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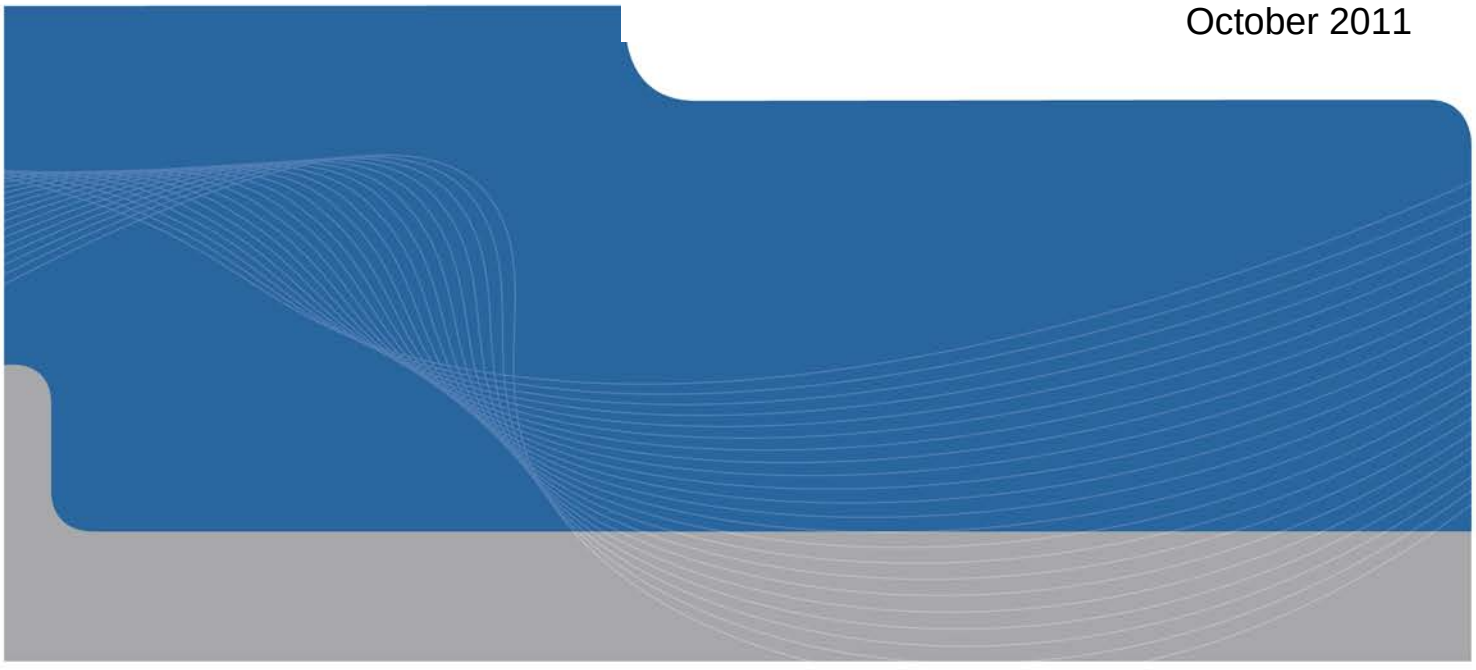
Tweed Shire Council

Report for Eviron Road Quarry and Landfill Proposal

Greenhouse Gas Assessment (Revised) - Stage 1 and Concept Plan

October 2011



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1. Introduction

1.1 Project Description

Tweed Shire Council's existing landfill, the Stotts Creek landfill, is predicted to reach capacity by 2012. As such, Council is seeking to develop new waste infrastructure to provide for the waste management requirements of the Tweed local government area (LGA) in the short term; and gain approval to develop additional waste infrastructure to meet the LGA's projected medium and long term needs.

Council is proposing to establish the Shire's new landfill facilities on existing Council owned land at Eviron Road, Eviron, within the Tweed LGA. Council has developed an overall Concept Plan for the proposed infrastructure. This outlines a proposed staged project to develop a landfill within the existing void space created by Quirks Quarry, the development of two further quarries to be used as landfills after exhaustion of the quarry resource, and necessary operational infrastructure such as a haul road and other minor associated facilities as required. This proposed method of landfilling in quarry voids is consistent with the method of landfill creation in the Tweed Shire to date. Material won from quarrying is used for road building and other Council civil projects, and overburden stockpiled for road construction, clay liners (where appropriate) and site rehabilitation purposes.

