MOOREBANK INTERMODAL COMPANY

Moorebank Intermodal Terminal Project Environmental Impact Statement

Volume 6

October 2014

PARSONS BRINCKERHOFF

Technical Paper 9
Greenhouse Gas Assessment

Technical Paper 9 – Greenhouse Gas Assessment

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Moorebank Intermodal Company

Moorebank Intermodal Terminal

Greenhouse Gas Assessment

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PARSONS BRINCKERHOFF
A BALFOUR BEATTY COMPANY

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Prepared by:	Aaron McKenzie	Date: 11/07/2014	Signature:
Reviewed by:	Delyth Toghill	Date: 11/07/2014	Signature:
Approved by:	Delyth Toghill	Date: 11/07/2014	Signature:

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Parsons Brinckerhoff Australia Pty Limited *ABN 80 078 004 798* Level 27 Ernst & Young Centre 680 George Street Sydney NSW 2000 GPO Box 5394 Sydney NSW 2001 Australia Tel: +61 2 9272 5100 Fax: +61 2 9272 5101 www.pbworld.com *Certified to ISO 9001, ISO 14001, OHSAS 18001*

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1. Introduction

1.1 The Moorebank Intermodal Terminal Project

The Moorebank Intermodal Terminal (IMT) Project (the Project) involves the development of an import/export (IMEX) and interstate terminal linked to Port Botany and the interstate freight rail network by rail. It also includes associated commercial infrastructure (i.e. warehousing), a rail spur connecting the Project site to the Southern Sydney Freight Line (SSFL) and road entry and exit points from Moorebank Avenue. The Moorebank Intermodal Company (MIC) is the proponent for the Project.

When completed, the IMT would include:

- *an IMEX freight terminal* – designed to handle up to 1.05 million twenty-foot equivalent units (TEUs) per annum (525,000 TEU inbound and 525,000 TEU outbound) of IMEX containerised freight to service port shuttle train services between Port Botany and the Project;
- *an Interstate freight terminal* – designed to handle up to 500,000 TEU per annum (250,000 TEU inbound and 250,000 TEU outbound) of interstate containerised freight to service freight trains travelling to and from regional and interstate destinations; and
- *warehousing facilities* – with capacity for up to 300,000 square metres (m^2) of warehousing to provide an interface between the IMT and commercial users of the facilities such as freight forwarders, logistics facilities and retail distribution centres.

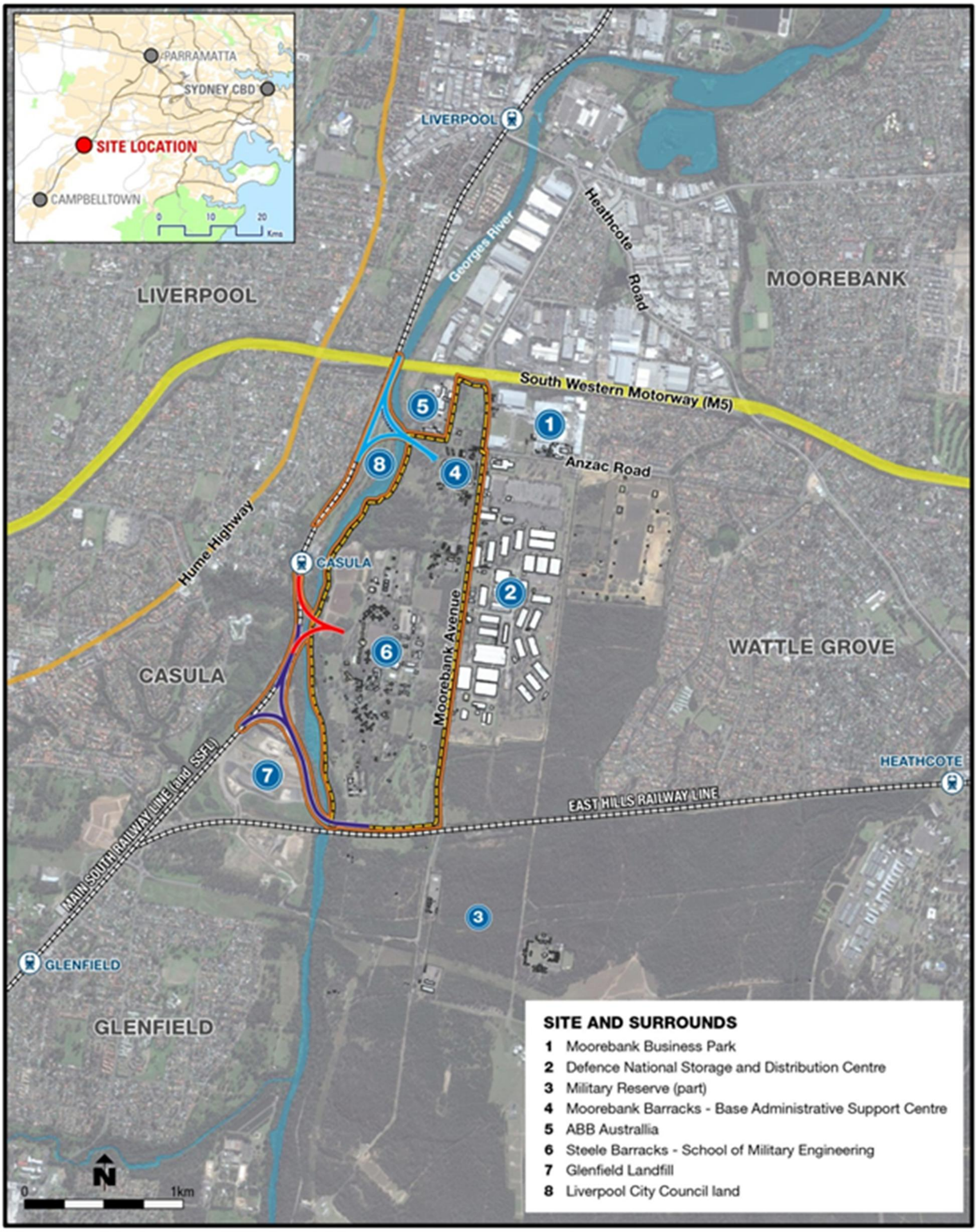
Access to the SSFL is proposed from the west of the Project site via a bridge structure over the Georges River either at the northern, central or southern part of the Project site. These are referred to as the 'northern, southern and central rail access options and are shown in Figure 1.1.

The Moorebank IMT Project would provide connectivity to Port Botany by rail, and would connect to major regional and interstate roads and highways via the M5 and M7 Motorways.

This Technical Paper assesses the Greenhouse Gas (GHG) impacts of the Project, as further described in section 2.

1.2 The Project site

The Project is situated on Department of Defence (DoD) land in the Sydney suburb of Moorebank, NSW (refer Figure 1.1). The Project site is approximately 220 hectares (ha) in area and currently consists of the School of Military Engineering (SME) (which will be relocated prior to the commencement of the Project), the Northern Commonwealth Land and the Northern Council Land. The Project site is surrounded by the residential suburbs of Casula, Wattle Grove and North Glenfield, as well as industrial, commercial and DoD land.



IMT boundary
Project site boundary
Northern rail access option
Central rail access option
Southern rail access option

Figure 1.1 Project site and context

1.3 Project delivery

The Project would be undertaken in a phased approach commencing with Early Works in 2015 through to Full Build which is expected to be reached in 2030. From 2018 onwards construction and operational activities will be undertaken simultaneously on the Project site.

For the purposes of assessing the impacts of the Project, the Environmental Impact Statement (EIS) describes five Project development phases as follows:

1. Early Works (2015);
2. Phase A – Construction of initial IMEX terminal and warehousing (2015–2018) (Project Phase A);
3. Phase B – Operation of initial IMEX terminal and warehousing, construction of additional capacity (2018–2025) (Project Phase B);
4. Phase C – Operation of IMEX terminal and warehousing, construction of interstate terminal and additional warehousing (2025–2030) (Project Phase C); and
5. Full Build – Operation of IMEX terminal, warehousing and interstate terminal (2030).

These phases are shown in Figure 1.2.

Construction of the Project is expected to begin in mid-2015, starting with the Early Works development phase, which is likely to occur for six months. Following this, Phase A could commence construction of the first 0.5 million TEUs of IMEX capacity and construction of 100,000 square metres (sq. m) of warehousing. The rail access to the SSFL would also be constructed at this time.

From 2018 Phase B involves the operation of the initial IMEX and warehousing. In 2023 construction of additional IMEX capacity (providing a total of 1.05 million TEUs per annum) and an additional 150,000 sq. m of warehousing would be undertaken.

Phase C involves the operation of the IMEX facility at 1.05 million TEUs per annum and 250,000 sq. m of warehousing. Construction of the interstate facility and an addition 50,000 of warehousing would commence in 2028.

Full Build would be reached at 2030. At Full Built the IMEX terminal's capacity would be 1.05 million TEUs per annum and the interstate terminal's capacity would be 0.5 TEUs per annum. Up to 300,000 sq. m of warehousing would be provided on the Project site.

