# Yanchep Rail Extension Part 2

Public Transport Authority of Western Australia

## Carbon and Energy Assessment Report

PTA_METRONET_YRE Part 2 Carbon and Energy Assessment Report | 1

14 May 2019

PTA Contract 180505

# Yanchep Rail Extension Part 2

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## Document history and status

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## Contents

## Appendix A. PTA Environment Policy

## Important note about your report

The sole purpose of this report and the associated services performed by Jacobs Group (Australia) Pty Ltd ("JACOBS") is to provide a qualitative air quality impact assessment for the project "Part 2 of the Yanchep Rail Extension" in accordance with the scope of services set out in the contract between JACOBS and the Public Transport Authority of Western Australia (PTA) (Contract PTA180505). That scope of services, as described in this report, was developed with the PTA

In preparing this report, JACOBS has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the PTA and/or from other sources. Except as otherwise stated in the report, JACOBS has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

JACOBS derived the data in this report from information sourced from the PTA (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. JACOBS has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by JACOBS for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of the PTA, and is subject to, and issued in accordance with, the provisions of the agreement between JACOBS and the PTA. JACOBS accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

# 1. Introduction

The Public Transport Authority (PTA) proposes to extend a future connection of the Northern Suburbs Railway by 7.2 kilometres (km), from north of the future Eglinton Station to the suburb of Yanchep in the City of Wanneroo. The proposed Yanchep Rail Extension (YRE), herein encompassing Part 2 of the YRE, will construct and operate the rail extension and one new intermodal (rail, bus, 'park and ride', 'kiss and ride', walk and cycle) transit station at Yanchep, and will include the construction and operation of a principal shared path and access roads.

The YRE is one of eight proposed developments of the wider METRONET Stage One project headed by the PTA. METRONET Stage One includes:

- Completing the Forrestfield-Airport Link;
- Extending the Joondalup Line to Yanchep;
- Linking Thornlie and Cockburn Central stations;
- Planning and building the new Morley-Ellenbrook Line;
- Extending the Armadale Line to Byford;
- Relocating Midland Station and extending the Midland Line to Bellevue;
- Building a new station at Karnup on the Mandurah Line;
- Starting a program to remove level crossings on the Armadale and Midland lines;
- Procuring the next generation of railcars, which is identified as a Strategic Project under the WA Jobs Act 2017, which has additional requirements for local job creation;
- Planning for alternative transport options to better connect communities; and
- Investigating increasing passenger parking at Mandurah Station.

Jacobs has been engaged to undertake an energy and carbon management assessment for the YRE Part 2 component of the project to support the needs of the PTA to prepare a greenhouse gas (GHG) assessment.

On 7 March 2019, the Environmental Protection Authority (EPA) revised its guidance on mitigating greenhouse gas emissions from significant new or expanding proposals in Western Australia. Although these guidelines were withdrawn by the EPA on 14 March 2019 due to the need for further industry and stakeholder consultation, the PTA will progress with the energy and carbon assessment using national GHG emissions guidelines and standards to support the development of the project.

## 1.1 Objective

The key objectives of this energy and carbon management assessment were to:

- Identify potential sources of greenhouse gases associated with the construction and operation of the proposal;
- Quantify the likely magnitude of these emissions; and
- Identify opportunities to reduce the emissions of greenhouse gases during construction and operation of the proposal.

## 1.2 Scope of Work

To meet the objectives of the assessment, specific tasks of this scope include:

- Identify and determine the relevant emissions sources/activities;
- Undertake a construction and operation energy and greenhouse gas assessment;

- Develop a greenhouse gas inventory for construction and operation; and
- Provide high level recommendations for reducing greenhouse gas emissions.

In addressing these objectives, the assessment was conducted in accordance with applicable policy and guidelines.

# 2. Yanchep Rail Extension Description

YRE Part 2 comprises an extension to the Northern Suburbs Railway of 7.2 kms, from north of the future Eglinton Station to the suburb of Yanchep in the City of Wanneroo, to provide future connection to these suburbs. The proposal is to construct and operate the rail extension, one new intermodal (rail, bus, 'park and ride', 'kiss and ride', walk and cycle) transit station at Yanchep, a Principal Shared Path and access roads.

Part 1 (excluded from this assessment) will involve the extension to the existing Joondalup railway line by 7.3 kms from Butler Station to the suburb of Eglinton in the City of Wanneroo.

The following detailed description is for Part 2 only. The Yanchep Station will be built in a cutting with a cut and cover tunnel approach to provide ground-level connections in a free to access concourse area to each side of the railway. Yanchep Station's future proof design provides land development opportunities, while meeting passenger needs from day one of operations.

The universally accessible station will include:

- Passenger amenity: public toilets, public services, such as vending machines, kiosk, passenger ticketing/information, staff amenities, station administration offices, storage/cleaning and operational facilities;
- Pedestrian/cycle access: well connected to a shared path west of the station, with two secure bicycle parking shelters, bike u-rails and ability to add two additional secure bicycle parking shelters in the future;
- Bus interchange: 14-stands with weather protection, seating and information facilities. Its flexible design could see buses dropping off passengers either internally to the bus station or externally next to commercial development to maximise the surrounding development potential. The interchange includes seven layover bays;
- Vehicle access: dedicated passenger drop-off area and approximately 1,000 parking bays; and
- Daily boarding estimated at 11,032 passengers (2031).