The waste infrastructure proposed by Council was declared by the Department of Planning to be a Major Project, to which Part 3A of the *Environmental Planning and Assessment Act, 1979* applies.

Council intends to undertake a staged approach to the development, and has thus sought two approvals from the Department of Planning:

- Project Approval for Stage 1 of the Concept Plan, which involves landfill within Quirks Quarry, development of a new quarry in the West Valley and associated infrastructure including a haul road from Stotts Creek landfill. This is referred to as the Stage 1 (Project Application) throughout this report as Stage 1 (Project Application) and refers to the components of the development that Council intends to develop in the short to medium term; and
- Concept Plan Approval for the overall Concept Plan, which includes all components of the Stage 1 Project Application, as well as the further development of a landfill, and a quarry and landfill, which are currently proposed as Stage 2 of the Concept Plan. The 'Concept Plan' thus refers to all components of Stage 1 and Stage 2 encompassing all currently proposed waste infrastructure.

This environmental assessment has been prepared by GHD Pty Ltd (GHD) in accordance with the requirements of Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to support an application to the NSW Minister for Planning for Concept Plan approval and Stage 1 project approval and to address the requirements of the Director-General of the NSW Department of Planning (the Director-General's Requirements) issued on 31st July 2008.

1.2 Purpose

The purpose of the greenhouse assessment is to calculate the predicted Scope 1 and 2 emissions of greenhouse gases associated with the Stage 1 Project Application and preliminary estimates for the remainder of the activities comprising the Concept Plan.

Emissions are classified into three scopes under the IPCC guidelines; these scopes, adopted by the Department of Climate Change, are:

- **Scope 1** – Direct emissions arising from activities within the boundaries of an organisation, such as the combustion of diesel and methane emissions.
- **Scope 2** – Emissions arising from outside of the boundaries of an organisation, due to the import of energy, such as electricity imported from the grid.
- **Scope 3** – Emissions arising from the wider economy due to an organisation's activities. This includes other life-cycle emissions, such as emissions arising from the oil extraction, processing and transportation of diesel.

This assessment covers only Scope 1 and 2 emissions.

1.3 Boundaries

The system boundaries for the greenhouse gas assessment are the Scope 1 and 2 emissions of the project. The following sources were assessed in developing the assessment:

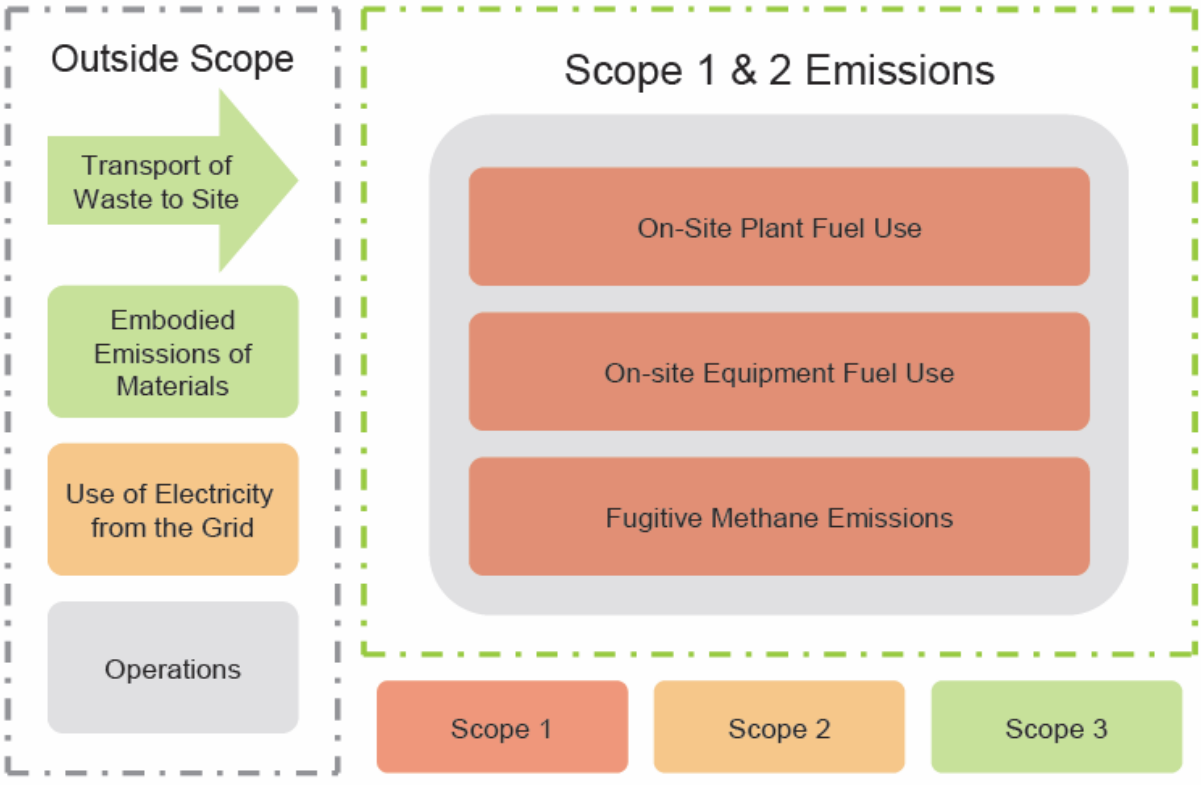
- Methane emissions;
- On-site equipment fuel consumption; and
- On-site plant fuel use.

