BEFORE THE HEARINGS PANEL
FOR THE WELLINGTON CITY COUNCIL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Proposed Plan Change 83 to the Wellington City District Plan

---

STATEMENT OF EVIDENCE OF ALEXANDER WILLIAM ORMISTON

ON BEHALF OF WELLINGTON CITY COUNCIL

20th November 2018

---

1 Introduction

1.1 My full name is Alexander (Sandy) William Ormiston. I am a Director of Ormiston Associates Limited; a geotechnical engineering and engineering geology consultancy specialising in quarry investigation, supervision and design. I have been a Director of Ormiston Associates Limited for 24 years.

1.2 I am a consulting Engineering Geologist with some 30 years' experience in the investigation, supervision and design of quarries throughout New Zealand. I have also worked in the mining industry in Australia.

1.3 I have a Bachelor of Science in Geology and a Master of Science in Engineering Geology from the University of Canterbury. I am a Member of the Australasian Institute of Mining and Metallurgy (AusIMM) and an Associate Member of the Institute of Quarrying.

1.4 I was engaged by Wellington City Council in October 2016 to assist with the Kiwi Point Quarry Southern Ridge geology and engineering geological aspects effecting quarry design for the proposed Plan Change 83.

1.5 I have visited the quarry on numerous occasions since 2014 and I am also engaged by Holcim (NZ) Limited the current Kiwi Point Quarry operators to provide geological and engineering geological advice including resource modelling and batter slope stability.

1.6 While I understand that the present hearing is not a matter to which the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2014) applies, I confirm that I have approached the preparation of this evidence in the same manner as I would for Environment Court proceedings and have complied with the requirements of the Code. I confirm that the issues addressed in this evidence are within my area of expertise and the opinions I have expressed are my own except where I have stated that I have relied on the evidence of other people. I have not omitted material facts known to me that might alter or detract from my evidence

2 SCOPE OF EVIDENCE

(a) I have been asked by Wellington City Council to prepare evidence on its behalf as proponent of Proposed Plan Change 83.

(b) The evidence I was asked to prepare specifically relates to why Wellington needs aggregate quarries, rock resource volume and quarry design including batter slope stability.

(c) My evidence will address the following points:

- Why does Wellington Need Quarries?
- The Reasons for Expansion of Kiwi Point Quarry
- Summary of Site Geological Investigations
- Quarry Design Proposal
- Resource Materials and Quantities
- Batter Slope Stability
- Vibration from Quarry Activities
- Noise and Air Blast
- Review of Application
- Review of Submissions

2. The key documents and information that I have referred to and relied on in preparing my evidence include:

- Begg JG , Johnston MR compilers 2000, Geology of the Wellington Area, IGNS 1:250,000, Geological Map 10
- Weathering scale from Table 3.1 Soil and Rock Mass Weathering, NZ Geotechnical Society 'Field Description of Soil and Rock for Engineering Purposes' 2005
- Proposed Map Amendments to Chapter 34; Kiwi Point Quarry – DPC 83
- Ormiston Associates Limited Drawing Number 4079-10 Rev 1, Drawing Number 3655 – SR 39, Drawing numbers 4079-11 and 4079-12
- '***Health and Safety at Opencast Mines, Alluvial Mines and Quarries'*** Good Practice Guidelines, Worksafe New Zealand November 2015.

- "***Where is that new earthquake loadings standard?***" presented to the New Zealand Society of Earthquake Engineering conference in 2004 (King et al, 2004)
- ***Auckland Council Code of Practice for Land Development and Subdivision Section 2 Earthworks and Geotechnical Design.***

3. Executive Summary

3.1 In my evidence I discuss the following key aspects of this application in support of the proposed expansion of the existing Kiwi Point Quarry into the Southern Ridge Open Space B zone to allow extraction of material for making aggregate to be used for the benefit of Wellington City and Region.

3.2 Expansion of the existing quarry is necessary because the operating Northern Pit is close to exhaustion and expanding the Business 2 zone allows an increase of quarry life from approximately 3 years (worst case) if limited to the existing Business 2 zone to approximately 20 years (most optimistic) within the expanded Business 2 zone.

3.3 Although there may be alternative quarry sites that might be developed further from the city centre and area of highest demand for aggregate there are long lead times to identify a suitable location, investigate the resource and obtain the necessary consents to enable quarrying. Additionally there is no guarantee that these consents would be granted.

3.4 I discuss slope stability risks on Gurkha Crescent and Shastri Terrace and conclude that based on slope stability analyses that the proposed ultimate pit excavation provides an acceptable factor of safety based on current guidelines. Some dwellings on Gurkha Crescent and Shastri Terrace are located on the crest of steep approximately 30° slopes descending to the north over a elevation of approximately 130metres whilst the proposed Southern Ridge quarry batter crest is at least approximately 70metres from the closest dwelling.

3.5 I have reviewed vibration records which show that for the three (3) monitoring points vibration complied with the standard on all but 2 occasions, both in 2013. Airblast overpressure records, also at these same three (3) locations, have shown compliance with the maximum limit on all but two occasions. This number of exceedances (4%) over the monitoring period is within the permitted maximum 10% of blasts.

4.0 WHY DOES WELLINGTON NEED QUARRIES

4.1 Quarries are the source of aggregates necessary for the maintenance and development of infrastructure and Kiwi Point Quarry provides these products within and around Wellington City. Quarries are the source of material for hard fill to construct land suitable for the development for all forms of infrastructure; aggregate for the foundations of roads (motorways, arterial routes and for access to and within subdivisions), railways, housing, commercial and industrial development; as aggregate for concrete to be used in all forms of construction; as aggregate for both tar seal and hot mix surfacing for roads and hardstand areas; rock for use in erosion protection, rock for landscaping and paths and for a wide variety of other uses.

4.2 The cost of the products from quarries depends on two principal factors – the cost of production and the cost of transport to the location where it is to be used. While the cost of production might, for a variety of reasons, reduce with distance from centres of population the cost of the additional transport is usually substantially greater than any savings that might result from the location. It is, therefore, economically beneficial to have quarries close to the centre of demand and from existing quarries with existing infrastructure.

4.3 With increasing density of population and concentration of commercial development in the central city the demand for aggregates continues to increase in the central city; new subdivisional development in the suburbs is also causing increasing demand for aggregates. These things together are creating the need for additional and improved arterial roading also contributing to the increasing demand for aggregates for use in concrete and roadworks. City population growth and with expansion of the city the requirements for existing facilities increases with the length of roading and highways such as Transmission Gully. These projects require significant volumes of aggregate from Wellington Region quarries for construction materials.

4.4 I refer to the report "Regional Demand Forecasts for Aggregates in Wellington" (Spire Consulting Ltd [undated]). It is my understanding that existing quarries in the area around Wellington City are almost all working to capacity. If Kiwi Point Quarry were to close the demand for aggregates from the two closest quarries (Horokiwi and Belmont) will result in a significant reduction in quarry life at those quarries in response to higher sales volume

required to meet the anticipated increase in demand for aggregate from these sources. New sites for developing quarries are not only limited due to competing pressure for other land uses but require construction of access roading and infrastructure along with constraints associated with high levels of management and stringent environmental controls on the development. With existing sites these limitations are already catered for so the development of the site is not only less expensive but the impacts are either already under control or very limited in their extent and are understood.

4.5 The proposed expansion of Kiwi Point Quarry will provide for the continued production of aggregate from a site having existing access directly to the motorway without the need for transport via residential streets, close to the centre of the City and have few impacts which are not already experienced at this location. The final landform comprising a platform within the final floor area will provide a building platform suitable for future commercial development that would otherwise not be available. The extraction of aggregate from the proposed expansion provides up to approximately 20 years of supply at the current rate of demand based on 55° batter slopes.

4.6 The proposed final land form on completion of aggregate extraction comprise a platform backfilled up to approximately RL67 that allows for long term development of commercial buildings on land at the ultimate batter slope toe that would not otherwise be suitable for such development.

5.0 REASON FOR QUARRY EXPANSION

5.1 The need for an alternative source of aggregate has developed due to the near exhaustion of the resources in the operational Northern Pit at Kiwi Point Quarry. To maintain production from the site it will be necessary to open a new area in a different part of the site. The proposed expansion into the Southern Ridge will provide Council with a source of aggregate supply to meet the demands of the Wellington market for approximately the next 13 to approximately 20 years.

The District Plan allows for the development of a quarry within the Business 2 zone which will only release a limited volume of aggregate allowing for between approximately 3 and 7 years extension in quarry life at current sales volumes.

5.2 As stated above the need to maintain aggregate supplies close to the centre of the City is fundamental to the maintenance of aggregate prices that permit the economic development

of residential, commercial and industrial development and maintenance of existing infrastructure. Continued production from Kiwi Point Quarry provides for part of this demand and as such has a significant impact on the continued prosperity of the City.

6.0 SUMMARY OF INVESTIGATIONS ON SITE

6.1 The Kiwi Point quarry working Northern Pit and proposed Southern Ridge quarry are underlain by Rakaia Terrane interbedded sandstone and mudstone sequences of Triassic period (252 - 201 million years) and commonly referred to as Greywacke rock (Begg JG, Johnston MR compilers 2000, Geology of the Wellington Area, IGNS 1:250,000, Geological Map 10). Greywacke is the predominant lithology forming the hills surrounding Wellington.

6.2 The geological weathering profile typically comprises the more intensively weathered rock which has reduced to soil at and close to the ground surface with decreasing weathering with increasing depth. Based on exposures in the operating Northern Pit and identified within investigation boreholes drilled on the Southern Ridge the weathering profile comprised the following from the surface down.

1. Surface residual soil and completely weathered rock veneer (Overburden).
2. Highly weathered rock (Brown Rock).
3. Moderately weathered rock (Blue brown rock)
4. Slightly weathered to Fresh rock (Blue rock)
   (Weathering scale from Table 3.1 Soil and Rock Mass Weathering, NZ Geotechnical Society 'Field Description of Soil and Rock for Engineering Purposes' 2005).

