CHAPTER 21

Waste and Resource Management

CALVERT TO KAGARU ENVIRONMENTAL IMPACT STATEMENT

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

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21.1 Scope of chapter

The purpose of this chapter is to describe baseline conditions relevant to waste and resource management, and to assess and propose measures to mitigate and manage waste impacts during construction and operational phases of the Calvert to Kagaru Project (the Project). The management of spoil material from the Project is further addressed in Appendix V: Spoil Management Strategy.

The chapter provides an assessment of the waste management requirements for the Project, including the identification of the applicable regulatory framework, waste management strategies and waste stream composition and quantity. This chapter is focused on the additional waste and resource impacts that may arise due to activities associated with the Project, in the context of the existing waste management conditions of the waste and resource management study area.

Waste and resource management activities associated with the Project will be carried out in line with the waste and resource management hierarchy presented in the *2018 National Waste Policy* and *Waste Reduction and Recycling Act 2011* (Qld) (WRR Act). Mitigation measures are proposed to reduce adverse impacts from waste generation and resource use on environmental values and sensitive receptors.

21.2 Terms of Reference

The Terms of Reference (ToR) describe the matters the proponent must address in the Environmental Impact Statement (EIS) for the Project. The matters relating to waste and resource management are contained in ToR 11.169 through to 11.175, as summarised in Table 21.1.

TABLE 21.1: TERMS OF REFERENCE COMPLIANCE TABLE—WASTE AND RESOURCE MANAGEMENT

Terms of Reference requirements		Where addressed
Impact assessment		
11.169	For wastes, besides wastewater (which is addressed in the Water section of this TOR), describe and quantify all expected significant waste streams (including spoil) from the proposed project activities during the construction and operational phases of the project.	Chapter 21: Waste and Resource Management, Section 21.6 Appendix V: Spoil Management Strategy, Section 2
11.170	Describe potential spoil disposal sites and their ability to service the project.	Chapter 21: Waste and Resource Management, Sections 21.6.3.3 and 21.6.3.4 Appendix V: Spoil Management Strategy, Sections 2 and 4
11.171	Define and describe the objectives and practical measures for protecting or enhancing environmental values from impacts by wastes. Take into account best practice waste management strategies as outlined in the National Waste Policy 2009 and the Waste Reduction and Recycling Act 2011 and the Environmental Protection Regulation 2008.	Chapter 21: Waste and Resource Management, Sections 21.5.1 and 21.8 Appendix V: Spoil Management Strategy, Sections 1.2 and 2–4
11.172	Describe the quantity, and physical and chemical characteristics of waste rock, any attributes that may affect its dispersal in the environment, and its associated risk of causing environmental harm.	Chapter 21: Waste and Resource Management Sections 21.6.3.2 and 21.6.3.3 Appendix V: Spoil Management Strategy, Section 2.2.2 The physical and chemical characteristics of geology and soils are addressed in Chapter 9: Land Resources, Section 9.5
Mitigation measures		
11.173	Assess the proposed management measures against the preferred waste management hierarchy, namely: avoid waste generation; cleaner production; reduce; recycle; re-use; reprocess and reclaim; waste to energy; treatment; disposal. This includes the generation and storage of waste.	Chapter 21: Waste and Resource Management: Sections 21.4.7 and 21.8 Appendix V: Spoil Management Strategy, Sections 2 and 3

Terms of Reference requirements		Where addressed
11.174	Describe how nominated quantitative standards and indicators may be achieved for waste management, and how the achievement of the objectives would be monitored, audited and managed.	Chapter 21: Waste and Resource Management, Section 21.8
11.175	Detail waste management planning for the proposed project especially how these plans would be applied to prevent or minimise environmental impacts due to waste at each stage of the project.	Chapter 21: Waste and Resource Management, Section 21.8 Appendix V: Spoil Management Strategy, Sections 2 and 3
11.176	Provide details on natural resource-use efficiency (such as energy and water), integrated processing design, and any co-generation of power and by-product re-use as shown in a material/energy flow analysis.	Natural resource-use efficiency, including by-produce re-use, is primarily addressed in Chapter 7: Sustainability, Section 7.7 Integrated processing design and co-generation of power are not applicable to the Project.

Appendix B: Terms of Reference Compliance Table provides a cross-reference for each ToR against relevant sections in this EIS.

21.3 Legislation, policies, standards and guidelines

Waste and resource management is primarily regulated by the State, with the Commonwealth providing broad policy guidance based on national-level outcomes and international obligations. Local governments, and commercial and industrial generators of waste are responsible for managing waste within their local areas and/or from their activities as required by the State government regulatory framework.

Local governments play an important role in providing household waste collection and recycling services, managing landfill sites, delivering education programs, providing and maintaining litter infrastructure. Commercial and industrial generators also play an important role in ensuring that the waste generated from their activities is dealt with in a manner consistent with environmental regulations and broader waste management principles.

The legislation, policy and guidelines relevant to waste and resource management of the Project are summarised within Table 21.2. Further guidance on legislation and corresponding potential approval requirements associated with the Project are provided in Chapter 3: Project Approvals.

TABLE 21.2: SUMMARY OF REGULATORY CONTEXT

Legislation, policy or guideline	Relevance to the Project
Commonwealth	
National Environment Protection Measures (Implementation) Act 1998 (NEPM)	NEPM related to the Project include: ▸ Used packaging materials ▸ Movement of controlled waste between States and Territories ▸ Assessment of site contamination.
National Greenhouse and Energy Reporting Act 2007 (Cth)	Waste generated from the Project will likely be disposed at facilities that are required to report energy consumption and greenhouse gas emissions.
2018 National Waste Policy: Less waste, more resources	The *2018 National Waste Policy* provides a framework for collective action by businesses, governments, communities and individuals until 2030. The policy identifies five overarching principles underpinning waste management in a circular economy. These principles are: ▸ Avoid waste ▸ Improve resource recovery ▸ Increase use of recycled material and build demand and markets for recycled products ▸ Better manage material flows to benefit human health, the environment and the economy ▸ Improve information to support innovation, guide investment and enable informed consumer decisions.