The following emission sources were not included in this assessment:

- Emissions arising from the leachate were ignored. The Intergovernmental Panel on Climate Change (IPCC) guidelines estimates that the emissions from leachate are in the order of 1% of total emissions and recommends their exclusion.
- Scope 3 emissions such as:
  - Embodied emissions of construction materials
  - Transportation of waste from the source to the transfer stations
- Emissions arising from waste transport to site.
- Use of electricity from the grid, although they are Scope 2 emissions Council verified that the existing infrastructure at Stott Creek would be utilised for this site, therefore there will not be electricity use at Quirks Quarry Landfill.

Figure 1 presents a diagram of the greenhouse gas assessment boundaries. Details of the exclusions and assumptions are provided in *Section 2*.

Figure 1 Boundaries Diagram



1.4 Methodology

The greenhouse assessment was prepared in accordance with the following general principles:

- The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard developed by the World Business Council for Sustainable Development (GHG Protocol). This is a recognised international standard.
- The emissions arising from fuel consumption have been estimated using the factors and methodologies detailed in the *National Greenhouse Accounts (NGA) Factors – June* 2010 published by the Department of Climate Change and Energy Efficiency (DCCEE).
- According to the *National Greenhouse and Energy Reporting System Measurement, Technical guidelines for estimation of greenhouse gas emissions by facilities in Australia – June 2009* published by the then DCC (now DCCEE), after the waste is deposited in the landfill site, a portion of the organic matter within the waste will decompose with time to generate gases including Carbon Dioxide (CO_2) and Methane (CH_4), which are both identified as greenhouse gases. The organic matter within the waste is assumed to be of biogenic origin. This means that it has been generated by vegetation as part of the carbon cycle; hence any CO_2 emissions arising from the disposal of the organic matter are considered part of the carbon cycle and have no net emissions. However, CH_4 has a higher global warming potential (GWP) than CO_2 so CH_4 emissions are considered and converted to CO_2-e units based on the differences between the GWP of CO_2 and CH_4.

- The factors and methodologies used to estimate the methane emissions are from the DCC (2009*) National Greenhouse and Energy Reporting System Measurement Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia*, June 2009.
- To estimate the methane emissions arising from the deposition of the waste in the landfill components the calculations were based on the predicted amount of waste to be received during the following
  - Quirks Quarry Landfill: 10 years of operation
  - West Valley Landfill – 12 years of operation
  - North Valley Landfill – 10 years of operation

  Thus the inventory represents present and future emissions arising from activities in the inventory year.

1.5 Data Collection

The data considered for this assessment was taken from the following sources:

- GHD (2009). *Draft Landfill Environmental Management Plan for Quirks Quarry Landfill* prepared for Tweed Shire Council
- GHD (2011). *Quirks Quarry Landfill Concept Design Report*. prepared for Tweed Shire Council
- GHD (2011). *Preliminary Quarry Study for the proposed West Valley Quarry*. prepared for Tweed Shire Council
- Preliminary estimates of landfill airspace and forecast waste acceptances for West Valley and North Valley Landfills.
- Fuel use for existing landfill and quarry operations as provided by Tweed Shire Council.