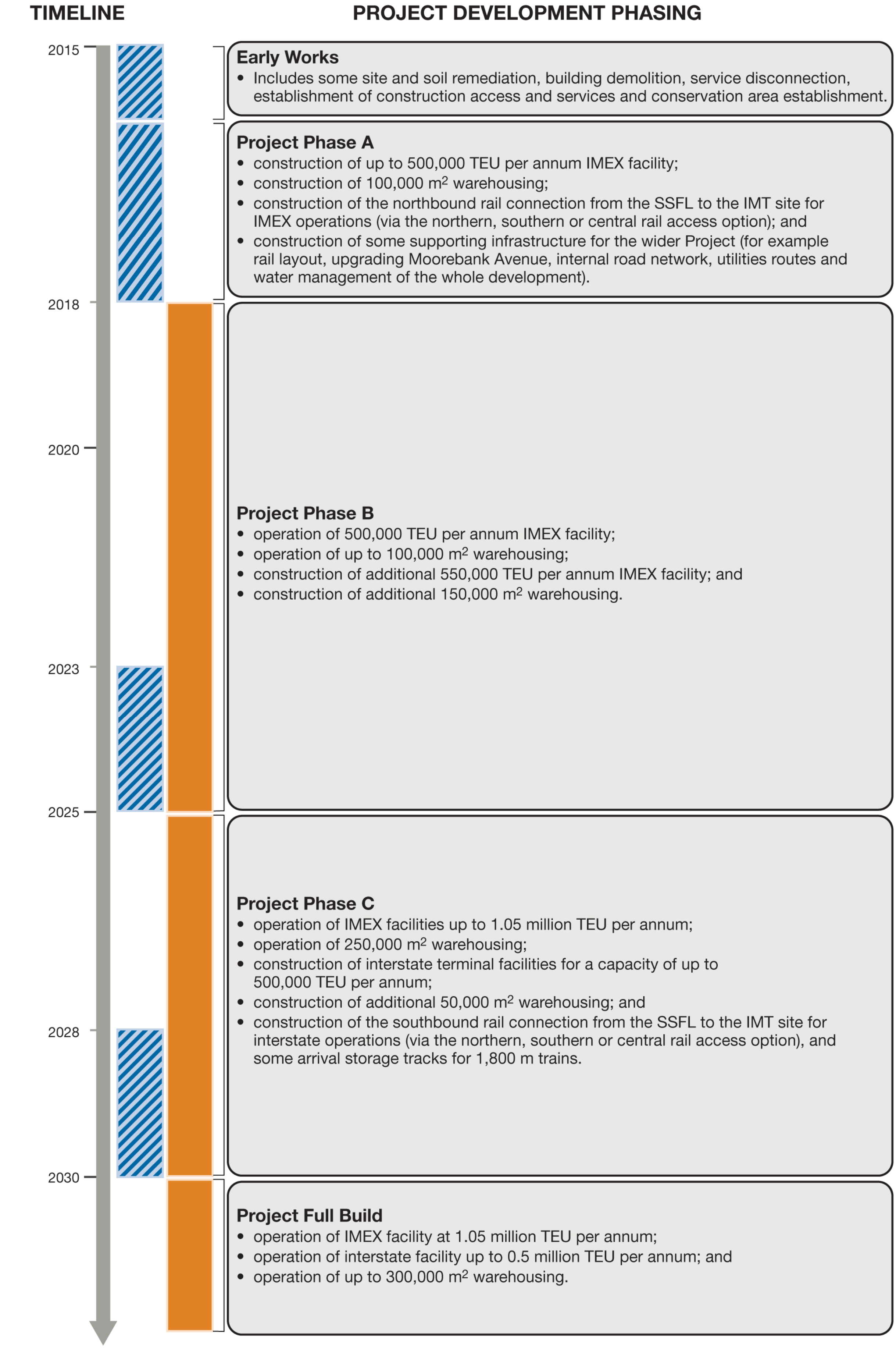


Figure 1.2 Indicative Project development phasing

1.4 Planning and assessment process

The purpose of the EIS, which this Technical Paper supports, is to seek approval for the Moorebank IMT Project under both the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as a controlled action; and the NSW *Environmental Planning and Assessment Act 1979 (*EP&A Act*),* as a Stage 1 State significant development (SSD).

In seeking this approval, a staged approval process is proposed, whereby successive stages of development on the Project site would be subject to further environmental assessment and planning approval (Stage 2 SSD approval) once the Project has been developed further through detailed design. Therefore the Project details at this stage are indicative only.

The exception to this is the Early Works development phase which MIC is seeking approval to undertake as part of the Stage 1 SSD, without the need for further approvals.

Therefore, this Technical Paper and the EIS assess the impacts of the Early Works development phase and all three construction and operation phase (Phase A, Phase B and Phase C), leading up to Full Build. The operational impact of Full Build are also assessed within this Technical Paper.

1.5 Environmental impact assessment requirements

This Technical Paper has been prepared by Parsons Brinckerhoff to address the assessment requirements of the NSW Department of Planning and Environment's (NSW DP&E's) Environmental Assessment Requirements (EARs). It is noted that no requirements specific to the GHG assessment were stipulated by the Commonwealth Government under the *EPBC Act* (the 'Final EIS Guidelines'). Specifically this Technical Paper addresses the requirements outlined in Table 1.2.

Table 1.1 EIS requirements addressed within this Technical Paper

Requirement source	Detail	Where addressed within the technical paper
NSW EP&A Act – DGR's	A Scope 1 greenhouse gas assessment, as defined by the Greenhouse Gas Protocol.	Sections 2–7
	Taking into account the Australian Greenhouse Office Factors and Methods workbook (AGO 2006)	Section 4.1

This Technical Study provides a baseline assessment of the GHG emissions associated with the proposed. The report is based on indicative traffic volumes, equipment/vehicle estimates, utilities' design and electricity consumption, generated through other studies undertaken as part of the EIS.

This assessment considers Scope 1 (direct) and Scope 2 (indirect) greenhouse gas emissions that would potentially be generated on an annual basis. The nature of construction works means that the primary source of greenhouse gas emissions are Scope 1, with a negligible contribution from Scope 2 sources associated with the office and administration of the site.

Given that the emissions sources associated with the Early Works and Phase A construction works will be similar and that the Early Works and initial stages of the Phase A construction are intended to take place within a 12-month period this Paper assessed both Early Works and Project Phase A as one combined scenario.

2. The greenhouse gas assessment

2.1 Construction and operational GHG assessment

As identified in section 1.3, the Project would be developed in phases progressively over time (Phase A Phase B, and Phase C). For the purposes of this assessment, the GHG emissions relating to the three construction phases (i.e. Early Works has been included as part of Phase A) and the operational phases (Phase B, Phase C and Full Build) have been assessed and presented as an estimated annual output of GHG emissions. The assessment also considers the GHG emissions derived from reductions in road freight transport and changes to background traffic as a result of Moorebank IMT over the phases of development.

The estimates of emissions are derived from the indicative design of the Project's construction and operation. The calculated GHG calculations are largely based on an estimate of energy and fuel demand for the operation of the Project, which are conservatively based on demand calculations and information available. As the Project is still in its early conceptual phase, the emissions have been estimated based on the best available information, but this information is likely to change once further details of the Project are known. Therefore as part of the Stage 2 SSD further assessment would be undertaken to reconfirm and update the GHG assessment for each individual Project phase.

Calculations presented are estimates each construction stage, and the annual operation emissions, using National *Greenhouse Account Factors* 2013 (NGA factors).

2.2 Assumptions and limitations

This assessment considers the major GHG emission sources based on preliminary estimates obtained using the indicative site layouts (refer to Appendix A) and the conceptual design. The report provides estimates of emissions from the:

- construction of the Project during the Early Works and three construction stages (Phase A, B and C); and
- operation of the IMT during Phase B, C and Full Build.

The GHG assessment only considers Scope 1 and Scope 2 emissions (refer section 4.2 for definition of Scope 1 and 2). Scope 3 emissions have not been accounted for this this assessment, as they do not require mandatory reporting.

The construction schedule at the time of the assessment was forecasted to be 60 hours per week. This is based on the workforce being onsite from Monday to Friday for 11 hours every day, and working 5 hours on Saturdays, equating to 312 workforce days of the year. Operations were considered to be 24 hour per day, 7 days a week, with the exception of 3 public holidays every year.

Where data was unavailable, or not considered robust, then a ‘materiality test’ was used to determine the appropriate level of detail for information required. Where it is reasonably expected that an activity will account for less than 5% of the total emissions (for example, end of Project life decommissioning activities), or if more detailed data would not likely alter the results greatly, then that item has not been considered.

It was assumed that the carbon intensity in the NSW grid electricity will remain the same over the Project’s operational life. However, it is likely that this will decline as technology for coal-fired power generation coupled with increased natural gas and renewables will increase. This could be considered in more detail in the further assessments undertaken as part of the Stage 2 SSD approvals.

Particular assumptions in relation to the GHG calculation methodology are identified in section 4.5 and section 4.6.

3. Greenhouse gas framework

3.1 International policy

In 1997, the United Nations Framework Convention on Climate Change (UNFCCC) produced the Kyoto Protocol aimed at limiting GHG emissions. The protocol was developed to work by setting a limit to individual mandatory GHG emission targets, using 1990 as a baseline level. Australia ratified the Kyoto Protocol in December 2007, agreeing to an emission target of 108% of the nation's 1990 emissions between 2008 and 2012. Australia has also committed to reducing its GHG emissions between 5–25% of 2000's emissions, and a longer-term target to cut emissions by 80% below 2000 levels by 2050.