Legislation, policy or guideline	Relevance to the Project
2018 National Waste Policy: Less waste, more resources (continued)	The policy embodies shifting away from 'take, make, use and dispose' to a more circular approach where the value of resources are maintained for as long as possible. It sets a national framework for action by governments, the business sector, the waste and resource recovery industries and communities to achieve sustainable waste management. The policy also facilitates annual reporting of waste emissions to air, land and water through the National Pollutant Inventory.
Construction and Demolition Waste Guide—Recycling and re-use across the supply chain	This guide outlines opportunities for business and industry to invest in activities that will create profit and improve environmental outcomes by extracting valuable resources from the construction and demolition waste stream.
Australian Code for the Transport of Dangerous Goods by Road and Rail (edition 7.6, 2018)	The *Australian Dangerous Goods Code* (edition 7.6, 2018) sets out the technical requirements and guidelines for transportation of dangerous goods across Australia. Dangerous goods anticipated to be used by the Project are further described in Chapter 20: Hazard and Risk.
State	
Environmental Protection Act 1994 (Qld) (EP Act)	Australian Rail Track Corporation (ARTC) has a general environmental duty and must report any potential environmental harm as a result of waste management activities. When dealing with land that is, or may be contaminated, the person undertaking the activity must meet the general environmental duty and obtain any permits that may be required to remove contaminated soil. The movement of certain regulated wastes must be tracked.
Environmental Protection Regulation 2019 (Qld) (EP Regulation)	In the context of waste and resource management for the Project, an approval may be required for the following Environmentally Relevant Activities (ERAs) under the Environmental Protection Regulation 2019: ▸ ERA 8—Chemical storage ▸ ERA 33—Crushing, milling, grinding or screening ▸ ERA 56—Regulated waste storage ▸ ERA 57—Regulated waste transport.
Waste Reduction and Recycling Act 2011 (Qld) (WRR Act)	Waste management activities associated with the Project will be carried out strategically, in line with the waste and resource management hierarchy. Where practical, all waste will be re-used or recycled in the first instance.
Waste Reduction and Recycling Regulation 2011 (Qld) (WRR Regulation)	Details the type of wastes waste levies apply to and associated fees for disposal. The Project is located within a levy zone and the disposal of waste will be subject to a fee unless an exemption applies. Section 26 of the WRR Act details exempt waste, including clean earth.
Waste Management and Resource Productivity Strategy (Qld)	In early 2018, the Queensland (QLD) State Government announced the development of a comprehensive new waste strategy to increase recycling and recovery and create new jobs. From 1 July 2019, a waste levy commenced under the WRR Act and the WRR Regulation. The new laws provide for QLD to be divided into a levy zone and a non-levy zone. Under the new laws, waste disposal from the Project will be subject to a fee, as the Project is located within a levy zone. The *Waste Management and Resource Productivity Strategy* has now been finalised. Underpinned by the waste levy, the Strategy focuses on transitioning to the principles of a circular economy. It provides the framework to help deliver coordinated, long-term and sustained growth for the recycling and resource recovery sector while reducing the amount of waste produced and ultimately disposed of, by promoting more sustainable waste management practices for business, industry and households.

21.4 Methodology

21.4.1 Study area

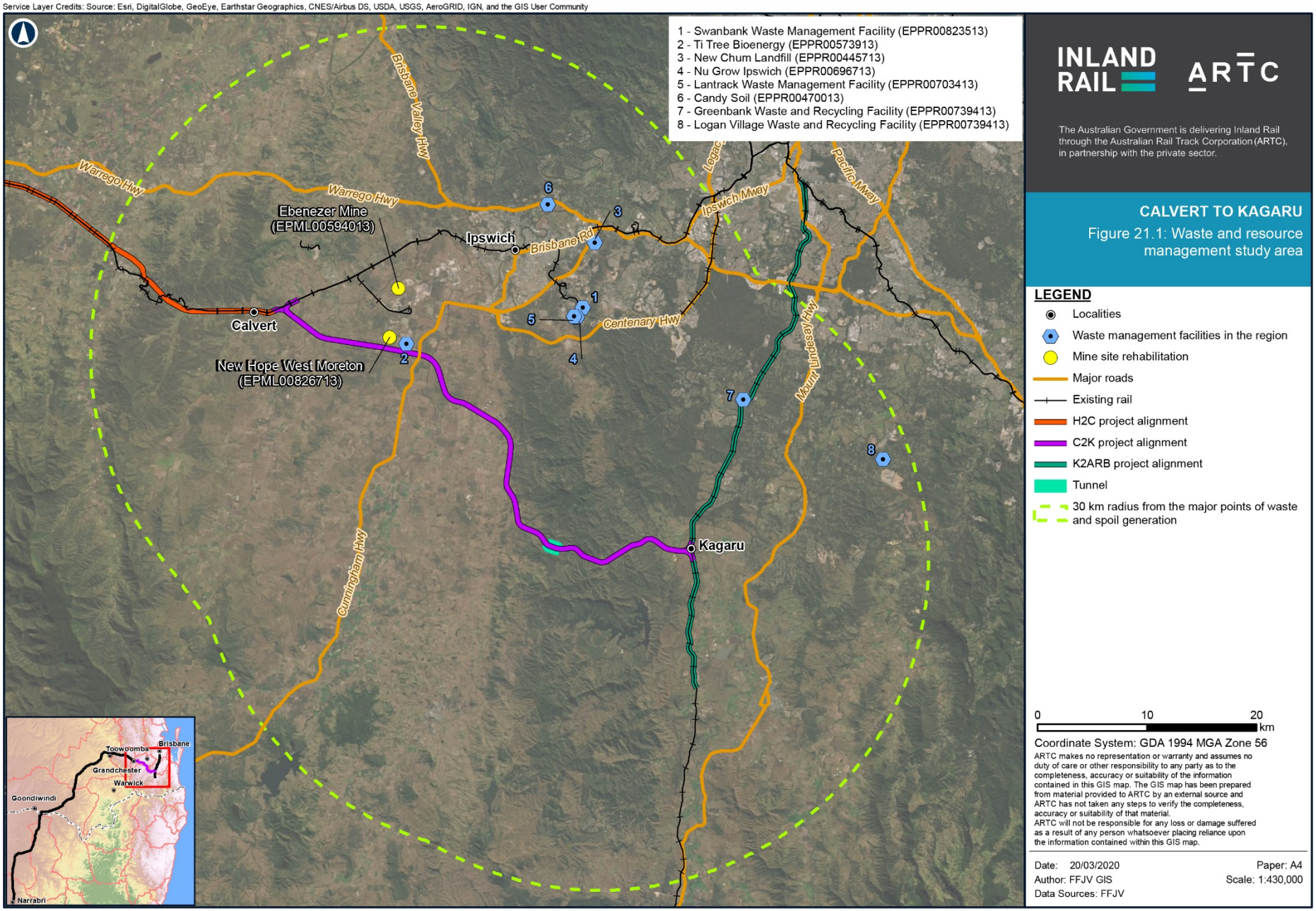
The study area for waste and resource management focuses on a spatial area limited to the rail corridor and associated construction works depicted on the design and quantified in the bill of quantities for the Project. Consideration has also been given to impacts on environmental values and sensitive receptors beyond this area, as a result of waste generation and management, including cumulative impacts from existing waste management facilities, third-party facilities and potential permanent borrow pit sites. Combined, these areas comprise the waste and resource management study area for the Project, as shown in Figure 21.1.