Brown rock is typically used as hardfill whilst blue brown and blue rock is used for concrete aggregate and a range of other purposes

6.3 In May 2014 Ormiston Associates Ltd were requested by Holcim (NZ) Ltd to supervise a programme of investigation of the potential aggregate resource remaining in the operating Northern Pit and that might be recovered from the Southern Ridge at the Kiwi Point Quarry. This programme consisted of surface mapping of the geological exposure and the drilling and geological logging of seven machine cored drill holes on the Southern Ridge ranging in depth from 30metres to 108metres. The results from this work along with existing topography have been uploaded into a 3 dimensional geological and topographical model in Leapfrog (3D computer modelling programme). The 3-dimensional conceptual

quarry model has been developed based on the geology and topography allowing calculation of the possible resource within the Southern Ridge and bounded by the limits applied for in this Plan Change.

7.0 QUARRY DESIGN PROPOSAL

7.1 Within the area on the Southern Ridge of Kiwi Point Quarry bounded by the limits applied for in this Plan Change Application as shown on Appendix 2 of the application (Proposed Map Amendments to Chapter 34; Kiwi Point Quarry – DPC 83), a conceptual design for the excavation of the resource assessing the potential quantities of brown, blue-brown and blue rock has been completed by Ormiston Associates Ltd.

Based on boreholes and exposures of the weathering profile as generally described in 6.2 the relative volume of each weathering grade has been calculated for the Southern Ridge.

This design has used two alternative parameters for batter slope angle derived from analysis of the working quarry faces in the Northern Pit as providing for a stable face for the ultimate excavation. The parameters used in this batter slope design are discussed in section 7.3 of my evidence.

7.2 Drawing Number 4079-10 Rev 1 attached to this statement shows the ultimate extent of the proposed Southern Ridge quarry excavation, the location of benches and batter slopes based on 55° batters, the position of roads and the location of sediment detention ponds for the treatment of stormwater runoff. Limitations adopted for the extent of the excavation include a number of constraints as discussed below. These are –

- The excavation against the boundary with Centennial Highway (SH 1) will be no lower than Reduced Level 70 metres and will be above road level.
- The excavation against the boundary with the Ngauranga Business Park will be no lower than Reduced Level 70 metres.
- Depending on the location, a bench approximately 8 metre wide will be constructed along these boundaries to the north east and south east of the excavation. This bench will be vegetated with native shrubs and trees to mitigate the visual impact of the development.
- The excavation against the South Western boundary of the proposed extension to the Business 2 zone will extend to the proposed boundary and

a protective fence will be constructed along the crest of the excavation. These features are shown on the Ormiston Associates Ltd Drawing Number 4079-10 Rev1 attached to this statement.

- Elsewhere the limit of excavation will be where the quarry batter slopes daylight on the existing slopes.

7.3 The ultimate excavation will be arrived at in a series of stages designed to minimise the environmental impacts of the development and to provide an efficient operation for the quarry. The excavation will first expose surface weathered soils and with increasing depth brown rock, blue brown rock and blue rock will be exposed and excavated. There are two (2) options for development of the proposed Southern Ridge quarry.

OPTION 1 Development from the North West

7.3.1 This option provides for the staged development of the quarry by providing access to the blue greywacke present in the toe of the ridge earlier than if the excavation is developed at the outset from the crest of the ridge.

7.3.2 Stage 1 of the development of the quarry will be initiated from the North West by extending the existing excavated platform to the South East. At the outset the Stormwater Detention Pond will be constructed at the existing floor level and all runoff from the site directed through this facility.

7.3.3 Stage 2 of the excavation will extend across the width of the ridge forming a batter slope running in a more or less North West – South East direction. This will extend to an elevation of approximately RL 155 metres. The quarry will be developed in a series of stages to provide for the maximum control on the impacts resulting from the development.

7.3.4 Once the Stage 2 development as described in section 7.3.3 above has extended to the boundary with the Ngauranga Business Park the direction of excavation will be turned to advance in a South Westerly direction. Stage 3 of the excavation will be initiated from the crest of the development 15 metres from the boundary of this application area. Successive batter slopes and benches will be cut from the crest and the working bench progressively lowered until it reaches the ultimate floor of the quarry.

7.3.5 During the construction of the final face described above deepening of the quarry floor to below RL 70 metres will be initiated to provide additional blue

rock that produces higher quality aggregates to the operation than will be produced from excavation of the batter slopes above. A peripheral bund at approximately RL 70 metres will be formed between the quarry pit and both Centennial Highway and Tyres Road Business Park.

OPTION 2 Initiate Stripping at the Ridge Crest

7.4.1 This option provides for the continuous development of the quarry from the crest by excavation to the final batter from the outset of the operation. This option allows for initiation of rehabilitation planting once the upper benches have been formed and means it will not be necessary to access the south western ridge crest area for the subsequent development of the quarry.

7.4.2 Overburden stripping will be initiated from the south western ridge crest and at the south eastern limits of the proposed ultimate pit and forming the upper final benches at an early stage of the development (Drawing Number 3655 – SR 39).

7.4.3 The disadvantage of Option 2 compared with Option 1 is that it will take longer to expose materials suitable for making aggregate but is preferred as it will enable the ecological and visual effects of the quarry to be mitigated at the earliest possible stage of development.

7.5 Depending on the nature of the rock exposed and the jointing within the batter slope faces the design of the face will comply with the following criteria.

- Batters will be not more than 15 metres high.
- Haul roads will be designed to 10 metres wide with bench widths of 8 metres.
- Batter slope angles will vary according to the rock material and discontinuities (jointing and bedding) exposed in the batters –
    - Completely weathered rock (soil) – batter at 1V in 2 H (approx. 26^{o}) at the ridge crest.
    - Highly weathered (Brown) rock and intensely jointed rock 1V to 1H (45 degrees) to 1V to 0.7H (55 degrees) depending on discontinuities exposed in the face.

- Moderately or less weathered rock (Blue Brown and Blue) and moderately jointed rock 1V to 1H (45 degrees) to 1V to 0.7H (55 degrees) depending on the discontinuities exposed in the face.

7.6 The overall slope of the 45° batter slopes with 8metre wide bench configuration is approximately 33° and for 55° batters with 8metre wide bench configuration is approximately 39°. The overall slope configurations are less steep than existing slopes descending from the north eastern end of the Southern Ridge to Centennial Highway.

7.7 Existing batter slopes associated with Centennial Highway construction and natural slopes descend towards Centennial Highway from the Southern Ridge at slopes ranging from 45° to 60°. Proposed batter slopes are less steep than sections of the existing slopes.

7.8 A number of existing dwellings on Shastri Terrace and Gurkha Crescent are located immediately on the crest of steep natural slopes descending from the dwellings towards the Taylor Preston works site. These natural slopes are at approximately 30° (from the horizontal) over an elevation difference of approximately 130metres. The proposed Southern Ridge Quarry ultimate batter crest is approximately 70metres from residential property boundaries. The ultimate batter height prior to backfilling at the base of the excavation will be approximately 160metres reducing to approximately 115metres after the excavation is backfilled to approximately RL 67 metres.

7.9 Quarry batter slope angle will be determined from analysis of rock mass discontinuities (fractures and bedding) which form planes of weakness in the rock. These will be assessed as the batters are excavated to ensure compliance with Worksafe '***Health and Safety at Opencast Mines, Alluvial Mines and Quarries'***. The risk and type of failure (for example planar failure, wedge failure, toppling failure) that might affect a slope from discontinuity intersections basically depends upon the angle of intersection between discontinuities and the batter slope. The batter slopes and discontinuities will be analysed to determine the final design batter angle. Additional investigations are required to obtain the required

rock mass data for analysis. These measurements can only be reliably made as the excavation of the face is carried out.

8.0 RESOURCE MATERIALS AND QUANTITIES

8.1 Using the conceptual quarry design as described above and the interpretation of the geology derived from the surface mapping and machine core drilling investigations a model of the potential quarry has been developed. It is recognised that drilling investigations completed to date are preliminary and that further more detailed core drilling investigations are required to provide a more reliable interpretation of the geology of the ridge. The available information also reflects on the relative quantities of the rock weathering grades calculated to form the resource within the area. For these reasons a range of potential resource quantities are presented as what might be quarried from the site.

8.3 Attached are interpretive geological cross sections through the Southern Ridge showing the interpretation of the geology as derived from the limited investigations completed to date. These are Ormiston Associates Ltd Drawing numbers 4079-11 and 4079-12. These interpretations are based on greater or lesser depths of weathering and degree of jointing providing batter slopes varying between 1Vertical to 1Horizontal (45 degrees) and 1V to 0.7H (55 degrees). From this interpretation of the geology the quantities of the various greywacke weathering grades have been calculated. The range of material quantities presented below is based on possible conservative (flatter) and optimistic (steeper) batter slope designs. These parameters are discussed in more detail in Section 9 of this statement.

8.4 The quantities of weathered to fresh Greywacke rock to be developed by the two proposed face configurations discussed above have been calculated and are presented in the table below -:

Table of Estimated Resource Quantities

Material Type	Conservative Batter Slope	Optimistic Batter Slope
Overburden (Estimated Vol)	300,000 m^3 (in situ)	300,000 m^3 (in situ)
Brown Rock	4,060,000 tonnes	2,780,000 tonnes
Blue Brown Rock	1,550,000 tonnes	2,548,000 tonnes
Blue Rock	2,100,000 tonnes	5,572,000 tonnes
Fault Breccia	1,175,000 tonnes	920,000 tonnes
Total Estimated Resource	8,885,000 tonnes (excludes overburden)	11,820,000 tonnes (excludes overburden)

9.0 BATTER SLOPE AND FACE STABILITY

9.1 Detailed and intensive investigation and assessment of the nature, intensity and direction of jointing has been completed in the existing Northern Quarry Pit at Kiwi Point Quarry batter slopes. While it is not at all certain that a similar joint configuration will be present in the Southern Ridge it is considered that, with limited evidence available, this information provides a guide as to what might be encountered when the Southern Ridge is excavated. Batter slope design to produce a stable face configuration relies on the nature of discontinuities (bedding and/or jointing) in the rock at and behind the faces exposed by the excavation of the quarry. The critical factors are the attitude (direction of discontinuity dip or slope and steepness of the dip) of the discontinuity relative to the quarry face, discontinuity intensity and the nature of the discontinuities in terms of their openness and cohesion. As stated above these factors can be best assessed once the face is being excavated. Limited discontinuity data can also be obtained from downhole geophysical logging which will provide preliminary design parameters.

