

Appendix I

Greenhouse Gas Assessment

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Acronyms

Term/acronym	Explanation
C&I	Commercial and industrial
C&D	Construction and demolition
DA	Development Application
(The) Development	The proposed expansion of an waste management facility at St Marys
DGRs	Director General's Requirements
EIS	Environmental Impact Statement
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
(The) facility	The existing waste management facility
FTE	Full time equivalent
GHG	Greenhouse Gas
NSW	New South Wales
OEH	Office of Environment and Heritage
Site	The area within the boundary of the existing St Marys Waste Management Facility
tpa	Tonnes per annum
tCO ₂ -e	Tonnes of Carbon Dioxide equivalent greenhouse gas emissions

1.0 Introduction

1.1 Proposed Development Description

Worth Recycling Pty Ltd (herein Worth) currently owns a waste management facility at St Marys (the St Marys Facility), approximately 43 kilometres from the Sydney CBD, and 7.5 kilometres from Penrith town centre. The facility currently has approval to accept up to 30,000 tonnes of acid sulphate soils (ASS) per year.

Worth is proposing to expand its current operations at St Marys to enable the relocation of its solid waste operations from the South Windsor Facility to the Site at St Marys, and to cater for future growth. The proposed development would enable the non-thermal treatment and processing of an additional 77,400 tonnes per annum to that currently received at the South Windsor Facility, comprising various waste streams as detailed in Table 1.

Table 1 Proposed waste streams (including treatment method and annual capacity)

Waste Stream	Treatment Method	Annual Capacity (approximate)
Drill muds	Chemical/centrifugal	47,000 tonnes
Restricted soils	Segregation/immobilisation	2,400 tonnes
Hazardous soils	Immobilisation	12,000 tonnes
Stormwater and canal dredgings	Settling/segregation/immobilisation	6,000 tonnes
Greases (and drum storage)	Immobilisation	1,000 tonnes
Oil Filters	Crushing/segregating	1,500 tonnes
Refinery Sludges	Immobilisation	4,800 tonnes
Packaged Waste	Sorting/segregation/immobilisation	300 tonnes
Construction / demolition waste	Sorting/segregation	2,400 tonnes

At this stage, waste streams to be treated at the St Marys Facility would be sourced mostly from within NSW. However, it is possible that following the establishment of the facility that waste may also be received from interstate.

1.1.1 Construction Activities and Materials

The proposed Development would involve limited construction activity, as the majority of facilities and structures already exist on the Site.

There is the potential that construction of the proposed Development would need to be staged to accommodate concurrent acid sulphate soil treatment operations, which have been approved under development consent DA12/0780. Detailed construction staging requirements would be determined during the detailed design phase of the proposed Development.

Construction activities are anticipated to be limited to the following activities:

Area One

- Civil works would involve construction of bunding and drainage for storage bunkers;
- The southern wall would be removed and part of the eastern wall (approximately four to five metres from the northern corner).
- The external bays located along the southern side of Area 1 would be bunded and enclosed using concrete and foundations with steel enforcements;
- Construction of roofing over external bunkers to the west of the Area 1 building. Roofing would consist of canvas material which would be mounted on a water-resistant frame;
- Building cladding would be constructed with roller doors for the drum/oil filter storage area;

- Installation of exterior materials, including a concrete panel at base of the Area 1 building, including metal wall cladding and a metal roof; and
- Installation of three reagent/additive storage hoppers, of 3 metres by 3 metres, with a height of 13 metres, immediately south of Area 1.

Areas 2, 3 and 4

- Installation of exterior materials, including a concrete panel at the base of building, with Colorbond metal wall cladding above;
- Construction of a treatment pit in Area 2 and Area 3, requiring the removal of concrete and excavation of soil, as well as concrete pour to form the pits;
- Construction of a catch drain along the southern extent of Area 2;
- Installation of drill mud treatment plant in Area 2, 3 and 4; and
- Installation of three 60kL tanks at a height of seven metres, immediately north of Area 2. The tanks would be delivered and installed with necessary foundations.

External bunkers (Eastern site boundary):

- New external bunkers approximately 6 metres deep would be constructed along the eastern boundary, and would comprise 250-300mm thick concrete lining and foundations, with steel reinforcements; and
- For bunkers that would contain waste other than construction and demolition waste, roofing would also be constructed. Roofing would be comprised of canvas material (curtain/synthetic) and would be mounted on a retractable water-resistant frame.