3.2 Australian Government Policy on climate change

In 2009, the Australian Government released the Australian policy on climate change. The policy aims to reduce GHG emissions, encourage low GHG intensive design and technology, and reduce the impact of climate change on a global context.

In 2011, the Australian Government committed to reduce carbon pollution by 5% from 2000 levels by 2020 irrespective of what other countries do. The Clean Energy Regulator is the Government body responsible for administering legislation to reduce carbon emissions and increase the use of clean energy.

To assist with Australia's climate change policy, the Australian Government also implemented several policy instruments and plans as additional measures that aim to achieve reduced emissions, including:

- Renewable Energy Target (RET) scheme – aiming to reduce Australia's electricity supply by substituting 20% from renewable sources (i.e. solar, wind, geothermal) by 2020. The RET is split into two parts: the Large-scale Renewable Energy Target and the Small-scale Renewable Energy Scheme. These schemes create a financial incentive for investment in renewable energy sources through the creation and sale of certificates.
- *National Greenhouse and Energy Reporting scheme, including the National Greenhouse Energy Reporting Act 2007* (NGER Act) – requiring constitutional corporations to report annually on GHG emissions, energy production and energy consumption if the thresholds defined in the Act are not met or exceeded.
- Carbon Farming Initiative – the Carbon Farming Initiative enables individuals and entities to earn Australian carbon credit units (ACCUs) through activities that store carbon or reduce greenhouse gas emissions on the land. ACCUs earned under the Carbon Farming Initiative can be sold to people and businesses wishing to offset liability under the carbon pricing mechanism or voluntarily offset their emissions.
- Carbon Pricing Mechanism – under current law, the carbon pricing mechanism is an emissions trading scheme that applies to Australia's biggest polluters who have to report on, and pay a price for, their carbon pollution.

Following the 2013 election, the Australian Government is now implementing a Direct Action Plan which is designed to efficiently and effectively source low cost emissions reductions. Further to this, the Australian Government has prepared draft legislation that will repeal the *Clean Energy Act 2011* and related legislation that established the carbon pricing mechanism in July 2014.

The Direct Action Plan includes an Emissions Reduction Fund to provide incentives for abatement activities across the Australian economy and will complement the Carbon Farming Initiative. The Emissions Reduction Fund will operate alongside existing programmes that are already working to offset Australia's emissions growth such as the Renewable Energy Target, Carbon Farming Initiative, NGER and energy efficiency standards on appliances, equipment and buildings.

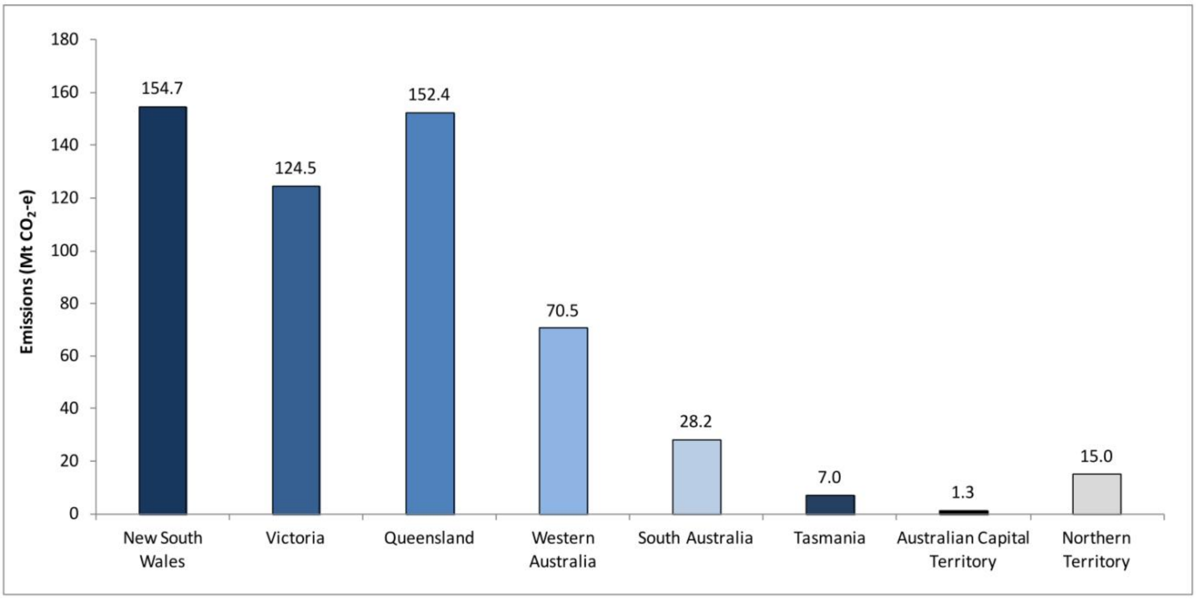
3.3 New South Wales regulatory framework

At the beginning 2003 the NSW Government introduced the NSW *Greenhouse Gas Reduction Scheme*. This scheme aims to reduce GHG emissions associated with the production and use of electricity, achieved by using project-based activities to offset the production of GHG emissions (i.e., renewable generated electricity).

In November 2006, the NSW Government released a policy document, *NSW 2021: A plan to make NSW number one*, which sets the Government's agenda for change and establishes NSW priorities' for the next 10 years. This document is an action plan to assist in tackling climate change by reducing the state's GHG emissions. The government is working to deliver economically efficient and environmentally effective initiatives, including (NSW Government, 2012):

- promoting energy efficiency, and clean and renewable energy
- promoting low-carbon agriculture
- encouraging waste reduction and resource recovery.

NSW 2021 seeks to assist local government, business and the community build resilience to future extreme events and hazards by helping these organisations understand and prepare for the impacts of climate change. The strategy has is also part of the response by the NSW government to NSW's significant GHG emissions in relative comparison to other states and territories, as shown in Figure 3.1.



Note: The NSW inventory includes ACT emissions from the stationary energy sector.

Source: Commmonwealth of Austraia 2014

Figure 3.1 State and Territory total GHG emissions 2011–2012 (Mt $CO_{2\text{-e}}$)

4. Calculation methodology

4.1 Greenhouse gas accounting

The approach for assessing GHG emissions for the IMT Project follows the accounting standards of the Greenhouse Gas Protocol (World Resources Institute/World Business Council for Sustainable Development, 2004) in conjunction with the following publications:

- NGA factors (2013) published by the (Australian Government) Department of Industry, Innovation, Climate Change Science, Research and Tertiary Education, which supersede the factors identified in the *Australian Greenhouse Office Factors and Methods Workbook* (AGO 2006). The factors supplied in this guideline have been used to calculate GHG emissions from estimates of energy consumption.
- Intergovernmental Report on Climate Change (2006), 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Japan.
- Published information, including manufacturer provided data obtained from various websites.

Where available, data supplied through the concept plan development has been used to calculate the main components that calculate to GHG emissions. Where values have not been available data has been retrieved from research or prior experience.

4.2 Emission sources

As discussed in section 2.2, the scope of this assessment includes the project's Early Works and three construction and operational phases of the Project.

The emission sources were categorised in accordance with the NGA factors. These categories represent the main emission sources that contribute to the release or capture of GHG emissions into the atmosphere. The main emission sources applicable for the project are:

- energy (stationary and transport);
- waste (putrescible and municipal);
- land use, land use change and forestry (refer to section 4.5 for further details); and
- industrial processes including use of synthetic gases.

The main GHG associated with the Project is carbon dioxide (CO_2), which is typically emitted from the combustion of carbon intensive fuels. It should be noted that GHG emissions are herein reported in terms of the standardised carbon dioxide equivalent (CO_2-e) values, which take into account the following GHG's:

- carbon dioxide (CO_2);
- methane (CH_4);
- nitrous oxides (N_2O); and
- synthetic gases including hydrofluorocarbons (HFC's), sulphur hexafluoride (SF_6) and tetrafluoromethane (CF_4).

In accordance with the guidelines of the NGA factors, the major sources of direct emissions were categorised into Scope 1 and Scope 2. It should be noted that Scope 3 emissions (indirect emissions that are not directly sourced, owned or controlled by the Project) have not been calculated as part of the assessment process as they do not require mandatory reporting. Below are the definitions of Scope 1 and 2 emissions according the NGA factors:

- Scope 1 emissions – direct emissions from sources within the boundaries of project operations such as fuel combustion within vehicles, plant and equipment.
- Scope 2 emissions – indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation. Scope 2 emissions result from the combustion of fuel to generate the electricity, steam or heat and do not include emissions associated with the production of fuel.

4.3 Emissions sources by boundary

The study area relevant to this GHG assessment is defined by the IMT Project site (as defined in section 1.2). This boundary footprint delineates emissions that have been included in the inventory. Emissions associated with the construction and operational phases and the full Build annual operation project are listed in Table 4.1 and Table 4.2. Further details on the emission assessed for the construction and operational phases are provided in sections 4.5 and 4.6.

Table 4.1 Construction emissions according to scopes

Scope	Emission sources
Scope 1	Transportation of materials (via heavy vehicles), light vehicles for staff use, fuel use for construction equipment, diesel on-site generator fuel usage, woody vegetation clearing.
Scope 2	Consumption of purchased electricity from the grid.
Scope 3	Not applicable.