# 3. Greenhouse Gases and Climate Change

Greenhouse gases (GHGs) is a collective term for a range of gases that are known to trap radiation in the upper atmosphere, where they have the potential to contribute to the greenhouse effect (global warming). Creating an inventory of the likely GHG emissions associated with a project has the benefit of determining the scale of the emissions and providing a baseline from which to develop and deliver GHG reduction options. Greenhouses gases include:

- Carbon dioxide ($CO_2$) – by far the most abundant, primarily released during fuel combustion;
- Methane ($CH_4$) – from the anaerobic decomposition of carbon-based material (including enteric fermentation and waste disposal in landfills);
- Nitrous oxide ($N_2O$) – from industrial activity, fertiliser use and production;
- Hydrofluorocarbons (HFCs) – commonly used as refrigerant gases in cooling systems;
- Perfluorocarbons (PFCs) – used in a range of applications including solvents, medical treatments and insulators; and
- Sulphur hexafluoride ($SF_6$) – used as a cover gas in magnesium smelting and as an insulator in heavy duty switch gear.

It is common practice to aggregate the emissions of these gases to the equivalent emission of carbon dioxide. This provides a simple figure for comparison of emissions against targets. Aggregation is based on the potential of each gas to contribute to global warming relative to carbon dioxide and is known as the global warming potential (GWP). The resulting number is expressed as carbon dioxide equivalents (or $CO_2e$).

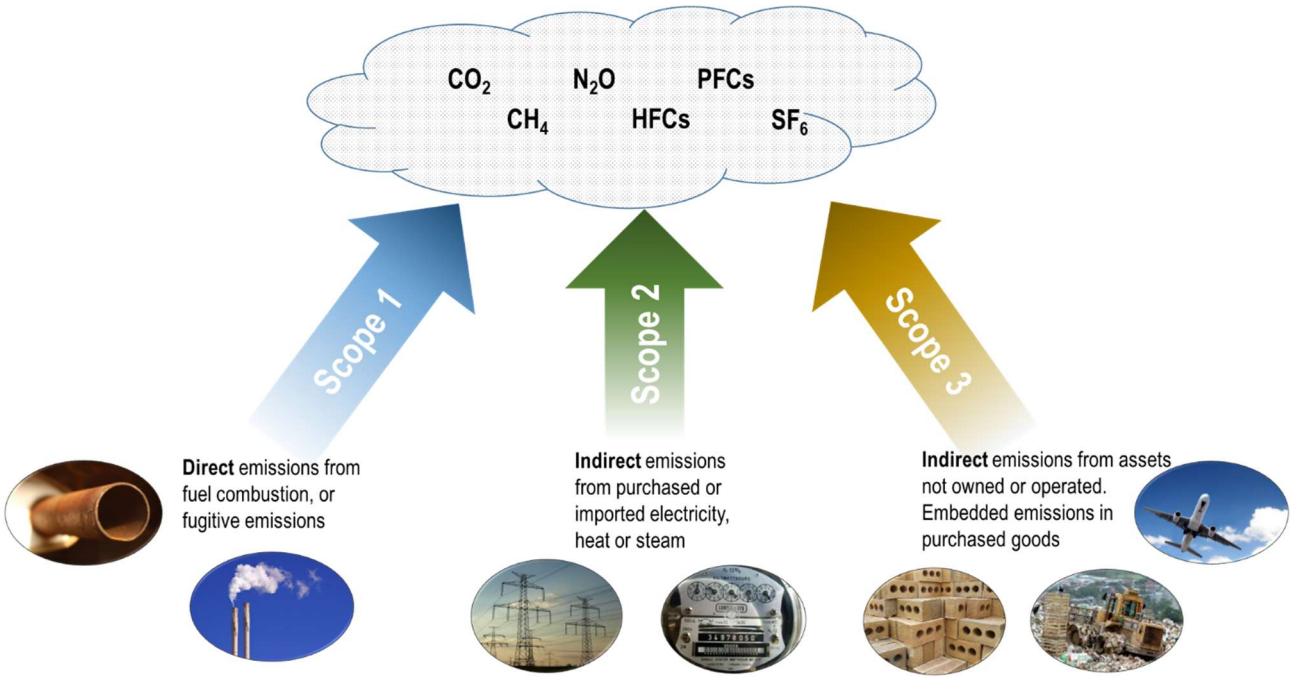
The GHG inventory in this document is calculated in accordance with the principles of the Greenhouse Gas Protocol (GHG Protocol)[1]. The GHG emissions that form the inventory can be split into three categories known as 'Scopes'. Scopes 1, 2 and 3 are defined by the GHG Protocol and can be summarised as follows:

- **Scope 1** – Direct emissions from sources that are owned or operated by a reporting organisation (examples – combustion of diesel in company owned vehicles or used in on-site generators);
- **Scope 2** – Indirect emissions associated with the import of energy from another source (examples – importation of electricity or heat); and
- **Scope 3** – Other indirect emissions (other than Scope 2 energy imports) which are a direct result of the operations of the organisation but from sources not owned or operated by them (examples include business travel (by air or rail) and product usage).

A visual description of the above is shown in **Figure 3-1**.

The first step in assembling a greenhouse gas inventory is to determine the sources of greenhouse gas emissions, assess their likely significance and set a provisional boundary for the study.

[1] The Greenhouse Gas Protocol is collaboration between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The Protocol provides guidance on the calculation and reporting of carbon footprints.




