Kings Quarry Limited

Pebble Brooke Road
Wainui

Kings Quarry - Stage 2 Development
Greenhouse Gas Emission Assessment

Report J24459

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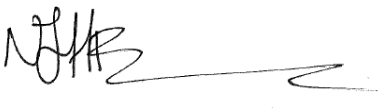

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Document History

No	Version	Amendments made	Issue Date
1	Draft for Planning Review	-	30 January 2025
2	FINAL	Minor amendments	26 March 2025

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1. Introduction

Kings Quarry Limited (KQL) have engaged Air Matters Limited to assess the greenhouse gas (GHG) emissions from activities relating to the proposed extension ('Stage 2') at Kings Quarry, Wainui. A range of resource consents are required for the Stage 2 development.

Stage 2 development is a listed project under the Fast-track Approvals Act 2024 (the Act). The assessment undertaken in this report is intended to demonstrate the potential impacts on GHG emission and climate change as a result of the Stage 2 development. Based on available information this report concludes that a reduction of 12,551 tonnes of CO_2 equivalent GHG emissions could be achieved annually as a result of the Stage 2 development. This is expected to have a positive immediate benefit in reducing New Zealand's transport related greenhouse gas emissions.

For the purpose of supporting the consenting process Air Matters have reviewed the available information to determine the high-level aggregate supply chains within the Auckland Region and the potential impact of the Stage 2 development. A standardised GHG reporting methodology has been used to inform the potential type of changes in GHG emissions, within the aggregate supply industry, as a result of the Stage 2 development. A quantitative GHG emission assessment has then been undertaken using The Ministry for the Environment's published guidance and emission factors.

The aim of this report is to estimate the impacts on New Zealand's GHG emissions as a result of the Stage 2 development at Kings Quarry. This assessment is not a comprehensive GHG inventory assessment for KQL. To meet best practise the assessment has followed standardised GHG reporting methodologies.

1.1 Kings Quarry

Kings Quarry was established in the 1930s and sits on a parcel of land totalling 167ha. Quarrying operations ceased in the 1990s, however an expansion to the Quarry is now being considered. Resource consent was granted in 2021 for the Stage 1 development. This initial stage was to allow 300,000 tonnes of aggregate to be removed over an area within the existing Quarry footprint. KQL are now looking to consent an expansion of the operation referred to as Stage 2.

Aggregate supplied from the site includes:

- GAP (General All Passing) 7, 20, 40 and 65 mm
- concrete aggregates including PAP (Premium All Passing) 7, 10/14 and 19 mm
- premium construction sand for concrete, and field and turf base layers
- decorative river pebble

The Stage 2 development is expected to provide an operational life time of up to 45 years at an annual average extraction rate of 500,000 tonnes. Once operational the quarry can provide a range of aggregate with capacity to crush and screen onsite. Quantity of the various products will depend on the demand which is likely to fluctuate year-by-year but would typically be 45% graded construction chip, 30% construction sand and 25% decorative pebble.

The target aggregate supply markets for the proposed Stage 2 development will be the North Shore and West Auckland areas, however supply will likely occur over the Auckland Region especially in relation to the decorative pebble.