21.4.2 Approach

The following tasks have been undertaken for assessing potential waste impacts and resource management opportunities as a consequence of the Project:

- Establishing a basis of significance for waste generated from the Project to give quantitative definition to the ToR
- Identifying environmental values
- Identifying potential waste generation during construction and operational phases of the Project
- Identifying potential impacts
- Assessment of identified impacts
- Identifying mitigation and management measures.

These are discussed further in the following sections.


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
1 - Swanbank Waste Management Facility (EPPR00823513)
2 - Ti Tree Bioenergy (EPPR00573913)
3 - New Chum Landfill (EPPR00445713)
4 - Nu Grow Ipswich (EPPR00696713)
5 - Lantrack Waste Management Facility (EPPR00703413)
6 - Candy Soil (EPPR00470013)
7 - Greenbank Waste and Recycling Facility (EPPR00739413)
8 - Logan Village Waste and Recycling Facility (EPPR00739413)
Brisbane Valley Hwy
Warrego Hwy
Warrego Hwy
Ebenezer Mine
(EPML00594013)
Ipswich
Brisbane Rd
Ipswich Mway
Pacific Mway
Calvert
Centenary Hwy
New Hope West Moreton
(EPML00826713)
Mount Lindesay Hwy
Cunningham Hwy
Kagaru
Toowoomba
Brisbane
Grandchester
Warwick
Goondiwindi
Narrabri
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
CALVERT TO KAGARU
Figure 21.1: Waste and resource management study area
LEGEND
Localities
Waste management facilities in the region
Mine site rehabilitation
Major roads
Existing rail
H2C project alignment
C2K project alignment
K2ARB project alignment
Tunnel
30 km radius from the major points of waste and spoil generation
0
10
20
km
Coordinate System: GDA 1994 MGA Zone 56
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21.4.3 Establish basis of significance

ToR 11.169 requires the identification and assessment of significant waste streams arising from the Project. To aid the assessment of environmental impact, a determination on significant waste streams has been made as follows:

- Waste at a broad category level that comprises less than 10 per cent of current waste generation within the region for that category, is deemed to be insignificant and able to be managed under current waste management arrangements within the region. Mitigation measures for these wastes are deemed to be covered under standard industry practice that is executed and modified to comply with statutory requirements and policy changes. These industry standard practices are not described within this chapter.
- Waste at a broad category level that comprises greater than 10 per cent of current waste generation within the region for that category, is deemed to be significant and requires specific mitigation measures. These wastes and their mitigation measures are presented within this chapter and within Appendix V: Spoil Management Strategy.

The 10 per cent increase in intensity of waste generation to define significance has been adopted as this value is commonly used in materiality assessment.

21.4.4 Identifying environmental values

For the purposes of identifying environmental values in the region of the Project, data was sourced from regional plans, waste facilities, legislation, policies and guidelines as noted in Table 21.2. The location of the existing waste management facilities and waste acceptance criteria have been investigated to assess the appropriateness of resource recovery and waste disposal options in the region of the Project.

Consultation was undertaken with local governments to ascertain current and forecast landfill capacities and waste transport service providers to understand capacities and industry processes. The project team also consulted with the Department of Transport and Main Roads regarding spoil management transport, acknowledging the key drivers of safety for road users, traffic management, and pavement life.

21.4.5 Identifying potential waste generation during construction and operational phases

The potential types and volumes of waste that may be generated by the Project have been derived from several sources, including a review of typical construction methods, design documentation, bill of quantities and constructability assessment for the Project.

21.4.6 Identifying potential impacts

The potential impacts likely to arise from the Project during construction and operational phases are described in Section 21.7. The potential impacts have been derived from an appreciation of waste generation and management issues that typically arise during the development of large-scale linear transport infrastructure.

21.4.7 Assessment of identified impacts

The potential impacts to sensitive receptors have been assessed using a risk assessment methodology, which considers the likelihood and consequence of a potential impact and its resultant level of risk. The risk assessment methodology is described in further detail in Chapter 4: Assessment Methodology.

