area - SH1 and public roads 28/10
- Follow up desktop review and analysis of each option
- Appraisal of short list option urban and landscape effects on:
  - visual amenity for motorists and pedestrians and cyclists travelling along SH1 (“” Section 7c)
  - visual amenity for adjacent residents (“” Section 7c)
  - natural character (as a matter to consider under Section 7f of the RMA)
  - urban form and function (“” Section 7f) and the relative contribution of each option to the quality of the urban environment including options for future landuse.
- Mitigation measures to be recommended
- Summative appraisal of effects and ‘Landscape’ scores following best practice mitigation.

Note:

Assessment findings and scores assigned consider:

- Temporary and permanent effects of each option resulting from the lifespan of the resource (avoiding the need to transfer effects to other sites), the staging process[3] and final nature and extent of the quarry face. This assumes:
  - Option 2 will provide for approximately 3 years’ additional resource and this will be quarried in 2 stages
  - Option 3, provides 14 years’ additional resource, through a 5-stage process; and
  - Option 4, 16 years+ (yield estimate to be confirmed by Holcim), potentially over 5 stages
- Cumulative effects due to the proximity of the existing quarrying activity and built development/modification to the Ngauranga Gorge natural landforms.
- Potential to build in benefits/enhance the gateway qualities of the site through e.g.:
  - improvements to open space and assisted revegetation, and/or
  - future high quality commercial/industrial development or recreational use. While the details of rehabilitation options are yet to be determined, and assessed in detail, it is assumed that Option 3 and 4 would provide greater opportunities for development than Option 2 i.e. a broader area of flat land near SH1 with a bund buffer, and;
- The assessment of alternative sites is being addressed in a separate process[4] and have not influenced the assessment of the short list of options.

Statutory Considerations

- **RMA** Section 7c and 7f are relevant i.e. the maintenance and enhancement of amenity[5] values and the quality of the environment. Section 7c - effects on visual amenity- is given more weighting in the context, however, Section 7f is relevant to the both existing natural character values - effects on unmodified landforms and regenerating vegetation - as well as the quality of the built environment -opportunities to enhance urban form and function. Works in the proximity of Ngauranga Stream would trigger Section 6a - preservation of natural character of rivers (and named streams) and their margins, as a matter of national importance but are not considered relevant to the short list of options.
- **Greater Wellington Regional Policy Statement** includes provisions that address regional form, design and function (Chapter 3.9). These objectives and policies emphasise the benefits of providing future land for

[2] Report on the Proposed Development for the Open Space B Area South Ridge Kiwi Point Quarry – Ormiston Associates Feb 2016
Issues and Options Report – Incite April 2016
Status Report – Incite September 2016

[3] As detailed in the indicative 5 stage development plans provided by Ormiston Associates Ltd

[4] Informed by the report: Regional Demand Forecasts for Aggregates in Wellington, Spiire Consulting Ltd (no date)

[5] RMA Section 2 Interpretation - *Amenity values* - means those natural or physical qualities and characteristics of an area that contribute to people’s appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes.

Business development with good connections to transport networks and location to achieve compact urban form. There are no relevant notations for the site in the proposed Natural Resource Plan.

- **Wellington City Council District Plan** provisions and design guide for Business 2 Zone provide some certainty as to the nature of development that might occur on the rehabilitated area; to provide for quality in the built environment.

Findings

Landscape values

Relate to the areas importance as part of the **gateway experience** for Wellington City. Contributing factors:

- Rugged, strong topography natural incised gorge although modified by SH1, the existing quarry and other development
- Urban wilderness characteristics (in contrast to the surrounding residential and waterfront areas) with areas regenerating vegetation (with remnant coastal forest in Tyers Reserve to the south west of the site), relatively unmodified ridgeline and remaining spurs and the Ngauranga (Waitohi) Stream; and
- Distinct spatial qualities, sense of enclosure, steep descent and dramatic emergence out to the harbor and city; contributing to the cities sense of place
- Recognisable elements including the spur that extends from Rangoon Heights into Area 2 and the ridgeline above this, in front of Shastri Tce and Burma Rd. These features form part of the viewshaft /western skyline to the gorge and amphitheater encircled by the Area 2 spur, Rangoon St – Burma Rd ridgeline and Tarawera Rd spur (existing quarry site).
- High visibility to SH1 but relatively limited views of the existing quarry and short list option final quarry face from existing residential areas - Khandallah to the west and future residential sites off Spenmoor St in Newlands. Long list Option 1B and 2a would have the greatest visibility from SH1 for south bound traffic; as the background in views from the Newlands interchange. Similarly, measures to decrease quarrying activity in Area 2c would limit visibility for northbound traffic. Adverse landscape and visual effects will be greater where the face extends up and over the skyline ridge and is not tied into existing contours smoothly. Natural landform boundaries to the quarry works e.g. saddle and minor valleys would help reduce adverse effects.

Urban Form and Function

Area is characterized by the existing large scale business development predominantly along the western edge of the highway and the SH1 transport corridor. Relevant elements/factors include:

- Large scale, existing industrial and warehouse development partially screened from the road by an earth bund with some planting
- 'One sided' access from SH1 -via Tyers Road and Taylors Preston Road. South bound traffic has to exit at Glovers St and circle back and North bound traffic return to the city via the Newlands interchange
- Limited flat land with good aspect. The south face is sunny but very steep; has limited options for business development currently.
- No / limited public transport connections
- Existing narrow pedestrian footpath/cycleway along Ngauranga Gorge used by Newlands and Johnsonville residents with no/poor connectivity to Tyers Stream Reserve and Khandallah Park (gateway to outer town belt). Aspect, SH1 connections and proximity of existing network may limit viability of other recreational uses

Long list of options

- **Area 1** would have additional landscape effects (compared to the short list options), removing the buffer to existing residential areas and potential effects on Ngauranga Stream. An alternative location could also improve rehabilitation/development options for the existing quarry site; as Area 1 forms the immediate outlook.
- **Area 2a** would result a broader footprint - quarry face - directly alongside SH1 making it more prominent (compared to the short list options) and may have increased effects on Ngauranga Stream. It also cuts across a minor valley and has an awkward tie in to permitted activity works and natural contours which increase its effects.

- **Area 2b** – Five Stage Development (Option 3) has a more logical relationship to the existing contours – removes the Rangoon Heights spur- and the cut faces are turned away from the suburb of Khandallah (but will be visible from a limited number of future properties in Newlands). Effects are increased by vegetation removal (although of a lesser value than in the Tyers Stream Reserve) and, in particular, by works over the skyline ridge (190m peak) within 100m from existing houses.
- **Area 2b** – Maximum Expansion (Option 4) has additional impact on both ridgeline and existing regenerating vegetation (compared to Option 3)
- **Area 2c** Expansion has reduced ridgeline effects (compared to Option 3 and 4) and increases the visual impact for the Business Park, has greater prominence from SH1 for north bound traffic and would require removal of more valued vegetation in Open Space B area – an extension of Tyers Stream Reserve.

Overall, an expansion into Area 2b will provide a better fit with the existing landforms and reduced visual amenity and natural character effects compared to Area 1, 2a and 2c. Measure to **reduce the impact on the skyline ridge** - peak at 190m – would bring the quarry face down into the vicinity of the permitted works. This would help retain the defining landforms and view-shaft through the gorge and improve the buffer to residential properties but may not be commercially viable. A further option, with improved tie into the natural landforms, would be to increase the extent of the quarry to the saddle behind the 190 peak, expanding the edges to minor gully's. Possible impact on the Tyers Scenic Reserve may be able to be offset by scheduling remaining Open Space B areas as reserve with assisted regeneration and could include purchase of some properties in the business park to provide greater yield and a future one-way road between Tyers and Taylor Preston. Purchase and/or other mitigation measures to the Gurkha Crescent properties could form part of this 'landform expansion' option.