*Adapted from – World Business Council for Sustainable Development – Greenhouse Gas Protocol*

**Figure 3-1 Sources of Greenhouse Gases**

The results of this assessment are presented in terms of the above-listed 'Scopes' to help understand the direct and indirect impacts of the project for Scopes 1 and 2 only. The GHG Protocol (and similar reporting schemes) dictates that reporting Scope 1 and 2 sources is mandatory, whilst reporting Scope 3 sources is optional. Reporting significant Scope 3 sources is recommended.

# 4. Legislation, Guidelines and Policy

Legislation and policy administered by federal and state government that relates to the assessment method, as well as those of the PTA / METRONET are outlined in this section.

## 4.1 International framework

### 4.1.1 Kyoto Protocol and COP21

On 3 December 2007, the then Australian Prime Minister, Kevin Rudd, signed the instrument of ratification of the Kyoto Protocol. Australia has met its Kyoto Protocol target of limiting emissions to 108% of 1990 levels, on average, over the Kyoto period 2008–2012. Over the five reporting years in the Kyoto period (2008 to 2012), Australia's net emissions averaged 104% of the base year level (DoE 2014). As such, Australia has committed to meeting its Kyoto Protocol long term target, and has set a target to reduce GHG emissions by 60% on 2000 levels by 2050.

The Paris Climate Conference (COP21) reached an agreement 'to achieve a balance between anthropogenic (human induced) emissions by sources and removals by sinks of greenhouse in the second half of this century'. Following COP21, international agreements were made to:

- Keep global warming well below 2.0 degrees Celsius, with an aspirational goal of 1.5 degrees Celsius;
- From 2018, countries are to submit revised emission reduction targets every 5 years, with the first being effective from 2020, and goals set to 2050;
- Define a pathway to improve transparency and disclosure of emissions; and
- Make provisions for financing the commitments beyond 2020.

Australia's commitment to the Paris COP21 includes the target for a reduction in emissions to 26–28 % on 2005 levels by 2030. This target represents a 50–52 per cent reduction in emissions per capita and a 64–65 per cent reduction in the emissions intensity of the economy between 2005 and 2030.

## 4.2 Commonwealth greenhouse gas framework

### 4.2.1 National Greenhouse and Energy Reporting Act 2007

The Federal Government uses the National Greenhouse Gas and Energy Reporting (NGER) scheme for the measurement, reporting and verification of Australian greenhouse gas emissions. This scheme has a range of purposes, including being used for international greenhouse gas reporting purposes. Corporations which meet the thresholds for reporting under NGER must register and report their greenhouse gas emissions.

Under the *National Greenhouse Gas and Energy Reporting Act 2007* (NGER Act), constitutional corporations in Australia which exceed thresholds for GHG emissions, energy production or consumption are required to measure and report data to the Clean Energy Regulator on an annual basis. The *National Greenhouse and Energy Reporting (Measurement) Determination 2008* identifies a number of methodologies to account for GHGs from specific sources relevant to a proposed development. This includes emissions of GHGs from direct fuel combustion (fuels for transport energy purposes), emissions associated with consumption of power from direct combustion of fuel (e.g. diesel generators used during construction), and from consumption of electricity from the grid.

By way of example, the current operator of the rail network in Sydney, Sydney Trains, at an organisational level exceeds the threshold for reporting under the NGER Act, and as such annually reports the GHG emissions from its rail operations to the Commonwealth Government. Once constructed, GHG emissions associated with operation of a proposal will need to be included in the NGERs reporting by the current operator at the time.

### 4.2.2 Commonwealth Renewable Energy Target

The Commonwealth Renewable Energy Target (RET) is an Australian Government scheme designed to reduce GHG emissions in the electricity sector and encourage the additional generation of electricity from sustainable and renewable sources. The RET scheme currently commits Australia to generating 33,000 Gigawatt hours (GWh) per year of electricity from 'low emission' sources by 2020 in order to achieve the goal of a 23.5% share of renewable energy in Australia's electricity supply by 2020.

The Clean Energy Regulator oversees the operation of the RET, and the Department of the Environment and Energy (DoEE) provides policy advice and implementation support for the scheme.

The RET is designed to encourage investment in new large-scale renewable power stations and the installation of new small-scale systems, such as solar photovoltaic (PV) and hot water systems in households. The REThas two core components: the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). Together, the LRET and SRES create a financial incentive for investment in renewable energy for both large and small scale (e.g. householder) generators. The LRET is currently scheduled to run until 2030.

### 4.2.3 Emissions Reduction Fund (ERF)

Previous legislation passed by the Australian Government to reduce carbon emissions was the *Clean Energy Act 2011*. This legislation established an Emissions Trading Scheme (ETS) or carbon price. Under this ETS, approximately 370 companies were required to purchase a permit for every tonne of carbon equivalent they emit.

The *Clean Energy Legislation (Carbon Tax Repeal) Act 2014* repealed the *Clean Energy Act 2011*. This abolished the carbon pricing mechanism from 1 July 2014, and was replaced with the Australian Government's Direct Action Plan, which aims to focus on sourcing low cost emission reductions. The Direct Action Plan included an Emissions Reduction Fund (ERF); legislation to implement the ERF came into effect on 13 December 2014, and is now considered to be the centrepiece of the Australian Government's policy suite to reduce emissions.

There is a range of emissions reduction and sequestration methodologies under the ERF which could provide the Project with the opportunity to earn carbon credits as a result of emissions abatement or avoidance activities put into place in its operation.