Wherever possible, estimates with high accuracy were used to calculate greenhouse gas emissions. Details of these assumptions and exclusions are provided in *Section 2.1 and 2.2.*

All emissions data has been converted into quantities of carbon dioxide equivalent and expressed in terms of tonnes of carbon dioxide equivalent (tCO_2-e).

1.6 Data Analysis

1.6.1 Methane Emissions Released from Landfill

- Methane emissions from the landfill were estimated in accordance with **Method 1**, one of the 3 methods available in the *National Greenhouse and Energy Reporting System Measurement – Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia June 2009 (Technical Guidelines)*.
- **Method 1** – Methane generation from solid waste disposal is estimated using the tonnage of solid waste materials received at the landfill and a First Order Decay (FOD) model. The FOD model provides default factors such as methane generation constants (k) and degradable organic carbon (DOC) contents of different types of waste. The Determination also provides default percentages for different waste streams (Municipal Solid Waste, Commercial and Industrial, and Construction and

Demolition) for each state and territory and also provides default percentages for each type of waste (e.g. food, garden, paper, wood, inert materials) under each of the waste streams.

- For the purpose of this assessment the default waste stream and waste type percentages for New South Wales as mentioned in the Technical Guidelines were considered. *See* Table 1.
- The modelling included determining landfill gas emissions for predicted waste received for each year of operation from 2012 onwards.

Table 1 Default Waste Stream and Waste Type Mix for New South Wales

	Waste Streams		
	Municipal Solid Waste	Commercial & Industrial	Construction & Demolition
	31%	42%	27%
	Waste Mix Type for each waste stream above		
Food	35	21.5	-
Paper and paperboard	13	15.5	3
Garden and park	16.5	4	2
Wood and wood waste	1	12.5	6
Textiles	1.5	4	-
Sludge	-	1.5	-
Nappies	4	-	-
Rubber and Leather	1	3.5	-
Concrete, metal, plastic and glass	28	37.5	89

(Source: NGER Measurement, Technical Guidelines 2009)

1.6.2 Fuel Use

The emission factors (EF) used for this inventory have been sourced primarily from the *National Greenhouse and Energy Reporting System Measurement Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia*, June 2009 published by the Department of Climate Change.

2. Exclusions and Assumptions

2.1 Exclusions

The following items were excluded from this assessment because their contribution to the inventory is anticipated to be neither minor, not relevant, or outside of the scope or because data was not available at the time of the assessment. Exclusions from the greenhouse gas assessment are:

- Emissions associated with electricity use from the grid; Council verified that there would be no requirements for a gate house, weighbridge, workshop, site office, wheelwash, recycling facilities and green waste processing as the existing infrastructure at Stotts Creek RRC would be utilised for this site;
- Emissions associated with the construction of operational infrastructure such as a haul road and other minor associated facilities as required;
- Emissions associated with maintenance of vehicles and equipment and the use of oils, grease, lubricants and replacement parts. Only fuel consumption related emissions have been included;
- Emissions associated with the manufacturing of construction vehicles and equipment and their transportation to site. The construction equipment is not manufactured primarily for this project and hence the emissions associated with manufacturing are not included, neither are the emissions from use of the construction equipment; and
- Emissions arising from the leachate were ignored. The Intergovernmental Panel on Climate Change (IPCC) guidelines estimate that emissions from leachate are in the order of 1% of total emissions and recommend their exclusion.

2.2 Assumptions

2.2.1 Stage 1 Project Application

Methane Emissions Released from Landfill

On the basis of forecast waste acceptance and the concept design for the Quirks Quarry landfill, and the estimated landfill void capacity that the landfill life with projected waste inputs will be approximately 10 years. The assumed landfilling start date is January 2012.

The estimated annual waste tonnages to be handled at Quirks Quarry Landfill are summarised in Table 2 below.

