Appendix H

Greenhouse Gas Emissions Assessment

Report for Element Environment

Jandra Quarry Intensification Project
Green House Gas Emissions Assessment

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edge environment

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1. Introduction

Holcim (Australia) Pty Ltd (Holcim) is seeking to modify the Jandra Quarry development consent (DA231-10-99) under Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act), to provide for an increase in production and transportation of finished quarry products to a maximum annual limit of 475,000 tonnes.

Jandra quarry is a hard rock quarry located approximately 17 kilometres south of Taree in the Greater Taree Local Government Area (LGA).

Edge Environment (Edge) has prepared this Greenhouse Gas (GHG) assessment on behalf of Element Environment Pty Ltd to assess the GHG emissions associated with the intensification project.

The current consent on the site permits quarry extraction of up to 250,000 tonnes per calendar year, for a duration up to 30 March 2025. An increase in production is required at Jandra Quarry to meet anticipated market demand.

1.1 Site Location and Context

Jandra Quarry is located on the Pacific Highway at Possum Brush, NSW. The Pacific Highway provides access to the site. The closest village to the site is Nabiac, located approximately 10 kilometres to the southwest of the site. The sites locality can be seen below in Figure 1.

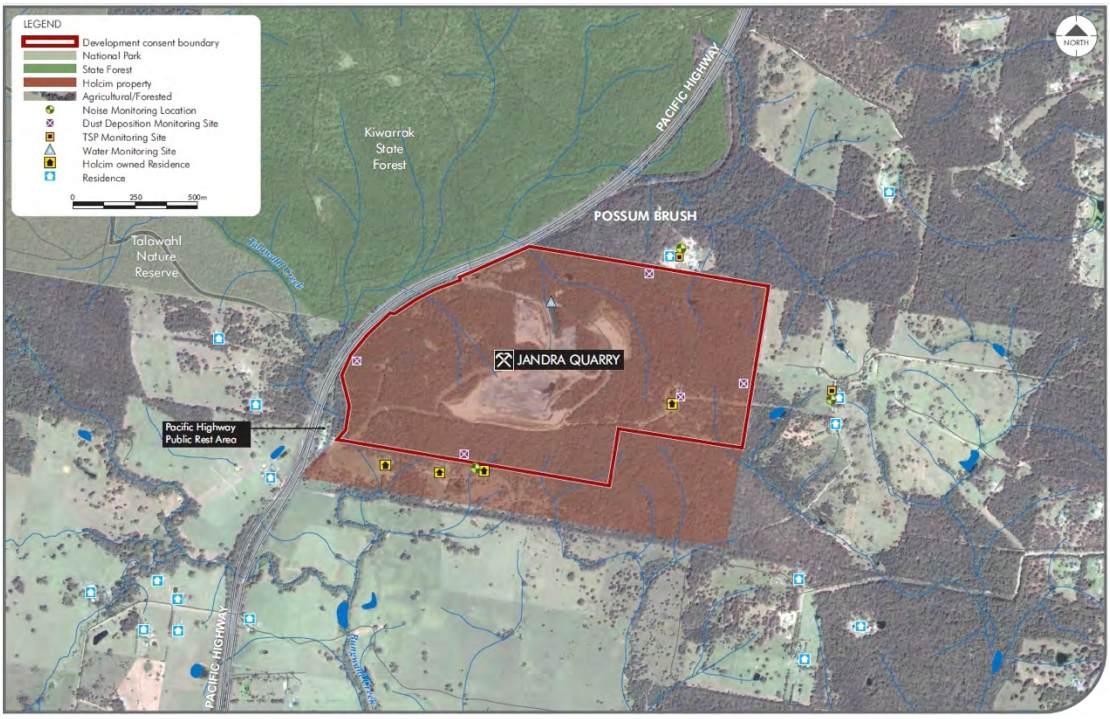

Figure 1 - Regional Locality

All land located within the development consent boundary is owned by Holcim (refer to Figure 2). Holcim also owns Lot 10, DP790056, which is located immediately south of the development consent boundary. The remaining surrounding land is primarily privately owned, with a State Forest located to the northwest of the quarry on the opposite side of the Pacific Highway.

Figure 2 - Site Ownership

1.2 Project Site – Existing Environment

The land immediately surrounding Jandra Quarry is well vegetated. The site is bound by privately owned land to the south; north and east (refer to Figures 1 and 3). Residences are located to the northeast (approximately 350 metres), east (approximately 850 metres), southeast (approximately 1.45 kilometres) and southwest (approximately 800 metres) of the operational areas of the site. The surrounding region is characterised by cleared agricultural land on the lower slopes and moderate to heavily vegetated land on the steeper areas. The topography of the site and surrounding area is generally undulating with rolling hills and valleys.

The existing quarry is cut into the northern face of the hillside and extends from the ridgeline in an easterly direction (refer to Figure 3).

The site is located within the headwaters of Talawahl Creek. Talawahl Creek joins with Bungwahl Creek, which subsequently joins the Wallamba River; approximately 5.5 kilometres to the south of the site (refer to Figure 1).

The area is underlain by an undifferentiated sequence of Devonian sediments that are approximately 345 to 395 million years old. The sequence consists of interbedded mudstone, sandstone, conglomerate, tuff and chert with local greywacke beds. A major greywacke bed is present within the site and is the target of the quarry operations.