## 4.3 State greenhouse gas framework

On 7 March 2019, the Environmental Protection Authority (EPA) revised its guidance on mitigating greenhouse gas emissions from significant new or expanding proposals in Western Australia. The Environmental Factor Guidance – *Greenhouse Gas Emissions and EPA Technical Guidance – Mitigating Greenhouse Gas Emissions* was developed to help proponents of significant proposals in the State prepare for an environmental assessment by the EPA. The purpose of the revised guidelines was to:

- outline the information required from proponents and how it may be considered by the EPA in its environmental impact assessment;
- set a clear threshold for when greenhouse gas emissions from proposals will be considered by the EPA, and what mitigation measures will likely be required.

The EPA withdrew these guidelines on 14 March 2019 to progress further industry and stakeholder consultation. There is currently no planned release date for these revised guidelines.

## 4.4 METRONET objectives

The Metronet Office has developed a set of sustainability objectives for the METRONET program to assist with planning, design, construction and operational maintenance. Those of relevance to GHG emissions are detailed in **Section** Error! Reference source not found. of this report.

## 4.5 PTA policy

The PTA has committed to managing its operations in an environmentally sustainable and responsible manner via the implementation of their Environment Policy (Appendix A).

# 5. Methodology

## 5.1 Inventory boundary definition

### 5.1.1 Introduction

The initial step for a greenhouse gas inventory is to determine the sources of greenhouse gas emissions, assess their likely significance and set a provisional boundary for the assessment. This section identifies potential sources of greenhouse gases associated with the construction and operation of the YRE Part 2.

Scopes 1 and 2 will be included in the report where they are shown to be material. The materiality threshold for this study is 1% for individual emissions sources, as long as in aggregate they do not equal more than 5% of the complete construction or operation inventory. Boundary inclusions and exclusions are listed in **Table 5-1.**

**Table 5-1 Greenhouse Gas Inventory Boundary for Proposal**

| Activity | Scope 1 or 2 emissions (included) | Scope 3 emissions (excluded from this assessment) | Excluded source of emissions |
|---|---|---|---|
| **Construction** | | | |
| Construction equipment – on site fuel consumption | ● | | |
| Construction equipment – on site electricity generation | | | ● |
| Electricity consumption (imported from grid) | | | ● |
| Vegetation clearance | ● | | |
| Water treatment (Scope 2 only) | | | ● |
| Waste disposal | | ● | |
| Employee commuting | | ● | |
| Construction material manufacture | | ● | |
| Construction material and waste transport | | ● | |
| Offsite project management | | | ● |
| **Operation** | | | |
| Operational fuel consumption (incl. maintenance) | ● | | |
| Operational electricity consumption | ● | | |
| Maintenance (materials) | | | ● |

More detail on each of the inclusions and exclusions is provided in the following sections.

## 5.2 Calculation methodology

This report has been prepared for YRE (Part 2) in line with the principles of AS14064-2 Greenhouse gases - Specification with guidance at the project level for quantification and reporting of greenhouse gas emission reductions and removal enhancements, and a number of tools as outlined in this section.

The sections below outline the calculation steps used in the assessment. Greenhouse gas inventories are typically completed by gathering data on the activities being undertaken and materials being used, and multiplying them by factors which represent the emissions of greenhouse gases for that activity. For this assessment, these factors (for fuel and electricity consumption) were derived from the DoEE's National Greenhouse Accounts Factors (NGA) (DoEE, 2018).

Loss of carbon sink (as a result of vegetation clearance) was calculated by using the Transport Authorities Greenhouse Group Carbon Gauge Tool (TAGG, 2013).

## 5.3 Construction data

Construction inputs were determined based on current concept design projections provided by the PTA. Construction data inputs confirmed by the PTA at the time of this assessment include:

- Construction timescale – approximately 33 months;
- Development envelope – 73 hectares (ha);
- Maximum vegetation cleared (within the development envelope) – approximately 63 ha
- Construction diesel use – 2,020 kilolitres (kL); and
- Construction petrol use – 20 kL.

The following section details the emissions sources relating to the construction stage.

### 5.3.1 Construction fuel consumption

A variety of construction equipment is anticipated to be used on site, using either diesel fuel, or drawing on electrical energy. Equipment and plant includes (but is not limited to):

- Piling Rigs;
- Excavators;
- Front end loaders;
- Mobile cranes;
- Generators;
- Compressors; and
- Concrete pumps.

Combustion of fuel in this equipment will lead to direct emissions of greenhouse gases (Scope 1). Projection estimates for total project fuel consumption have been made available for this assessment by the PTA. The PTA advised that total project fuel consumption is 6,800 kL, and that 30% of this is for YRE Part 2. Of the 30%; 1% is petrol. Therefore 2,020 kL has been used for construction diesel consumption and 20 kL has been used for construction petrol consumption in this assessment.

Using the NGA for fuel combustion emissions – liquid fuels, the following formula and emissions factors were used to estimate greenhouse gas emissions from the stationary combustion of each type of liquid fuel (diesel and petrol):

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\,000}$$

Where:

- Eij is the emissions of gas type (j), (carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO2-e tonnes);
- Qi is the quantity of fuel type (i) (kilolitres) combusted for stationary energy purposes;
- ECi is the energy content factor of fuel type (i) (gigajoules per kilolitre) for stationary energy purposes, according to Table 3,
  - If Qi is measured in gigajoules, then ECi is 1; and
- EFijoxec is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO2-e per gigajoule) according to those outlined in **Table 5-2**.