Water Treatment Plant

- The water treatment plant would be containerised plant, with necessary electricity connections provided. Four 60kL storage tanks would also be installed immediately north of the water treatment plant.

Dangerous Goods Store

- Provision for a dangerous goods store along the Site boundary south of Area 1. The store would consist of compartmentalised banded storage areas within a shipping container. No service connections would be required for this structure.

1.1.2 Construction Plant and Equipment

The described construction activities would require the use of the following indicative types of plant and equipment:

- At least one crane of at least 100 tonnes and one small franna crane;
- A hydraulic concrete rock breaking hammer;
- Angle grinders;
- Excavators and other earth moving equipment;
- Scissor lifts and mobile cranes;
- Miscellaneous electrical hand tools;
- Concrete pumps and delivery trucks; and
- A portable compressor.

1.1.3 Construction Traffic

Traffic movements associated with the construction of the proposed development would comprise both heavy and light vehicles. Construction traffic would be generated by the following sources:

- Light vehicle movements would be generated mainly by construction crews travelling to and from the site.
- Heavy vehicle movements would be generated by the delivery / removal of:
 - Construction plant and equipment:
 - 1 crane of at least 100 tonnes and 1 small franna crane
 - Excavators and other earth moving equipment.
 - Scissor lifts and mobile cranes.
 - Concrete pumps and delivery trucks.
 - General construction supplies and equipment.
 - Removal of waste from demolition, excavation, and/or other construction activities.

1.1.4 Construction Hours and Duration

Construction would be undertaken during the following standard hours:

- 7am to 6pm Monday to Friday; and
- 8am to 1pm on Saturdays.

Construction may be undertaken in stages to reflect market demands. If all elements are constructed simultaneously, construction would occur over six months, including two months for civil works, three months for construction works and one month for commissioning of the proposed Development. Should concurrent operation and construction activity be required, an Environment, Health and Safety plan for construction activity would be implemented to manage any conflicts.

1.1.5 Construction Workforce

The construction workforce required for the proposed Development has been estimated at around 15 full time positions. Confirmation of the construction workforce and any staging of these personnel in accordance with construction staging would be undertaken during the detailed design phase of the proposed Development.

1.2 Climate Change and Greenhouse Gases

Greenhouse gases (GHGs) are emitted into the Earth's atmosphere as a result of natural processes and human activities.

Since the industrial revolution there has been an increase in the amount of GHGs emitted which has increased the concentration of GHG emissions in the atmosphere. This has led to an increase in the Earth's average temperature (surface temperature) and has caused Climate Change (or global warming) to occur.

The recent *State of the Climate 2012* report (CSIRO and Bureau of Meteorology, 2012) confirms the long term warming trend over Australia's land and oceans, showing that in Australia, each decade has been warmer than the previous since the 1950s. Other observed trends include an increase in record hot days, a decrease in record cold days, ocean warming, sea-level rise and increases in global GHG concentrations (Intergovernmental Panel on Climate Change (IPCC), 2007).

GHG emissions are reported as tonnes of carbon dioxide equivalent (tCO₂-e). There are numerous GHGs which contribute to the Greenhouse Effect. These gases have varying Global Warming Potential (GWP). The higher GWP, the higher the intensity of effect each tonne of that gas has on the Greenhouse Effect. GHGs are standardised by expressing them as carbon dioxide equivalent emissions (CO₂-e) and carbon dioxide has a GWP of 1. For example, the GHG methane (CH₄) has a GWP of 21, thus one tonne of methane has a Greenhouse Effect equivalent to 21 tonnes of carbon dioxide. However it should be noted that from 2017 onwards the Australian Government has committed to adopt a methane GWP of 25, in accordance with updated international GHG accounting (DCCEE, 2012D).