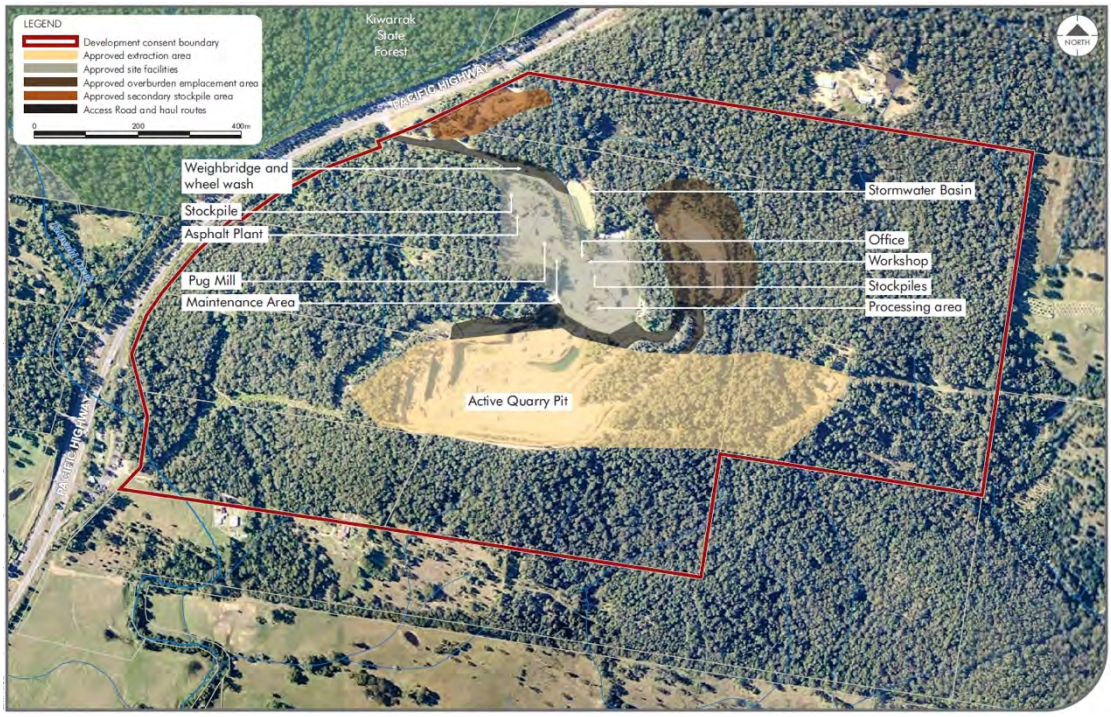

Figure 3 - Local Topography

1.3 Project Site – Proposed Intensification Works

Holcim is seeking to modify the Jandra Quarry development consent (DA231-10-99) to provide for the intensification of quarry operations with a maximum annual production and transportation limit of 475,000 tonnes of finished quarry products.

The existing approved quarry pit design, as detailed in the 1999 EIS, has a depth limit of RL20 and (at the time) contained 16.5 million tonnes (Mt) of fresh rock. To date, Holcim has extracted and processed in the order of 3Mt of this resource.

The proposed modification is being sought to extract and produce a maximum of 475,000 tonnes per annum, with an approval period of 30 years. As such, it is not proposed to increase extraction of the overall resource and therefore no modification to the approved quarry pit disturbance area is proposed or considered necessary.

To support the proposed intensification in production, changes to the existing site and operations are proposed. Key changes proposed to the site can be seen in Figure 4 and are discussed in sections 1.3.1 and 1.3.2. These changes involve the construction of new infrastructure, not approved under the existing development consent. It is these construction activities that are outlined and assessed in section 2.