**Table 5-2 : Emissions factors for diesel oil and gasoline for stationary combustion of each liquid fuel.**

| Fuel combusted | Energy content factor (GJ/kL) | Emissions factor kg CO2-e/GJ | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| Diesel oil | 38.6 | 69.9 | 0.1 | 0.2 |
| Gasoline | 34.2 | 67.4 | 0.2 | 0.2 |

### 5.3.2 Vegetation clearance

Vegetation clearance requires fuel for clearing and transport equipment, but also results in the loss of the carbon stored in the vegetation. The level of carbon stored in the vegetation is proportional to its type, age and condition. For example, where vegetation is previously disturbed (i.e. previously cleared), then depending on the amount of regrowth, there is likely to be a much lower level of stored carbon.

This assessment assumed that vegetation within the entire project development envelope extent would be cleared as a result of the YRE Part 2. Although this proposal is in an urban location, 85% of the project development envelope will impact vegetation (with a large proportion of this being native remnant vegetation) and the remaining is previously disturbed/cleared area. The project development envelope comprises a mixture of native shrublands and woodlands varying in condition (approximately 63 ha) and already cleared areas (approximately 10 ha).

To determine likely carbon store, a simple approach to accounting for loss of carbon sink from the Transport Authorities Greenhouse Group Australia and New Zealand (TAGG) Carbon Gauge Tool (TAGG, 2013) was applied. This applies a factor per hectare of clearance based on the vegetation type. For Yanchep WA, a max biomass class of '1' is derived from Carbon Gauge which represents 0-50 tonnes (t) dry matter per hectare. Carbon Gauge calculates the likely loss of carbon sink in $tCO_2e$[2].

The assumptions outlined in **Table 5-3** were made for inputs into the Carbon Gauge Tool for the vegetation data provided by the PTA.

[2] $tCO_2e$ – Tonnes of carbon dioxide equivalent

**Table 5-3 : Vegetation type within the YRE Part 2 development envelope and relevant Carbon Gauge Tool vegetation class.**

| ID | Vegetation type | Extent in development envelope (ha) | Carbon Gauge Tool Vegetation Class | Carbon Gauge Tool Vegetation Class Description |
|---|---|---|---|---|
| VT01 | *Acacia saligna* and *Xanthorrhoea preissii* tall shrubland | 15.75 | G | Open Shrubland |
| VT02 | *Banksia sessilis* and *Melaleuca systena* mid-shrubland | 5.24 | G | Open Shrubland |
| VT03 | *Banksia sessilis* and *Spyridium globulosum* tall shrubland | 8.57 | G | Open Shrubland |
| VT03a | *Spyridium globulosum* tall shrubland | 2.80 | G | Open Shrubland |
| VT04 | *Banksia attenuata, B. menziesii* low woodland | 4.75 | F | Mallee and Acacia Woodland |
| VT05 | *Lomandra* sp. herbland | 5.31 | I | Grasslands |
| VT06 | *Eucalyptus gomphocephala* tall woodland | 2.13 | D | Open Woodlands |
| VT07 | *Eucalyptus* sp. and *Agonis flexuosa* woodland | 0.32 | D | Open Woodlands |
| VT08 | *Melaleuca huegelii* and *M. systena* shrubland | 0.05 | G | Open Shrubland |
| VT09 | *Banksia attenuata* woodland | 4.01 | G | Open Shrubland |
| VT10 | *Xanthorrhoea preissii* shrubland | 1.46 | G | Open Shrubland |
| VT12 | Planted | 8.87 | G | Open Shrubland |
| VT13 | Scattered natives | 3.04 | G | Open Shrubland |
| **Total vegetation** | | **62.3 ha** | | |
| CL | Cleared | 10.56 | Not applicable | Not applicable |
| **Total disturbance footprint** | | **72.86 ha** | | |

### 5.3.3 Construction materials

Construction materials used in the proposal have been excluded from this assessment as they are a Scope 3 source of emissions.

### 5.3.4 Construction electricity consumption

During the construction phase, there will be no electrical energy consumption from a grid supply source as on-site power will be supplied/generated via fuel consumption. Electrical energy use has been accounted for in construction fuel usage (diesel).

### 5.3.5 Material transport

Construction materials will be hauled/transported from their place of manufacture to the site to be used and these vehicles are likely to belong to the manufacturer, or a contractor. In addition, spoil will be hauled from the site to a reuse, recycling or disposal location. This would typically be included as 'waste management' transport in the quantification and reporting of emissions.

Construction material and waste transport has been excluded from this assessment as they are operated by third parties and therefore classified as Scope 3.

## 5.4 Operation

Energy will be consumed during operation through the following:

- Electrical energy consumed by locomotives;
- Electricity consumption in stations;
- Liquid or gaseous fuel consumed within stations;
- Electricity consumption by signalling and ventilation equipment; and
- Liquid fuels used during maintenance activities.

Operational energy use was estimated by the PTA based on existing Perth train station network data. The assumptions are as follows:

- Total station footprint – 73 ha, of this approximately 63 ha is vegetation;
- Yanchep Station life – 50 years;
- Annual train electricity use – 6,714 megawatt hours (MWh); and
- Annual station operational electricity use – 308 (MWh).

As per **Table 5-1**, operational water use has been excluded from this assessment. The following section details the emissions sources relating to the operational stage.