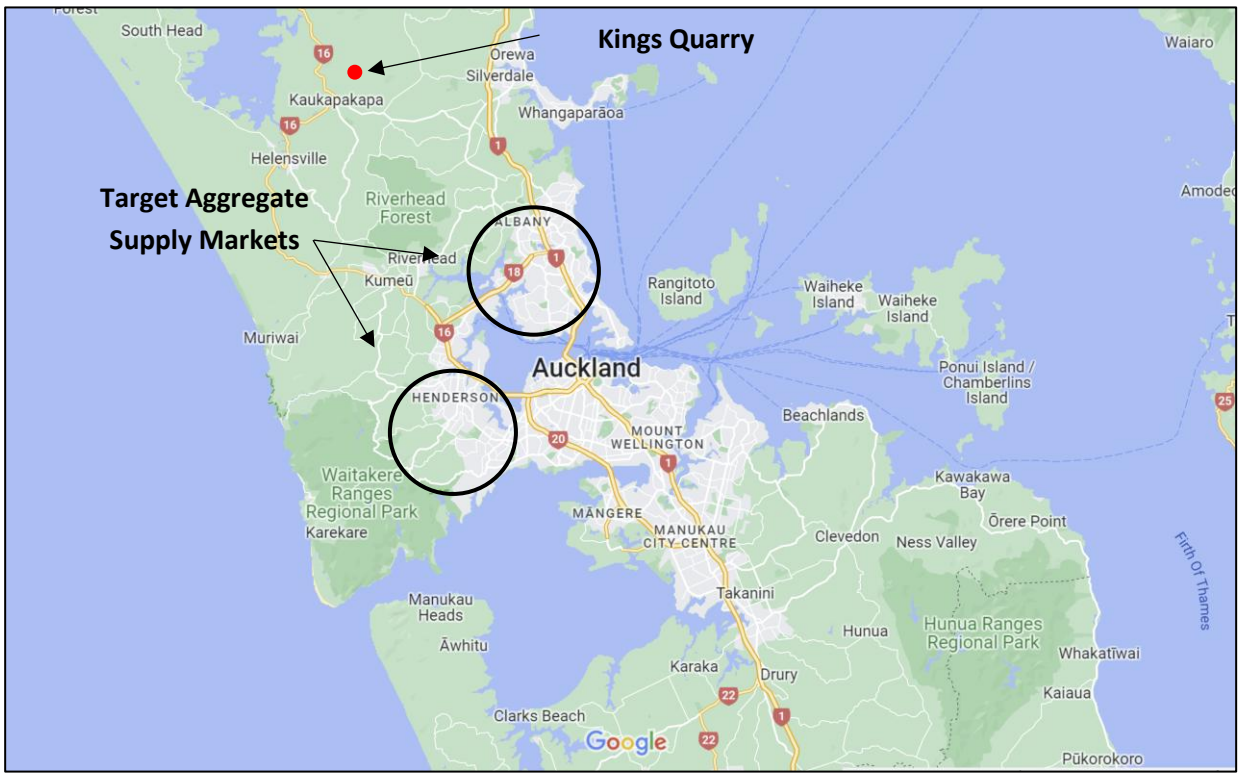

Figure 1-1: Location of Kings Quarry in relation to Auckland. Aggregate from the proposed development would focus on meeting demand in the North Shore and West Auckland areas. *Base map sourced from maps.google.com.*

1.2 Aggregate Supply

Typically, aggregates are mostly supplied from nearby sources because of the geographic dispersion of quarry locations (Welvaert, 2018) and the cost to transport. Due to these typically short distances, aggregates within New Zealand are almost entirely transported by road as opposed to rail or coastal shipping (Waka Kotahi, 2022).

Ministry of Transport data show that in 2012/13, aggregate transport accounted for 11% of road freight transport and there was rarely any aggregate freight transport between the Regions, with the exception of Auckland and Wellington. A 2017/2018 national freight demand study estimated that this had increased to 15% of total Road freight (MfE, 2022).

1.2.1 *Auckland Regional Supply*

Total demand in Auckland cannot currently be supplied within the region (Waka Kotahi, 2022). Additional supply in the case of Auckland is sourced by aggregates from Northland and the Waikato.

An economic impact assessment was carried out on the Stage 2 development (m.e Consulting, 2025) and included an estimate of the potential savings in transport costs. To inform this, historic annual aggregate supply and demand in the Auckland Region was analysed. Estimates of future population and economic growth in Auckland was then used to demonstrate the potential aggregate demand out to 2048. In summary the assessment noted that the Auckland Region does not have enough aggregate production capacity to support itself currently or into the future. Therefore, for the purpose of this assessment, it is assumed that the entire annual volume of aggregate (500,000 tonnes) supplied from Kings Quarry would be used within the Auckland Region.

In addition to bulk aggregate for construction and roading, Kings Quarry will produce decorative rock in the form of pebbles. Supply into Auckland for this type of rock is currently from Manawatu and the South Island (Alex Semenoff, pers comms).

2. Methodology

Ministry for the Environment have produced a series of documents which have been used as a guidance for this assessment (MfE, 2024a). The guideline aligns with and endorses the use of the GHG Protocol Corporate Accounting and Report Standard and ISO 14064-1:2018.