The design of the batter slopes for the Southern Ridge Quarry has used parameters derived for the Northern Pit and has adopted two interpretations; one being conservative based on an anticipated joint configuration that would produce low (45 degree) angle batter slopes (as observed in the Northern Pit western batter slopes) and the other optimistic being based on an anticipated joint configuration that would produce higher (55 degree) angle stable batters. In reality batter slopes are likely to vary between the two slope angles depending on variations in the rock mass discontinuity configuration.

9.2 As a further part of the design stable batter angles will also depend on the degree of weathering in the rock excavated. In general the more highly weathered materials present at the Southern Ridge crest of the excavation will require flatter angles to achieve a stable batter than will the less weathered deeper materials.

9.3 These factors have all been incorporated into the modelling completed to produce two conceptual designs for the excavation of a quarry with an acceptable stable ultimate highwall face. The aggregate quantities calculated depend on these possible designs. Drawings showing the anticipated face configuration representing the models developed from the two sets of criteria are presented as Ormiston Associates Ltd Drawing numbers 4079 11 and 4079 - 12

9.4 The design of an acceptable stable quarry face depends principally on the assessed Factor of Safety (FOS) for the excavation. Wellington City Council has recommended the guidelines included in a paper entitled "***Where is that new earthquake loadings standard?***" presented to the New Zealand Society of Earthquake Engineering conference in 2004 (King et al, 2004). This paper does not provide factors of safety and is directed at all buildings not batter slopes.

9.5 For "normal buildings" which is the category for residential buildings such as present in Gurkha Crescent and Shastri Terrace the ultimate limit state (ULS) to be adopted is a 1 in 500 year earthquake and the serviceability limit state (SLS) to be adopted is a 1 in 25 year earthquake. To ensure that the worst case scenario is considered the calculations for FOS have used the optimistic conceptual design (55 degree batter slopes) for the quarry face and the full ultimate pit before any backfill is placed at the toe of the batter slope. The results for the ultimate faces are for the FOS at the closest boundary of the lots off Gurkha Crescent and Shastri Terrace. This analysis calculates FOS 2.6 for the static limit state, FOS 2.1 for the serviceability limit state and FOS 1.3 for the ultimate limit state.

As Wellington City Council does not have standards for FOS of excavated slopes we have adopted those from the Auckland Council being ***Auckland Council Code of Practice for Land Development and Subdivision Section 2 Earthworks and Geotechnical Design, Schedule 2c: Factors of Safety and Risk Guideline (page 33)***. This code requires that the FOS of a slope be–

- *Static limit state (design ground water table) FOS >1.5*
- *Static limit state (extreme ground water table) FOS >1.2*
- *Ultimate limit state Seismic (1 in 150 year earthquake) FOS >1.2*

9.6 While these criteria for these limits do not conform directly to those adopted by Wellington City Council the FOS levels stated provide a figure against which the analysis completed by Ormiston Associates Ltd can be compared. In all cases the criteria used by Ormiston Associates Limited are more severe than those used by Auckland Council and in all cases the FOS calculated are substantially better than those required by the Auckland Council code of practice.

9.7 It is observed from the stability analysis that, with the criteria assumed in the analysis, individual batter slopes, ie those between consecutive benches, are likely to be subject to some failure in the ultimate limit state (1 in 500 year earthquake). If the analysis from the data measured in the excavated batter faces constructed for the ultimate excavation do not meet the stability criterion required, then improvement of the individual batter stability can be achieved in a variety of ways including rock bolting, covering the face with mesh or shotcreting the face or a combination of the above.

10.0 VIBRATION

10.1 I am not an expert in vibration and have assessed Kiwi Point Quarry vibration records against the standard to assess compliance.

Vibration in a quarry is derived from three main sources – vehicle movement, blasting and the operation of the crushing and screening plant.

1. **Vehicle Movement –** It is anticipated that apart from the initial stripping of the upper slopes the impact of vibration from vehicle operation and movement will be masked by the height difference of the operation below the crest of the ridge and the distance of operations from the property boundary. It is considered that

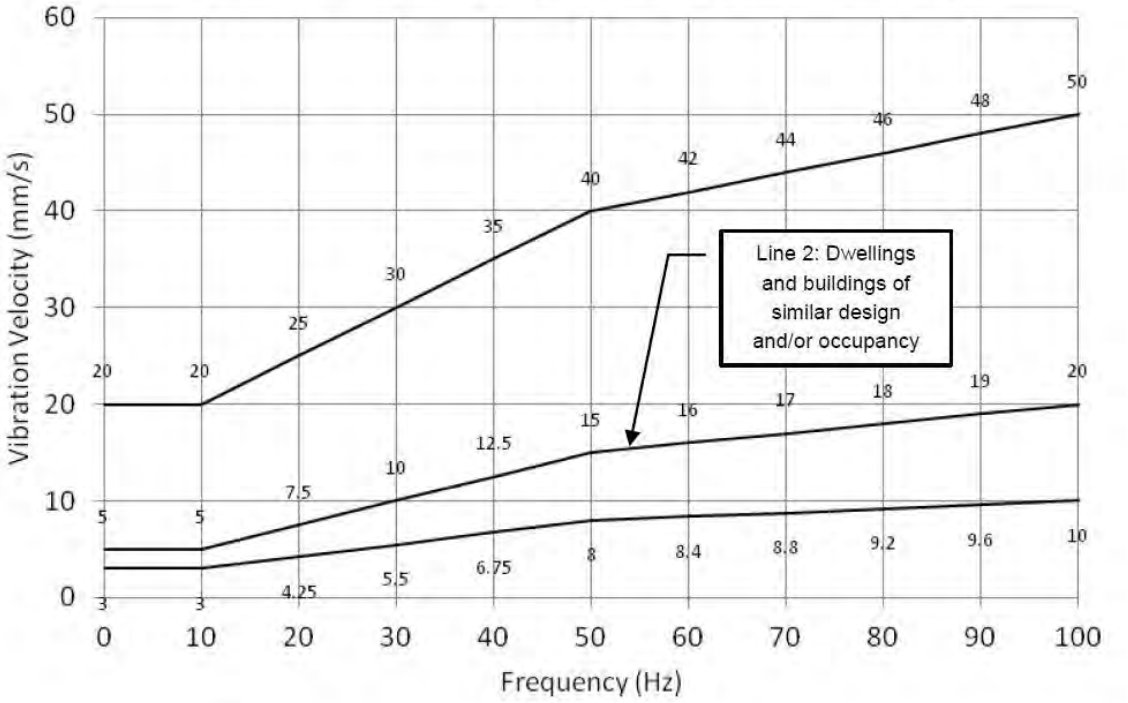
the vibrations from this source will be significantly less than from trucks passing the houses in the street.

2. **Blasting –** Blasting will be carried out intermittently on the face below the residences. Vibration from this source will be felt in, at least, the houses closest to the quarry. The ***Good Practice Guidelines: Health and Safety at Opencast Mines, Alluvial Mines and Quarries***, WorkSafe New Zealand; requires the implementation of a Management Plan for the use of any explosives. This includes an assessment of the vibration to be generated by any blast to be fired. Also, it is anticipated that a requirement of the resource consent will be for the design and monitoring of blasting in the quarry to ensure that vibration at the residential sites will not exceed predetermined levels set to ensure that no damage will result from the vibration. Finally it is also anticipated that before blasting the quarry operator will be required to notify all nearby residents to ensure that they are aware of the event as is currently standard procedure.

10.2 In New Zealand the normally accepted standard for vibration is DIN 4150:1999. This includes Vibration Velocity Guideline Values as set out in the graph below. For residential buildings the recommended limit is as shown by Line 2 on this graph. To comply with this standard -:

> "***Vibration levels on the foundation of the nearest residential building will not exceed the limits as described by line 2 on the attached graph (Figure 2) and the vibration at all frequencies of the horizontal plane of the highest floor of the residence will not exceed 15 mm/sec***".

Figure 2: DIN 4150:1999 Vibration Velocity Guideline Values



10.3 Records of monitoring of Kiwi Point Quarry blasting have been carried out at three locations around the site for every blast at the Northern Pit since the beginning of 2013.

10.4 These records show that the vibration at each of the three recording sites was below the trigger level for 27, 17 and 46 blasts, respectively, of the 54 blasts at the Northern Pit. Of all the records only two records (both prior to the end of 2013) exceed 10 mm/sec and another three exceed 5 mm/sec but are less than 6 mm/sec.

10.5 At the end of 2013 Holcim (NZ) Ltd changed the management structure at the quarry and since that time the control of blasting has been managed to minimise the impact of vibration. These same management practices are proposed to be implemented at the proposed Southern Ridge quarry.

11.0 Noise

11.1 I am not a noise expert and have assessed noise monitoring results and explanatory report prepare by Marshall Day Acoustic Consultants in the vicinity of the quarry. Noise from vehicles; excavators, bulldozers, trucks and plant will be the principal noise impact from the quarry operation. Blasting noise being of short duration is considered differently.

The New Zealand standard for noise in residential areas is -:

"The noise level at the notional boundary of the nearest residence measured in accordance with NZS6801:2008 Acoustics Measurement of Environmental Sound and NZS6802:2008 Acoustics, Environmental Noise will not exceed L_{eq} 50 dBA between the hours of 7am to 5pm Monday to Saturday and L_{eq} 45 dBA at all other times."

Note: The notional boundary is a line 20 metres from the nearest facade of the dwelling or the legal boundary of the dwelling, whichever is closer to the building.

11.2 In the District Plan Wellington City Council has modified these levels to 50dBL(15mins) and 45 dBL(15mins) and has extended the time duration from 7 am until 10 pm. In the Wellington City Council District Plan Rules for Kiwi Point quarry Rule 34.6.1.1.2 Noise, the noise emissions from activities within Business 2 Areas when measured at or within the boundary of any site or at the outside wall of any buildings on any site other than the site from which the noise is emitted in Business 2 Areas shall not at all times exceed 65dBLAeq(15min) and 85dB LAF max from 7 am until 10 pm.

11.3 **Noise Monitoring**

I am in receipt of the noise survey report from Marshall Day Acoustics (Kiwi Point Quarry, Environmental Noise Survey, Rp 001 R01 20181245, dated 14 November, 2018)and attached as appendix 1. The noise levels measured in this survey have been assessed in terms of the District Plan and my conclusions follow.