GHG emissions are categorised into three different scopes (either scope 1, 2 or 3) in accordance with the Greenhouse Gas Protocol (World Resources Institute (WRI) and World Business Council for Sustainable Business Development (WBCSD), 2004), IPCC and Australian Government GHG accounting/classification systems. Emissions are categorised into the different scopes to help delineate between direct emissions from sources that are owned or controlled by the project and indirect emissions that are a consequence of project activities but occur at sources owned or controlled by another entity. The three GHG scopes, illustrated in Figure 1 below, include:

- Scope 1 emissions, also called “direct emissions”. These emissions are generated directly by the project, e.g. methane emissions generated as waste decomposes in an anaerobic environment
- Scope 2 emissions, also referred to as “indirect emissions”. Scope 2 emissions are generated outside of the project’s boundaries to provide energy to the project, e.g. the use of purchased electricity from the grid
- Scope 3 emissions, are all indirect emissions (not included in Scope 2) due to upstream or downstream activities. For example indirect upstream emissions associated with the extraction, production and transport of purchased construction materials.

It should be noted that Scope 3 emissions have not been calculated as part of this GHG assessment since there is very limited opportunity for the project design to influence the quantity of these emissions via mitigation measures.

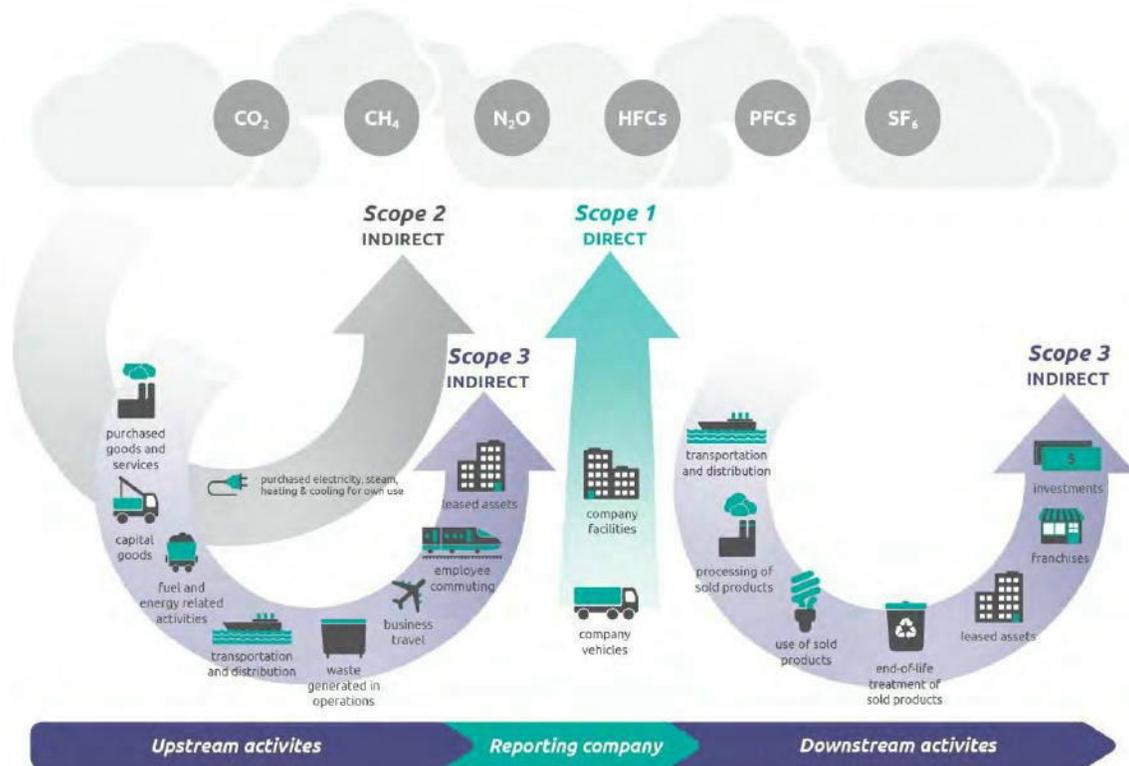


Figure 1 GHG Scopes (WRI&WBCSD 2011 p5)

1.3 Director-General's Requirements

The Director-General's Requirements (DGRs), dated 12 February 2013, include the following environmental assessment requirements:

The EIS must address the following specific issues:

Air quality – including greenhouse gas emissions in accordance with relevant EPA guidelines.