When compiling a GHG inventory the guideline recommends the following relevant considerations:

- **Organisational boundaries** (which activities within an origination should be accounted for)
- **GHG emission source inclusions and exclusions** (defined as Scope 1-3)
- **Types of Greenhouse Gases** and factoring in their Global Warming Potential (GWP)
- Selecting an appropriate **base year** as a comparison

These have been considered in the following section.

2.1 Organisational Boundaries

Organisational boundaries were set with reference to the methodology described in the GHG Protocol and ISO 14064-1:2018 standards. The GHG Protocol allows two distinct approaches to consolidate GHG emissions: the equity share and control (financial or operational) approaches. For this assessment we used 'operational control' for KQL's stage 2 activities with only the transport operations being included. How emissions from these sources are accounted for is detailed below.

2.2 GHG emission source inclusions and exclusions

The GHG emissions sources included in this inventory were identified with reference to the methodology in the GHG Protocol, classified under the following categories:

- Direct GHG emissions (Scope 1): emissions from sources that are owned or controlled by the company
- Indirect GHG emissions (Scope 2): emissions from the generation of purchased electricity, heat and steam consumed by the company
- Indirect GHG emissions (Scope 3): emissions that occur as a consequence of the company's activities but from sources not owned or controlled by the company

Figure 2.1 shows a breakdown of the various quarry operations that produce GHG emissions and provides their Scope level and information on whether they are included or excluded from this assessment.

Figure 2-1: GHG emission sources associated with the establishment and operation of Kings Quarry.

Activity	Emission source	Emission level (scope)	Included / excluded
Establishing the Quarry			
Mobile plant (earth moving equipment)	Diesel	Scope 1	Excluded
Vegetation clearance	Forest - harvest	Scope 1	
Site office and equipment	Electricity	Scope 2	
Construction material	Steel; concrete; other building supplies	Scope 3	
Operation of the Quarry			
Mobile plant (earth moving equipment)	Diesel	Scope 1	Excluded
Stationary machinery and plant	Diesel and electricity	Scope 1	
Motor vehicles (company)	Ute – diesel, >2000cc	Scope 1	
Motor vehicles (private)	Ute – diesel, >2000cc and Car – petrol, <2000cc	Scope 3	
Waste from site (landfill)	Landfill gas emissions	Scope 3	
Transportation			
Bulk transport of aggregate	Diesel	Scope 1 and 3	Included*

***Data source: Kilometres (vehicle distance) and kilometres per tonne (bulk haulage) based on assumption of distance travelled and volume of material transported.

2.3 Reasons for the exclusions

In this assessment the establishment of the Quarry and ongoing operations have been excluded. These exclusions are based on the assumption that these activities would have no material differences from any other aggregate quarries in terms of GHG emissions. To support this the following observations are made:

- The process of establishing a quarry include: establishing site accesses and internal roadways; removing overburden and establishing site offices and machinery. Methods and materials for these types of activities are similar between quarries (for example excavators, bulldozers and trucks for removing overburden).
- Vegetation removal will be required to establish the Stage 2 development. As part of the ecological mitigation the loss of native vegetation will be offset by additional plantings both surrounding the quarry and in other areas near the quarry as outlined in Bioresearches (2025) report. The vegetation required to be cleared is approximately 28.97ha of scrub that existed prior to 1990 equating to a GHG emission of 8,075 tons[1]. The proposed offsite planting of 61ha in addition to the 22ha to be rehabilitated onsite will result in a carbon sink of 662 tons/year[2]. Based on this, GHG emissions as a result of the clearance will be offset within a 13-year period. Additional GHG offsets will also be achieved through the proposed 88.28ha of enhancement plantings. Due the absence of an applicable MfE Emission Factor for enhancement planting, their contribution to a GHG offset, has not been quantified.
- Kings Quarry is an existing site which has established site access. Therefore, its GHG emissions during establishment of Stage 2 are expected to be similar to other expanding quarries and likely significantly less than a virgin quarry.
- Ongoing operations would include extracting aggregate, screening, crushing, washing and stockpiling. The energy requirements and power sources to undertake these processes would be typical of a quarry in New Zealand.

When undertaking a full GHG inventory for the quarry operations these processes should be included. For the purpose of this assessment, which considers the potential GHG emissions compared to extraction from another quarry, these exclusions are considered appropriate.