21.4.8 Identifying mitigation and management measures

Mitigation measures to avoid and reduce potential impacts from waste on environmental, social and economic values of the Project been identified in Section 21.8. Mitigation measures have been developed in accordance with relevant legislation, including the EP Act and WRR Act. They have also been prepared to align with the waste and resource management hierarchy (refer Figure 21.2).

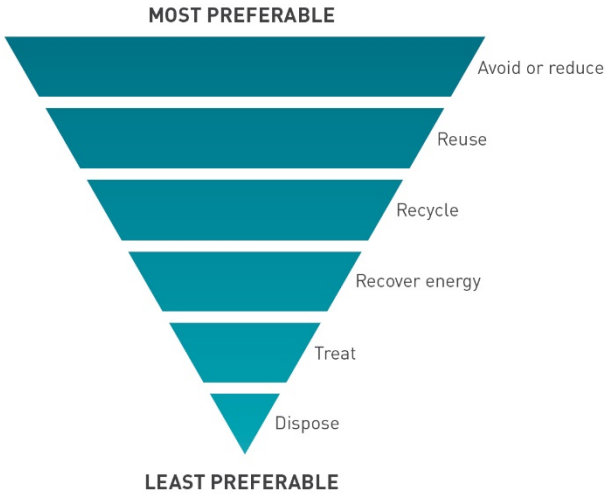

FIGURE 21.2: WASTE AND RESOURCE MANAGEMENT HIERARCHY

Source: *Waste Reduction and Recycling Act 2011* (Qld) (WRR Act)

21.5 Existing waste management environment

This section describes existing environmental values and waste management operations in proximity of the Project.

21.5.1 Environmental values

Under Section 9 of the EP Act, an environmental value is a quality or physical characteristic of the environment that is conducive to ecological health, public amenity or safety. In accordance with this definition, the following environmental values have been identified as being in proximity to the Project:

- Human receptors:
  - Site personnel
  - Landholders and communities adjacent to the Project
  - Drivers, pedestrians and residents who use roads and footpaths within the waste and resource management study area
- Environmental receptors:
  - Receiving natural environments surrounding the Project, such as land, surface water and air
  - Areas of recognised ecological significance (i.e. Gum Tips Nature Reserve and Purga Nature Reserve)
- Commercial and industrial receptors:
  - Existing land uses and the productive capacity of land (i.e. its potential for use for cropping activities and animal husbandry)
  - Vehicle operators travelling on the State-controlled and local government road networks
  - Adjacent waste collection, recycling and disposal facilities.

21.5.2 Licensed waste contractors and waste facilities

Land use within the Project is predominantly rural agricultural, interspersed with small townships and rural-residential dwellings. As such, existing waste streams are primarily associated with agricultural activities and minor amounts derived from domestic purposes.

Regional councils provide waste collection, recycling and disposal facilities and services for residential properties. However, it is likely that waste disposal from the Project will predominantly occur at commercial facilities. Appropriately licensed contractors will also provide additional options for collection, treatment and disposal of wastes.

Details of the existing waste management facilities in proximity to the Project that have potential to accept waste from commercial operations are listed in Table 21.3 and illustrated in Figure 21.1. Potential waste receiving facilities have been considered based on the industry-accepted haul route distance of 50 km for bulk waste and 15 km for municipal waste.

Waste transport routes have not been assessed for the Project, as there is no significant forecast increase in the demand for waste collection services on a regional scale (refer Table 21.6). Spoil disposal routes have been assessed in Appendix U: Traffic Impact Assessment Technical Report. Spoil will be transported by road, considering commonly adopted haul route distances and where possible staying on arterial roads and outside of town centres.

The lifespan of the potential waste receival facilities has been determined based on initial consultation with operators, a review of existing environmental authority licencing (under the EP Regulation) for each facility and the Project's contribution to the regional waste generation. On the basis of this preliminary analysis, the capacity of the potential waste facilities is deemed sufficient to accommodate waste generated from the Project.

The confirmation of waste acceptance criteria and available/permissible annual disposal rates will be undertaken in consultation with the relevant operator, during detailed design.

TABLE 21.3: WASTE MANAGEMENT FACILITIES IN THE REGION

Facility	Type	Operator	Contact details	Lifespan	Capacity	Waste accepted	Environmental authority licence
Swanbank Waste Management Facility	Landfill and transfer station	Remondis	Swanbank Road, Swanbank Qld 4305 (07) 3294 2400	15+ years	>200,000t/yr	▸ Commercial and industrial waste ▸ Construction and demolition waste ▸ Green waste ▸ General (putrescible/non-putrescible) waste ▸ Regulated waste	EPPR00823513
Ti Tree Bioenergy	Landfill (Bioreactor)	Veolia/ JJ Richards JV	Champions Way, Willowbank Qld 4306 (07) 5464 3484	50+ years	>200,000t/yr	▸ Construction and industrial waste ▸ Construction and demolition waste ▸ Green waste ▸ General (putrescible/non-putrescible) waste ▸ Regulated waste	EPPR00573913
New Chum Landfill	Landfill	Cleanaway	100 Chum St, New Chum Qld 4303 (07) 3816 2166	5+ years	>200,000t/yr	▸ Some commercial and industrial waste ▸ Construction and demolition waste ▸ Green waste ▸ Some regulated waste	EPPR00445713
Lantrack Waste Management Facility	Landfill and transfer station	Lantrack	1 Memorial Drive, Swanbank Qld 4306 (07) 3294 1986	20+ years	>200,000t/yr	▸ Commercial and industrial waste ▸ Construction and demolition waste ▸ Green waste ▸ General (putrescible/non-putrescible) waste ▸ Regulated waste	EPPR00703413
Candy Soil	Soil manufacturer	Candy Soil	237–239 Mount Crosby Rd, Tivoli Qld 4305 (07) 3282 7388	Indefinite (soil manufacturing; operation permitted for as long as ERA is in force)	Not applicable	▸ Construction and demolition (soil) waste	EPPR00470013