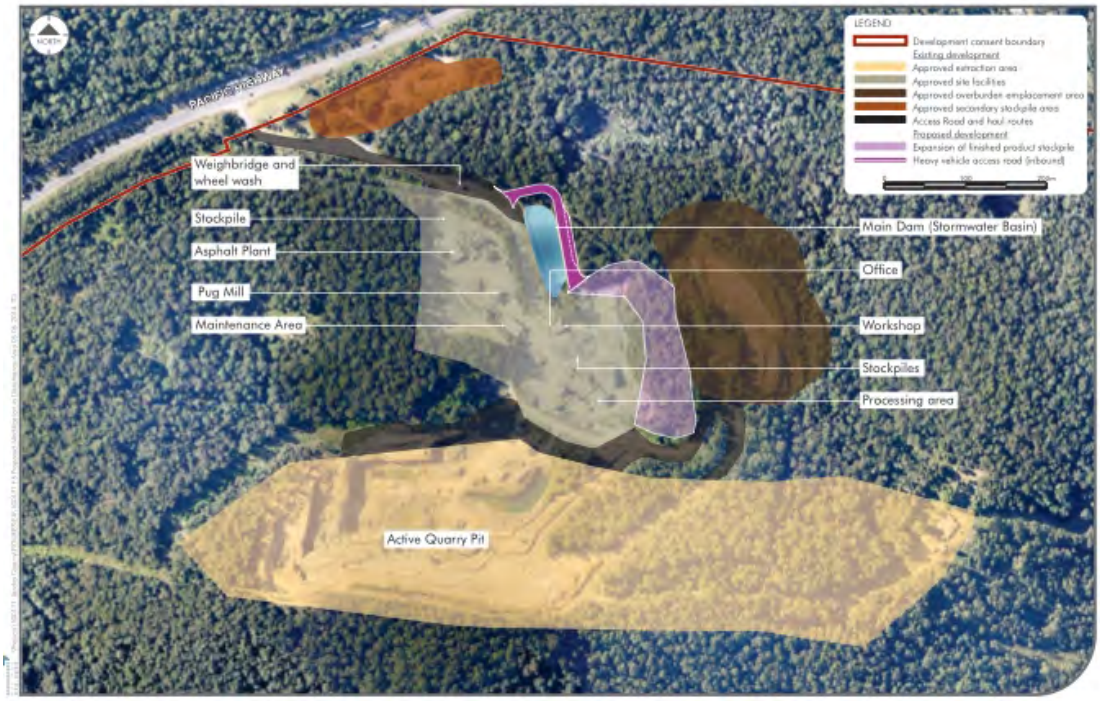

Figure 4 - Proposed Site Modifications

1.3.1 Heavy Vehicle Access Road

To improve vehicle safety on site, Holcim propose to separate inbound heavy vehicles from outbound heavy and light vehicles after passing through the weighbridge. A new heavy vehicle access road is proposed around the outside (northern and eastern side) of the existing stormwater basin (refer to Figure 4). After passing through the weighbridge, inbound heavy vehicles will keep left, using the new road to gain direct access to the finished product stockpile area for loading. Outbound loaded heavy vehicles will then use the existing access road to pass through the wheelwash and weighbridge before existing the site onto the Pacific Highway.

1.3.2 Finished Product Stockpile Area

Holcim have also identified the requirement to expand the size of the existing finished product stockpile area towards the existing overburden emplacement area (refer to Figure 4).

1.3.3 Proposed Site Operating Parameters

To support the proposed intensification in production, certain changes will also be required to the existing operations. The proposed changes are identified in Table 1.

Table 1 - Site Operations

Project Component	Approved Operations	Proposed Operations
Production and transportation limit	250,000 tonnes per calendar year	475,000 tonnes per calendar year
Consent duration	30 March 2025	30 years from modification approval i.e. 2044
Operating hours	6am - 6pm Monday to Friday	Quarry operations: 6am - 10pm Monday to Friday
	6am - 3pm Saturday	Quarry operations: 6am - 6pm
	Refueling, servicing and maintenance approved from 6am - 9pm Monday to Saturday	Quarry operations: 6am - 6pm
		Allow for the return of trucks from Newcastle haul to midnight
Blasting hours	9am - 5pm Monday to Friday	No change
	9am - 3pm Saturday	No change
Quarrying methods	Drill & blast	No change
	Load & haul	No change
Processing methods	Primary, secondary crushing and screening plants (capacity limited to 350, 000 tpa)	Introduction of a mobile crusher to increase processing capacity to 475,000 tpa
	Pugmill	No change
	Asphalt plant	Operate a mobile asphalt plant 24 hours on a campaign basis primarily to cater for night road works
		Allow for concrete recycling
Maximum daily vehicle movements	100 movements per day (50 loads)	Maximum of 24 truck movements per hour (12 loads per hour)
Infrastructure	Workshop	No change
	Fuel Shed and maintenance area	No change
	Lunch room	No change
	Office	No change
	Training room (not built yet)	Second training room
	Ablutions (toilets and showers)	No change
	Envirocycle sewage treatment system	No change

Project Component	Approved Operations	Proposed Operations
		Construction of a new heavy vehicle access road. Approximately 25m of 10m carriageway and 75m of 15m carriageway. Requiring 2500m^2 of vegetation clearance and groundwork.
		Expansion of the existing finished product stockpile area. Requiring 1.034ha of vegetation clearance and groundwork.
Overburden storage	3.1 hectare overburden emplacement area.	No change
Quarry development	Benching approved to RL20	No change to current extraction footprint or to depth of extraction
Staff	7 full time employees	10 full time employees
	7 truck drivers	10 truck drivers

1.4 Context of Greenhouse Gas

In 2007, the Intergovernmental Panel on Climate Change (IPCC) released its fourth assessment report (AR4) on climate change. It stated that warming of the climate system is unequivocal, as is evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. It also states that most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas (GHG) concentrations (IPCC 2007). In 2013, the IPCC released its fifth assessment report (AR5), which states that annual global GHG emissions have continued to grow since AR4. AR5 further states that human influence, through the emission of greenhouse gases, has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid 20th century (IPCC 2013).

In Australia and NSW, there are a number of policies, guidelines and regulations, which have been developed to manage and reduce GHG emissions. These include the following:

- The Australian Government has committed to reduce its emissions by between 5 and 15 or 25 per cent below 2000 levels by 2020. The five per cent target is unconditional. The up to 15 per cent and 25 per cent targets are conditional on the extent of international action. It has also committed to a long term emissions reduction target of 80 per cent below 2000 levels by 2050;
- The National Greenhouse and Energy Reporting (NGER) Act was introduced in 2007 and requires corporations to register and report emissions, energy consumption or production that meets certain thresholds every year. For GHG emissions, thresholds are currently set at 25,000 tonnes carbon dioxide equivalent (tCO2e) for a facility under a corporation and 50,000 tCO2e for a corporation as a whole for 2010-2011 (DCC 2008);

- The NSW Department of Infrastructure, Planning and Natural Resources – Department of Energy, Utilities and Sustainability Guidelines for Energy and Greenhouse in EIA provides guidance on the consideration of energy and greenhouse issues when developing projects and when undertaking environmental impact assessment (EIA) under the Environmental Planning and Assessment Act 1979 (EP&A Act); and
- Australia introduced a price on carbon on 1 July 2012. A price on carbon is an incentive for those that will pay it to change the way they do business. It will encourage businesses to use or generate renewable energy, reduce energy consumption, implement technologies that will improve energy efficiency and/or invest in renewable energy, such as solar and wind.

The Commonwealth Department of Environment publishes National, State and Territory Greenhouse Gas Inventories annually. This provides an overview of the latest available estimates of GHG emissions for the Australian States and Territories based on a Kyoto accounting basis. Table 2 outlines the best available emissions estimates for Australia broken down by economic sector. It can be seen that emissions from metal ore and non-metallic mineral mining and quarrying makes up a relatively small proportion of overall emissions in Australia. However, emissions in this sector have also been growing since 1989/90. This assessment will estimate the CO_2 emissions associated with the construction and operation of the proposed expansion and identify actions to manage and minimise these emissions where feasible.