2.4 Types of greenhouse gases

The MfE guide (2024b) covers the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). Because GHG's can trap different amounts of heat in the atmosphere, they have different relative impacts on climate change. To enable a meaningful comparison between the gases, the GHG emissions are commonly expressed as carbon dioxide equivalent (CO_2-e). To do this the emissions of each gas are multiplied by the Global Warming Potential (GWP) in a 100-year period.

[1] Regenerating pre-1990 natural forest
[2] Based on Post-1989 regenerating natural forest

Given this assessment will focus on road transport and the use of hydrocarbons (diesel), the GHG emission factors specified in the MfE calculator have been used (MfE, 2002a). These take into account relevant GHGs and their GWP.

2.5 Scope

Bulk transport of aggregates from the Stage 2 development will include both the quarry operator's own transport fleet (Scope 1) and subcontracted bulk carriers (Scope 3). In this assessment the emission factors for Scope 3 (km and km.tonne) have been used for all transport-related activities. This is based on the assessment being focused on future emissions as opposed to calculating based on past usage, where using actual volume of diesel would be appropriate. It is expected the chosen factors will provide the most accurate estimation of GHG emissions.

3. Greenhouse Gas Emissions Assessment

As discussed in Section 1, a portion of North Shore's and West Auckland's aggregate demand is currently supplied from South Auckland and areas outside of Auckland Region including Waikato and Northland. Over time aggerate demand in Auckland is expected to increase with further supply constraints resulting in potentially higher reliance on out-of-region supply.

The operation of Kings Quarry Stage 2 will provide long term security for an inner region supply of aggregates. Given the cost to transport bulk material, Kings Quarry is expected to favourably displace more distant supplies.

Choosing a 'base year' is important as a meaningful and consistent comparison of emissions over time and requires a performance datum with which to compare current and future emissions. Annual information on regional and inter-regional aggregate transport is not available and therefore it is not practical to define a base year from which to make comparisons from. For the purpose of this assessment, it is considered more appropriate to understand how a supply from Kings Quarry may impact the cartage of aggregates over a year. Based on this the following assumptions are made:

- All GAP, PAP and sand material sourced from Kings Quarry will be used within the Auckland Region with target local markets being North Shore and West Auckland:
- Of the 500,000 tonnes/year of aggregate supplied to the Auckland Region from Kings Quarry, it will displace other aggregate supplies at the following ratios:
  - South Auckland Region: 40%
  - Out-of-Region (Waikato and Northland): 40%
  - The remaining 20% will supply 100,000 tonnes of decorative pebble to the Auckland market (equating 40% of current market) directly displacing supply from Manawatu Region and the South Island. The accuracy of these figures has been reviewed and confirmed by representatives of KQL, with experience in the market.
- Extrapolating an annual GHG emission value over a consent or quarry life time (45 years) is not practical given that the supply and demand for aggregate may change over time and changes in transport methods. Therefore, providing an annual value based on current best available information is most appropriate.

Table 3.1 below estimates the potential changes in heavy vehicle transport expressed as kilometres based on the Stage 2 operation displacing more distantly-located aggregate supplies. For simplification it has been broken down into three categories:

- Inter-region (South Auckland);
- Out-of-region (Waikato/Northland), and
- Out-of-region for decorative pebble.

Taking into account the distance and expected tonnage of aggregates, Table 3.2 estimates the potential annual changes in GHG emissions. Given the large range of assumptions, there is a moderate uncertainty with the derived GHG emissions.

Table 3-1: Estimated reduction in distance (per round trip) to supply North Shore or West Auckland markets from Kings Quarry compared to other current aggregate supply locations. Sourced from Google Maps directions.