Facility	Type	Operator	Contact details	Lifespan	Capacity	Waste accepted	Environmental authority licence
Greenbank Waste and Recycling Facility	Transfer station	Logan City Council	124 Pub Lane, New Beith Qld 4124 (07) 3412 3412	Indefinite (transfer station, not ultimate waste repository. Operation permitted as long as ERA is in force)	Not applicable	▸ Commercial and industrial waste ▸ Construction and demolition waste ▸ Domestic waste	EPPR00739413
Logan Village Waste and Recycling Facility	Transfer station	Logan City Council	1432 Waterford Tamborine Road, Logan Village Qld 4207 (07) 3412 3412	Indefinite (transfer station, not ultimate waste repository. Operation permitted as long as ERA is in force)	Not applicable	▸ Commercial and industrial waste ▸ Construction and demolition waste ▸ Domestic waste	EPPR00739413
Jimboomba Landfill	Non-operational landfill with active EA, potential to accept clean fill	Logan City Council	356 Mundoolun Road, Jimboomba Qld 4280 (07) 3412 3412	Currently under investigation, dependant on future land use	Limited. 30,000m^2 site Rehab volume <100,000m^3	▸ Clean soil for profile and capping if compliant with specifications	EPPR00739413
Browns Plains Waste and Recycling Facility	Landfill and transfer station	Logan City Council	41 Recycle Way, Heritage Park Qld 4118 (07) 3412 3412	5+ years	100,000–200,000t/yr	▸ Some commercial and industrial waste ▸ Construction and demolition waste ▸ Green waste ▸ Some regulated waste	EPPR00897713

21.6 Waste generation

The generation of waste will occur throughout the construction and operational phases of the Project. The waste types and waste quantities identified by this assessment are indicative only. The waste types, waste quantities and management measures will be further defined as the Project progresses and documented in the Waste Management Plan that supports the Draft Outline Environmental Management Plan (Draft Outline EMP) (refer Chapter 23).

An estimate of regional waste generation (i.e. existing waste generation without the Project) is provided in Section 21.6.1 to inform the impact assessment presented in Section 21.9.

21.6.1 Existing waste generation

Table 21.4 presents an estimate of regional waste generation characteristics by headline waste types (i.e. municipal waste, construction and demolition waste, commercial and industrial waste, and green waste) on an annual basis, as sourced from *Recycling and Waste in Queensland 2018* (Queensland Government, 2018c).

TABLE 21.4: REGIONAL WASTE GENERATION CHARACTERISTICS

Waste type	South East Queensland (tonnes)	Darling Downs–Maranoa (tonnes)	Total (tonnes)
Commercial and industrial	1,116,108	36,353	1,152,461
Construction and demolition	2,354,502	27,660	2,382,162
General (municipal)	1,287,508	114,250	1,401,758
Green	354,817	53,232	408,049
Regulated (including asbestos, contaminated soil)	Not reported regionally		

21.6.2 Project waste types

The Project is expected to produce solid wastes as classified under the EP Regulation and *Queensland Waste Management and Resource Recovery Strategy*, as listed in Table 21.5.

TABLE 21.5: WASTE TYPES, DESCRIPTION AND POTENTIAL PROJECT SOURCES

Waste type	Definition	Potential project source
Commercial and industrial	Wastes that are produced by business and commerce. In the case of green waste, it includes material delivered by commercial operation	▸ Site offices
Construction and demolition	Non-putrescible waste arising from the construction or demolition activity. Construction and demolition waste includes materials such as brick, timber, concrete and steel	▸ Demolition/removal of existing structures ▸ Construction work fronts ▸ Demobilisation of construction activity facilities (including project amenities, laydown areas and temporary haul/access roads)
General	Wastes not defined as regulated waste under legislation. General wastes comprise putrescible wastes (easily decomposed, treated by composting) and non-putrescible wastes (not easily decomposed, may be recyclable)	▸ Site offices ▸ Construction work fronts ▸ Laydown areas ▸ Clean, excess spoil
Green	Includes grass clippings; tree, bush and shrub trimmings; branches and other similar material resulting from landscaping or maintenance activities	▸ Clearing and grubbing ▸ Site preparation works
Recyclables	Wastes that can be reconditioned, reprocessed or re-used. Recyclables can be recovered from commercial and industrial (C&I) waste, construction and demolition (C&D) waste and general waste	▸ Site offices ▸ Construction work fronts ▸ Laydown areas

Waste type	Definition	Potential project source
Regulated	Wastes that require specific controls or actions as defined by legislation. Listed hazardous, regulated, controlled or trackable wastes typically have unique handling and disposal requirements in order to manage specific hazards associated with them. It is waste that is commercial or industrial waste and is of a type or contains a constituent of a type mentioned in Section 42 of the EP Regulation. Regulated waste includes asbestos, pesticides, a range of chemicals and other industrial wastes	▸ Used containers and residues of hazardous chemicals and dangerous goods ▸ Demolition/removal of existing structures

21.6.3 Construction phase wastes

Key stages and activities undertaken within the construction phase of the Project include:

- Site preparation:
  - Vegetation clearing and grubbing
  - Topsoil stripping
  - Demolition of existing infrastructure
  - Establishment of site compounds and facilities
  - Installation of temporary and permanent fencing
  - Installation of drainage and water management controls
  - Construction of site access roads
- Civil works:
  - Bulk earthworks
  - Construction of cuts and embankments
  - Construction of tunnel portals and the main line tunnel
  - Installation of permanent drainage controls
  - Bridge and watercourse crossing construction
- Track works:
  - Installation of ballast, sleepers and rails
  - Installation of rail systems infrastructure and wayside equipment
  - Installation of signals
  - Installation of turnouts
  - Installation of asset monitoring infrastructure
- Commissioning:
  - Integration testing
- Construction demobilisation/decommissioning:
  - Removal of site facilities (e.g. site offices and amenities and associated infrastructure)
  - Removal of temporary access/haul roads
  - Removal of laydown areas and hardstands.