Using the NGA for transport fuel emissions, the following formula and emissions factors were used to estimate GHGs from the combustion of each type of fuel (diesel and petrol):

$$E_{ij} = \frac{Q_i \times EC_i \times EF_{ijoxec}}{1\,000}$$

Where:

- Eij is the emissions of gas type (j), carbon dioxide, methane or nitrous oxide, from fuel type (i) (CO2-e tonnes);
- Qi is the quantity of fuel type (i) (kilolitres or gigajoules) combusted for transport energy purposes;
- ECi is the energy content factor of fuel type (i) (gigajoules per kilolitre or per cubic metre) used for transport energy purposes,
  - If Qi is measured in gigajoules, then ECi is 1; and
- EFijoxec is the emission factor for each gas type (j) (which includes the effect of an oxidation factor) for fuel type (i) (kilograms CO2-e per gigajoule) used for transport energy purposes — see **Table 5-4**.

**Table 5-4 : Emissions Factors for diesel oil and gasoline (transport fuel)**

| Fuel combusted | Energy content factor (GJ/kL) | Emissions factor kg CO2-e/GJ | | |
|---|---|---|---|---|
| | | $CO_2$ | $CH_4$ | $N_2O$ |
| Diesel oil | 38.6 | 69.9 | 0.1 | 0.5 |
| Gasoline | 34.2 | 67.4 | 0.5 | 1.8 |

### 5.4.1 Electrical energy consumed by trains

Trains on YRE Part 2 will be powered by electricity, fed from the South West Interconnector System (SWIS). The traction energy from this is included as Scope 2 (the emissions are not directly emitted on site but are emitted as a consequence of fuel combustion at the point of generation).

Electricity consumption for the entire Perth train network (173km of track - for 1st July 2017- 30th June 2018 reported to the Clean Energy Regulator) is 161,329 MWh, providing a rate of annual energy consumption of approximately 933 MWh / km. For the 7.2 km extension, extrapolation of this figure provides a forecast of 6,714 MWh / year.

The NGA emission factor for SWIS is 0.70 kg $CO^2$-e/kWh.

### 5.4.2 Electrical energy consumed by stations and other facilities

Electrical energy will be used and assumed to be fed from grid during operation of the Yanchep Station for running the station and other facilities.

Existing Perth train station data was used to estimate annual electrical energy consumption. The PTA advised that Joondalup Train Station would be the best fit 'proxy' station from the existing network stations and so existing available energy data for Joondalup Station was used as an indicator of proposed Yanchep Station energy use. Joondalup Train Station's annual use for 2017/2018 was 308 MWh.

Other train stations at the northern end of the line are shown in **Table 5-5** and are comparable to Joondalup.

**Table 5-5 : 2017/2018 Station Energy Use (MWh)**

| Train Station | MWh in 2017/2018 |
|---|---|
| Joondalup | 308 |
| Edgewater | 341 |
| Currumbine | 354 |
| Clarkson | 428 |
| Butler | 287 |

### 5.4.3 Electricity consumption by signalling and ventilation equipment

The other main operation impact from a greenhouse gas perspective will be the electricity consumption of electrical equipment used in the proposal. The most significant aspects of this will be the electricity consumed for:

- Signalling and communications;

- Ventilation of tunnels; and
- Operation of water treatment plants.

### 5.4.4 Liquid or fuel consumed during operations

Transport fuel emissions for diesel and petrol during operations

To represent fuel used by vehicles supporting operation of the YRE Part 2, representative data was taken from a year of operation of the whole of the current PTA network (length 173 km) and scaled for the project only (length 7.2 km). The operational vehicle fleet use for diesel and petrol for the whole existing 173 km of rail network provided by the PTA was 234 kL of diesel and 1,025 kL unleaded petrol, providing a rate of annual fuel usage of approximately:

- 1.4 kL diesel per km of rail; and
- 5.9 kL petrol per km of rail

For the YRE Part 2 (7.2 km extension) this therefore results in:

- 10.08 kL diesel; and
- 42.48 kL petrol.

# 6. Results

This section presents the results of the YRE Part 2's construction and operational GHG emissions assessment. The results are then presented in the context of national emissions. The results of the calculations of GHG emissions factors associated with the proposal are shown in **Table 6-1** and **Table 6-2**.

## 6.1 Construction

Construction GHG emissions factors calculations are presented below.

**Table 6-1 : Calculation of GHG Emissions – Construction**

| Emission Source | Energy | Quantity | Unit | Emissions Factor: Scopes (t $CO_2e$ / unit) | | | GHG Emissions (t $CO_2e$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 1 | 2 | 3 |
| Diesel Use – On site construction | Fuel combusted - Diesel oil | 2,020 | kL | 2.70 | | | 5,474 | | |
| Petrol Use – On site construction | Fuel combusted - Gasoline | 20 | kL | 2.31 | | | 46 | | |
| Lost carbon sink | Vegetation removal | 63 | ha | | | | 6,903 | | |
| **Total over 33 months** | | | | | | | **12,423** | | |
| **Total per annum*** | | | | | | | **4,517** | | |

**Note: Assuming emissions are spread evenly across the construction period.*

## 6.2 Operation

Operational electricity consumption multiplied by GHG emissions factor from the NGA were used to determine total emissions associated with the operation of Yanchep Station. Greenhouse gas emissions factors used in this assessment are presented in **Table 6-2**.