1.4 GHG Assessment Objectives

The objective of this GHG Assessment is to:

- 1) quantitatively assess the potential Scope 1 and 2 GHG emissions of the construction and operational stages of the Development;
- 2) qualitatively assess the potential impacts of these emissions on the environment; and
- 3) describe the measures which could be implemented to mitigate GHG emissions.

1.5 Legislative and Policy Context

A number of legislative and policy mechanisms include GHG mitigation considerations and requirements. The following provides a summary of these mechanisms:

- the Clean Energy Plan (Securing a clean energy future: the Australian Government's climate change plan, 2011) describes the Australian Government's commitment to reducing GHG emissions and includes targets:
 - five per cent emission reduction from 2000 levels by 2020, irrespective of commitments made by other countries
 - 15 per cent or 25 per cent emission reduction from 2000 levels by 2020, if commitments are made by other countries
 - 80 per cent emission reduction from 2000 levels by 2050.
- the Carbon Price Mechanism (CPM) set out in the *Clean Energy Act 2011* is the central national climate change mitigation instrument which will put a price on Scope 1 GHG emissions and provide a financial incentive for reducing GHG emissions
- the CPM is underpinned by the *National Greenhouse and Energy Reporting Act, 2007* (NGER). NGER is the national framework for reporting and disseminating information on Scope 1 and Scope 2 GHG emissions, energy use and energy production associated with the activities of Australian corporations
- the *Energy Efficiency Opportunities Act 2006* (EEO Act) requires users (corporations or corporate groups) of more than 0.5 petajoules of energy per year to assess their energy use, identify cost-effective energy efficiency opportunities, and report publicly on the outcomes.

GHG emissions reduction is one of the four key objectives of the National Waste Policy. The *National Waste Policy* (developed in 2009 and endorsed by the Council of Australian Governments in 2010) sets the direction for Australia's waste management from 2010 to 2020.

2.0 Methodology

2.1 Assessment Principles

This GHG assessment was conducted according to the general principles outlined in:

- *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition)*, WRI and WBCSD (2004)
- *National Greenhouse Accounts (NGA) Factors*, Australian Department of Climate Change and Energy Efficiency (2012).

The assessment was guided by the following generally accepted GHG accounting and reporting principles (WRI and WBCSD, 2004):

- relevance – Ensure that the GHG inventory appropriately reflects the activities and GHG emissions of the Project and contains information to support decision making by stakeholders internal and external to the Project
- completeness – Inclusion of all relevant GHG emission sources within the chosen inventory boundary and the disclosure and justification of omissions and instances where estimates have been made with an insufficient level of quality
- consistency – Use consistent calculation methods, data, criteria and assumptions to enable valid comparisons
- transparency – Include clear and sufficient information on the procedures, assumptions and limitations of the GHG inventory, to enable others to understand the basis of the results and to make decisions regarding the use of GHG inventory results with reasonable confidence
- accuracy – Reduce bias and uncertainties, as much as practical, to enable users to make decisions with reasonable confidence in the integrity of the results.

To calculate the GHG emissions associated with the construction and operational stages of the Development, the following four steps were undertaken:

- 1) the GHG assessment boundary was determined for the Development
- 2) GHGs relevant to the Development were identified
- 3) the emission sources were classified according to scope
- 4) the quantity of GHG emissions was calculated.

It should be noted that the estimated GHG emissions are based on data provided by the project design team and Worth at the concept design stage of the Development. Hence the estimated GHG emissions results provided are an estimate only, and subject to the accuracy of the estimated operational project data / construction material / resource quantities and current project design stage and all other project assumptions.

2.2 GHG Calculations, Data and Assumptions

The GHG calculations and assumptions used in the assessment include:

2.2.1 Construction

Diesel fuel use would be associated with:

- Demolition works (assumed area of 150m²)
- Earthworks of bunded storage areas
- Construction of reinforced concrete bunded storage areas
- Installation of storage tanks and other machines required during operation.

It has been assumed that all construction vehicle/equipment/plant would run on diesel fuel (i.e. no petrol would be used).

It is assumed that one machine with a standard fuel use rate of 15L/hr would be operational for total construction period. It is assumed that the construction would be carried out over a 6 month period and for worst case 66hour week.

It has been assumed that a dedicated site office/amenities would not be required during the construction stage, existing facilities would be used by construction staff. Hence it is assumed that no material amount of electricity would be consumed during the construction stage.