Mitigation Options

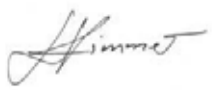
Options through the construction process to reduce temporary effects include bunding and planting to SH1 as well as planting to the disused benches (no longer required for access) and cut faces as soon as practicable - as each stage is completed. Options for staged development could also be considered - to open up part of the area next to SH1 for Business activities during e.g. Stage 4 and 5 - but may be limited by access requirements.

Long term mitigation options relate to:

- **Planting** along the benches (with topsoil enhancement if practicable) and cut faces (hydro brush technique) although likely to be long term/ gorse based regeneration process (60 years +). Planting treatment could be applied to all options - with/without backfill- to provide passive open space /green backdrop as part of city gateway (but potential loss/waste of useable land for business activities). Land to the State Highway edge of the permitted activity works will be retained at RL 70m (and approximately 25m wide) and could be planted before quarry operations commence to provide screening. Planting to adjacent areas clear of the final cut face with coastal forest species could also be considered, for example, to tie into the Tyers Scenic Reserve, enhance regeneration in Area 1 and 2a (where not considered for future development) and as a buffer to residential areas.
- **Alternative landuse** in Business Zone area - e.g. backfill to 67RL - allowing for a range of development options. Extension of business park/industry/warehousing/large format retail most likely but disadvantaged by one way connection to SH1. Residential activity may be impractical - views of surrounding landuses and poor connectivity are likely to decrease demand. Similarly, additional sports ground/community facilities are not required in this location -there are many other facilities in the area Onslow College, Alex Moore Park, Helston Park, Newlands Park with better connections to residential areas. This will be informed by a further landuse option report for the project.
- **Recreation links** – from Ngauranga Gorge to Tyers and Khandallah Park for pedestrians and mountain bikes although this is likely to have an adverse effect on privacy for residents along connecting streets.

Short List Option Scoring

Option	MCA Score	Notes
1. Do nothing	0	
2. Permitted Activity Development	-2	Visual amenity and landscape effects are significant but reduced compared to Option 3 and 4 and has limited long term mitigation options, particularly for business development and a short resource life - other sites will need to be considered within 4-5 years.
3. Five Stage Development	-3	Landscape and visual amenity effects are significant (greater than Option 2), however there are greater options for future development, planting and recreation links build in benefits. Greater yield also means that alternative sites can be avoided for at least 15 years.
4. Maximum Expansion	-3	Landscape and visual amenity effects are significant with additional ridgeline, vegetation and residential proximity effects compared to Option 3.



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Memo

To	Logen Logeswaran (WCC), Aaron Edwards (Incite)
cc	Darcy Maddern, Andy Campbell
From	Nicky Hogarth
Date	12 December 2016
Subject	KPQ Southern Expansion: Quarry Operators Specialist Scores

Following the KPQ workshop held at Wellington City Council on Thursday 3 November, we provide a summary report in support of the allocated scores for Quarry Operators considerations for the KPQ Southern Expansion. A summary of the allocated scores for the four options are outlined in Table 1.

Table 1: Quarry Operators Summary

Specialist Assessment	Option 1 Do nothing	Option 2 Permitted Activity	Option 3 5 Stage Development	Option 4 Area 2B Max Expansion
Quarry Operators	-3	-1	2	3

HNZL have taken in to account a number of factors when assessing the different options including (but not limited to);

- Cost of removing overburden verses the recoverable rock
- Life of resource verses predicted sales
- Operational logistics (i.e. location of overburden placement and aggregate washing);

Option 1: Do Nothing

Holcim consider that doing nothing is the worst case scenario. Not only would it mean the quarry resources would be exhausted after 4 years, it is likely that aggregates will need to be sourced from increasingly distant locations, driving up the costs to receive aggregate into Wellington.

HNZL have given this option a score of -3

Option 2: Permitted Activity ((45º Batter Angle)

Option 2 covers the area encompassing land zone as Business Centre and which is already approved for quarrying in the district plan. It is assumed for the purposes of this assessment that the annual rate of extraction will be between 300,000 to 320,000m^3.