11.4 Referring to the Short-Term measurement surveys the conclusions relating to each measurement site are -:

Opposite Westmount School – This site is on the Quarry Boundary for which the permitted limit is LAEq15 ≤ 65 dB. The recorded measurement is 61 dBA Leq. It was

noted that the dominant noise was quarry plant noise. The result complies with the District Plan.

11.5 Opposite 130 Fraser Ave – This site is within the Residential Zone and represents the closest house to the quarry in this area. Recorded measurements are 47 dBA Leq and 51 dBA Leq which is at the limit of the noise level permitted by the District Plan. It was noted that the difference between the two records was from SH1 road noise. The quarry plant was not running for either measurement.

11.6 End Of Tarawera Rd – this site is within the Residential Zone and represents the closest house to the quarry in this area. The recorded measurement was 45 dBA Leq which is within the District Plan limit of 50 dBA Leq. The quarry plant was running. These measurements are within the limits of the District Plan.

11.7 End of Plummer St – This site is within the Residential Zone and represents the closest house to the quarry in this area. The recorded measurement is 53 dBA Leq which is above the District Plan limit. It was noted that the noise from construction sites could be heard over the dominant noise from SH1. The quarry plant was running but unable to be identified.

11.8 South of 76 Piper Way - This site is within the Residential Zone and represents the closest house to the quarry in this area. Two measurements were made at this site with records of 47 dBA Leq and 51 dBA Leq. For the first measurement the quarry plant was not operating but heavy quarry machinery was still operating. The first record is within the District Plan limit of 50 dBA Leq and for the second measurement the quarry was not operating and the dominant noise was from the Taylor Preston site.

11.9 End of Gurkha Cst - This site is within the Residential Zone and represents the closest house to the quarry in this area. Although the quarry plant was not operating the heavy machinery at the quarry was a dominant source of noise. The recording was heavily affected by plane noise and the anticipated noise level excluding planes is expected to be 45 dBA Leq. This is within the limit of the District Plan.

11.10 End of Shastri Tce - This site is within the Residential Zone and represents the closest house to the quarry in this area. It was noted that he dominant noise (55dBA) was from SH1 although noise from heavy machinery at the quarry could be heard. The quarry plant was not operating. Again, the noise level was affected by noise from planes and trains.

Referring to The Long-Term Survey

11.11 Two sites, one on the north ridge and the other on the south ridge had loggers running for two weeks. A summary of the noise levels on two days being November 2nd and 5th, 2018, taken in the hour prior to commencement of quarry activities and for the hour after both in the morning and afternoon shows there is little difference in the noise levels between when the quarry is operating and not. The highest readings of 64 dBA Leq were recoded after the quarry had closed on November 5th. It was noted that both records were affected by plane and train noise as well as construction noise from activities in Newlands.

11.12 Our observations from the records provided by Marshall Day are that the ambient noise in the area around the quarry is slightly in excess of the limits set in the District Plan. The influence of noise from the quarry may, in some locations and at times, be the dominant noise source but the evidence presented suggests that this is only intermittent and other sources of noise are more often dominant. The short-term noise survey shows that the ambient noise levels, during the day at least, exceed the limits of the District Plan and the quarry is not the dominant source of this noise.

Blast Air Overpressure

11.13 Air overpressure from blasting is measured as noise but is considered independently of background noise. We have found no standards for New Zealand but the conditions for the Holcim (NZ) Limited Bombay Quarry in Auckland have been reviewed and require that -:

"The noise/sound pressure overpressure created by the use of explosives measured at a notional boundary of 20 metres from occupied dwellings not owned by the consent holder shall not exceed a peak overall sound pressure of 128 dB linear peak. Sound pressure shall not exceed 123 dB on more than 10% of blasts over a 12 month period."

11.14 To put this into context an airblast of 130 dB intensity is equivalent to a wind gust of 37 km/hr and an airblast of 120 dB is considered "mildly unpleasant".

11.15 The air overpressure from blasting has been monitored at Kiwi Point Quarry as part of the monitoring programme carried out at the quarry. This shows that for the three recording

sites the greatest reading has been 125 dBL. Of the 54 blasts carried out at the Northern Pit the records show that the limit of 123 dBL as required by the Auckland Council condition for the Holcim (NZ) Limited Bombay Quarry has been exceeded on respectively 0, 2, and 0 occasions at the three recoding stations of the 54 blasts since 2013.

12.0 REVIEW OF APPLICATION

12.1 This application, DPC 83 seeks to change the zoning of an area of Council owned land from Open Space B to Business 2. This change will permit quarrying within the area as a controlled activity. The controls will include existing conditions and new conditions which will apply specifically to the proposed quarrying activity.

12.2 Ormiston Associates Ltd have reviewed the technical aspects of the proposed conditions and have reported on these in the statement above. Within the limits expressed in this document, Ormiston Associates Ltd are of the opinion that the proposed plan change to permit quarrying in this area is an appropriate use of the land and that impacts from the activity can be maintained within the limits of the District Plan or other appropriate standards.

13.0 REVIEW OF SUBMISSIONS

13.1 A total of 35 submissions have been received from interested parties including individual residents, the local residents association, local businesses and local authorities. Of these 18 oppose the application 11 support unconditionally and 6 support conditionally.

13.2 The principal concern of both the submitters opposing the change and those providing conditional support is related to dust. Also frequently mentioned are vibration, noise including air overpressure and visual impacts. A small number of submitters are concerned about potential detrimental impacts on the stability of the site. Several submitters request that conditions to require site rehabilitation at the earliest possible time be included in any consent granted. Traffic is mentions by two submitters.

13.3 It is our assessment that, of the issues on which we can make technical comment, most of the concerns are currently managed by the quarry operator to mitigate the impacts to levels which meet the proposed conditions.

13.4 The relevant conditions of the existing consent either comply with or are more conservative than the appropriate New Zealand or International Standard. If these

conditions are imposed for this application then it is our opinion that the concerns expressed by the submitters should be adequately addressed.

Alexander William Ormiston

20th November 2018

APPENDIX 1

ACOUSTIC REPORT

MARSHALL DAY Acoustics

KIWI POINT QUARRY
ENVIRONMENTAL NOISE SURVEY

Rp 001 R01 20181245 | 14 November 2018

MARSHALL DAY Acoustics

Level 2 EMC² House
5 Willeston Street
PO Box 25442
Featherston Street
Wellington 6146 New Zealand
T: +64 4 499 3016 F: +64 4 472 1493
www.marshallday.com

Project: **KIWI POINT QUARRY**

Prepared for: **Wellington City Council**
101 Wakefield Street
Te Aro
Wellington 6011

Attention: **Logen Logeswaren**

Report No.: **Rp 001 R01 20181245**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
			09 Nov 2018	N.Arbuckle	S.Arden
		Updated figures and tables. Amended results	14 Nov 2018	N.Arbuckle	S.Arden

TABLE OF CONTENTS

1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by Wellington City Council (WCC) to carry out monitoring of operational noise emissions from Kiwi Point Quarry in Ngauranga Gorge, Wellington.

The purpose of the monitoring is to report the current noise levels received at the surrounding residential sites.

A glossary of terminology used in this report is included in Appendix A.

2.0 SITE AND ACTIVITY DESCRIPTION

The subject site is located at Ngauranga Gorge, Wellington.

The subject site is zoned Business 2 under the Wellington City Council Operative District Plan (ODP). Sites immediately adjacent to the quarry are zoned Open Space B. The closest residential dwellings are beyond this Open Space B zoning and are all zoned Outer Residential. The subject site and the surrounding area is shown in context of the ODP in Figure 1.

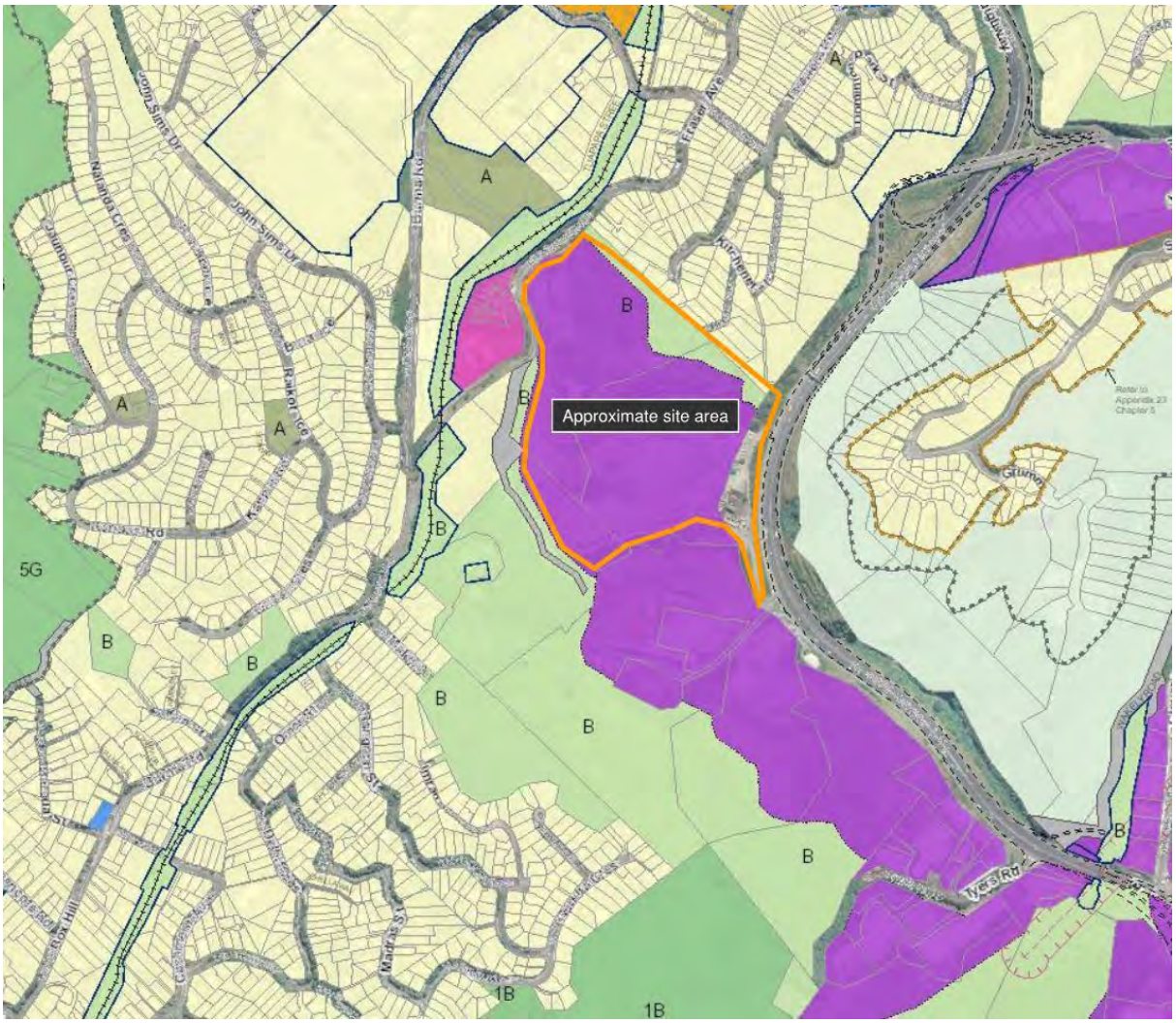


Figure 1: Subject site shown in context of WCC ODP **[Base image: WCC ODP]**

3.0 NOISE SURVEY

3.1.1 Methodology Summary

Short term attended, and long term unattended measurements were carried out close to the residentially zoned sites.