2.2.2 Operation

Diesel fuel use would be associated with:

- Operation of site vehicles and operational equipment (e.g. cranes, loaders, dozers, etc).

It is assumed that one machine with a standard fuel use rate of 15L/hr would be operational during the standard operating hours of the facility.

It has been assumed that all operational vehicles/machinery/plant would run on diesel fuel (i.e. no petrol would be used).

Electricity (sourced from the NSW grid) would be used to power operational machinery. Where data on specific machinery is not available a standard 5.5kW has been assumed. It should be noted that specific machines have not yet been specified for the Development.

It has been assumed that a dedicated site office/amenities would not be required during operation of the Development, existing facilities would be used by staff. Hence it is assumed that no material amount of electricity would be consumed during the operation stage of the Development.

2.3 Assessment Boundary

The GHG assessment boundary defines the scope of GHG emissions and activities included in the GHG assessment. The principal of relevance is an important consideration in development of the boundary. This relates to selection of an appropriate boundary that considers (WRI and WBCSD, 2004):

- the intended use of the GHG assessment results
- the needs of decision makers
- the activities of the Development that generate GHG emissions
- construction and operational boundaries relating to the Development and the activities that incur GHG emissions.

The next section summarises the GHG emissions sources which have been included within the GHG Assessment boundary.

2.4 GHG Emission Sources and Scope

Scope 1 and 2 GHG emissions would be generated during the construction and operation of the Development. During the construction stage, electricity and fuel would be consumed generating emissions, for example, as the diesel fuel is combusted on-site by construction equipment.

Operation of the Development would also generate GHG emissions, for example from the consumption of diesel fuel and electricity to run the facility.

2.4.1 Construction

The GHG emission sources which were included in the assessment boundary for the construction of the Development and the relevant GHG scope are listed in Table 4.

Table 2 GHG Assessment Boundary – construction stage

Emission Source	Activity	Emission Scope	
		1	2
Diesel fuel used	Operation of construction equipment and site vehicles	✓	

2.4.2 Operation

The GHG emission sources which were included in the assessment boundary for the operational stage of the Development and the relevant GHG scope are listed in Table 5.

Table 3 GHG Assessment Boundary – Operational stage

Emission Source	Activity	Emission Scope	
		1	2
Diesel fuel used	Operation of stationary equipment	✓	
	Operation of mobile equipment	✓	
	Operation of site vehicles	✓	
Electricity used	Operation of facility		✓

2.4.3 Exclusions

The following emission sources have been excluded from the GHG inventory boundary for the reasons stated below:

- Emission sources that are less than five percent of total construction/operational emissions are considered immaterial and may be excluded from the assessment.
- Scope 3 indirect GHG emissions. For example the emissions embodied in construction and operational materials and the emissions associated with the transport of waste/products/staff to/from the site. It is assumed that all of the waste/facility products would be transported to/from the site by external parties. Scope 3 GHG emissions have not been included as there is very limited opportunity for the project design to influence the quantity of these emissions via mitigation measures. In addition the quantity of fuel used by construction and operational workers travelling to/from the site would generate emissions less than five percent of the total emissions associated with the Development (i.e. immaterial).
- Scope 2 emissions associated with the use of electricity to power site office and amenities during the construction and operational stages would not be material. This is due to the use of the existing office and amenities onsite by construction staff.
- Emissions associated with works carried out prior to the construction stage (for example, to power design offices and office supplies). These GHG emissions have already been generated and would be a small percentage of total emissions associated with the Development.
- Emissions associated with the transport, placement and decomposition of construction waste –construction waste emissions are considered negligible as this waste is inert and does not decompose in a landfill and generate GHG emissions (specifically methane).
- It is assumed that no vegetation would be cleared to construct the project.

3.0 Results

3.1 Construction

The diesel fuel used on-site by construction equipment and site vehicles is the only source of direct Scope 1 GHG emissions. The amount of electricity used during the construction stage of the development would be minimal as the existing facility site offices/amenities would be used by construction staff therefore no calculations have been made for Scope 2 during the construction stage.

It is estimated that the construction stage of the Development would generate approximately 63 tCO₂-e of direct Scope 1 GHG emissions, as shown in Table 2.