Table 2 - National emissions by economic sector in 2010/11 (DIICCSRTE 2013)

ANZSIC code	Industry Classification	Emissions (Mt CO_2-e)				Change in emissions (%)		
		1989/90	2009/10	2010/11	2011/12	1989/90 – 2010/11	2009/10-2010/11	2010/11-2011/12
Div A	**Agriculture, forestry and fishing**	**231.2**	**109.3**	**103.0**	**106.2**	**-53%**	**-6%**	**3%**
Div B	**Mining**	**36.9**	**65.2**	**68.5**	**65.9**	**77%**	**5%**	**-4%**
06	Coal mining	20.2	33.0	34.7	33.9	63%	5%	-2%
07	Oil and gas extraction	12.8	25.0	25.7	22.7	95%	3%	-12%
08-10	Metal ore and non-metallic mineral mining and quarrying	3.9	7.2	8.1	9.4	85%	13%	16%
Div C	**Manufacturing**	**67.1**	**71.9**	**71.6**	**66.3**	**7%**	**0%**	**-7%**
11-12	Food, beverages, tobacco	4.8	4.6	4.7	4.2	-4%	2%	-11%
13	Textiles, clothing, footwear and leather	0.6	0.4	0.4	0.4	-33%	0%	0%
14-16	Wood, paper and printing	2.0	2.3	2.1	1.9	15%	-9%	-10%
17-19	Petroleum, coal and chemical	15.2	18.9	19.1	16.8	24%	1%	-12%

ANZSIC code	Industry Classification	Emissions (Mt CO_2-e)				Change in emissions (%)		
		1989/ 90	2009/ 10	2010/ 11	2011/ 12	1989/90 – 2010/11	2009/10- 2010/11	2010/11- 2011/12
20	Non-metallic mineral products	10.0	11.8	11.8	11.1	18%	0%	-6%
21-22	Metal products	33.6	33.0	32.6	10.7	-2%	-1%	-67%
24	Machinery and equipment	0.8	0.7	0.7	0.6	-13%	0%	-14%
25	Other manufacturing	0.1	0.1	0.1	0.2	0%	0%	100%
Div D	**Electricity, gas and water**	**136.1**	**209.0**	**204.6**	**199.2**	**54%**	**-2%**	**-3%**
Div E-H, J-Q	**Commercial services and construction**	**33.0**	**35.7**	**35.5**	**35.2**	8%	-1%	-1%
Div I	**Transport and storage**	**13.1**	**24.8**	**26.4**	**26.8**	**89%**	**6%**	**2%**
	Residential	**40.7**	**52.5**	**53.2**	**54.9**	**29%**	**1%**	**3%**
	Residential (non transport)	8.1	10.7	11.0	11.2	32%	3%	2%
	Residential (transport)	32.6	41.8	42.2	43.7	28%	1%	4%

1.5 Scope of Works

The scope of this GHG assessment is to undertake an assessment of projected GHG emissions from the proposed construction and operation of the Jandra Quarry intensification project. The assessment will be used to identify actions for mitigating or reducing emissions, where possible. The scope of works for this assessment is to:

- Identify the main sources of emissions during construction and operational stages of the expansion;
- Scope and calculate the emissions from each source using factors and methods outlined in the National Greenhouse Accounts (NGA) Factors, published by the Australian Government Department of Climate Change and Energy Efficiency (2012), the GHG Protocol published by the World Business Council for Sustainable Development (2001) and the BPIC/ICIP Project's Methodology Guidelines for the Materials and Building Products Life Cycle Inventory Database; and
- Investigate and recommend strategies for emissions mitigation to reduce GHG emissions associated with project development and operation.

Figure 5 illustrates the measurement boundaries and emissions sources investigated in this GHG assessment.