A detailed discussion of construction activities for the Project is presented in Chapter 6: Project Description. The construction of the Project is planned to start in 2021 and is expected to be completed in 2026.

The wastes generated during the construction phase of the Project are shown in Table 21.6. The quantities of wastes were estimated based on information from the constructability assessment, design documentation and bill of quantities for the Project. These details will be subject to further refinement during progression of the detailed design, post-EIS. All procured material (i.e. concrete, steel, timber and ballast) will be required to meet material specifications and an assumption of 2 per cent of the total quantity has been made for unsuitable material and potential wastage. This calculation is generated based on the waste allowance made in the bill of quantities for the Project. Where unavailable, the density of waste types has been informed by the Tchobanoglous et al. (1993) *Integrated Solid Waste Management: Engineering Principles and Management Issues*, to assist in approximating the proportion of waste generation from the Project compared to that of the South East Queensland (SEQ) and Darling Downs–Maranoa regions. The assessment also has assumed that site amenities and compounds will be demountable in nature and on demobilisation will be returned to suppliers for re-use.

Based on the basis of significance described in Section 21.4.3, no significant waste streams have been identified for the Project (with the exception of spoil) and it should be noted that for most of the waste streams their contribution in the context of the existing waste management system is less than 1 per cent (i.e. practically immeasurable). The insignificant waste streams expected to be produced by the Project have been categorised at a broad level only, as they will be managed by the contractor who will be required to comply with industry standards and all statutory requirements pertaining to waste and resource management through condition of contract.

In accordance with the Draft Outline EMP (refer Chapter 23), the contractor must prepare a Waste Management Plan as part of the Construction Environmental Management Plan (CEMP) detailing:

- Waste targets (or waste reduction targets) to be achieved for the Project
- General protocols and performance objectives for keeping the work site clean and tidy
- Processes for documenting waste volumes, types and how these will be compared to waste targets e.g. describe potential waste impacts, waste streams and estimated volumes, temporary waste storage areas and disposal locations onsite and offsite (including stockpiles and landfilling) and waste disposal and NEPM criteria for disposal sites
- Requirements for waste segregation e.g. green waste, spoil, construction and demolition waste, general waste, regulated waste and recyclables
- Requirements for secure temporary storage, collection frequency and disposal/recycling requirements
- Effluent management for construction staff amenities
- Procedures and reporting/documentation requirements for ensuring waste transporters and receivers are appropriately licensed according to the type of waste
- Requirements for training, inspections, audits, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction.

TABLE 21.6: CONSTRUCTION PHASE WASTE QUANTITIES

Waste/resource description	Waste classification	Estimated quantity produced	Quantity re-used within Project (as per design)	Residual as proportion of existing waste generation
Vegetation clearing and grubbing	Green	6,000,000 m^2 (assume 2,000,000 m^2 per annum)	100%	Not applicable—to be re-used within the Project
Topsoil	Construction and demolition	500,000 m^3 (assume 160,000 m^3 per annum)	100%	Not applicable—to be re-used within the Project
Rock	Construction and demolition	824,534 m^3 (assume 260,000 m^3 per annum)	100%	Not applicable—to be re-used within the Project
Spoil	Construction and demolition	1,622,504 m^3 excess material (assume 500,000 m^3 per annum)	Material that is unsuitable without immediate re-use	35% of annual C&D waste production
Site office waste	General (municipal)	20 tonnes (assume 6 tonnes per annum)	0%	0.001% of annual general waste production
Steel (rail)	Construction and demolition	200 tonnes (assume 60 tonnes per annum)	0%	0.001% of annual C&D waste production
Treated timber sleepers	Regulated	140 tonnes (assume 45 tonnes per annum)	0%	Data on regional proportion of regulated waste is not available
Ballast	Regulated	3,800 tonnes (assume 1,200 tonnes per annum)	0%	Data on regional proportion of regulated waste is not available
In-situ concrete (culverts)	Construction and demolition	90 tonnes (assume 30 tonnes per annum)	0%	0.001% of annual C&D waste production
In-situ concrete (bridges)	Construction and demolition	2,700 tonnes (assume 900 tonnes per annum)	0%	0.06% of annual C&D waste production
Precast concrete (bridges)	Construction and demolition	490 tonnes (assume 160 tonnes per annum)	0%	0.04% of annual C&D waste production

Waste/resource description	Waste classification	Estimated quantity produced	Quantity re-used within Project (as per design)	Residual as proportion of existing waste generation
Spent pavement and hardstand material from temporary accesses and construction compounds	Construction and demolition and/or regulated (if contaminated through leaks and spills during construction)	4,800 tonnes	0%	0.2% of annual C&D waste production

Table notes:
The volume of spoil produced by the Project is deemed unsuitable for use as embankment material, in accordance with ARTC Earthworks Material Specification (ETC-08-03). If the total volume of spoil produced by the Project was disposed to landfill, it is deemed to present a significant impact for existing waste management infrastructure. The use of spoil, subject to confirmation of suitability, for quarry and mine rehabilitation and/or cover (day, interim, final (cap)) for landfills is not considered disposal but is considered to support restoration of degraded land. Further details are provided in Appendix V: Spoil Management Strategy.

21.6.3.1 Wastewater

As per ToR 11.169, the description and quantification of wastewater produced from the Project's activities is not required to be considered as part of the assessment of waste and resource management for the Project.

Wastewater generated from stormwater discharges during the construction phase of the Project has been assessed for water quality impacts through the adoption of a MUSIC model (refer Chapter 13: Surface Water and Hydrology). It is anticipated that potential stormwater discharges will have a negligible impact on surrounding rural areas. Water collected from within the tunnel infrastructure will require specific management for releases into receiving waters. The collected water will be required to meet the water quality objectives (WQOs) for Purga Creek (refer Chapter 13: Surface Water and Hydrology) and will likely require processing through a water treatment plant including hydrocarbon separation.