**Table 6-2 : Calculation of GHG Emissions – Annual Operation**

| Emission Source | Energy | Quantity | Unit | Emissions Factor: Scopes (t $CO_2e$ / unit) | | | GHG Emissions (t $CO_2e$ / annum) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 1 | 2 | 3 |
| Electricity – Traction | Electricity | 6,714* | MWh | | 0.7 | | | 4,700 | |
| Electricity - Station | Electricity | 308 | MWh | | 0.7 | | | 216 | |
| Transport fuel emissions | Diesel oil | 10* | kL | 2.72 | | | | 0.5 | |
| Transport fuel emissions | Gasoline | 42* | kL | 2.38 | | | | 0.1 | |
| **Total per annum** | | | | | | | **3** | **4,917** | |
| **Total over 50 years** | | | | | | | **150** | **245,776** | |

**Note: these figures were derived from the Clean Energy Regulator for the whole existing 173 km of rail network and have been pro-rated to 7.2 km for Yanchep Station (data for 1st July 2017 to 30 June 2018).*

## 6.3 GHG Emissions Summary

A summary of the estimated GHG emissions associated with the proposal are presented below.

**Table 6-3 : GHG Emissions Results**

| Emission Source | TP classification | Quantity | Unit | GHG Emissions (t CO2e) | | | | % of Total Emissions |
|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | Total | |
| **Construction Emissions** | | | | | | | | |
| Liquid Fuel | Energy | 2,040 | kL | 5,520 | | | 5,520 | 44% |
| Lost carbon sink | Vegetation removal | 63 | ha | 6,903 | | | 6,903 | 56% |
| **Total** | | | | | | | **12,423** | **100%** |
| **Annual Operational Emissions** | | | | | | | | |
| Electricity - Traction | Energy | 6,714 | MWh | | 4,700 | | 4,700 | 96% |
| Electricity - Stations | Energy | 308 | MWh | | 216 | | 216 | 4% |
| Transport fuel | Energy | 1,259 | kL | 3 | | | 1 | 1% |
| **Total** | | | | | | | **4,917** | **100%** |

WA's annual GHG emissions for 2016 were approximately 88,355,000 t $CO_2$-e (DoEE 2019). The construction of the YRE Part 2 is approximately equal to 0.01% of WA's (2016) annual GHG emissions. Annual operation of the Yanchep Station will represent 0.006% of state emissions. Noting that these proportions are based on the project's Scope 1 and 2 inclusions only, as per **Table 5-1**.

The GHG emissions from construction and 50 years of operation are projected to be 258,198 t $CO_2$-e.

# 7. GHG Mitigation Measures

There are a number of high level recommendations that could assist in reducing greenhouse gas emissions for YRE Part 2'ss construction and operational greenhouse gas footprint. Opportunities for greenhouse gas reduction and avoidance are presented below for consideration.

It is recommended that the PTA consider revising this assessment as the project progresses and estimates are updated and/or become available for those scope 3 items that were excluded.

## 7.1 EPA's mitigation hierarchy

The EPA's objective is to ensure that the mitigation hierarchy is applied such that significant impacts to environmental factors caused as a result of proposals are avoided or reduced, and residual emissions offset, in the planning, design and operational stages.

The EPA's greenhouse gas management framework is currently being prepared and will aim to align with the mitigation hierarchy (avoid, reduce, offset). The framework may include the following measures which the PTA could consider as part of their ongoing GHG emissions reduction strategy:

- Avoiding emissions through best practice design and benchmarking;
- Continuous improvement to reduce emissions over the project life; and
- Offsetting emissions (carbon offsets).

## 7.2 Passenger Mode Shift

The operation of the Yanchep Station would see improvements in travel times for those accessing sections of Perth's transport network. It is envisaged that this would see passengers move away from buses and vehicles.

As part of assessing the business case for YRE Project, which includes this proposal, the Department of Transport's Strategic Transport Evaluation Model (STEM) was used to assess how the YRE Project will impact the transport network and its use. Key future land use assumptions are incorporated into STEM to ensure forecast development is taken into account. The YRE Project was subsequently assessed against a 'base case' network to calculate changes in demand, which was then used as an input to an economic model that evaluates a range of benefits.

Rapid growth is forecast for the northwest corridor of Perth, which will be served by the YRE Project. From the modelling, annual fuel savings are predicted resulting from reduced amounts of road vehicle travel. Increased use of public transport has the effect of removing vehicles from the road network. This results in a 'saving' in vehicle fuel usage and a corresponding reduction in greenhouse gas emissions from road user activity.

From these estimated fuel savings, energy content and emission factors from the Department of Environment and Energy (DoEE) *National Greenhouse Account Factors July 2018* were applied to estimate the associated carbon dioxide equivalent ($CO_2e$) emission savings. Based on STEM modelling, the YRE Project is estimated to provide an annual reduction of 14,140 t $CO_2$-e) in the year 2022 due to this removal of vehicles from the road network. With forecast urban growth, this will increase to an annual saving of 35,386 t $CO_2$-e in the year 2031. Cumulatively, a total saving of 287,966 t $CO_2$-e is estimated from opening in 2022 to the year 2050 associated with vehicles removed from the road network (METRONET Office 2018).