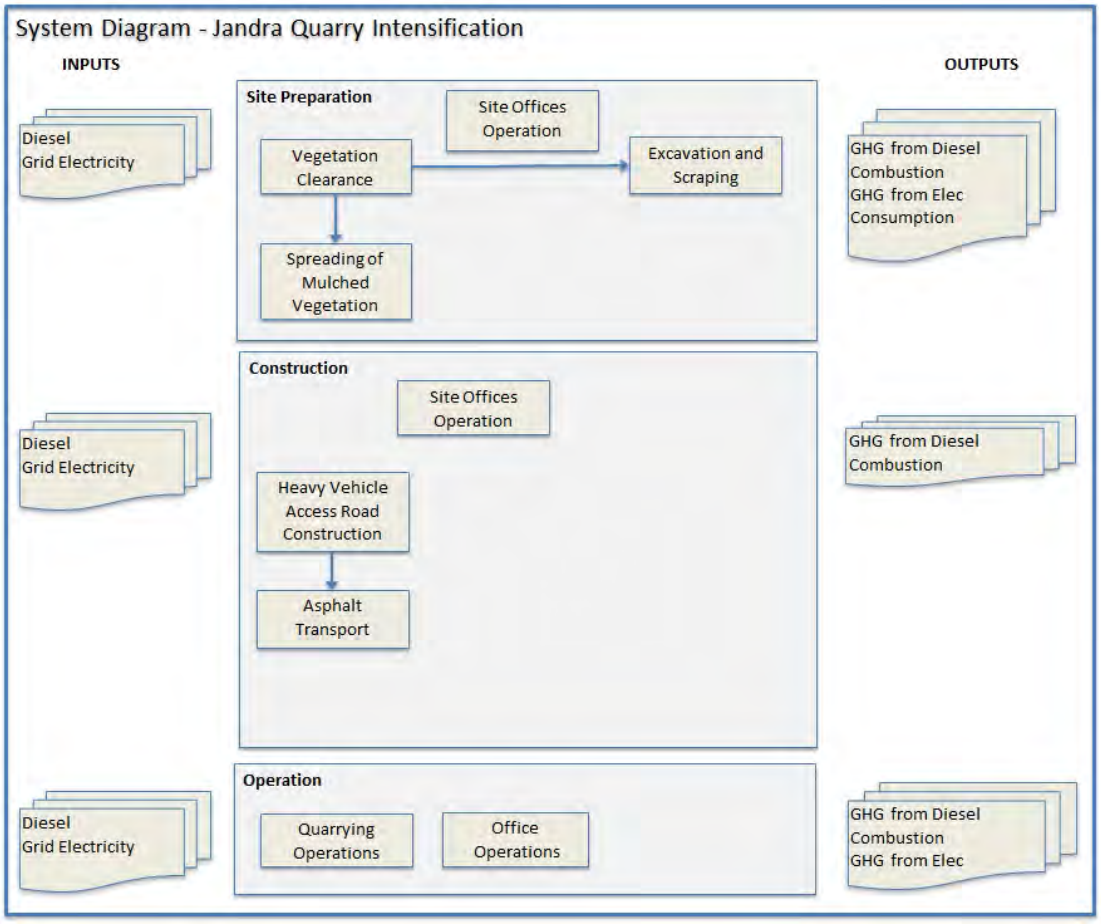

Figure 5 - GHG emissions boundary for intensification project

The scoping processes used within this report for the operation of the facility are adapted from the 'The Greenhouse Gas Protocol' (WBCSD 2001). Under this protocol, the projects direct and indirect emissions sources can be delineated into three 'scopes' (Scope1, Scope 2 and Scope 3) for GHG accounting and reporting purposes. This method of scoping helps to improve transparency, and assists in setting emissions reduction objectives.

The GHG protocol definitions for each scope are presented in Figure 6 and described in further detail below.

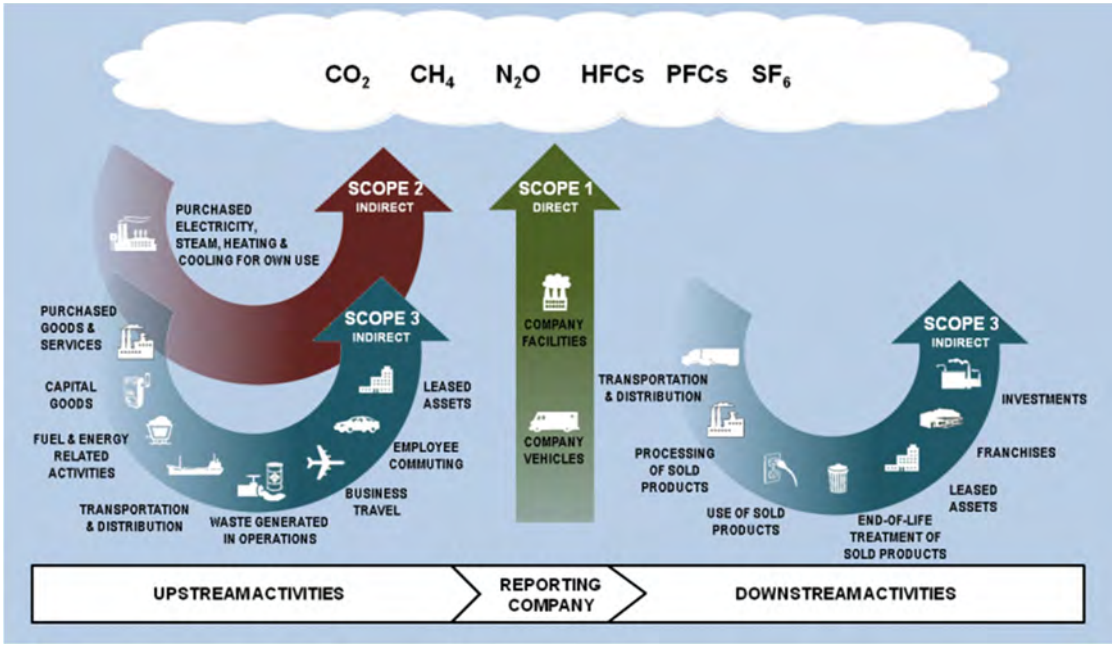

Figure 6 - Overview of scopes and emission sources (Source: World Business Council for Sustainable Development, 2001)

- **Scope 1 – Direct GHG emissions:** Scope 1 emissions are direct emissions that occur from sources on site. This would include emissions arising from the combustion of fuels in equipment on-site (e.g. boilers, furnaces, generators, vehicles, machinery, fugitive emissions etc.);
- **Scope 2 – Electricity indirect GHG emissions:** Scope 2 emissions account for GHG emissions arising from the generation of purchased electricity consumed on-site. Scope 2 emissions are considered indirect as they occur at an off-site facility where electricity is generated; and
- **Scope 3 – Other indirect GHG emissions:** Scope 3 emissions are an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities on, but occur away from the development site and are not under Holcim control.

This assessment has been undertaken using the best available current and historical data. Assumptions have been outlined, where appropriate to maintain transparency.

2. Construction Based GHG Inventory

The construction activities associated with the proposed intensification in production will include the transport of materials to and from site, decomposition of vegetation waste and the use of machinery and vehicles for preparation of the site and civil works. These activities require the use of fuels and electricity, which will result in the release of associated GHG emissions.