Table 4.2 Operational emissions according to scopes

Scope	Emission sources
Scope 1	Operational fuel usage in vehicles and equipment; liquefied natural gas, municipal wastewater, changes to heavy-vehicle and background traffic VKT travelled (refer to separate section 5.3), synthetic gases used in refrigeration, SF_6.
Scope 2	Consumption of purchased electricity from the grid.
Scope 3	Not applicable.

Estimates for the main components that contribute to GHG emissions have been sourced from available concept project information, including current traffic volumes, utilities design, electricity consumption and equipment/vehicle estimates.

4.4 Greenhouse gas emissions during construction

Fuel use for transport, construction equipment and power generation was assessed for all construction phases of the Project (Early Works, Phase A, Phase B and Phase C). This included direct emission sources such as fuel use for facilitating transport activities for staff on-site (light vehicles), transport of materials (heavy vehicles) and fuel use for constriction equipment. Construction equipment was assumed to be powered by diesel fuel, as was power generation from generators. Fuel consumption required to power construction equipment such as earthmoving vehicles, heavy duty trucks, welders, cranes and diesel generators was estimated using a construction equipment list, equipment specifications of engine capacities, and extrapolated to calculate amount of fuel required to power the particular engine over the duration of assumed construction hours as discussed in section 2.2.

Preliminary estimates of power consumption during construction of the Project were based on indicative construction workforce for each Project phase as follows

- Early Works – 150–300
- Phase A – 1076
- Phase B – 1236
- Phase C – 474.

Note that the construction workforce figures above are 'peak', representing the 'worst-case' scenario.

It was assumed that power from the grid would supply the office and administration facilities during all construction works for Phase A, Phase B, and Phase C. The carbon intensity of grid supplied electricity for NSW has been assumed to be as listed by current NGA factors, which at the time of reporting had an emission factor scope of 0.88 kg CO_2-e/kWh for total electrical energy power consumption. Indirect emissions associated with purchased electricity from the grid in are presented in Table 5.1, Table 5.2 and Table 5.3.

An area of approximately 44, 48 and 53 hectares (ha) of remnant vegetation is proposed to be cleared for the Project, in line with the northern, the central and the southern rail access options and associated IMT layouts respectively. The main types of native major vegetation groups to be cleared consisted of alluvial woodland, Castlereagh Scribbly gum woodland, and riparian forest. For the purposes of this assessment the worst-case scenario in term of clearing being the 53 ha has been used for the GHG calculations.

During construction, it is assumed that on-site putrescible waste and waste water would be transported offsite. Therefore, any emissions associated with these sources are not applicable to the assessment.

The construction assessment considers emissions from construction activities only and does not consider any emissions associated with the partial operation of the IMT terminal (i.e. movement of IMEX and interstate trains) at any of the construction phases – as these are assessed separately in the operation phases as described in section 4.6 below.

4.5 Greenhouse gas emissions during operation

This report has assessed the operational phases starting with Phase B in 2018, Phase C in 2025 and Full Build from 2030.

Vehicles and mobile plant are considered to be Scope 1 emissions, and include fuel used in light vehicles, heavy vehicles, IMEX and Interstate trains within the site compound, equipment used in the warehouses facilities and stand-by diesel power generation. The information used to derive emission estimates were based on anticipated traffic volumes, mobile plan numbers, operational hours and fuel consumption. Typical fuel consumption rates for mobile plant such as forklifts, sidepicks, switch engines and intermodal terminal vehicles were adopted from their respective equipment specifications.

Locomotive GHG contributions were calculated from typical fuel consumption rates per kilowatt of locomotive power and anticipated operations.

As part of Project operation natural gas (NG) supply would serve administration buildings, maintenance and repair facilities and the customs buildings. Gas will be an energy source for heating purposes such as space heating, water heating and minor domestic purposes.

A packaged wastewater treatment plant will be provided for the treatment of domestic wastewater from an equivalent population of 40 individuals working in two of the administration buildings and 40 individuals working in the maintenance repair workshops. During operation, on-site waste will be transported offsite. Therefore, any emissions associated with these sources are not applicable to the assessment.

Refrigerant usage (R134a) is based on the estimate number of refrigerated containers (sometimes referred to as reefers) used in the Project, derived from the following assumptions contained within Project design documents:

- 2% of full containers are refrigerated;
- up to 1.05 million TEU (twenty foot units) will be used per annum (p.a.) for IMEX and 0.5 million TEU will be used for interstate container traffic; and
- there will be approximately 31,000 refrigerated containers used per year.

SF_6 use in switchgear has been estimated based on comparisons with other large, similar infrastructure projects in Sydney (such as North West Rail Link).

Indirect emissions associated with purchased electricity from the grid are for power of the storage yard, rail terminal, refrigerated containers, buildings and warehouse facilities. Preliminary estimates of annual electricity consumptions from the grid for the operation of Moorebank IMT have been provided by Parsons Brinkerhoff.

4.6 Calculating greenhouse gas emissions from vegetation clearing

GHG emissions resulting from vegetation clearing were calculated using the *Carbon Accounting Model v3.40* (FullCAM) (Department of Climate Change and Energy Efficiency 2012), which consists of a carbon stock model for different forest and agricultural land uses developed by the Department of Climate Change and Energy Efficiency. FullCAM is an integration tool capable of modelling various land use management changes such as vegetation clearing and conversion of land into pastures.

FullCAM was specifically used in this GHG assessment to calculate carbon stocks representative of the affected land including existing vegetation. Vegetation carbon stocks were calibrated by classifying the existing vegetation units according to a flora and vegetation assessment by Parsons Brinckerhoff (2014) to provide an indication of carbon sequestration potential of each specific vegetation unit. The area to be cleared at each stage was also accounted for.

The FullCAM model is then utilised to simulate changes in carbon stocks due to clearing of respective vegetation units and areas, and works on the assumption that carbon content from the cleared vegetation will be emitted into the atmosphere via the natural process of plant decomposition The modelled baseline carbon stocks are then compared with post-clearing carbon stocks for the existing vegetation units.

Post–clearing carbon stocks were defined by the debris carbon stock stabilising over time. The difference in carbon stocks were then compared to give a carbon content amount. The carbon stocks were then converted from tonnes of carbon to t CO_2-e by using a 44:12 carbon ratio.

4.7 Calculating greenhouse gas emissions associated with project-related changes to background traffic and heavy vehicle freight movements

A preliminary draft strategic transport modelling study by Parsons Brinckerhoff (2014) provided a forecast of traffic impacts with the development of Moorebank IMT. The impacts were assessed in the form of VKT within the Sydney network for both heavy freight vehicles and background traffic. For the purpose of this report, background traffic is referred to as any vehicle other than heavy vehicles occupying the road space. The study found that the project results in a significant decrease in heavy vehicle journeys on some of Sydney's arterial road network (specifically from Port Botany to Moorebank), as the IMEX and interstate trains, and network improvements would relieve the Sydney road network of freight transport movements. The fuel saved from a reduction in VKT's from heavy vehicles has been converted to a GHG reduction equivalent (t CO_2-e).

However, it was also found that background traffic (i.e. light vehicles and non-heavy vehicles driven by the general public) experienced increased VKT's as the introduction of the IMT redistributed background traffic both during construction and full-build operation, making for a longer traffic journey.

5. Estimated greenhouse gas emissions

5.1 Construction

This section provides a breakdown of major direct and indirect (scope 1 and 2, respectively) GHG emissions generated from the construction of the Project over the Project development stages. This section gives a breakdown of the major GHG emission sources associated with construction of the IMT facility according to the sectors defined by the 2006 IPPC Guidelines (2006). This accounts for GHG emissions resulting from transport and stationary fuel consumption, purchased electricity consumption and clearing of native vegetation.

A breakdown of Scope 1 and 2 emissions for construction phases Early Works and Phase A, Phase B and Phase C is provided in Table 5.1, Table 5.2 and Table 5.3, respectively.

Table 5.1 Breakdown of Scope 1 and 2 emissions for Moorebank IMT according to scopes and sources for Early Works and Phase A construction

Scope	Emission source	Source total	Emissions t CO_2-e
Scope 1	**Transport**		
	Light vehicles use for staff and onsite-activities	797 kL	1896
	Diesel heavy vehicle use for transport of materials	1,671 kL	4,503
	Stationary		
	Fuel use for equipment fleet	10,661kL	28,600
	Land use, land use change and forestry		
	Net loss of carbon sequestration potential due to clearing of woodlands, shrublands and forest[1]	53 ha	14,442
Scope 2	**Stationary energy**		
	Purchased electricity use	157,498 kWh	139
	Total Early Works and Phase A construction		**49,580**

Notes: [1]In line with assumptions used in the Ecological Impact Assessment (Parsons Brinckerhoff, 2014) a worst-case modelled scenario has been selected whereby the full requirement of vegetation clearance takes place during the Phase A construction period.