Table 2 Estimated Waste Volumes per Year

Year		Waste Mass (tonnes)
1	2012	47,893
2	2013	48,851
3	2014	50,316
4	2015	51,826
5	2016	53,381
6	2017	54,982
7	2018	56,632
8	2019	58,330
9	2020	75,030
10	2021	77,131

Fuel Use

The total fuel (diesel) used for plant and equipment at Quirks Quarry for the 2008/2009 financial year was 147,394.81 litres. It is therefore assumed that the same amount of fuel will be used per year during the operation of the West Valley Quarry.

Relatively minor amounts of diesel are utilised by Council in operating the landfills, with a report of 88.94 litres only being utilised at Stotts Creek in the 2008/2009 financial year. This is due to the landfill operations being conducted under contract, with the contractor being required to report their fuel usage and greenhouse gas emissions separately. This will continue to be the case during the operation of the landfills at Eviron Road.

Table 3 Predicted Total Fuel Use – Diesel (Stage 1 2012 - 2021)

Source	Fuel Used per Year (kL)	Total Fuel Used (kL)
On-site plant & equipment fuel use	147.5	1622

2.2.2 Concept Plan

Methane Emissions Released from Landfill (West Valley and North Valley)

Utilising the same emissions factors, waste composition, fuel consumption as that adopted for the Stage 1 activities, a preliminary estimate of the GHG emissions associated with the West and North Valley Landfills and North Valley Quarry have been made.

The operational lives of each of these facilities was based on forecast quarry extraction rates and landfill waste acceptance rates provided by Council, which results in the following:

- West Valley Landfill: 2022-2031
- North Valley Landfill: 2031 – 2044

It is noted that at present the GHG assessment has not factored in increased diversion of organic materials, and lower landfilling rates that will be likely following Council's implementation of AWT. The emissions forecast are based on business as usual waste acceptance rates forecast by Council. Therefore the emission rates presented herein are considered to be conservative and overestimate the likely GHG emissions from the West Valley and North Valley landfills.

3. Greenhouse Gas Assessment Results

3.1 Emissions Summary – Stage 1

Taking into account the assumptions and exclusions listed in *Section 2*, the result indicates total emissions of approximately 144,968 tCO_2-e for the Quirks Quarry Landfill. Of this total:

- 82,771 tCO_2-e arise from methane emissions during the landfill operational life; and
- 4,709 tCO_2-e arise from the plant and equipment fuel use for the West Valley Quarry and Quirks Quarry Landfill.

Methane emissions are the largest source contributing 97% of all emissions, with the remaining 3% arising from plant and equipment fuel use. A breakdown of the estimated emissions for the overall project is shown in Figure 2. The detailed sources of emissions are listed in Table 4. It is noted that this table does not account for emissions after closure of the landfill

Table 4 Summary of GHG Emissions Stage 1 Project Application

Source	Greenhouse Gas Emissions (tCO_2-e)
Methane Emissions	140,259
On-site plant & equipment fuel use	4,709
Total	**144,968**

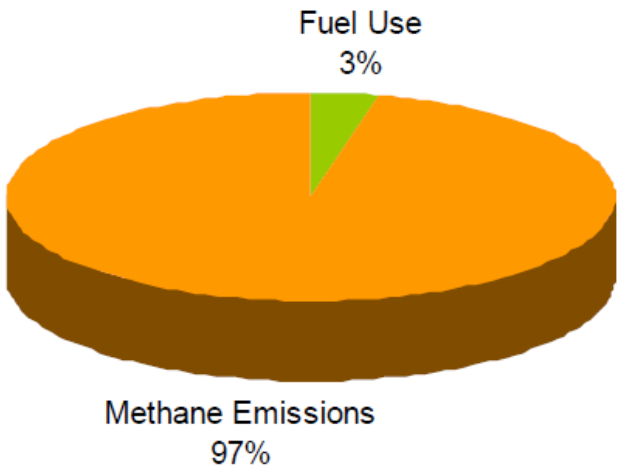


Figure 2 Stage 1 Project Application (Quirks Quarry Landfill and West Valley Quarry) Emission Sources (%)

3.2 Methane Emissions Released from Quirks Quarry Landfill

3.2.1 Methodology

As mentioned above, Method 1 has been used to model methane emissions from the Quirks Quarry landfill site. Method 1 uses the default waste stream and waste type percentages (as shown in Table 1) as outlined in the NGERS Technical Guidelines to characterise the waste that enters the landfill. The waste stream and waste type mix is important in the model calculations, as they determine the amount of degradable organic carbon that is available from which methane can be generated.