Three short-term environmental noise surveys were carried out on 02 November 2018 between 0645hrs and 0940hrs, 07 November 2018 between 1630hrs and 1815hrs and on 12 November between 1645hrs and 1815hrs. We understand that activities on site were in full operation during this period.

Measurements were carried out and assessed generally in accordance with the provisions of NZS 6801:2008 "*Acoustics – Measurement of Environmental Sound" and* NZS 6802:2008 *"Acoustics – Environmental Noise"*

A Brüel & Kjaer Type 1 2250 Sound Level Meter (S/N 3011587, calibration due 24/05/2019) was used for the measurements. This was calibrated both before and after measuring noise levels using a Brüel & Kjaer Sound Level Calibrator Type 4231 (S/N 2730707, calibration due 02/03/19). No drift in calibration was observed.

Two long term loggers were deployed; one on the northern ridge of the site area by Plumer Street and the other on the southern ridge by Gurhka Crescent. These were both calibrated prior to and after the noise survey period using a Brüel & Kjaer Sound Level Calibrator Type 4231 (S/N 2730707, calibration due 02/03/19). All measurements during the survey period were considered valid in accordance with NZS 6801:2008.

During the surveys on 02 November and 12 November, weather conditions were fairly calm, with average wind speeds measured as 4 ms^{-1} or less and no precipitation.

During the survey on 07 November, average wind speeds measured in excess 10ms^{-1} and slight precipitation was observed. These wind conditions are outside the appropriate range as set out in 7.2.4 of NZS 6801:2008, and as such, have not been reported in this document.

3.1.2 Noise Measurements

An aerial image showing the measurement positions is presented in Figure 2

The short-term measurement results are presented in Table 1, along with the corresponding measurement for the identical period at the long-term logger locations.

Table 1: Measurement Results

Measurement Position	Start Time	Duration (mins)	Measured L_{eq} (dBA)	North Ridge L_{eq} (dBA)	South Ridge L_{eq} (dBA)
02 November					
Position 1 – Opposite Westmount School	0915 hrs	15:02	61	50	58
Position 2 – Opposite 130 Fraser Ave	0645 hrs	15:01	47	49	57
Position 2 – Opposite 130 Fraser Ave	0715 hrs	15:02	51	52	58
Position 3 – End of Tarawera Road	0800 hrs	15:02	45	49	58
Position 4 – End of Plumer Street	0830 hrs	15:03	53	50	58
12 November					
Position 5 – South of 76 Piper Way	1751 hrs	9:01	47	47	54
Position 5 – South of 76 Piper Way	1800 hrs	15:01	51	50	56
Position 6 – End of Gurkha Crescent	1645 hrs	15:01	53	55	57
Position 7 – End of Shastri Terrace	1715 hrs	15:01	55	53	56

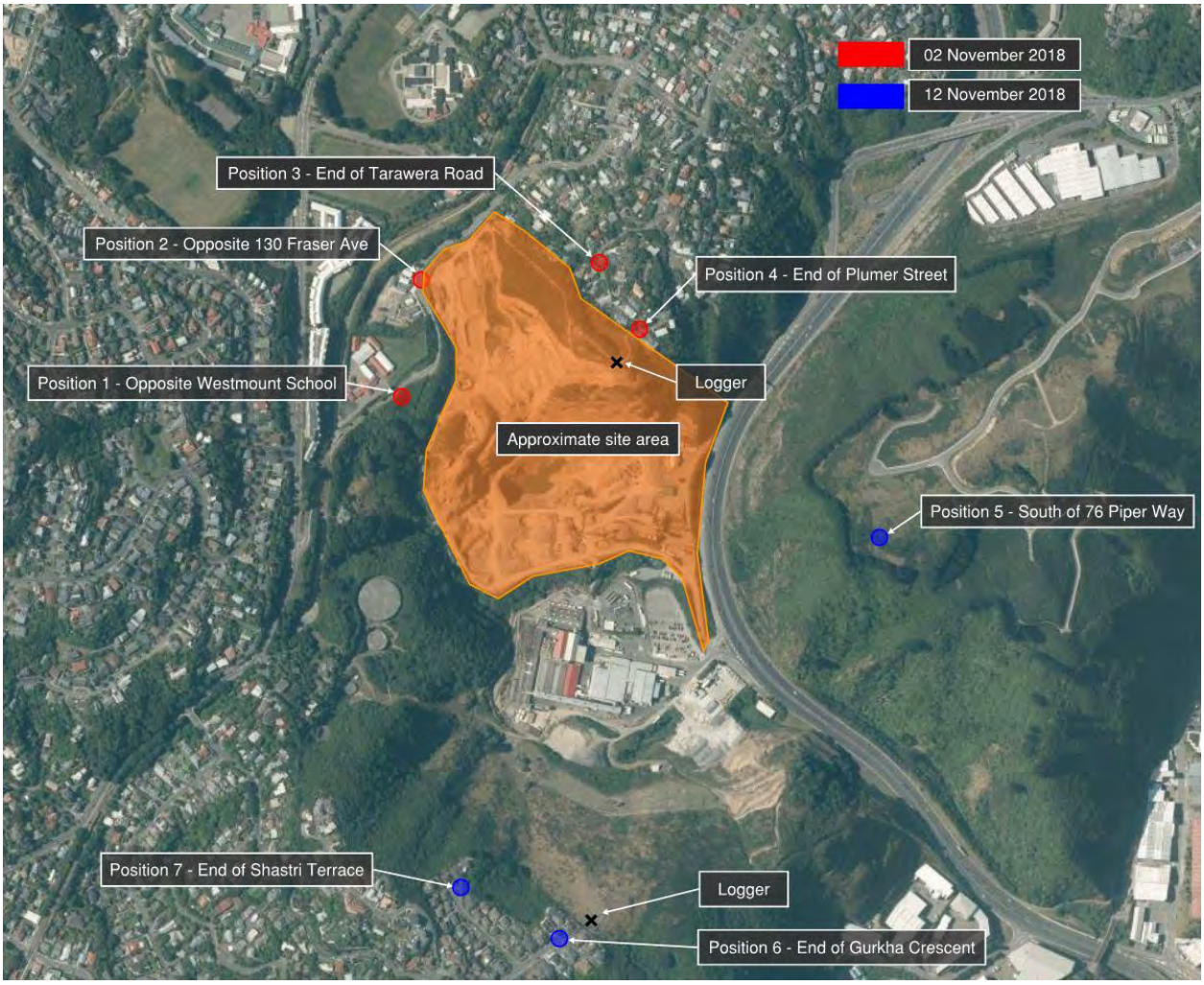


Figure 2: Site and measurement positions **[Base image: LINZ]**

3.1.3 Discussion (Short term)

Measurement Position 1: Opposite Westmount School

Position 1 was selected as direct line of site could be maintained with site activities.

The measurement period was from approximately 0915 hrs to 0930 hrs and resulted in an L_{eq} of 61 dBA. The dominant noise source was quarry plant noise, most of this coming from the crusher towards the south-east corner of the site area. Excavators and trucks could also be heard at times over the noise of the crusher. At this location SH1 was only slightly audible. Construction noise on Burma Road could be heard at times.

Extraneous noise sources included traffic on Fraser Avenue which were excluded from the measurement as much as reasonably practicable.

Measurement Position 2: Opposite 130 Fraser Avenue

Position 2 was selected to be representative of the residential sites located on Fraser Avenue. These are the closest residentially zoned sites to the west of the subject site.

Two measurements were taken at this position; one during the half hour prior to the start of quarry activities, and one immediately after the commencement of quarry activities.

The first measurement was measured from approximately 0645 hrs to 0700hrs and resulted in an L_{eq} of 47 dBA. The dominant noise source was birds from surrounding foliage. Traffic and construction noise from Burma Road and traffic noise from SH1 was also audible.

The second measurement was measured from approximately 0715 hrs to 0730 hrs and resulted in an L_{eq} of 51 dBA. At this position there is some shielding from the main operational area of the quarry, and as such, noise from quarry activities could only be heard from time to time. We attributed the 4 dB increase from the first measurement to an increase in background noise such as traffic from SH1 and Burma Road, planes, and trains, with only a small contribution from quarry activities.

Extraneous noise sources included traffic on Fraser Avenue which was excluded from the measurement as much as reasonably practicable.

Measurement Position 3: End of Tarawera Road

Position 3 was selected to be representative of the residential sites located on Tarawera Road.

This measurement was measured from approximately 0800 hrs to 0815 hrs and resulted in an L_{eq} of 45 dBA. The dominant noise source was birds from surrounding foliage. Traffic from Fraser Avenue and SH1 was also audible as well as construction noise in the surrounding areas. It was difficult to determine if any noise was coming from the quarry due to the combination of background and construction noise.

Measurement Position 4: End of Plumer Street

Position 4 was selected to be representative of the residential sites located on Plumer Street. These are the closest residentially zoned sites to the North of the subject site.