Table 5.2 Breakdown of Scope 1 and 2 emissions for Moorebank IMT according to scopes and sources for Phase B construction

Scope	Emission source	Source total	Emissions t CO_2-e
Scope 1	**Transport**		
	Light vehicles use for staff and onsite-activities	831 kL	1978
	Diesel heavy vehicle use for transport of materials	1,528 kL	4,119
	Stationary		
	Fuel use for equipment fleet	2,165 kL	5,808
	Land use, land use change and forestry		
	Net loss of carbon sequestration potential due to clearing of woodlands, shrublands and forest	N/A	N/A
Scope 2	**Stationary energy**		
	Purchased electricity use	125,998 kWh	111
	Total Phase B construction		**13,945**

Table 5.3 Breakdown of Scope 1 and 2 emissions for Moorebank IMT according to scopes and sources for Phase C construction

Scope	Emission source	Source total	Emissions t CO_2-e
Scope 1	**Transport**		
	Light vehicles use for staff and onsite-activities	266 kL	632
	Diesel heavy vehicle use for transport of materials	258 kL	695
	Stationary		
	Fuel use for equipment fleet	3,252 kL	8,724
	Land use, land use change and forestry		
	Net loss of carbon sequestration potential due to clearing of woodlands, shrublands and forest	N/A	N/A
Scope 2	**Stationary energy**		
	Purchased electricity use	86,480 kWh	76
	Total Phase B construction		**11,414**

5.1.1 Construction summary

The total emissions generated by the construction of Moorebank IMT during construction are 49,580, 13,945 and 11,414 t CO_2-e for Phases A (including Early Works), B and C respectively.

The main emissions associated with all construction stages are associated with stationary energy, with the exception of Phase B where the main emissions are due to transport (flight and heavy vehicles). Stationary energy accounts for 58% (Early Works and Phase A), 42% (Phase B) and 76% (Phase C) of emissions throughout the construction phases. Transport energy contributes to approximately 13% of emissions for Early Works and Phase A, 44% of emissions for Phase B, and 12% of emissions for Phase C2.

The total net loss of carbon sequestration as GHG emissions as a result of vegetation loss due to clearing is approximately 14,442 t CO_2-e. However, the GHG emissions due to land clearing is not expected to be as significant as calculated, as it is expected to be partly balanced by native vegetation restoration within the footprint boundary. Refer also to section 7.1 of this assessment for further information.

Scope 2 emissions from purchased electricity use are minimal compared to other emission sources, as electricity use contributes between 0.2 % and 0.7% of emissions for each phase.

5.2 Operational annual emissions

This section provides a summary of operational Scope 1 (direct) and Scope 2 (indirect) GHG emissions generated from the Phase B, Phase C and full build development of the Moorebank IMT Project. This table gives a breakdown of the major GHG emission sources associated with the operation of the intermodal facility and has been classified according to the sectors defined by the 2006 IPPC Guidelines (2006). These sectors include energy (transport and stationary, including natural gas) and waste (municipal).

Table 5.4 Breakdown of annual operational Scope 1 and 2 emissions for Moorebank IMT according to scopes and sources for Phase B operation

Scope	Emission source	Source total	Unit	Emissions[1] (t CO_2-e/year)
Scope 1	**Transport**			
	Light vehicles use for staff and onsite-activities	101,069	L (petrol)	240
	Diesel heavy vehicle use	503,805	L (diesel)	1,358
	IMEX locomotive trains	538,200	L (diesel)	1,450
	Mobile Plant			
	Fuel use for equipment fleet (forklifts, sidepicks, switch engines and stand-by power generation)[2]	2,544,684	(LNG and diesel)	6,826
	Intermodal Terminal Vehicles	3,416,400	L (LNG)	5,259
	Natural Gas			
	Natural gas distributed in a pipeline	2,192	GJ	112
	Waste			
	Wastewater treatment onsite	100	Personnel	23
	Industrial processes including use of synthetic gases			
	Sulphur Hexafluoride (SF_6) losses	0.2	tonnes	23
	Refrigerant (HFC R134a) losses	6.1	tonnes	606
Scope 2	**Stationary energy**			
	Purchased electricity use (storage yard, rail terminal, reefer storage box, flooding lighting, onsite buildings, and warehousing)	53,653,264	kWh	47,215
Total annual operational emissions (t CO_2-e/year)				**63,113**

(1) Numbers are rounded to the nearest whole number

(2) Equipment fleet is fuelled by LNG with the exception of switch engines which are diesel fuelled

Table 5.5 Breakdown of annual operational Scope 1 and 2 emissions for Moorebank IMT according to scopes and sources for the Phase C operational scenario

Scope	Emission source	Source total	Unit	Emissions[1] (t CO_2-e/year)
Scope 1	**Transport**			
	Light vehicles use for staff and onsite-activities	243,418	L (petrol)	579
	Diesel heavy vehicle use	1,142,024	L (diesel)	3,077
	IMEX locomotive trains	1,068,600	L (diesel)	2,880
	Stationary			
	Fuel use for equipment fleet (forklifts, sidepicks, switch engines and stand-by power generation)[2]	2,544,684	(LNG and diesel)	6,826
	Intermodal Terminal Vehicles	3,416,400	L (LNG)	5,259
	Natural Gas			
	Natural gas distributed in a pipeline	4712	GJ	242
	Waste			
	Wastewater treatment onsite	215	Personnel	50
	Industrial processes including use of synthetic gases			
	Sulphur Hexafluoride (SF_6) losses	0.2	tonnes	23
	Refrigerant (HFC R134a) losses	12.8	tonnes	1,272
Scope 2	**Stationary energy**			
	Purchased electricity use (storage yard, rail terminal, reefer storage box, flooding lighting, onsite buildings, and warehousing)	105,958,132	kWh	93,243
Total annual operational emissions (t CO_2-e/year)				**113,452**

(1) Numbers are rounded to the nearest whole number

(2) Equipment fleet is fuelled by LNG with the exception of switch engines which are diesel fuelled

Table 5.6 Breakdown of annual operational Scope 1 and 2 emissions for Moorebank IMT according to scopes and sources for the Full Build (2030) operational scenario

Scope	Emission source	Source total	Unit	Emissions[1] (t CO_2-e/year)
Scope 1	**Transport**			
	Light vehicles use for staff and onsite-activities	313,279	L (petrol)	745
	Diesel heavy vehicle use	1,983,827	L (diesel)	5,346
	IMEX locomotive trains	1,068,600	L (diesel)	2,880
	Interstate locomotive trains	93,600	L (diesel)	252
	Stationary			
	Fuel use for equipment fleet (forklifts, sidepicks, switch engines and stand-by power generation)[2]	3,074,568	L (LNG and diesel)	8,248
	Intermodal Terminal Vehicles	6,964,200	L (LNG)	10,720
	Natural Gas			
	Natural gas distributed in a pipeline	6,903	GJ	354
	Waste			
	Wastewater treatment onsite	315	Personnel	73
	Industrial processes including use of synthetic gases			
	Sulphur Hexafluoride (SF_6) losses	0.2	tonnes	23
	Refrigerant (HFC R134a) losses	19	tonnes	1,877
Scope 2	**Stationary energy**			
	Purchased electricity use (storage yard, rail terminal, reefer storage box, flooding lighting, onsite buildings, and warehousing)	136,617,564	kWh	120,223
Total annual operational emissions (t CO_2-e/year)				**150,743**

(1) Numbers are rounded to the nearest whole number

(2) Equipment fleet is fuelled by LNG with the exception of switch engines which are diesel fuelled

5.2.1 Operational summary – Full Build

The total annual emissions generated by the Moorebank IMT during Full Build operations are estimated to be 150,743 t CO_2-e/year in 2030. The main sources of emissions associated with the Project are related to stationary energy (Scope 2), being 79% of the total operational emissions during Full Build. Stationary (Scope 1) accounts for 13% of Full Build operational emissions and transport accounts for 6%. Wastewater treatment and use of onsite natural gas contributes to <0.5% of Full Build operational emissions.

5.3 Greenhouse gas emissions associated with project-related changes to background traffic and heavy vehicle freight movements

The Project will result in an overall reduction in vehicle kilometres travelled (VKT), primarily as a result of the mode shift from trucks to trains for freight travelling between Port Botany and the Project site.

Table 5.5 provides an estimation of heavy vehicle emission reductions as a result of the IMT project.

Table 5.7 Potential emission reductions derived from reduction in heavy vehicle VKT as a result of the IMT

Year (Stage of operation)	Reduction in VKT travelled/yr	Fuel reduction (kL/yr)	Emissions reduction (t CO_2-e/yr)
2023 (Operation Phase B)	5,210,548	1,563	4,212
2028 (Operation Phase C)	11,792,216	3,538	9,533
2030 (Full Build operations)	20,499,230	6,150	16,572

The potential GHG emission reductions from reductions in heavy vehicle transport as a result of the Moorebank IMT are 4,212 and 9,533 t CO_2-e in 2023 and 2028 respectively. At the Full Build operational stage, potential GHG emission reductions from reductions in heavy vehicle transport as a result of the Moorebank IMT are 16,572 t CO_2-e per annum.

Table 5.8 provides an estimation of additional emissions due to background traffic diverting around the Project site, and resulting in increased VKT's.

Table 5.8 Potential emission increases derived from increases in background traffic VKT as a result of the IMT

Year (Stage of operation)	Increase in VKT	Fuel (kL)	Emissions contribution (t CO_2-e)
2018 (Phase B)	2,571,306	244	581
2025 (Phase C including construction)	4,090,715	389	925
2030 (Full Build operations)	3.908,094	371	884

The potential GHG emission increases from the reassignment of background traffic due to the location of the Moorebank IMT are 413 and 1,321 t CO_2-e in 2018 and 2025 respectively. In 2030 (Full Build operational stage), potential GHG emission increases from the reassignment of background traffic due to the location of the Moorebank IMT are 909 t CO_2-e per annum.