21.6.3.2 Spoil production

The Project has endeavoured to achieve a net balance of cut to fill to minimise the need for the offsite disposal of spoil. Where possible, materials won from excavation such as cuttings, will be re-used as general earth fill. ARTC's *Earthworks Material Specification* (ETC-08-03) version 1.2 describes material types, associated compliance criteria and classification/suitability of materials for use within the Inland Rail Program. The differentiation of general earth fill types is dependent on particle size distribution, which determines the compaction ability of the general earth fill. This then determines the materials suitability for use in the construction of engineered embankments. Type A or Type B fill have a minimum California Bearing Ratio (CBR) of 3 per cent whereas Type C and D fill have a minimum CBR of 1 per cent.

In accordance with ARTC's *Earthworks Material Specification* (ETC-08-03) version 1.2, some materials may initially be deemed unsuitable for re-use within the engineered embankments without treatment for the following reasons:

- Moisture content: Based on the natural moisture content, the material may either be too wet or too dry in its current condition to meet the required specifications or consistency. Noting that in-situ treatments can be undertaken to modify the moisture content and consistency.
- Organic content: Materials with organic content are typically considered unsuitable due to being highly compressible, degradable and susceptible to collapse. These materials may be suitable for use in topsoil and vegetation rehabilitation applications with blending.
- Dispersive: Dispersive materials (Emerson Class <4) have a high potential for erosion; therefore, it is recommended their use is restricted to areas where they are not exposed to free water. Dispersive materials that can meet Type C/D requirements may potentially be incorporated into the core of a zoned embankment or used with due consideration for the associated risks. Alternatively, the dispersive characteristics of materials can be potentially reduced using chemical additives.
- Compaction requirements: Materials that are unsuitable to be re-compacted to a suitable density to achieve the minimum CBR design requirements (nominally CBR 3 per cent) or to achieve the required engineering design characteristics.

- Reactivity: Reactive materials with significant shrink swell potential may lead to excessive movement within the fill. Reactive materials that can meet Type C/D fill requirements may potentially be incorporated into the core of a zoned embankment or used where they are protected from significant moisture variations. Alternatively, chemical treatment could be considered to modify the reactivity of the clayey materials. Reactive soils up to swelling indices of 7 per cent have been found present along the Project alignment.
- Acidity: Acidic soils such as the surface layers of kurosols expected to be encountered generally with a pH less than 5.5. Noting that in-situ treatments, such as the addition of lime, can be a successful method of ameliorating soil acidity. While the acidity of the soils has no impact on the engineering characteristics of the materials, the reusability of the stripped topsoil can be improved if the acidity is managed. Due to the topographic position of the Project, no acid sulfate soils are anticipated to occur along the Project.
- Contamination: Contaminants may be present in the material due to several factors. Based on the land uses within the waste and resource management study area and the findings of a desktop assessment, potential sources of contamination for the Project are considered to include:
  - Agricultural activities: hydrocarbons (fuel and oil storage and use), pesticides and herbicides, asbestos and lead paint, arsenic (cattle dips), landfilling
  - Quarries: hydrocarbons (fuel and oil storage and use), metals/metalloids, hazardous materials
  - Queensland Raceway, Willowbank: hydrocarbons (fuel and oil storage and use)
  - Landfilling and waste disposal: hazardous materials, hydrocarbons, metals/metalloids, phenols, polychlorinated biphenyls, phthalates, volatiles and pesticides and herbicides
  - Existing rail corridor: metals, asbestos, hydrocarbons, pesticides/herbicides
  - Road crossings: metals and hydrocarbons
  - Unknown fill material: asbestos, metals/metalloids, hydrocarbons.
- Oversize materials: blasted or ripped rock with particles larger than 150 mm are typically excluded from earthworks, as they cannot be adequately compacted. The oversize material can be considered for use as rock fill or rip-rap. The oversize sedimentary rock fragments are typically broken down to approximately 150 mm size particles by tracking with a tracked earthmoving machinery, such as excavators and dozers.
- Atterberg Limits or weighted plasticity index values exceeding the maximum limits stated in the Project specification.

The Project design calculates that 5,859,671 m^3 of cut material will be produced during construction, primarily from surface works. A calculated 4,237,167 m^3 of this cut material (including 824,534 m^3 of rock) is estimated to be suitable for immediate re-use as general earth fill, as per ARTC's *Earthworks Material Specification* (ETC-08-03). A calculated excess of 1,622,504 m^3 of spoil will be managed or treated with the potential for re-use.

21.6.3.3 Spoil management hierarchy

The cut and fill assessment is for the Calvert to Kagaru Project in isolation, for the purpose of informing the primary Project approval. It is acknowledged that in the detailed design and execution phases of the Project, and adjacent Inland Rail projects, there will be opportunities to optimise the use and placement of spoil material outside of the extent of each individual project. It is not appropriate to undertake this level of assessment until the Project contractors have been appointed and the level of design including earthwork balance and placement strategies have been further progressed. The assessment of the cumulative impacts of combining the management of spoil across more than one project will be undertaken once the detailed design and earthwork balance and placement strategies are available. Cumulative impacts for the current spoil disposal approach are presented in Chapter 22: Cumulative Impacts.

Spoil produced by the Project will be managed in accordance with Appendix V: Spoil Management Strategy, considering the spoil management hierarchy as presented in Table 21.7 and Figure 21.3.