Table 4 Construction stage of the Development GHG emissions

Emission Category Emission Source	Quantity	Units	GHG Emissions (tCO ₂ -e)	
			Scope 1	Scope 2
Fuel use - construction equipment and site vehicles	23	kL	63	NA

Note: The estimated GHG emissions are based on data provided by the project design team and Worth at the concept design stage of the Development. Hence the GHG emissions results provided are an estimate only, and subject to the accuracy of the estimated construction material / resource quantities and current project design stage and all other project assumptions.

Refer to Section 2.2.1 for details and assumptions used to calculate the construction stage GHG emissions.

3.2 Operation

3.2.1 Annual Emissions

The use of electricity to power the facility is the only source of Scope 2 GHG emissions.

It is estimated that the annual operation of the Development would generate approximately:

- 1,199 tCO₂-e of direct Scope 1 GHG emissions
- 561 tCO₂-e of indirect Scope 2 GHG emissions

The total annual operational (Scope 1 and 2) GHG emissions would be approximately 1,761 tCO₂-e.

The estimated annual operational GHG emissions associated with the Development are given in Table 3.

Table 5 Operation stage of the Development GHG emissions (annual)

Emission Category Emission Source	Quantity	Units	Annual GHG Emissions (tCO ₂ -e)	
			Scope 1	Scope 2
Electricity use	630,811	kWhr / yr	NA	561
Fuel use - operational equipment & site vehicles	445	kL / yr	1,199	NA
Total			1,761	

Note: The estimated GHG emissions are based on data provided by the project design team and Worth at the concept design stage of the project. Hence the GHG emissions results provided are an estimate only, and subject to the accuracy of the estimated operational project data and all other project assumptions.

Refer to Section 2.2.2 for details and assumptions used to calculate the operational stage GHG emissions.

3.3 Comparison with Emissions in NSW

3.3.1 Construction

The annual GHG emissions (including emissions and removals from land use and land use change) for NSW were 157.4 million tCO₂-e in the year 2009 to 2010.

The estimated total Scope 1 GHG emissions associated with the construction of the Development (approximately 63 tCO₂-e) are approximately equivalent to 0.00004 percent of NSW's annual GHG emissions (in 2009 to 2010).

3.3.2 Operation

The estimated total annual operational (Scope 1 and 2) GHG emissions associated with the Development (approximately 1,761 tCO₂-e.) are approximately equivalent to 0.001 percent of NSW's annual GHG emissions (in 2009 to 2010).

Solid waste disposal on land in NSW generated approximately 4.2 million tCO₂-e in the year 2009 to 2010. The estimated total annual operational (Scope 1 and 2) GHG emissions associated with the Development (approximately 1,761 tCO₂-e.) are approximately equivalent to 0.04 percent of NSW's annual (2009 to 2010) waste sector (solid waste disposal on land) GHG emissions.

4.0 Mitigation Measures

To reduce the scope 1 and 2 GHG emissions from the Development during construction and operation, the following options are available:

- minimising the quantity/or emission intensity of fuel used by plant and equipment
- minimising the amount/or emission intensity of electricity used

The following lists mitigation measures which could be implemented during construction and operation to reduce the scope 1 and 2 GHG emissions associated with the Development, where reasonable and feasible:

- use of low GHG intensive alternative fuels (for example biofuels) in equipment and vehicles
- preferential use/purchase of vehicles with low fuel consumption ratings
- training of staff in the practices to reduce fuel consumption of equipment and vehicles
- regularly maintaining equipment and vehicles to maximise fuel efficiency
- preferential purchase of energy efficient equipment/plant

5.0 Conclusion

During the construction stage, electricity and fuel would be consumed. These activities would generate Scope 1 and 2 GHG emissions directly and indirectly. It is estimated that the construction stage of the Development would generate approximately 63 tCO₂-e of direct Scope 1 GHG emissions. This is approximately equivalent to 0.00004 percent of NSW's annual GHG emissions (in 2009 to 2010).

Operation of the Development would also generate GHG emissions, for example from the consumption of diesel fuel and electricity to run the facility.

It is estimated that the annual operation of the Development would generate approximately:

- 1,199 tCO₂-e of direct Scope 1 GHG emissions.
- 561 tCO₂-e of indirect Scope 2 GHG emissions.