Market location	Current Aggregate supply		With Kings Quarry being operational		Net reduction in distance (km per round trip)
	Supply location	Average distance to Market (km per round trip)	Supply location	Average distance to Market (km per round trip)	
North Shore/West Auckland (Aggregate)	Inter-region (South Auckland)	102^^	Kings Quarry	77^	25
North Shore/West Auckland (Aggregate)	Out-of-region (Waikato/Northland)	168##	Kings Quarry	77^	91
Auckland (Decorative Pebble)	Out-of-region (Manawatu)	1,020++	Kings Quarry	90+	930

^ Average distance of a return trip between Kings Quarry and central North Shore (Wairua);
^^ Average distance of a return trip between Drury (central location for South Auckland Quarries) and central North Shore (Wairua)
Average distance of a return trip between Hampton Downs (mid-point between Mercer, Huntly and Maramarua quarries) and central North Shore (Wairua)
+ Average distance of a return trip between Kings Quarry and central Auckland;
++ Average distance of a return trip between Central Auckland & Palmerston Nort

Table 3-2: Potential annual net-changes in transport-related GHG emissions resulting from Stage 2 development of Kings Quarry. The estimated net-changes are a result of Kings Quarry supplying local (North Shore/West Auckland) markets and displacing more distant alternative aggregate supplies.

Emissions from heavy vehicles (kg CO_2-e per km)

Aggregate supply displacement	Tonnes of aggregate (per year)	No. of heavy vehicle movements (27 tonne per vehicle)	km saved per year (km per trip from Table 3.1)	Emission factor[+] (kg CO_2-e per km)	CO_2-e emissions (tonne per year)
Inter-region (South Auckland)	200,000	7,407	185,185	1.499	278
Out-of-region (Waikato/Northland)	200,000	7,407	674,074	1.499	1,010
Out-of-region (Manawatu)	100,000	3,703	3,444,444	1.499	5,163

Emissions from freighting goods (kg CO_2-e per tonne.km)

Aggregate supply displacement	Tonnes of aggregate (per year)	km saved per year (km per trip from Table 3.1)	Tonne kilometre	Emission factor[^] (kg CO_2-e per tonne.km)	CO_2-e emissions (tonne per year)
Inter-region (South Auckland)	200,000	12.5*	2,500,000	0.105	262
Out-of-region (Waikato/Northland)	200,000	45.5*	9,100,000	0.105	955
Out-of-region (Manawatu)	100,000	465*	46,500,000	0.105	4,882
Total (Stage 2 provides a net CO2-e benefit)					**12,551**

* Based on transporting one way and assuming no backhauling of bulk material occurring.

[+] MfE Measuring Emissions: A guide for organisations – 2024. Emission Factor Workbook. ROAD freight emission factors for heavy goods vehicles. HGV diesel >30,000kg (2010-2015 fleet).

[^] MfE Measuring Emissions: A guide for organisations – 2024. Emission Factor Workbook. ROAD freighting goods in New Zealand. Long-haul heavy truck

4. Conclusion

The development of Stage 2 at Kings Quarry will likely increase supply of local aggregate with a high proportion of the supply meeting the demand in the North Shore and West Auckland areas. Currently the wider Auckland Region imports a share of its aggregate from Northland and Waikato and a high percentage of inter-region supply is provided from South Auckland quarries.

Taking into account the potential savings in bulk transport Kings Quarry Stage 2 development will have a positive immediate benefit in reducing New Zealand's transport related greenhouse gas emissions. Based on current available information it is estimated that a reduction of 12,551 tonnes of CO_2 equivalent GHG's could be achieved annually. A moderate level of uncertainty should be considered given the number of high-level assumptions that have been made. To provide context this equates to ~0.35% of New Zealand's total heavy vehicle CO_2 equivalent GHG emissions, using Ministry of the Environment's transport data from 2019 as a base year.

Ministry for the Environment guidelines and emissions factors have been followed as a basis for this assessment. Some departures from guidelines have taken place but are considered appropriate given the intention of the assessment to support a resource consent application. Any departures from the guidelines have been noted in the report.

Most notably the impacts of establishing and operating the quarry itself have not been included in this assessment. It is assumed that the GHG emissions from these activities would be similar to any other existing aggregate quarry. Compared to a greenfield quarry development, the GHG emissions from Kings Quarry Stage 2 are likely to be significantly less. This is based on the site already having established infrastructure including access road and a historic quarry face.

5. Limitations

This assessment is intended as a GHG emission report and has made a number of assumptions regarding the aggregate supply market. These assumptions have been based on the best available information and are clearly identified throughout the report where used. This report is not intended as an economic assessment of aggregate supply and demand.

6. References

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