## 7.3 High Level Recommendations for GHG Mitigation

As highlighted in Section 7.2, the greatest GHG mitigation delivered by this project will be the passenger mode shift associated with moving passengers from more GHG intensive modes of transport to a less intensive mode. In addition to this significant saving, there are other opportunities for GHG mitigation through construction and operation of the proposal including:

Construction:

- Reviewing the cut and fill balances required and managing excess fill within the project;
- Reviewing the opportunity to use renewable forms of energy, such as photovoltaics on temporary structures, and biofuels in construction fleet;
- Considering lower carbon construction material alternatives where there is no unacceptable trade off in material performance or lifetime.

Operation

- Considering the principles of ecologically sustainable design in the design and construction of the Yanchep Rail Station;
- Considering opportunities for use of renewable sources of electricity to provide traction power and power to the Yanchep Rail station.

# 8. Limitations

The project description and assumptions made throughout this assessment are subject to final design and approval.

Jacobs has assumed the following data made available by the PTA is accurate to the best of their knowledge:

- High level estimates of fuel usage for the construction phase;
- Vegetation clearing figures;
- Vehicle fuel usage to support the PTA train maintenance activities;
- The PTA historical operational electricity usage for the train traction system; and
- The PTA historical electricity usage data for existing train stations.

The assessment was based on the data available; where detailed construction information was available this was used, and where designs were not yet fully scoped the standard factors contained within our databases were used to determine indicative values for the proposal.

# 9. References

Department of the Environment and Energy (DoE) (2014). Quarterly Update of Australia's National Greenhouse Gas Inventory - September Quarter 2013, Commonwealth of Australia, 2014.

DoEE (2018). National Greenhouse Accounts Factors. Australian National Greenhouse Accounts. Commonwealth of Australia, 2018.

DoEE (2019). Australian Greenhouse Emissions Information System, accessed Apr 30 2019 - http://ageis.climatechange.gov.au/SGGI.aspx

METRONET Office (2018), CO2 Emission Savings TCL and YRE, 2018.

PricewaterhouseCoopers (PwC) (2018), PwC Calculations, PwC demand forecasts based on Department of Transports STEM, April 2018

Transport Authorities Greenhouse Group Australia and New Zealand (2013). Carbon Gauge Tool. TAGG, 2013.

Transport for NSW (2017). NSW Sustainable Design Guidelines Version 4.0. Government of NSW, 2017.

# Appendix A. PTA Environment Policy

Government of Western Australia
Public Transport Authority

# ENVIRONMENT POLICY

## 1. POLICY

1.1. The Public Transport Authority of Western Australia (PTA) shall manage its operations in an environmentally sustainable and responsible manner by complying with the requirements of relevant State and Commonwealth legislation, regulations and codes and by applying responsible standards in situations where such laws, regulations and codes do not currently exist.

1.2. The PTA shall take all reasonable steps to:

1.2.1. minimise adverse impacts on the environment and communities;

1.2.2. operate professionally and in a way that promotes a strong environmental culture; and

1.2.3. support Sustainability through enhanced environmental work practices.

1.3. In order to meet its obligations and achieve the aims of this Environment Policy the PTA shall:

1.3.1. comply with the requirements of the PTA Environmental Management System Manual;

1.3.2. ensure that all staff and contractors are actively encouraged to adopt environmentally responsible work practices;

1.3.3. require that all personnel whose work may create a significant impact upon the environment, receive appropriate training;

1.3.4. purchase goods, services and works or dispose of goods in accordance with sound environmental considerations, practices and life-cycle assessment;

1.3.5. communicate regularly with stakeholders, including the wider community, on environmental issues of concern;

1.3.6. review work operations, waste management practices and emissions by embracing the principles of risk management, recycling, reuse and redesign through the improvement of process or technology to protect the environment;

1.3.7. seek to continuously improve the efficiency with which the PTA uses resources, including water and energy;

1.3.8. regularly conduct audits in accordance with the Audit Policy to review procedures and seek to continually improve environmental performance; and

1.3.9. report on environmental performance quarterly.

## 2. DEFINITIONS

**Environmental Management System Manual (EMS) –** means the manual developed to help the PTA achieve legal compliance, control risks for operations and capital works, and encourage continuous improvement in its environmental performance. The EMS Manual is complementary to the Project Management Framework and the Emergency Management Manual.

**Sustainability –** means the meeting of the needs of current and future generations through the integration of environmental protection, social advancement and economic prosperity.

## 3. RELEVANT LEGISLATION AND STANDARDS

Contaminated Sites Act 2003

Environmental Protection Act 1986

Environmental Protection and Biodiversity Conservation Act 1999

Environmental Protection and Biodiversity Conservation Amendment (Wildlife Protection) Act 2001

Environmental Protection (Landfill) Levy Act 1998

Environmental Management Systems Manual (PTA)

Rail Safety National Law (WA) Act 2015

AS/NZ ISO 14001:2015 Environment Management

Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC: 2018 (2005)]

**POLICY OWNER**

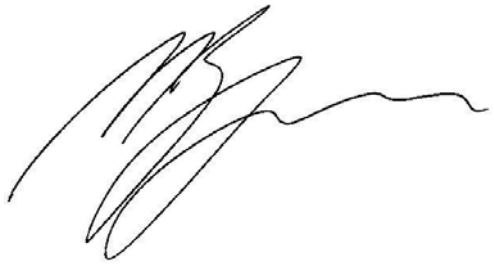
Executive Director Safety and Strategic Development

**ACTIVE DATE**

July 2016

**REVIEW DATE**

July 2019



Mark Burgess

**MANAGING DIRECTOR**