The total annual operational (Scope 1 and 2) GHG emissions would be approximately 1,761 tCO₂-e. This is approximately equivalent to 0.001 percent of NSW's annual GHG emissions (in 2009 to 2010).

It should be noted that the estimated GHG emissions results provided above are an estimate only, and subject to the accuracy of the estimated construction and operational project data and all other project assumptions.

To avoid/reduce GHG emissions associated with the Development, mitigation measures are recommended which relate to:

- minimising the quantity/or emission intensity of fuel used by plant and equipment
- minimising the amount/or emission intensity of electricity used onsite

References

- Australian Government, 2012, *Securing a clean energy future: the Australian Government's climate change plan*, 2011. Available at: <http://www.cleanenergyfuture.gov.au/clean-energy-future/our-plan/>
- Australian Department of Climate Change and Energy Efficiency (DCCEE), 2010, *Australian National Greenhouse Accounts State and Territory Greenhouse Gas Inventories, 2009–10*. Available at: <http://www.climatechange.gov.au/~media/climate-change/emissions/2011-12/StateAndTerritoryGreenhouseGasInventories-2009-10.pdf>
- DCCEE, 2012A, *Australian National Greenhouse Accounts, Quarterly Update of Australia's National Greenhouse Inventory, March Quarter 2012*. Available at: <http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-gas-inventory-march-2012.aspx>
- DCCEE, 2012B, *National Greenhouse Accounts (NGA) Factors*. Available at: <http://www.climatechange.gov.au/publications/greenhouse-acctg/national-greenhouse-factors.aspx>
- Australian Government, Department of Sustainability, Environment, Water, Population and Communities, 2009, *The National Waste Policy: Less waste, more resources*. Available at: <http://www.environment.gov.au/wastepolicy/about/index.html>
- Intergovernmental Panel on Climate Change (IPCC), 2007. *Climate Change 2007, Synthesis Report*. Available at: <http://www.ipcc.ch/>
- IPCC, 2006, *Guidelines for National Greenhouse Gas Inventories*. Available at: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_4_Ch4_Bio_Treat.pdf
- NSW Government, 2007, *Waste Avoidance and Resource Recovery Strategy 2007*. Available at:
- NSW Government, 2011, *National Waste Policy Implementation Report 2011*. Available at: <http://www.scew.gov.au/strategic-priorities/national-waste-policy.html>
- Transport Authorities Greenhouse Group (TAGG), 2011, *Greenhouse Gas Assessment Workbook for Road Projects*.
- World Resources Institute (WRI) and World Business Council for Sustainable Business Development (WBCSD), 2004, *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Revised Edition).

Appendix A

GHG Calculations

Appendix A GHG Calculations

Operational Stage - GHG Emission Calculations

Waste Stream	Treatment Method	Annual Capacity (approx)	Unit	Source
Drill muds	Chemical/centrifugal	47,000	tpa	Concept Design
Restricted soils	Segregation/immobilisation	2,400	tpa	Concept Design
Hazardous soils	Immobilisation	12,000	tpa	Concept Design
Stormwater and canal	Settling/segregation/imm	6,000	tpa	Concept Design
Greases (and drum storage)	Immobilisation	1,000	tpa	Concept Design
Oil Filters	Crushing/segregating	1,500	tpa	Concept Design
Refinery Sludges	Immobilisation	4,800	tpa	Concept Design
Packaged Waste	Sorting/segregation/imm	300	tpa	Concept Design
Construction /	Sorting/segregation	2,400	tpa	Concept Design

Operating hours	6am to 6pm Monday to Friday	
	8am to 2pm Saturdays	
	Weekly operating hrs	66
	Annual operating hrs	3,432