Table 2: Option 2: Expected Rock Recovery

Resource	Conservative	Optimistic
Brown	95,000	480'000
Blue-Brown	210,000	398,000
Blue	73,000	251,000
Fault Breccia	748,000	34'000

Currently AML and Downers have a supply agreement which sets a specification for the rock they will be supplied with from KPQ. AML typically need premium grade resource for use in concrete manufacture. AML have an annual contracted volume of 20,000 tpa (12,500m^3), but currently require in excess of 35,000tpa. Downer's supply contract specifies that KPQ must supply all of the asphalt plant aggregate need and their contractual specification is for premium grade resource.

If a conservative volume is used for rock suitable for use in concrete and asphalt manufacture (premium rock resource) then there is only around a year of reserves available to meet this requirement. Therefore the time to remove overburden to access high quality rock vs the production life makes this option financially unviable.

Storage of overburden is also constrained as there is only limited space in the southern area to place this material, and it is anticipated that some may need to be transported to the north adding to development costs. Once the development is completed the area available for future flat land for potential industrial/business land uses is extremely limited as most of the area would be taken up with a rock fall exclusion zone (the width of which is not yet determined). There is no possibility to link to Tyers Road due to the location of existing buildings.

For this reason HNZL have scored this option -1.

Option 3: 5 Stage Development (45º Batter Angle)

Option 3: Covers land zoned a Business Centre and extends into land zoned Open Space B (with a 20m buffer extending to the edge of Open Space B). Land zoned as Open Space B is not currently approved for quarrying in the district plan. It is assumed for the purposes of this assessment that the annual rate of extraction will be between 300,000 to 320,000m^3

Table 3: Option 3: Expected Rock Recovery

Resource	Conservative	Optimistic
Brown	1,647,000	1,133,000
Blue-Brown	508000	773000
Blue	625000	1030000
Fault Breccia	356000	198000

NOTE: volumes are indicative only as further drilling required to define exact resource

This option is considered viable for HNZL as it extends the life of the quarry considerably. It gives the quarry in-excess of 15 years of quarryable resource. Approximately 4 hectares of flat land would be created for future industrial uses, although there would still need to be a rock fall exclusion zone against the quarry highwall (the width of which still needs to be determined). There is no possibility to link to Tyers road without moving the existing buildings in the Tyers Road industrial park.

HNZL have scored this option **+2.**

Option 3: 2B Maximum Expansion (45º Batter Angle)

Option 4: Covers land zoned a Business Centre and extends to the edge of land zoned Open Space B Land zoned as Open Space B is not currently approved for quarrying in the district plan. It is assumed for the purposes of this assessment that the annual rate of extraction will be between 300,000 to 320,000m^3.

HNZL have modelled a scenario which extends to the ridge crest and is approximately 70m from Gurkha Crescent. It is expected that the potential extraction volumes are outlined in Table 4. Option 2B is likely to generate a flat area after completion of quarrying and filling of around 8.5ha (there will need to be a rock fall exclusion zone, the width of which still needs to be determined),

Table 4: 40m from Gurkha Crescent: Expected Rock Recovery

Resource	Conservative	Optimistic
Brown	2,864,000	1,961,000
Blue-Brown	782,000	1,161,000
Blue	1,451,000	2,215,000
Fault Breccia	656,000	413,000

NOTE: volumes are indicative only as further drilling required to define exact resource

HNZL believe this is the best option as it maximises extraction of premium quality blue rock. It also maximises land for future development. This option could also link to Tyers Road.

HNZL have scored this option +3.

MWH now part of Stantec

KIWI POINT QUARRY EXPANSION ALTERNATIVES ASSESSMENT:

WATER QUALITY

Prepared for Wellington City Council

November 2016

QUALITY STATEMENT

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1 Introduction

The purpose of this report is to assess Kiwi Point Quarry expansion options in terms of the potential impact on existing water quality and aquatic ecology values. The options assessment is part of a Wellington City Council (WCC) project which seeks to enable a change in the district plan provisions to provide for an expansion of the Quarry to meet forecast regional aggregate demand. The background to this project is detailed in an issues and options report prepared by Incite for Wellington City Council (Incite, 2016).