This measurement was measured from approximately 0830 to 0845 and resulted in an L_{eq} of 53 dBA. The dominant noise source was from SH1. Reverse beepers with Special Audible Characteristics could be heard over noise from SH1 but were identified as being from surrounding construction sites rather than from the quarry. Specific noise sources associated with the quarry was unable to be determined.

Measurement Position 5: South of 76 Piper Way

Position 5 was selected to be representative of the residential sites located on Piper Way. Line of site could be made with a small section of the southern part of the quarry above Taylor Preston Limited (TPL). These are the closest residentially zoned sites to the east of the subject site.

The first measurement was measured from approximately 1750 hrs to 1800 hrs and resulted in an L_{eq} of 47 dBA. At this time the crusher was not operating but heavy machinery could still be seen moving on site. The second measurement was measured from approximately 1800 hrs to 1815 hrs and resulted in an L_{eq} of 51 dBA. The quarry was not in operation. The dominant noise source was a mid-frequency hum generated by plant noise from TPL. SH1 could be heard at times over the plant noise as well as barking dogs from TPL. This 4 dB increase was attributed to plane flyovers.

Measurement Position 6: End of Gurkha Crescent

Position 6 was selected to be representative of the residential sites located on Gurkha Crescent.

This measurement period was from approximately 1645 hrs to 1700 hrs and resulted in an L_{eq} of 53 dBA. As mentioned above, the crusher was not operating but the sound of heavy machinery could be heard coming from the direction of the quarry, however, the dominant noise source was SH1. This position was heavily affected by plane noise as the flight path was directly overhead. The measured L_{10} was 47 dBA. As such, without the presence of the planes it is expected that the L_{eq} would be approximately 45 dBA.

Position 7: End of Shastri Terrace

Position 7 was selected to be representative of the residential sites located on Shastri Terrace. These are the closest residentially zoned sites to the south of the subject site.

This measurement was measured from approximately 1715 hrs to 1730 hrs and resulted in an L_{eq} of 55 dBA. The dominant noise source was SH1 and was received much louder at this position than position 6 at the end of Gurkha Crescent. Again, the crusher was not operating but the sound of heavy machinery could be heard coming from the direction of the quarry.

Note: All positions were affected by plane and train noise.

3.1.4 Discussion (Long term)

Table 2 summarises data received by both loggers an hour before and after commencement of quarry activities as well as an hour before and after cessation of quarry activities, on two separate days. These time periods were selected as weather conditions were most suitable.

The North Ridge logger is located just south of Plumer Street. At this location there is shielding from both quarry activities and SH1.

The South Ridge logger is located to the North East of Gurhka Crescent. The logger has line of site with both the quarry and SH1.

Both loggers were also affected by plane and train noise at the times reported below as well construction noise from activities in Newlands.

Figure 3 and Figure 4 show the noise levels measured over a period of 2 weeks.

Table 2: Long term logger measurements

Date	Time	North Ridge	South Ridge	Quarry Operational
02 Nov 2018	0600 – 0630	46	46	No
	0630 – 0700	48	47	No
	0700 – 0730	50	49	Yes
	0730 – 0800	53	54	Yes
	1345 – 1415	52	59	Yes
	1415 – 1445	50	59	Yes
	1445 – 1515	55	59	No
	1515 – 1545	50	59	No
05 Nov 2018	0600 – 0630	52	56	No
	0630 – 0700	52	57	No
	0700 – 0730	54	57	Yes
	0730 – 0800	52	55	Yes
	1515 – 1545	50	60	Yes
	1545 – 1615	55	63	Yes
	1615 – 1645	54	64	No
	1645 – 1715	52	64	No