Accurately quantifying these emissions at this stage requires a number of assumptions to be made including distances travelled and hours of use for vehicles and machinery. Other factors which will affect GHG emissions during the construction phase include construction methods, time table, materials sources and transport methods.

Emissions were calculated by estimating fuel use, electricity consumption and vegetation decomposition using available data. Emissions in tonnes CO_2 equivalent were calculated using factors and methods from the Australian Government National Greenhouse Accounts Methods and Factors Workbook. Specific assumptions were made with regard to fuel use, electricity consumption, construction schedules, material quantities, material transport and waste decomposition are outlined in detail in the following sections. These assumptions are based on Edge's experience in similar construction projects. General assumptions and calculations are provided in the report.

2.1 Site Preparation

The total estimated emissions from site preparation are ***8.26tCO$_2$e***. The breakdown of these emissions is detailed in the following sections. This includes emissions from the following construction activities:

- Vegetation clearing to prepare the site for construction of the new heavy vehicle access road and the expansion of the finished product stockpile area (including emissions from decomposition).

Table 3 - Summary of GHG emissions from site preparation by construction activity

Construction activity	Scope 1 Emissions (tCO_2e)	Scope 2 Emissions (tCO_2e)	Scope 3 Emissions (tCO_2e)	Total Emissions (tCO_2e)
Vegetation clearing to prepare site (including emissions from decomposition)	6.91		0.51	7.42
Spreading mulched vegetation	0.78		0.06	0.84
TOTAL	**7.69**	**0.00**	**0.57**	**8.26**

Assumptions used in calculating the above emissions are set out below:

- Site works are expected to take 2 months in total;
- The area of cleared shrubs and trees was taken to be 1.284ha, as indicated on McGLASHAN & CRISP drawing No.F922/4714;
- A vegetation mass factor of 20t/ha for high shrubs and medium dense trees was assumed. This is based on estimates from aerial photography and observations from site photographs;
- A fuel consumption estimate of 2kL/ha was assumed for vegetation removal. This factor assumes vegetation removal will be conducted using conventional plant (i.e. graders and dozers);
- It was assumed that all cleared vegetation was mulched and spread on site;
- A fuel consumption factor of 0.0004kL/m^3 was assumed for spreading of mulched vegetation. This factor assumes earthworks will be conducted using conventional plant (i.e. graders and dozers);
- The above factors and methods of calculation are taken from Greenhouse Gas Assessment Workbook for Road Projects, Transport Authorities Greenhouse Group, June 2011;

2.2 Construction of Heavy Vehicle Access Road

The total estimated emissions from the construction of the heavy vehicle access road were ***37.11tCO$_2$e***. It should be noted that the majority of the pavement material for the construction of the new heavy vehicle access road will be produced on site. It is anticipated that the provision of these materials will fall under normal site operations and only a limited number of materials will be imported to the site.

Table 4 - Summary of GHG emissions from construction of heavy vehicle access road

Construction activity	Scope 1 Emissions (tCO_2e)	Scope 2 Emissions (tCO_2e)	Scope 3 Emissions (tCO_2e)	Total Emissions (tCO_2e)
Bitumen transport fuel	0.08		0.01	0.09
Fuel use from road construction	25.04		1.86	26.90
Fuel use from drainage construction	9.42		0.70	10.12
TOTAL	**34.54**	**0.00**	**2.57**	**37.11**

Assumptions used in calculating the above emissions are set out below:

- Site works are expected to take 2 months in total;
- The area of cleared shrubs and trees was taken to be 0.25ha, as indicated on McGLASHAN & CRISP drawing No.F922/4714;
- The surface area of road to be constructed was estimated to be approximately 1375m^2, as indicated on McGLASHAN & CRISP drawing No.F922/4714;
- A quantity of 0.002t/m^2 was assumed for bitumen provision;
- A fuel consumption factor of 0.0004kL/m^3 was assumed for transport of bitumen to site. This factor assumes 2 return trips of 50km for a truck with 8m^3 capacity;
- A fuel consumption factor of 0.00677kL/m^2 was assumed for road construction. This factor assumes a grader based gang using average production rate for 500mm of aggregate, density of 2,000 kg/m^3;
- A fuel consumption factor of 0.035kL/m^2 was assumed for drainage construction. This factor assumes conventional construction methods using plant typical for this type of work;
- The above factors and methods of calculation are taken from Greenhouse Gas Assessment Workbook for Road Projects, Transport Authorities Greenhouse Group, June 2011.

2.3 Summary of Construction Based GHG Emissions

Figure 7 illustrates the breakdown of Scope 1 and 2 emissions from the construction phase. It can be seen that construction of the heavy vehicle access road is estimated to be the most significant emissions source during the construction phase. Emissions from drainage construction are the next most significant emissions sources followed by emissions from the clearing of vegetation and groundwork.