An Options Workshop Briefing Paper also prepared by Incite outlines the short List options which are to be assessed as part of an alternatives workshop. These are:

Option 1: Do nothing
Option 2: Permitted Activity Development
Option 3: Five Stage Development
Option 4: Area 2B Maximum Expansion

2 Methodology

2.1 Option Scoring

A general methodology for an assessment review is described in Incite (2016). In Stage 1 the analyses of alternatives carried out by WCC and Incite is reviewed by the specialists to confirm that the process to date is satisfactory and that, in terms of each specialist area, appropriate options have been identified. If any discounted option should have been carried forward, or if an option hasn't been identified at all, these shall be identified and carried forward to be assess in Stage 2.

In Stage 2 each of the options is to be assessed and scored by each specialist within their area of expertise. It is noted that:

- The scoring of each option is to be based on its potential impact assessed as the magnitude and significance of change to the existing environment and values;
- The existing environment is defined as the current layout of the site and surrounding landscape;
- Scoring is to consider implementation of acceptable mitigation of effects; and
- A reason or rationale for the scoring is to provided, based on the effects with best practicable mitigation.

Scoring is to be based on a 7 point system, i.e., how the option ranks against the relevant interests of the specialist area and against the context of the Do Nothing Option. The 7 point system is as follows:

+3 *Significant positive*
+2 *Moderate positive*
+1 *Minor positive*
0 *Neutral or de minimus*
-1 *Minor negative*
-2 *Moderate negative*
-3 *Significant negative*
F *Fatal flaw is also available to indicate that an options should not proceed*

2.2 Assessment of the level of effect on water quality and ecology

In order to focus on the specialist areas of water quality and aquatic ecology, the following steps were undertaken using the matrices in Tables 2-1, 2-2 and 2-3 (adapted from EIANZ, 2015):

a) Establish the existing **ecological values** of indigenous habitats associated with Ngauranga Stream and its tributaries;

b) Determine the **magnitude of the potential effects** for each option; and

c) Assess the **level of ecological effects** from the combination of a) and b).

Table 2-1: Ecological Values.

Value	Explanation
Very High	Nationally threatened – critical or vulnerable
High	Nationally at risk - declining
Moderate-high	Nationally at risk – recovering, relict or naturally uncommon
Moderate	Locally uncommon/rare, not nationally threatened or at risk
Low	Not threatened nationally, common locally

Table 2-2: Magnitude of Effects

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the existing baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. AND/OR Having negligible effect the known population or range of the element/feature.

Table 2-3: Level of Ecological Effect showing corresponding option assessment score in brackets (refer Section 2.1)

Level of Effect		Ecological Value			
		Very High	**High**	**Moderate**	**Low**
Magnitude	**Very High**	Very High (-3)	Very High (-3)	High (-2)	Moderate (-1)
	High	Very High (-3)	Very High (-3)	Moderate (-1)	Low (0)
	Moderate	Very High (-3)	High (-2)	Low (0)	Very Low (0)
	Low	Moderate (-1)	Moderate (-1)	Low (0)	Very low (0)
	Negligible	Low (0)	Low (0)	Very Low (0)	Very Low (0)

3 Statutory and Other Considerations

Guidance on the allocation of water and the development of a minimum flow regime for Ngauranga Stream is provided by Policies P113 and WH.P1 of the Proposed Natural Resources Plan (PNRP) for the Wellington Region. Policy P71 of the PNRP provides guidance on an acceptable level of water clarity reduction resulting from a discharge to water. PNRP constraints on both the taking of water from Ngauranga Stream and the discharge of stormwater or process wash-water to Ngauranga Stream have been used in this report to define an acceptable level of use of the water resource and to determine likely mitigation requirements.

4 Existing Environment

4.1 The Ngauranga Stream Catchment

Ngauranga Stream (including Tyers Stream and Waitohi Stream) drains a highly developed catchment which includes parts of Khandallah, Johnsonville and Newlands (Figure 4-1). A significant proportion of the catchment is in areas of urban land use, including large areas of impervious surfaces (roads, carparks, roofs, etc). With the exception of Tyers Stream, almost all of the headwater tributaries and much of the middle and lower stream are now piped under roads and residential developments.