Electricity used during operation

Equipment	Power	Unit	Source	Amount	Unit	Total	Unit	Notes:
Drill muds								
Hydro cyclone		10 kWh/t		1	47,000 tpa	470,000	kWh/yr	
Shaker Screen		5.5 kW		2	3,432 hr/yr	18,876	kWh/yr	
Pumps		10 kW		5	3,432 hr/yr	34,320	kWh/yr	
Restricted soils, hazardous soils, greases and refinery sludges - immobilisation								
Pug mill		5.5 kW	Assumed		2,746 hr/yr	15,101	kWh/yr	Assumed operation 80% of total operating hours
Enclosed screw conveyor		10 kW	Assumed		686.4 hr/yr	6,864	kWh/yr	Assumed operation 20% of total operating hours
Stormwater and canal dredgings								
Pumps		10 kW		5	6,000 hr/yr	60,000	kWh/yr	
Oil Filters								
Crushing machine		4.6 kW		6	150 hr/yr	690	kWh/yr	Assumed total operating hours based on 100t/hr
Water treatment								
Water treatment		0.4 kWh/kL		7	62400 kL/yr	24,960	kWh/yr	Assumed total kL/yr based on 200kL/day rate
						630,811	Total kWh/annum	

Sources/Notes:

- Celleco Twister™ Hydro cyclone, GL&V. <http://www.kawanee.co.jp/pdf/sareco.pdf>
- HXJQ. <http://www.hxjq-crusher.com/40.htm>
- Caterpillar equipment data
- Assumed drill mud 'cake' quantity is 50% of drill muds tpa
- Assumed 2 pumps at 5kW each
- Assumed based on ELECTRIC/HYDRAULIC DRUM CRUSHER/COMPACTOR - HDC-900-IDC. <http://www.vestikiocs.com/drawings/HDC-900-IDC.pdf>
- Osmofo data received from supplier via email (23/03/2013)

Operational Stage - GHG Emission Calculations

Emissions Source	Scope 2 Emission factor (kg CO2-e/kWh)	Source
Electricity (NSW)	0.00069	NGA Factors 2012 Table 45

Emissions Source	Electricity Used (kWh/yr)	Emission Factor (tCO2-e/kWh)	GHG Emissions (t CO2-e / yr)
Electricity		Scope 2	Scope 2
Electricity (NSW)	630,811	0.00069	561

Fuel used during operation

Equipment	Fuel use	Unit	Source	Quantity	Unit	Amount	Unit	Total	Unit
Internal Operational Movements									
Forklifts, Front end loader, Excavators, Street sweeper		0.015 kL/hr		3	3,432 hr/yr	Assume one item operating for total operational hours		51	kL/yr
Waste Processing									
Drill muds									
Front end loader		0.015 kL/hr		3	500 l/hr	23,500 tpa. Note#4		353	kL/yr
Restricted soils, hazardous soils, greases and refinery sludges - immobilisation									
Soil - front end loader or		0.015 kL/hr		3	500 l/hr	14,400 tpa		0.432	kL/yr
Slurry waste - front end loader		0.015 kL/hr		3	500 l/hr	1200 tpa		0.036	kL/yr
Stormwater and canal dredgings									
Excavator		0.02 kL/hr		3	500 l/hr	1500 tpa		0.06	kL/yr
Construction and demolition waste									
Front end loader		0.015 kL/hr		3	500 l/hr	2,400 tpa.		36	kL/yr
Packaged waste									
Front end loader		0.015 kL/hr		3	500 l/hr	300 tpa.		5	kL/yr
						445	Total kL/annum		

Operational Stage - GHG Emission Calculations
Energy Content Factors and Emission Factors

Emissions Source	Energy Content Factor (GJ per kL)	Scope 1 Emission factor (kg CO ₂ -e/GJ)			Emissions Factor (t CO ₂ -e /kL)	Source
		CO ₂	CH ₄	N ₂ O		
Diesel - transport - post 2004 vehicles / stationary	38.6	69.2	0.01	0.6	2.69	NGA Factors 2012 Table 4.

Emissions Source	Diesel used (kL/yr)	Emissions per unit quantity (t CO ₂ -e / Scope 1)	GHG Emissions (t CO ₂ -e / yr) / Scope 1
Diesel - transport - post 2004 vehicles	445.01	2.69	1199

1761 Total Scope 1 & 2 GHG emissions/yr

Comparison with NSW's annual emissions

157400000 Annual GHG emissions (including emissions and removals from land use and land use change) for NSW were 157,4 million tCO₂-e in the year 2009 to 2010.
0.001 % of NSW's emissions
1.119E-03

4200000 Solid waste disposal on land in NSW generated approximately 4.2 million tCO₂-e in the year 2009 to 2010.
0.04 % of NSW's waste emissions