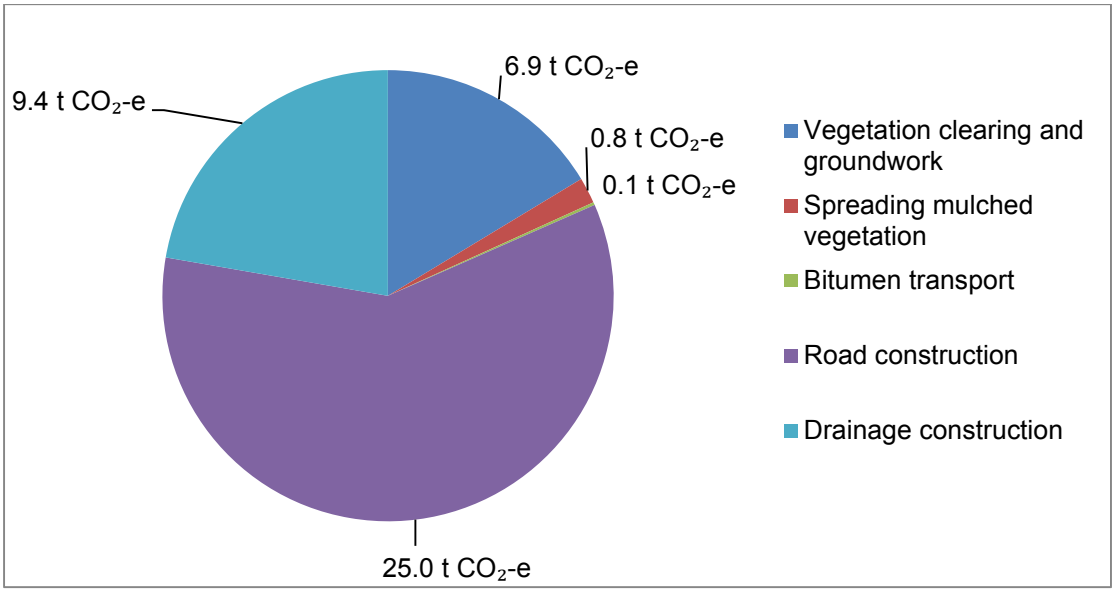

Figure 7 - Emissions breakdown by construction phase

The National Greenhouse Accounts Methods and Factors workbook (DCCEE 2012) also provides guidance on estimating Scope 3 emissions associated with fuel and electricity use. Scope 3 emissions are the indirect emissions associated with the extraction, processing and transport prior to the fuel or electricity being used on site. The scope 1 and 3 emissions associated with all fuel use during construction are outlined in Table 5 below.

Table 5 - Scope 3 emissions associated with fuel and electricity use in construction activities

Construction activity	Estimated fuel use (L)	Fuel type	Scope 1 Emissions factor tCO_2-e/L	Scope 1 Estimated emissions (tCO_2-e)	Scope 3 Emissions factor tCO_2-e/L	Scope 3 Estimated emissions (tCO_2-e)
Site preparation	2,858.9	Diesel	0.00269	7.69	0.0002	0.57
Construction of new road and drainage	12,840	Diesel	0.00269	34.54	0.0002	2.57
Total (Fuel)	***15,698.9***			***42.23***		***3.14***

3. Operations Based GHG Inventory

This section will outline the GHG emissions associated with the proposed site operations following the intensification in production. This section will include a quantitative assessment of Scope 1, 2 and 3 emissions based on the current operation of the facility and the proposed intensification in production.

3.1 On Site Operations

The main emissions sources from operating the Jandra quarry are expected to be from electricity and diesel fuel, with an inconsequential contribution directly from the blasting process. These emissions sources are the result of the following activities within the facility:

- ***Quarrying***: The primary quarrying method on site is drill & blast combined with load and haul removal. It is assumed that diesel fuel is predominantly used to run the vehicles and machinery for this process;
- ***Processing:*** The quarried materials encounter primary and secondary crushing and screening processes. The site also operates a 'pugmill' and asphalt plant. It is assumed that diesel fuels and electricity are predominantly used to run the vehicles and machinery for these processes;
- ***Infrastructure:*** The quarry complex contains facilities such as a workshop, fuel shed and maintenance area, lunch room, office, training room (not built yet), ablutions (toilets and showers). It is assumed that electricity is used to operate these facilities; and
- ***Distribution:*** Finished quarry products from Jandra are all transported by truck. It is assumed that diesel fuel is used for the transportation of products from site.

3.2 Operations Based GHG Emissions

Tables 6, 7 and 8 below illustrate historical energy use and associated emissions onsite based on information provided by Holcim. It also includes projected emissions based on extrapolation of the proposed maximum production rate following the intensification works.

Table 6 - Historical and projected electricity use and GHG emissions from the Jandra Quarry

Period	Annual Consumption (kWh)	Scope 2 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)
2013	554,142	487.64	99.75
Proposed	1,028,398	904.99	185.11
Difference	474,256	417	85

Assumptions used in calculating the above emissions are set out below:

- Consumption data for 2013 provided by Holcim (assumed to include operation of asphalt plant);
- Electricity consumption is calculated based on the current consumption rate of 2.17kWh/t;
- Production and consumption rates taken from communication with Holcim in May 2014; and
- National Greenhouse Account Factors for electricity from July, 2012.

Table 7 - Historical and projected onsite diesel use and GHG emissions from the Jandra Quarry

Period	Annual Consumption (kl)	Scope 1 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)
2013	180.71	486.12	36.14
Proposed	335.38	902.16	67.08
Difference	154.66	416.04	30.93

Table 8 - Historical and projected offsite diesel use and GHG emissions from the Jandra Quarry

Period	Annual Consumption (kl)	Scope 1 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)
2013	176.20	473.98	35.24
Proposed	327.00	879.63	65.40
Difference	150.80	405.65	30.16

Assumptions used in calculating the above emissions are set out below:

- Consumption data for 2013 provided by Holcim (including operation of asphalt plant);
- Onsite consumption is calculated based on the current consumption rate of 0.71l/t; Offsite consumption is calculated based on the current consumption rate of 0.69l/t;
- Production and consumption rates taken from communication with Holcim in May 2014; and
- National Greenhouse Account Factors for electricity from July, 2012.