The urban area of the catchment is predominantly residential but also includes commercial and light industrial activities such as Kiwi Point Quarry and Taylor Preston Abattoir. No landfills are operating in the catchment, however the area now occupied by Raroa Park was operated as a landfill from 1961 to 1971. Leachate from that landfill is diverted to the sewer, although evidently the diversion has been only partially successful as some leachate discharges to a tributary of Ngauranga Stream upstream of Kiwi Point Quarry causing elevated boron, iron, manganese and ammonia concentrations (MWH, 2004) . The catchment is bisected by the Wellington to Porirua motorway (SH1) which has an average daily traffic count in excess of 50,000 vehicles and which is likely to be a source of copper, zinc, oil & grease and PAHs in stormwater runoff to Ngauranga Stream.

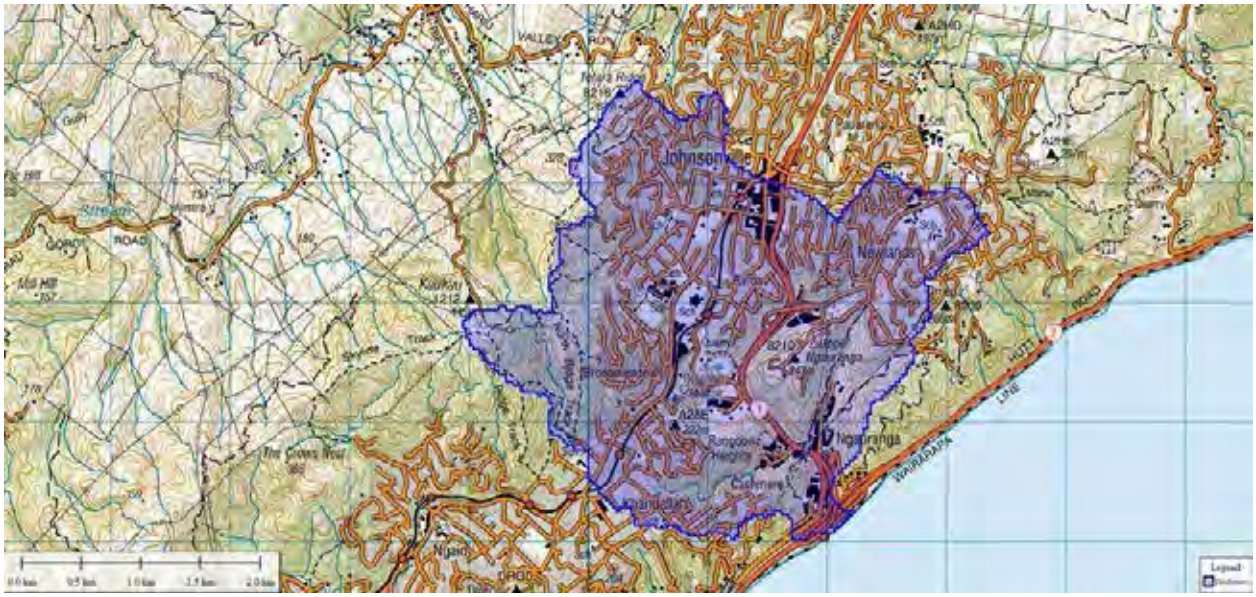

Figure 4-1: Ngauranga Stream catchment

4.2 Hydrology

Ngauranga Stream is a minor watercourse draining a catchment of approximately 923 hectares and having an estimated mean flow of 140 L/s, an estimated mean annual low flow of 23 L/s, and a 2 year ARI flood flow of 26,000 L/s. At KPQ the catchment area is 606 hectares and 2 year ARI flood flow of 17,000 L/s. The existing quarry has a catchment of approximately 5.9 hectares and a two year ARI rainfall event is predicted to cause stormwater runoff to peak at 190 L/s, which is approximately 1% of flow in the stream.