3.2.2 Results

The total emissions emitted to the atmosphere are calculated by multiplying the greenhouse gas emissions by a methane oxidation factor of 10%.

The modelling results show that a total of 140,259 tCO_2-e will be generated from decaying organic matter at the Quirks Quarry landfill during its operational life (Table 5).

Table 5 Methane Emissions per Year (tCO_2-e)

Year	Waste Tonnage (per year)	Emissions per Year (tCO_2-e)
2012	47,893	1,700
2013	48,851	4,842
2014	50,316	7,722
2015	51,826	10,395
2016	53,381	12,896
2017	54,982	15,252
2018	56,632	17,988
2019	58,330	20,538
2020	75,030	23,022
2021	77,131	25,904
	TOTAL	140,259
2022		23,263
2023		21,017

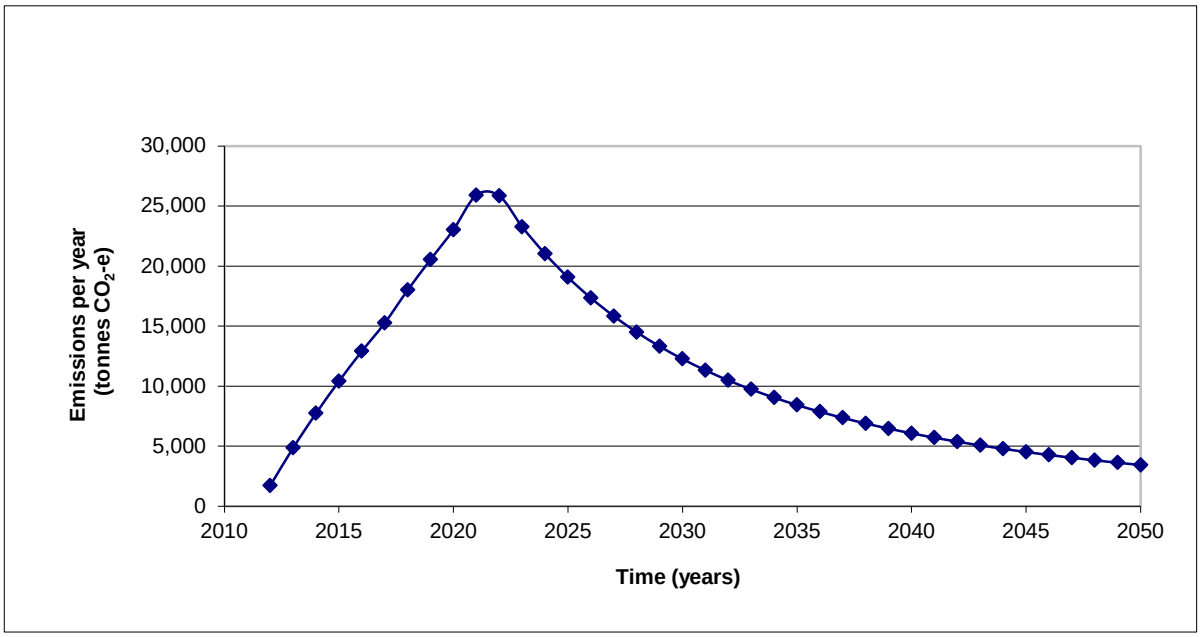


Figure 3 Quirks Quarry Landfill Methane Emissions per Year (tCO_2-e)

The First Order Decay method assumes that biodegradable component in waste decays slowly throughout a few decades, during which CH_4 and CO_2 are formed. If the landfill conditions are constant the rate of methane production will depend on the amount of carbon remaining in the waste.

As a result emissions of CH_4 from waste deposited in a landfill site are highest in the first few years after deposition and then gradually decline as the degradable carbon in the waste is consumed by the bacteria responsible for the decay. Therefore, emissions will continue to be emitted over a long period of time after the landfill has been closed as shown in Figure 3.

The methane emissions model was run for 100 years from 2021 and the results show that 498,055 tCO_2-e will be generated from decaying organic matter at the Quirks Quarry landfill over that period after closure.