3.3 Operations Based GHG Emissions Summary

Total emissions from the operation of the facility are expected to increase by approximately 1,385.49tCO_2-e to 3,004.36tCO_2-e/annum. This increase is directly related to the increased production capacity following the proposed intensification in production. The intensification works increase the annual GHG, but as the resource is being extracted in a shorter time period the total emissions associated with the operations will not increase.

Table 9 - Total emissions from all sources by scope for the Jandra Quarry

Period	Scope 1 Estimated emissions (tCO_2-e)	Scope 2 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)	Total Estimated emissions (tCO2-e)
2013	960.10	487.64	171.13	1,618.87
Proposed	1,781.79	904.99	317.59	3,004.36
Difference	821.69	417.35	146.46	1,385.49

4. Intensification Project GHG Impact Assessment

Table 10 illustrates a comparison between the estimated emissions from the construction and operation of the quarry.

Table 10 - Overall emissions summary

Period	Scope 1 Estimated emissions (tCO_2-e)	Scope 2 Estimated emissions (tCO_2-e)	Scope 3 Estimated emissions (tCO_2-e)	Total Estimated emissions (tCO2-e)
Construction Works	42.23	0.00	3.14	45.37
Operation 2013	960.10	487.64	171.13	1,618.87
Operation Proposed	1,781.79	904.99	317.59	3,004.36

When compared with the operational emissions the construction emissions of 45.37 tCO_2e represents approximately 3% of current annual operational emissions and approximately 1.5% of the anticipated operational emissions following the intensification in production.

5. GHG Management and Mitigation Options

The carbon management principles (shown in Figure 8) provide a robust framework for the management and reduction of GHG emissions.

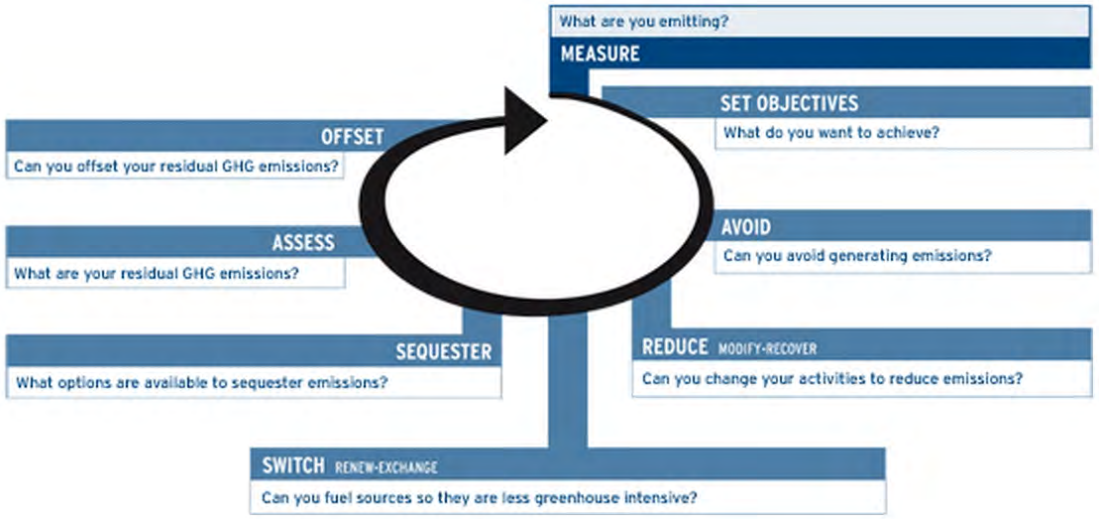

Figure 8 - Carbon management principles for emissions reduction (Victorian EPA)

The earlier sections in this assessment represent the emissions measurement and setting objectives components of the carbon management principles. This section recommends actions to further reduce emissions throughout the project development. GHG emissions reduction actions should ideally be prioritised according to the carbon management principles.

Avoid: Actions which avoid emissions, in the first instance, should be considered as a priority;

Reduce: Actions which result in a reduction of emissions should be considered next;

Switch: Actions which switch energy sources to reduce emissions should be the next considered;

Sequester: Actions which sequester GHG emissions do not reduce emissions but store them; and

Offset: Offsetting of emissions through the purchase of offsets. This should be considered as a last resort.

Possible GHG management actions could include:

- Regular monitoring of emissions throughout the project to assess the effectiveness of emissions mitigation actions;
- Where construction materials cannot be sourced from the quarry, use locally sourced materials to reduce emissions associated with transport;
- Recycle/compost waste wherever possible;
- Plan construction and operational works to avoid double handling of materials and minimise haulage distances, thereby minimising the use of fuel;
- Train both on-site and product transportation staff on efficient driving practices for example throttling down and switching off machinery when not in use;

- Make use of recycled or low impact materials to reduce emissions associated with embodied energy (not estimated in this report);
- Investigate the procurement of energy efficient equipment for the site (i.e. replacement parts for the processing plant, mobile crushing plant, dozers, excavators, front end loaders and trucks etc.). Consider the procurement of equipment that uses lower GHG intensive fuel (e.g. gas, ethanol);
- Sourcing electricity and fuels with low GHG intensity, where practical;
- Regular maintenance of equipment to maintain optimum operations and fuel efficiency; and
- Incorporate energy efficiency design aspects wherever possible to reduce energy demand. Examples could include energy efficient lighting systems, natural ventilation, insulation and other renewable forms of energy.

5.1 Conclusion

The findings of this GHG report show that estimated construction emissions associated with the intensification in production at Jandra Quarry are relatively insignificant compared to the operational emissions. Total operational emissions per annum are expected to increase following intensification. However, the emissions intensity per ton of finished product is expected to remain the same. Following the proposed GHG management actions will result in emission reductions in both construction and operation and are recommended to minimise GHG impacts from the site.

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