4.3 Stream water quality

GWRC has no state of the environment monitoring sites on Ngauranga Stream and has not conducted regular baseline monitoring since 2003. Prior to that time GWRC reports consistently found it to have poor water quality and a degraded benthic fauna. Its poor condition is attributed largely to the fact that virtually the entire stream, except for the unnamed tributary that runs along Tyers Road (referred to here as Tyers Stream), is enclosed in stormwater pipes and that its headwaters consist mostly of gutters and drains in urban Johnsonville, Newlands and SH1. We have not been able to locate any significant lengths of open stream upstream of the Kiwi Point Quarry and only intermittent short lengths of often concreted lined open channel downstream of the Quarry.

Kiwi Point Quarry conducts regular monthly monitoring of total suspended solids (TSS) and pH in Ngauranga Stream water immediately upstream of the quarry, which shows the stream has a relatively low suspended sediment content at base-flow with a median value 2.2 mg/L, whereas targeted wet weather monitoring at the same site shows a 10-fold increase in median value. Water pH values are typically close to 7.5 in both wet and dry weather conditions.

4.4 Fish Communities

A fish survey was undertaken at three locations in Tyers Stream during 2009 by GWRC. Tyers Stream originates above Khandallah on Mount Kaukau and joins the Ngauranga Stream nearly 1 km downstream of Kiwi Point Quarry. It is the only remaining tributary of Ngauranga Stream that has retained a significant area of relatively undisturbed habitat, although this stream is also piped some distance under urban Khandallah. Four native fish were recorded, these being banded kokopu, koaro, longfin eel and shortfin eel, as well as freshwater crayfish or koura. The threat status for longfin eel and koaro is 'At Risk – Declining' (Goodman, et al., 2014)

4.5 Summary

Urbanisation of the catchment throughout Khandallah, Johnsonville and Newlands as well as construction of the SH1 motorway through Ngauranga Gorge have resulted in widespread loss of aquatic habitat and reduced ecological function of Ngauranga Stream (loss of natural flow regime, loss of connection to its floodplain, loss of connectivity to groundwater, barriers to fish migrations, loss of riparian vegetation). Due to the scale of these developments the ecological value of Ngauranga Stream is assessed as low, except within parts of the Tyers Stream tributary which have retained moderate to high ecological values.

5 Assessment of Options

The key characteristics of each option, as it relates to stream water quality, quantity and aquatic ecology are outlined below and summarised in Table 5-1.

Table 5-1: Summary characteristics of Options 1 to 4

Assessment category	Option 1 Do nothing	Option 2 Permitted Activity Development	Option 3 Five Stage Development	Option 4 Area 2B Maximum Expansion
Quarry area (ha)	5.9	12.5	16.5	~17
Water take (m^3/day)	55	140	140	140
Stormwater discharge TSS (g/m^3)	120	120	120	120
Stormwater discharge events/year	3	20	5	5
Loss of open stream length (m)	0	0	0	0
Loss of stream riparian habitat (m)	0	0	0	0
Diversion of flow (%)	0	<1	1	2

Option 1:

Status quo; continuation of the existing (northern) quarry face until the rock resource is exhausted, estimated to be in 3 to 4 years:

1 Water is taken from the Ngauranga stream at one location at a rate of up to 55 m^3/day.

2 There are very few discharges of stormwater or process water to the stream because excess water is stored in the pit and later recycled.

3 All wet weather discharges to the stream are treated and are required to contain <120 g/m^3.

Option 2:

Would open up the southern extension, doubling the existing quarry area:

1. In the short term the amount of water permitted to be taken from Ngauranga Stream would increase to 140 m^3/day. In the medium and longer term as the north face quarry is complete and the storage is developed in the new southern pit the water demand is expected to decrease.
2. During the initial stages of this development, stormwater discharges to the stream would occur frequently, after every significant rainfall event, because of the lack of storage at the southern expansion area. That situation would improve gradually as the southern pit is excavated.
3. All discharges to the stream would be treated so as to achieve a discharge standard of <120 g TSS per m^3.
4. Would not cause any loss of existing stream channel or riparian habitat compared to the status quo.