6. Summary

6.1 Summary of construction emissions

This report has reviewed emissions associated with the construction and operation of the Moorebank IMT.

The assessment has concluded that the lifetime of the three construction stages will emit:

Table 6.1 GHG emissions during the construction of the Project

Phase	GHG emissions (t CO_2-e)
Early Works and Phase A	49,580
Phase B	13,945
Phase C	11,414

The predominant source of emissions throughout Early Works, Phase A and Phase C is from stationary energy. This is mainly attributable to fuel use by construction equipment. For Phase B the predominate source if from transport. A breakdown of the emissions for each stage is shown in Figure 6.1.

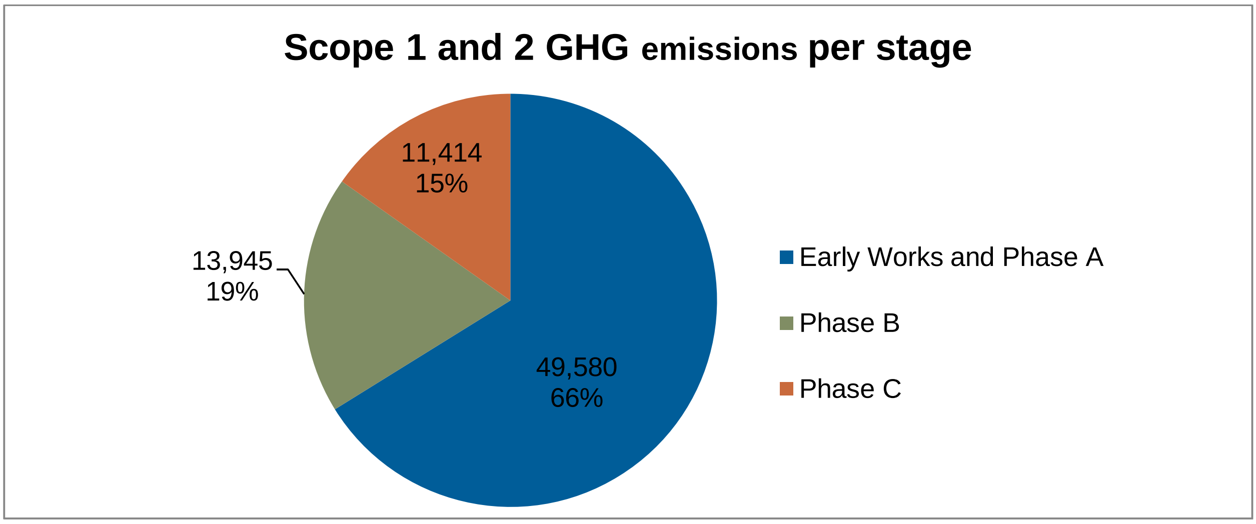


Figure 6.1 GHG emission sources for each construction phase (t CO_2-e)

6.2 Summary of operational emissions

The GHG assessment findings indicate that the 2030 Full Build operation phase will result in Scope 1 GHG emissions of approximately 30,520 t CO_2-e per year, of which the majority is associated with stationary intermodal terminal vehicles. The operational facility involves processing and transportation activities conducted 7 days a week, 24 hours a day, and is anticipated to generate approximately 120,223 t CO_2-e per year of Scope 2 emissions. Over the entire year of 2030, the Project is estimated to emit up to 150,743 t CO_2-e (Scope 1 and 2) of operational GHG emissions.

Figure 6.2 and Figure 6.3 summarise the composition of Scope 1 and 2 operational emissions sources for 2030 operations at Moorebank IMT.

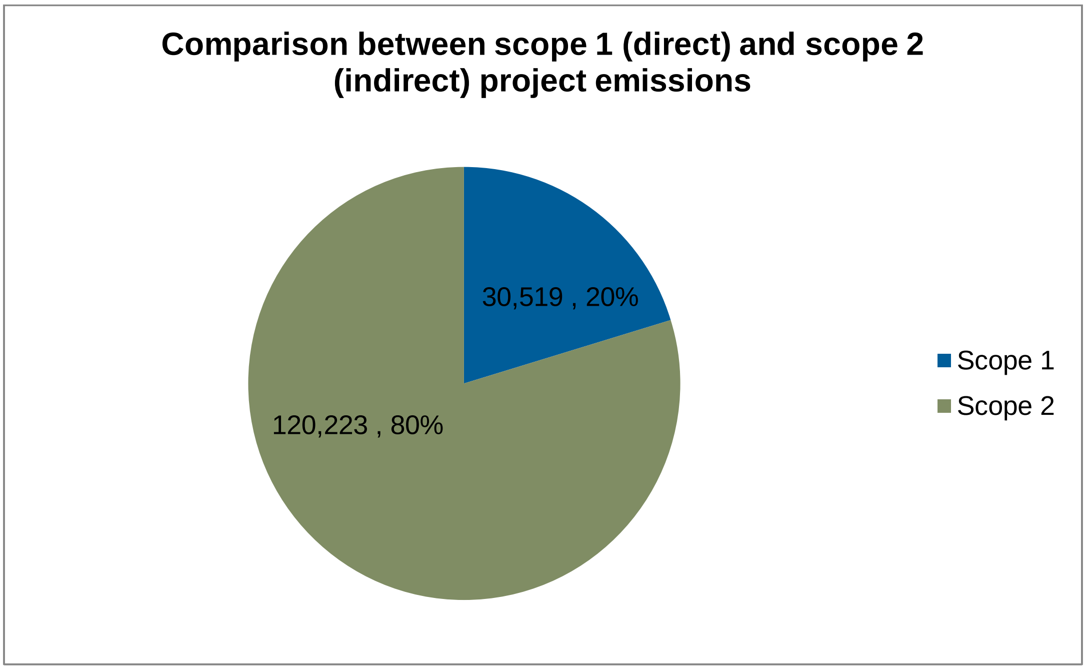


Figure 6.2 Comparison between Scope 1 and 2 GHG emissions during the 2030 full build operational phase (t CO_2-e)

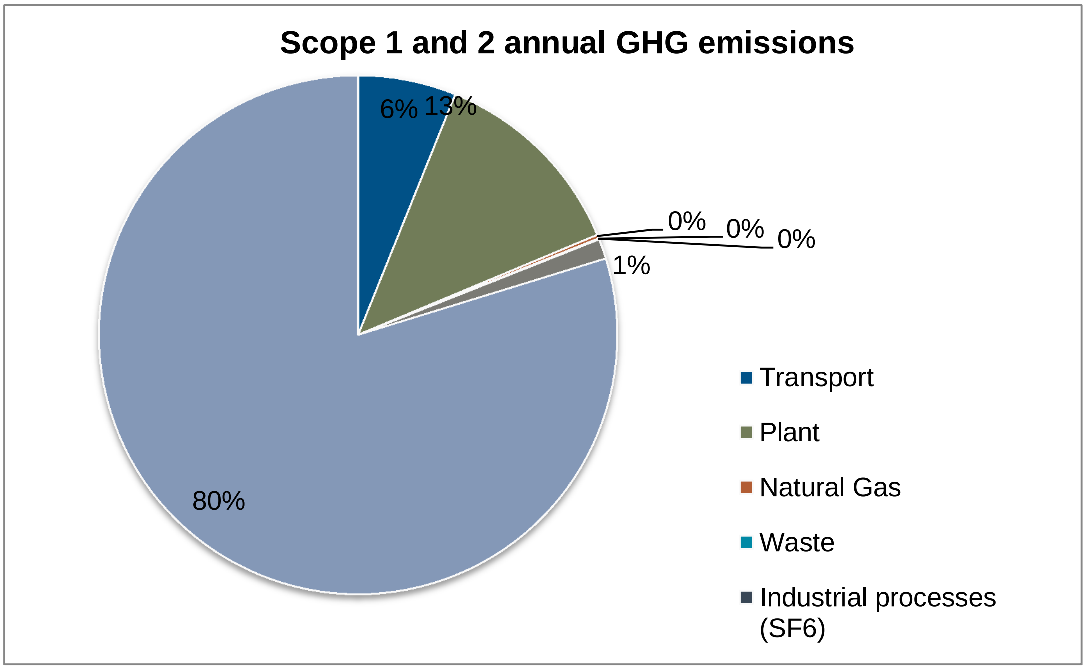


Figure 6.3 Composition of GHG emission sources during the 2030 full build operational phase

The findings of a strategic transport modelling report VKT were used to calculate GHG impacts and savings. Figure 6.4 indicates that the overall reductions in freight transport emissions as a result of Moorebank IMT outweigh the increases in emissions from changes to background traffic, resulting in a net reduction in potential emissions from road transport as a result of the IMT. The reduction in emissions can be attributed to network improvements and projected decreases in heavy vehicles on part of the Sydney arterial motorway network (specifically from Port Botany to Moorebank).