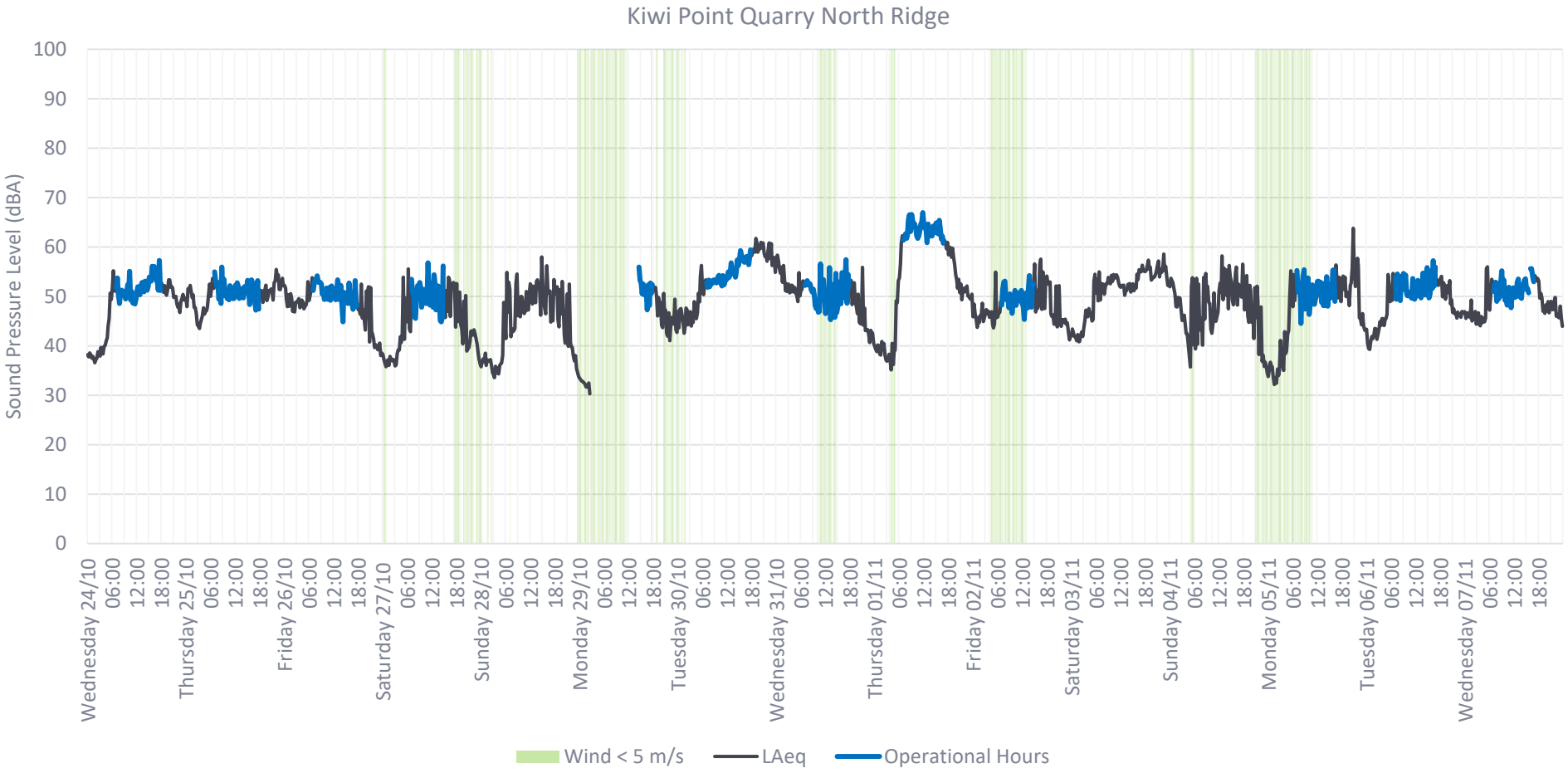


Figure 3: North Ridge logger measurements

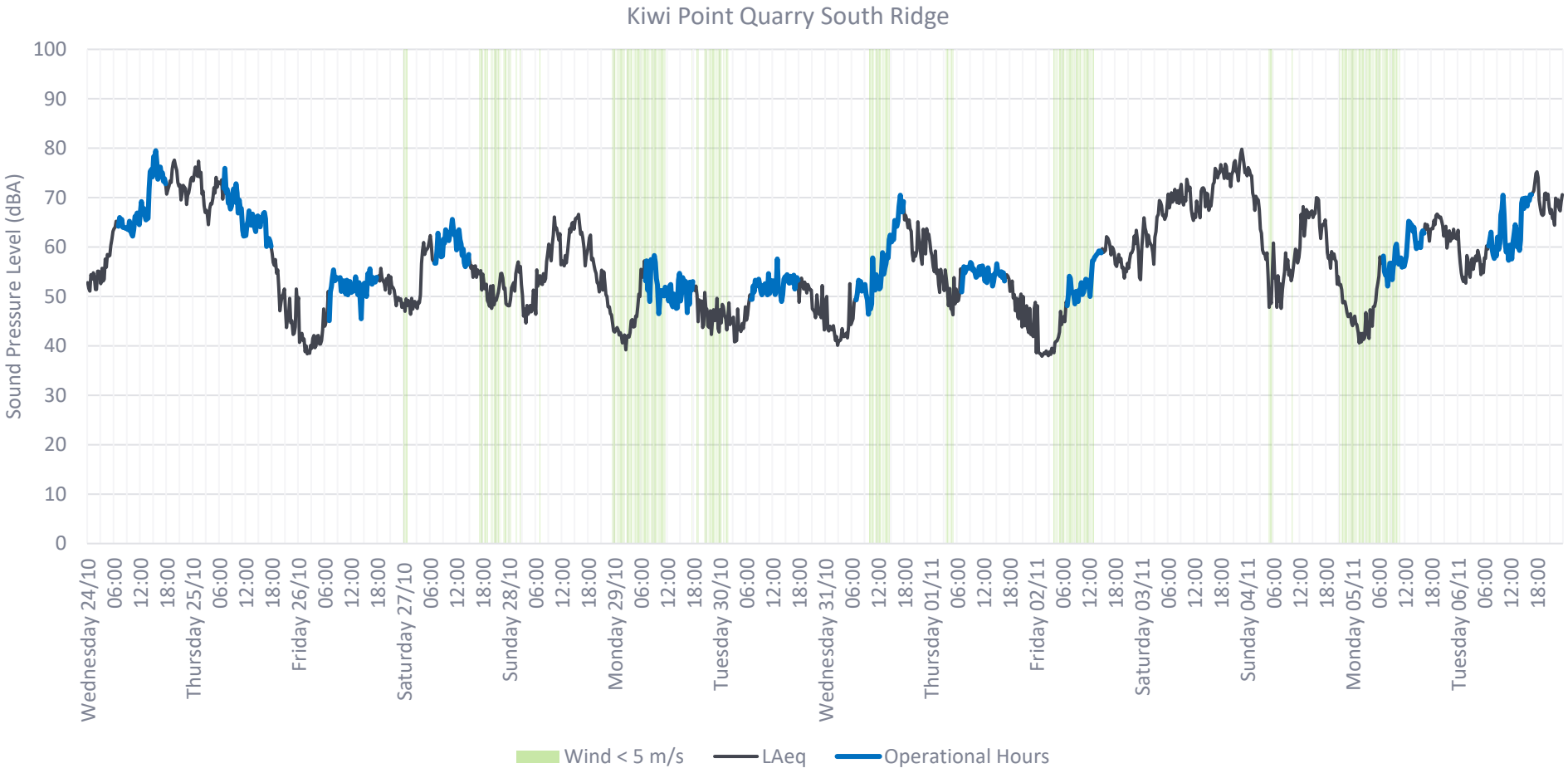
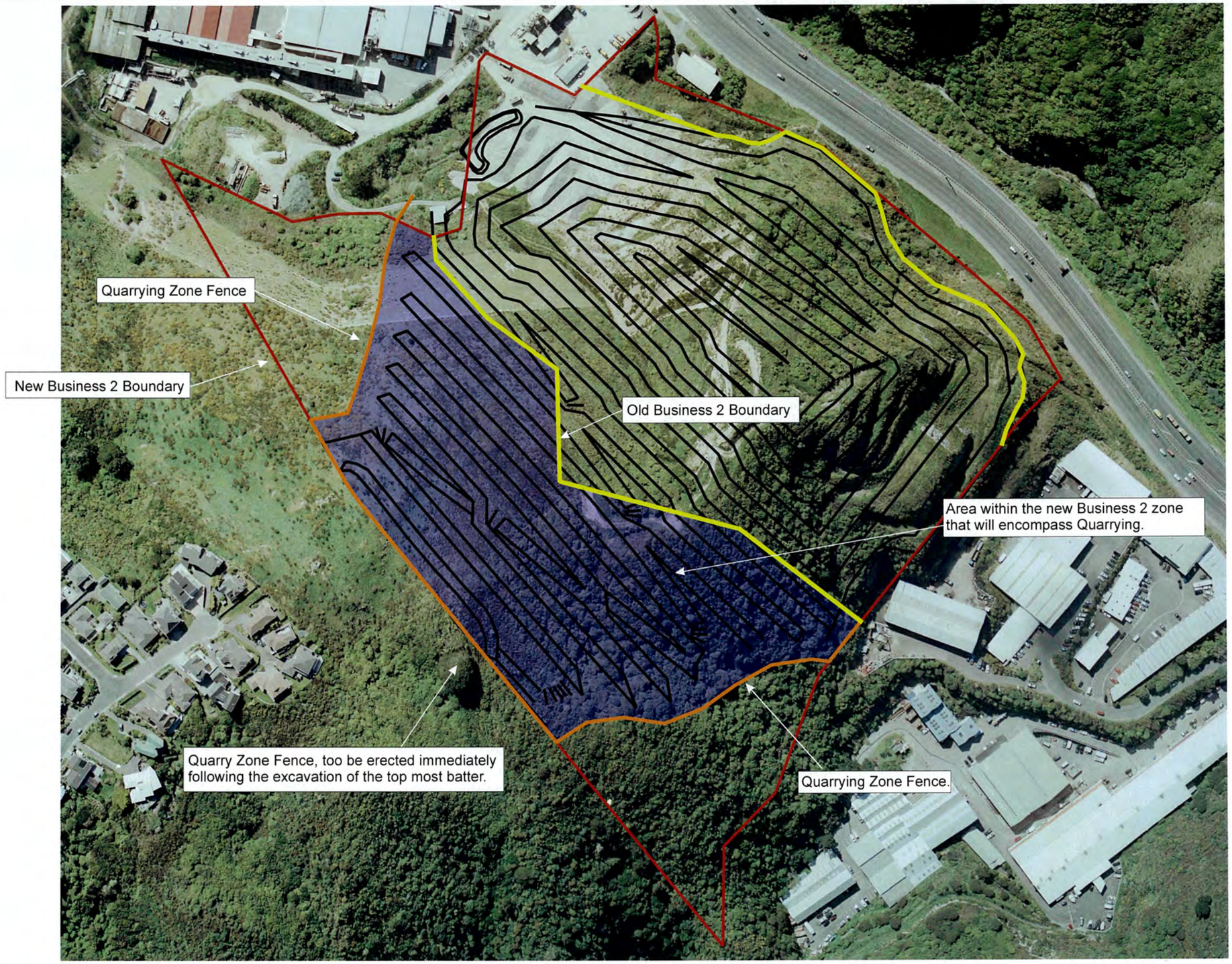


Figure 4: South Ridge logger measurements

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
Special Audible Characteristics	Distinctive characteristics of a sound which are likely to subjectively cause adverse community response at lower levels than a sound without such characteristics. Examples are tonality (e.g. a hum or a whine) and impulsiveness (e.g. bangs or thumps).
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
L_{eq}	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 "Acoustics – Measurement of Environmental Sound"
NZS 6802:2008	New Zealand Standard NZS 6802:2008 "Acoustics – Environmental Noise"

Drawings



Scale 1:2,500

0m 100m 200m 300m

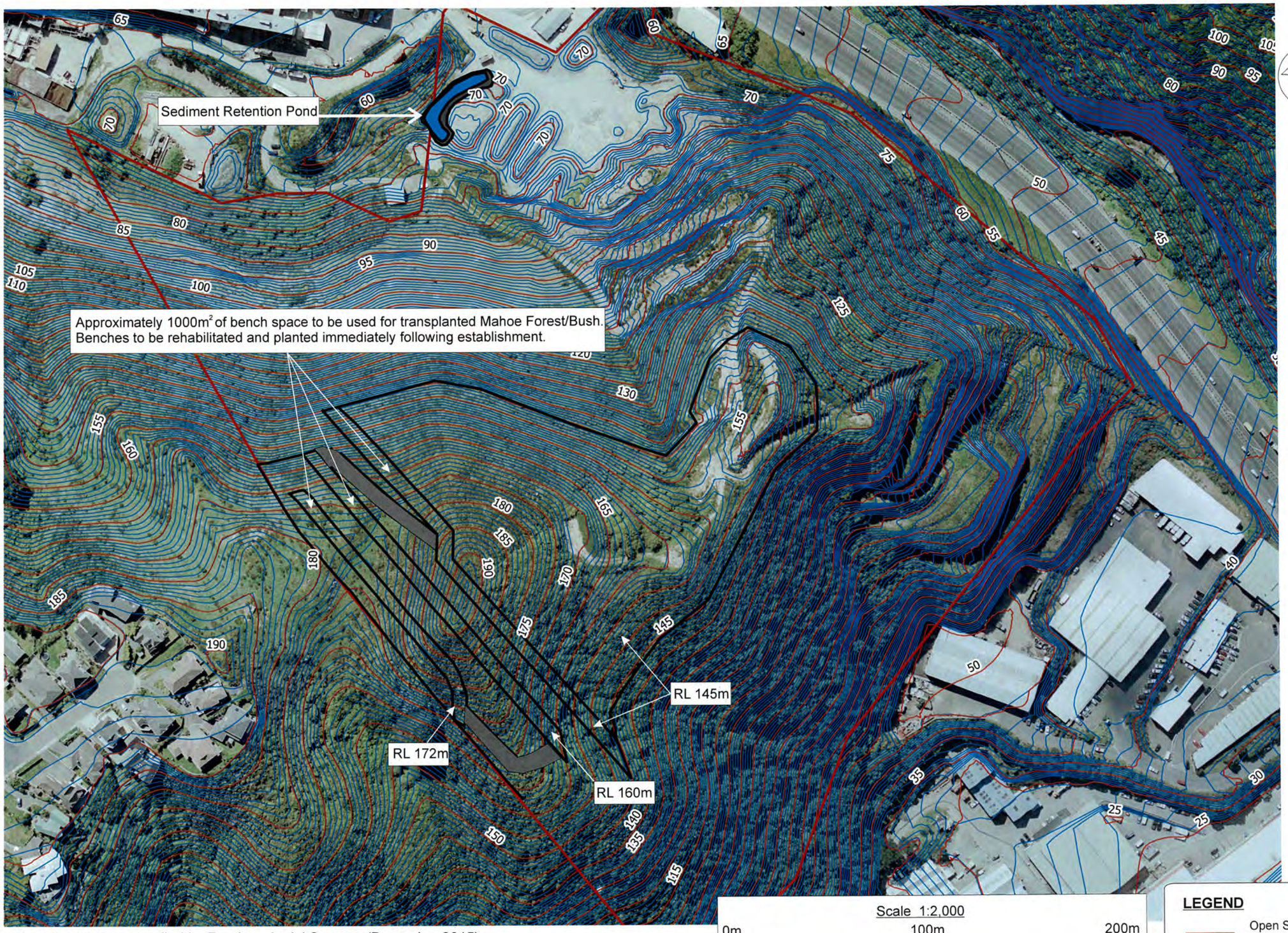
NOTE: Plan based on Areal Photography supplied by Precision Aerial Surveys (30th September 2015)

ORMISTON ASSOCIATES LTD
CONSULTANTS IN GEOTECHNICAL ENGINEERING, GEOLOGY & ENGINEERING GEOLOGY
Level 2, 90 Symonds Street, Grafton, Auckland City
P O Box 47-822, Ponsonby, Auckland 1144, New Zealand
Ph (09) 302 2193 Fax (09) 302 2197 Email: mail@ormiston.co.nz

CLIENT: Wellington City Council
LOCATION: Southern Ridge, Kiwi Point Quarry
TITLE: Southern Ridge- Open Space B Area Designation

SCALE: 1:2,500 @ A3
DRAWN: HW
DATE: 28th Aug. 2018
CHECKED: SJC

DRAWING NO
4079-10 Rev 1
SHEET 1 OF 1



NOTE: Plan based on survey data supplied by Precison Aerial Surveys (December,2015).
NOTE: RL height labels refer to bench heights.