Option 3:

Would expand the southern expansion development by a further 4 hectares compared to Option 2. However, by the time option 3 could be implemented the northern quarry will be complete, with the possible exception of rehabilitation works:

1 In the short term the amount of water permitted to be taken from Ngauranga Stream would increase to 140 m^3/day. In the medium and longer term as the north face quarry is complete and the storage is developed in the new southern pit the water demand is expected to decrease.

2 Gradual reduction in the need to discharge stormwater from the site as the southern pit is developed.

3 All discharges to the stream would be treated so as to achieve a discharge standard of <120 g TSS per m^3.

4 Would not cause any loss of existing stream channel or riparian habitat compared to the status quo.

5 Would divert stormwater runoff from an area of approximately 2.5 hectares, which currently drains into the lower reaches of the Tyers Road tributary, into the main stem of the Ngauranga Stream. This area amounts to approximately 1% of the Tyers Stream catchment and would therefore have negligible impact on the hydrology of either stream reach.

Option 4:

Would maximise the southern expansion but this would be partially balanced by the completion and rehabilitation of the northern quarry:

1 In the short term the amount of water permitted to be taken from Ngauranga Stream would increase to 140 m^3/day. In the medium and longer term as the north face quarry is complete and the storage is developed in the new southern pit the water demand is expected to decrease.

2 Gradual reduction in the need to discharge stormwater from the site as the southern pit is developed.

3 Discharges to the stream would be treated to achieve a discharge standard of <120 g TSS per m^3.

4 Would not cause any loss of existing stream channel or riparian habitat compared to the status quo.

5 Would divert stormwater runoff from an area of approximately 4 hectares into the main stem of the Ngauranga Stream, instead of the lower reaches of Tyers Stream. This area amounts to less than 2% of the Tyers Stream catchment and would therefore have negligible impact on the hydrology of either stream reach.

6 Cumulative Effects

Cumulative effects are defined as “changes to the environment that are caused by an action in combination with other past, present or future human actions”.

Extensive urban development in the Ngauranga catchment over the last 50 to 100 years has modified the character of the area to a considerable degree. While the proposed activities at Kiwi Point Quarry will contribute to that modification, it is notable that the effects of these activities as they relate to water quality and aquatic ecology are all reversible; the need to take water for use on site or to discharge treated process water would cease on completion of the quarry. All four options will be supported by a rehabilitation plan to facilitate recovery of the Quarry site in the long term. Rehabilitation of finished areas and wasteland can be conducted so as to incrementally re-vegetate steeper parts of the site, which will have benefits for the aquatic ecology of Ngauranga Stream.

7 Suggested Mitigation

The potential adverse effects of Options 2, 3 and 4 on the water quality and aquatic ecology of Ngauranga Stream can be appropriately mitigated by the following:

- Adopting a water allocation regime and minimum flow limits that are consistent with policies of the PNRP;
- Optimising on-site water storage so as to minimise the frequency and duration of stormwater and/or process wash water discharges to Ngauranga Stream;
- Treatment and management of stormwater and process wash water to ensure that all wet weather discharges to Ngauranga stream have a total suspended solids content of <120 g/m^3; and all dry weather discharges have a total suspended solids content of <45 g/m^3 and a flow rate of <5 L/s.

It is assumed, for the purpose of option scoring in Section 8, that these mitigation measures would be applied.

8 Scoring

The scores allocated to Options 2, 3 and 4 relative to the status quo are shown in Table 8-1. All of the scores are negative because each option involves taking more water from the stream and extension of both the area and duration of quarrying activities with consequent impacts on aquatic habitats. Options 3 and 4 cover a larger area and have a longer duration than option 2, and consequently score marginally higher. However none of the options are likely to cause any more than a minor adverse effect when compared to the status quo.

Table 8-1: Scoring of quarry expansion options 1 to 4

Assessment category	Option 1 Do nothing	Option 2 Permitted Activity Development	Option 3 Five Stage Development	Option 4 Area 2B Maximum Expansion
Water quality	0	-1	-1	-1
Water quantity	0	0	-1	-1
Habitat quality & aquatic ecology	0	0	-1	-1
Mean	**0**	**-0.3**	**-1**	**-1**

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