3.3 Fuel Use – Stage 1

The total fuel (diesel) used for plant and equipment at Quirks Quarry for the 2008/2009 financial year was 147,394.81 litres. It has been assumed that the same amount of fuel will be used per year during the 11 years of the quarry's life.

Table 6 Predicted Total Fuel Use – Diesel (2012 - 2019)

Source	Fuel Used per Year (kL)	Total Fuel Used (kL)
On-site plant & equipment fuel use	147.4	1621.3

3.4 Emissions Summary Concept Plan

Utilising the same emissions factors, waste composition, fuel consumption as that adopted for the Stage 1 activities (refer Section 2), a preliminary estimate of the GHG emissions associated with the West and North Valley Landfills and North Valley Quarry have been made. The operational life of each of these facilities was based on forecast quarry extraction rates and landfill waste acceptance rates provided by Council.

As was the case with the Stage 1 activities methane emissions from landfilled waste are the largest source of GHG emissions for the remainder of the Concept Plan. Utilising the assumptions outlined above a breakdown of the source and estimated emissions for each of the activities in the Concept Plan beyond Stage 1 activities is provided in Table 9-38.

Table 3-7 Summary of GHG Emissions for Concept Plan (beyond Stage 1)

Source	Greenhouse Gas Emissions (tCO_2-e)
Landfill Methane Emissions (during operational life)	
- West Valley Landfill (2022-2033)	305,295
- North Valley Landfill (2034-2045)	417,807
On-site plant & equipment fuel use	
- West Valley Landfill	3
- North Valley Quarry	1497
- North Valley Landfill	3
Total	**724,605**

The landfill methane emissions models were run for 100 years from the closure date of the West Valley and North Valley landfills. This showed that 926,394 tCO_2-e and 1,271,284 tCO_2-e will be generated from decaying organic matter at the landfills respectively over the period after closure. This is displayed in Figure 4 below for both landfills.

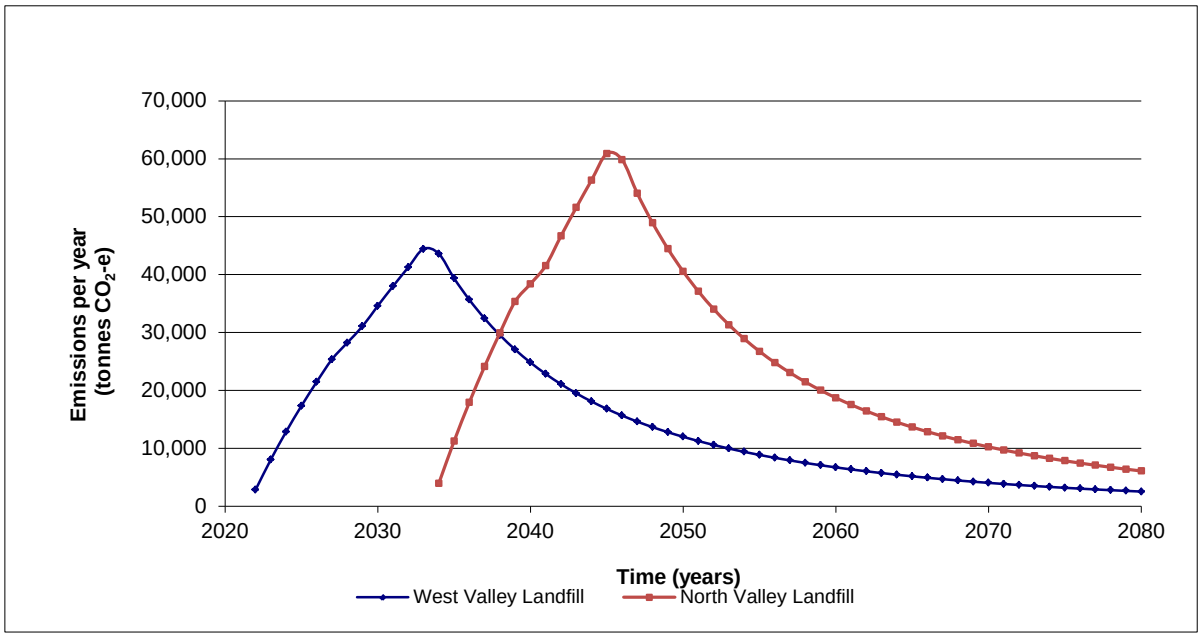


Figure 4 Estimated Landfill Methane Emissions Concept Plan (beyond Stage 1)