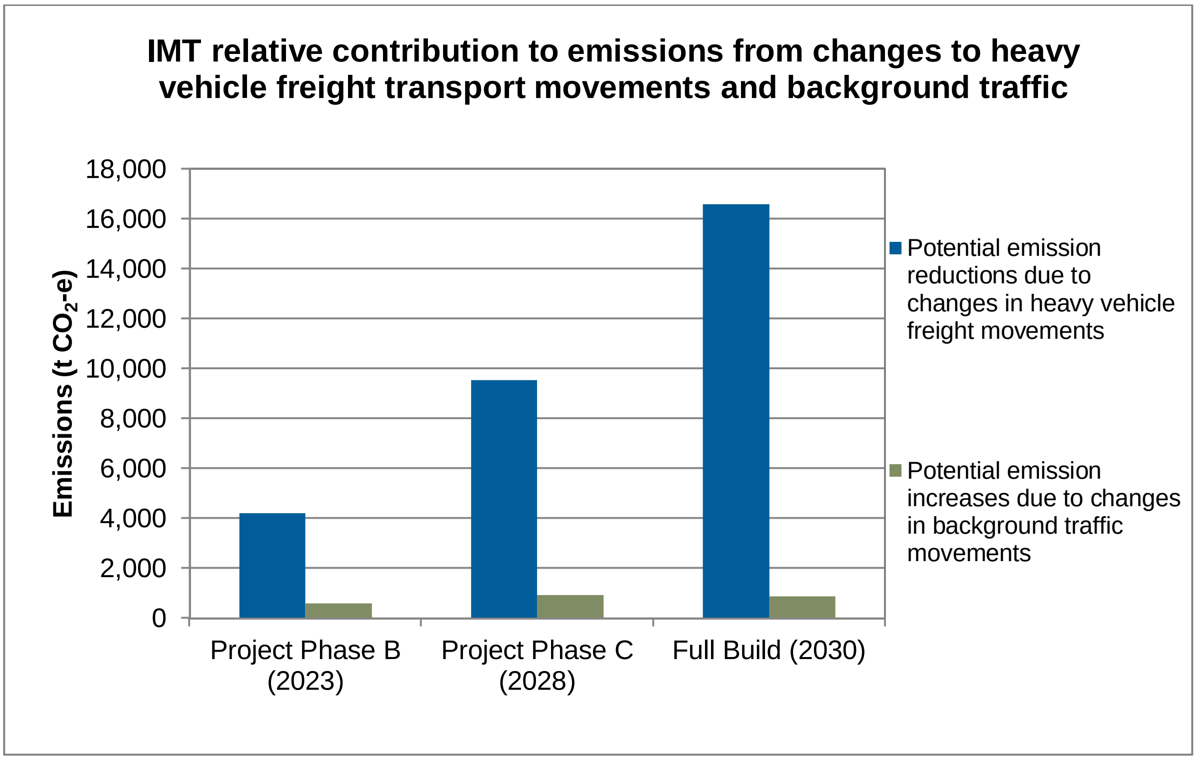


Figure 6.4 Comparison of GHG emissions using VKT findings

Annually, the Full-Build operation of the IMT Project will emit 150,743 t CO_2-e. However, it is recognised that the IMT will reduce the emissions from heavy vehicle road traffic, both during the construction and operational stages, as freight transportation is progressively transferred to the rail network.

Overall, Australia's total annual emissions for 2009/2010 were 560.8 Mt CO_2-e and NSW's annual emissions in 2009/2010 were 157.4 Mt t CO_2-e (Department of Climate Change and Energy Efficiency, 2012). By comparison, the annual operation of the project (Full Build in 2030) is projected to represent approximately 0.02% of Australia's total emissions (2009–2010) and 0.09% of NSW's emissions (2009–2010) respectively.

7. Greenhouse gas abatement strategy

7.1 Greenhouse gas abatement and mitigation

During the construction and operational phases, the overriding objective will be to improve operational efficiencies, where practicable, by implementing best practice technologies to reduce energy consumption and subsequent GHG emissions. The following measures are recommended for consideration in order to minimise GHG emissions for energy consumption and are also discussed in Table 7.1:

- Implementing energy-efficient guidelines for operational work, such as minimal idling time for machinery or complete shut off;
- Using biofuels (e.g. biodiesel, ethanol, or blends such as E10 and B880) to reduce GHG emissions from plant and equipment, where feasible;
- Using vehicles with GHG emissions ratings of a minimum of 7.5 for passenger vehicles and 6 for light commercial vehicles, as described in the Green Vehicle Guide (www.greenvehicleguide.gov.au);
- Establish an Environmental Management System (EMS) that involves regular monitoring, auditing and reporting on energy, resource use and GHG emissions from all relevant activities; include energy audits with a view to progressively improving energy efficiency and investigation of renewable energy sources (e.g. on-site solar generation), where feasible;
- Development of Key Performance Indicators for plant efficiency and GHG intensity; and
- Reducing losses from industrial processes (refrigerants and SF_6).

Establishing areas of native flora and vegetation either within the Moorebank IMT footprint or at alternative suitable locations will generate significant benefits in terms of carbon sequestration. However, these benefits do not qualify under Australian Government Guidelines as formal carbon offsets, and mitigation by this method typically takes many years to decades to accrue significant amounts of carbon sequestration.

7.2 Available options for mitigation measures

The previous section indicated that a reduction of emissions can be achieved through a series of mitigation options such as strategic choices fuels and suppliers. A list of some of these options identified and their potential to reduce the project emissions due to energy consumption is shown in Table 7.1. It is recommended that these options be considered during detailed design and Project procurement.

Table 7.1 Major emissions source and possible mitigation options for energy consumption

Emissions source	Project use	Suggested alternative	Potential reduction (% of GHG intensity)	Comments
Diesel	Plant and equipment	Biodiesel (B20)	14.8%	Switch engine manufacturers have different acceptance levels towards Biodiesel blends. e.g. Isuzu accept only B5, Caterpillar accepts B20 on Compact and Mid-Range Industrial Engines.
	Transport	Biodiesel (B20)	14.8%	A key issue with Biodiesel for trucks might be the reduction in power output although with blends this reduction in power is not significant.
Truck movements and fuel usage	Materials haulage	Materials haulage	Various	Despite difficulty in measuring the t CO_2-e reduced, it is clear that by minimising prolonged idling typical vehicles can avoid 2 to 2.5 L of fuel per hour of idling.
		Movement planning	Various	Despite difficulty to measure the t CO_2-e reduced, by planning delivery schedules so that there are fewer and shorter trips energy/GHG emissions can be saved.
Electricity usage	Electricity use for construction and operation	50–100% green power	50–100%	Green power is sourced from renewable energy sources and generally has a small price premium attached to it, dependent on the % of green power sourced.

8. References

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Appendix A

Site layouts

INDICATIVE NORTHERN RAIL CONNECTION CONCEPT LAYOUT
MOOREBANK INTERMODAL TERMINAL

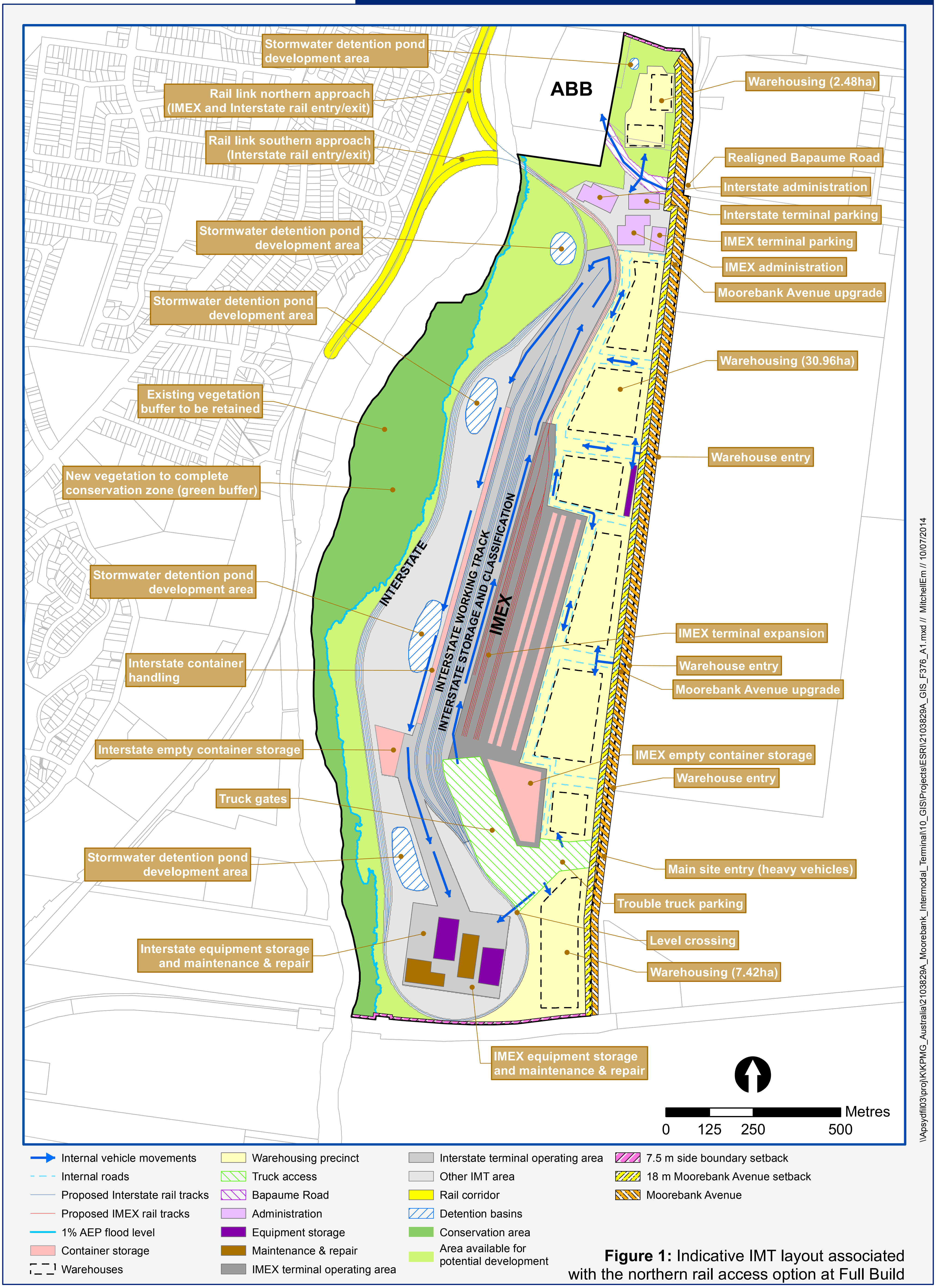

Figure 1: Indicative IMT layout associated with the northern rail access option at Full Build