Scale 1:2,000

0m 100m 200m

LEGEND

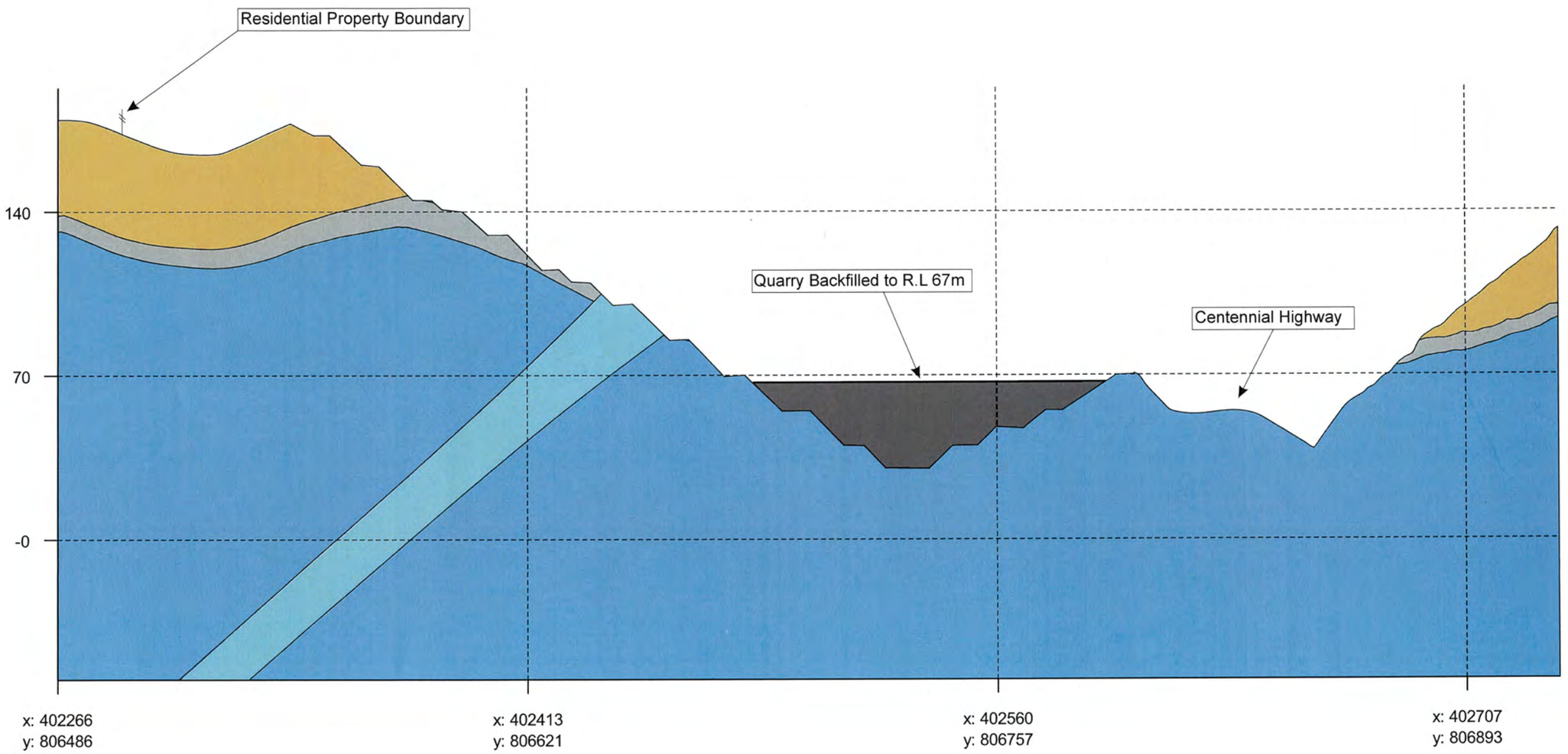
Open Space b Boundary

ORMISTON ASSOCIATES LTD
CONSULTANTS IN GEOTECHNICAL ENGINEERING, GEOLOGY & ENGINEERING GEOLOGY
Level 2, 90 Symonds Street, Grafton, Auckland City
P O Box 47-822, Ponsonby, Auckland 1144, New Zealand
Ph (09) 302 2193 Fax (09) 302 2197 Email: mail@ormiston.co.nz

CLIENT: Wellington City Council
LOCATION: Kiwi Point Quarry, South Ridge
TITLE: Open Space B to Property Boundary 55 Degree Batters- Stage 1a Development Quarry Plan

SCALE: 1:2000 @ A3
DRAWN: HW
DATE: 27th Aug. 2018
CHECKED: AWO

DRAWING NO
3655-SR39
SHEET 1 OF 1



Blue Rock
Blue-Brown Rock
Brown Rock
Fault Breccia

Scale 1:2,000

0m 100m 200m

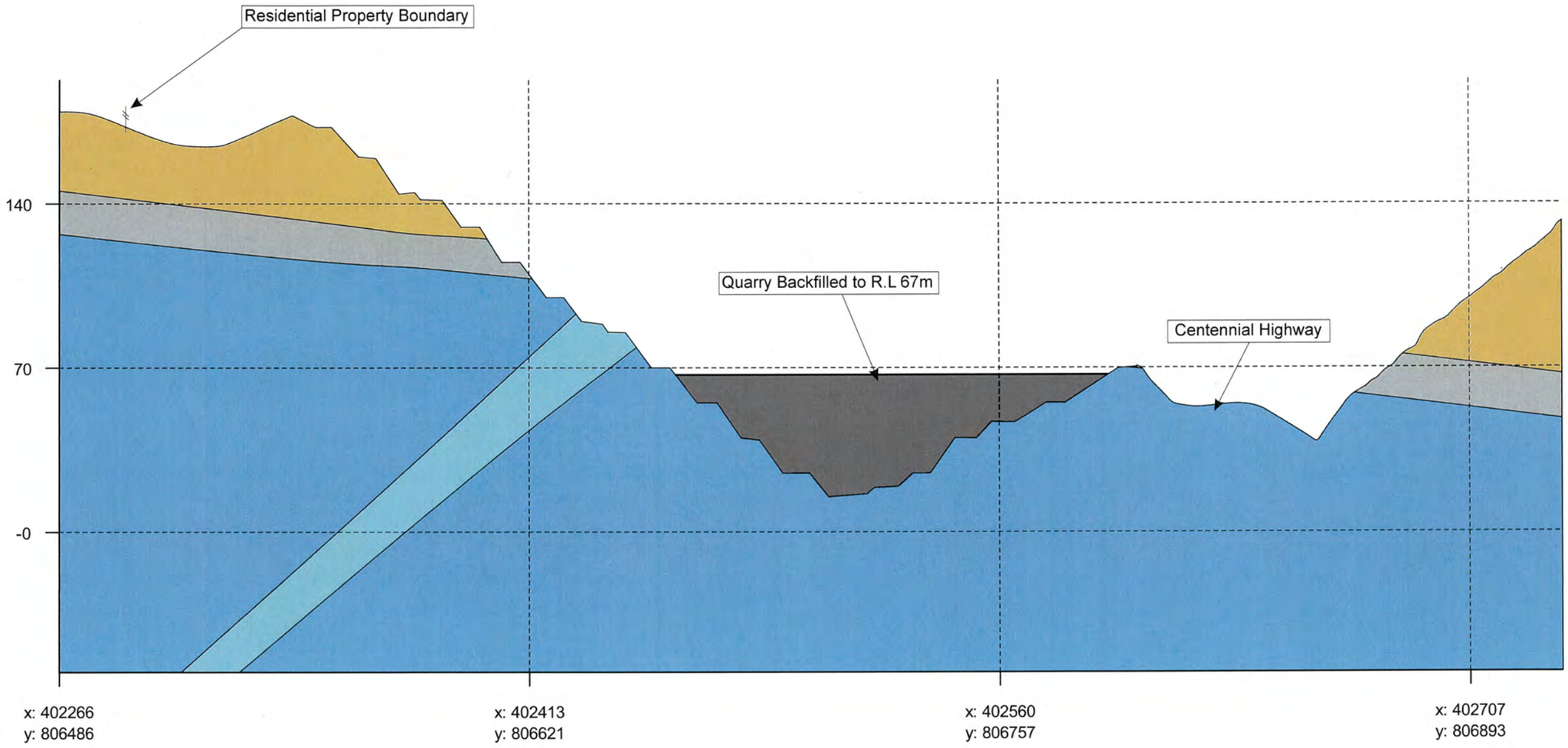
NOTE: Plan based on Areal Survey supplied by Precision Aerial Surveys (30th September 2015)

ORMISTON ASSOCIATES LTD
CONSULTANTS IN GEOTECHNICAL ENGINEERING, GEOLOGY & ENGINEERING GEOLOGY
Level 2, 90 Symonds Street, Grafton, Auckland City
P O Box 47-822, Ponsonby, Auckland 1144, New Zealand
Ph (09) 302 2193 Fax (09) 302 2197 Email: mail@ormiston.co.nz

CLIENT: Wellington City Council
LOCATION: Southern Ridge, Kiwi Point Quarry
TITLE: Southern Ridge- 45 Degree Batter Conservative Quarry Design

SCALE: 1:2,000 @ A3
DRAWN: HW
DATE: 27th July 2018
CHECKED: SJC

DRAWING NO
4079-11 Rev1
SHEET 1 OF 2



LEGEND

- Blue Rock
- Blue-Brown Rock
- Brown Rock
- Fault Breccia

Scale 1:2,000

0m 100m 200m

NOTE: Plan based on Areal Survey supplied by Precision Aerial Surveys (30th September 2015)

ORMISTON ASSOCIATES LTD
CONSULTANTS IN GEOTECHNICAL ENGINEERING, GEOLOGY & ENGINEERING GEOLOGY
Level 2, 90 Symonds Street, Grafton, Auckland City
P O Box 47-822, Ponsonby, Auckland 1144, New Zealand
Ph (09) 302 2193 Fax (09) 302 2197 Email: mail@ormiston.co.nz

CLIENT: Wellington City Council
LOCATION: Southern Ridge, Kiwi Point Quarry
TITLE: Southern Ridge- 55 Degree Batter Optimistic Quarry Design

SCALE: 1:2,000 @ A3
DRAWN: HW
DATE: 27th July 2018
CHECKED: SJC

DRAWING NO
4079-12 Rev 1
SHEET 2 OF 2