4. Recommendations

In addition to the initiatives identified in the Landfill Environmental Management Plan, such as resource recovery activities, diversion of recyclable and reusable items from landfill and the implementation of measures to minimise the potential for environmental impacts from the future waste management operations, GHD recommends the following:

4.1 Methane Emissions

Landfills are the main source of greenhouse gas emissions from the waste management sector. From the results of the inventory it can be seen that the emissions are dominated by methane emissions, to minimise these emissions it is recommended that:

- The landfill should be capped as soon as possible following the deposition of the waste. It is recommended that the cap is designed, constructed and maintained to minimise the leakage of gas from the decomposing waste.
- Reducing biodegradable organic content of waste going into the landfill would also reduce the methane emissions; however the quantity of LFG available for electricity generation along with the amount of carbon sequestered would also be reduced. To quantify the effects on the overall carbon footprint, an assessment would be required that also considers the implications of the emissions arising from the diverted waste.

4.2 Fuel

Diesel combustion is the second main source of greenhouse emissions. The following options may reduce these emissions:

- Switching to fuels with lower carbon intensity, such as biodiesel blends or LNG.
- Switching off equipment and stationary plant when not required.
- Optimising transport routes, payloads and journey timing to minimise fuel consumption.
- Selecting higher efficiency vehicles and stationary plant when making capital purchases and ensuring their size is appropriate for the intended tasks.
- Ensuring that vehicles are well maintained and have optimal tyre pressures.
- Ensuring that the operators and drivers are trained to operate vehicles and plant efficiently.
- Reviewing the current waste network and operational procedures to identity potential opportunities to minimise transportation requirements and double handling of waste.

4.3 Recovering Waste Energy

Depending on the quantity of landfill gas generated and captured infrastructure such as a flare will be installed as a minimum, and investigations into the viability and feasibility of tapping into or replicating the Stotts Creek Renewable Energy Facility will be undertaken once landfill gas flows and compositions can be verified. Council is committed to sustainable landfill gas management. Further investigation of the costs, benefits and logistics of tapping into or expanding (replicating) the existing infrastructure at the

Stotts Creek RRC Facility will be undertaken to identify whether this is a more advantageous solution to the provision of a flare at the future Quirks Quarry landfill. Either way, as a minimum

Based upon previous assessments carried out by GHD it is expected that at a minimum, gas extraction wells and a flare would be comprised of:

- LFG extraction wells spaced at approximately 50 m centres;
- Gas manifold pipework systems from each of the staged area;
- A gas ring main located along the landfill perimeter;
- Condensate traps located along the gas ring main to collect condensate produced as the gas moves through the pipework; and
- Possible gas extraction flare (initial installation), with the potential for construction of an energy recovery plant depending upon the gas extraction volumes.

Council has a commitment to sustainable landfill gas management and has identified a potential alternative to onsite landfill gas infrastructure at this site. Further investigation of the costs, benefits and logistics of tapping into or expanding (replicating) the existing infrastructure at the Stotts Creek RRC Facility will be undertaken to identify whether this is a more advantageous solution to the provision of a flare at the future Quirks Quarry landfill.

There may also be opportunities to reduce greenhouse emissions by recovering waste energy. In particular, the waste heat from the LFG generators could be used if a local requirement for heat could be found, or cooling (such as office air-conditioning) by the use of waste heat in adsorption chillers. Various regenerator systems are also available to capture and reuse the energy involved in vehicle breaking to reduce fuel consumptions.

4.4 Carbon Offsetting

In addition to the mitigation of greenhouse gases by on-site programs, the carbon footprint of the project could be reduced by the purchase of offsets. These offsets can be generated from a variety of sources such as renewable energy, forestry plantations and energy efficiency projects.

5. References

Department of Climate Change, (2009). *National Greenhouse and Energy Reporting System Measurement - Technical Guidelines for the estimation of greenhouse gas emissions by facilities in Australia, June 2009,* Department of Climate Change, Canberra

Department of Climate Change and Energy Efficiency (2010). *National Greenhouse Accounts (NGA) Factors, June 2010*, Department of Climate Change and Energy Efficiency, Canberra

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