INDICATIVE CENTRAL RAIL CONNECTION CONCEPT LAYOUT
MOOREBANK INTERMODAL TERMINAL

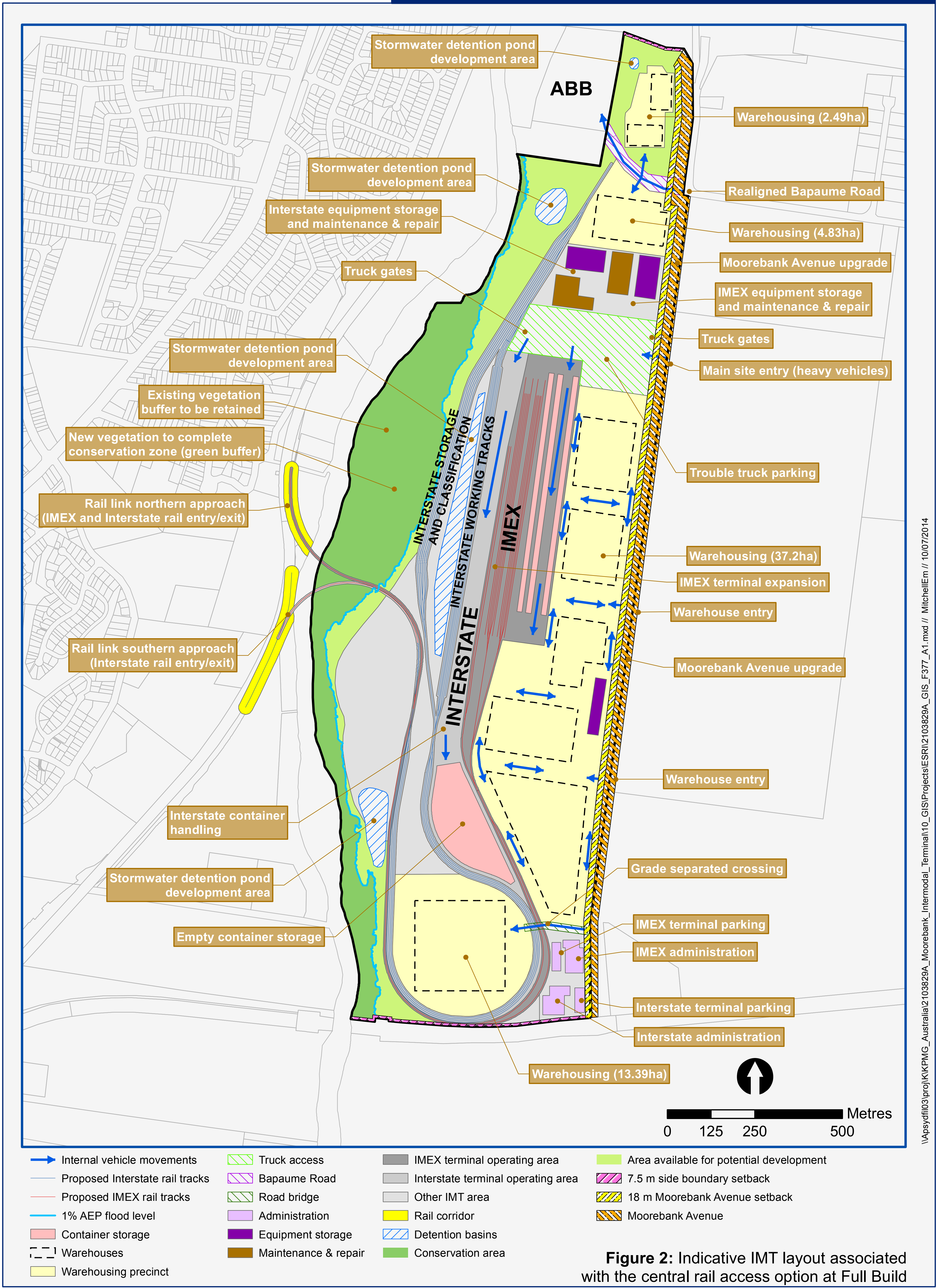

Figure 2: Indicative IMT layout associated with the central rail access option at Full Build

INDICATIVE SOUTHERN RAIL CONNECTION CONCEPT LAYOUT
MOOREBANK INTERMODAL TERMINAL

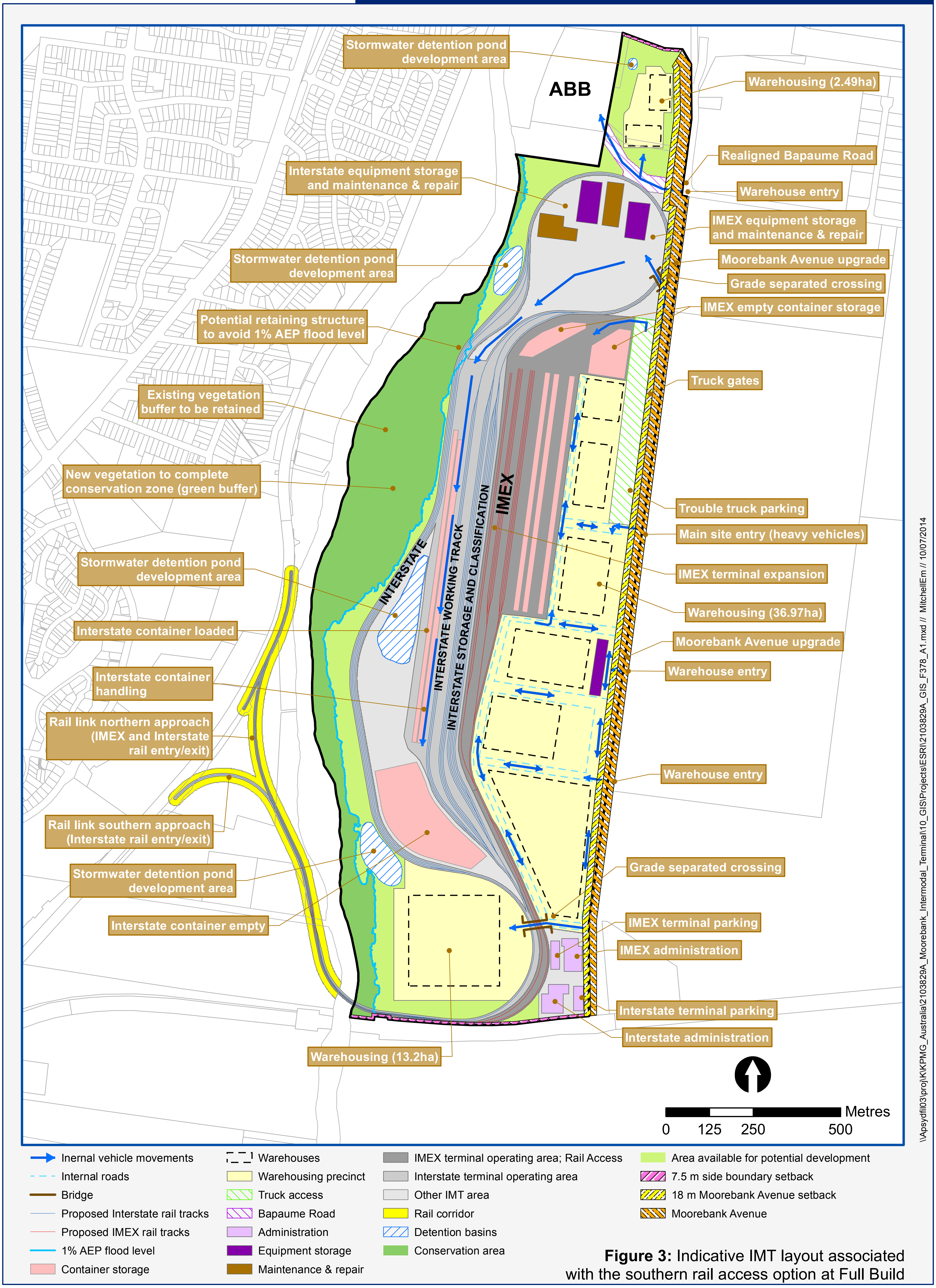

Figure 3: Indicative IMT layout associated with the southern rail access option at Full Build