TABLE 21.7: SPOIL MANAGEMENT HIERARCHY

Rank	Options	Example
1	Avoid and reduce spoil	Reduce the amount of spoil generated by the Project, through reducing the extent and scale of cut where an immediate re-use opportunity in proximity to the source location does not exist, e.g. sections of the Project where a surplus of material will be generated
2	Re-use within the rail corridor	Re-use within the Project, subject to the material complying with the ARTC Earthworks Material Specification, to establish formation, fill embankments and mounds within short haulage distance of the source location
3	Re-use for environmental works and land restoration	Examples include: ▸ Re-use in the rehabilitation of native vegetation ▸ Re-use for landscaping ▸ Re-use for land re-instatement, including end-of life mines currently proposed for alternate use as waste and recycling facilities (Ebenezer Mine and New Hope West Moreton), subject to outcomes of planning applications ▸ Re-use for landfill covers (day and interim covers) and final capping (where deemed suitable)
4	Re-use on other development	Re-use for fill embankments and mounds on projects within a reasonable haulage distance (less than 80 km) from the site, prioritising other components of the Inland Rail Program
5	Dispose offsite as waste	Disposal of excess spoil as waste at an approved facility licensed to receive the material. Offsite disposal to landfill should only occur if the material is considered unsuitable without treatment for other uses, e.g. due to contamination

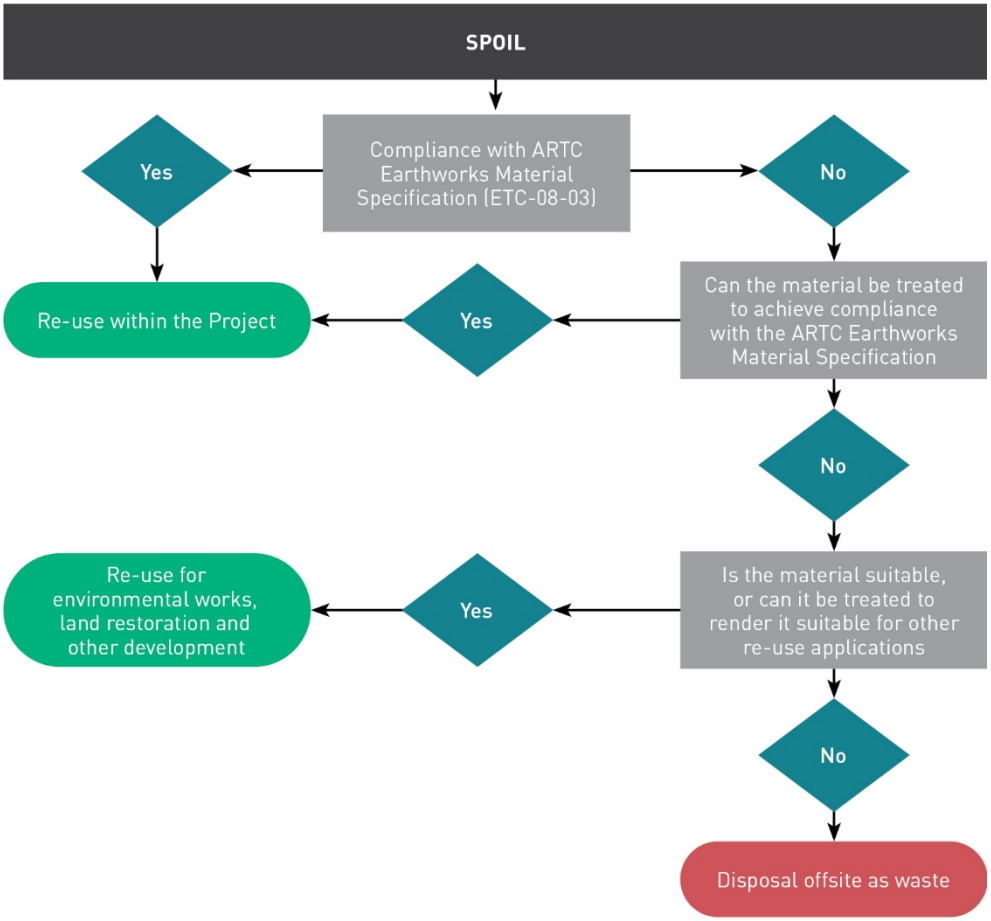

FIGURE 21.3: SPOIL MANAGEMENT HIERARCHY

Waste rock

Waste rock is a term typically derived from the resources industry, where waste rock sometimes has pyritic qualities. Chapter 9: Land Resources provides information on the geology and soils generated from the Project, including management requirements in the event that acidic materials are encountered during Project activities. Based on the assessment of desktop information and field investigations, rock with acid-producing qualities has not been identified within the Project. Therefore, all rock that is won through excavation has been assumed to be re-used on the Project and is not defined as a waste (refer Table 21.6). This is subject to the material being tested to determine the waste classification and suitability for re-use, in accordance with the guidelines, specifications and CEMP adopted for the Project.

If rock is not contaminated, it may be crushed and re-used onsite as aggregate for fill, construction pads/laydown areas or road base. Under the EP Regulation, an approval for ERA 33 is not required for the extraction of material from a place for constructing a road or railway at the place. An approval for ERA 33 will only be required for the crushing, milling, grinding or screening of material exceeding 5,000 tonnes per year if the activity is undertaken outside of the Project. It has been assumed that such activities would be undertaken by a third-party commercial operation and they would be responsible for obtaining the requisite ERA to allow this activity to occur. As such, these places are not included within this assessment.

In accordance with the Draft Outline EMP (refer Chapter 23), soil conditions across the disturbance footprint will be appropriately characterised at a suitable scale through additional geotechnical surveys during the detailed design phase of the Project to inform design and required management measures.

Contaminated land

A Tier 1 Preliminary Site Investigation (contaminated land assessment) has been undertaken for the Project (refer Chapter 9: Land Resources), in line with the processes and guidance detailed in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (Cth) (ASC NEPM). As per Chapter 9: Land Resources, the disturbance of existing contaminated land at the construction phase of the Project has been identified as presenting a medium (mitigated) risk. It should be noted that the extent and type of contamination has not yet been defined for the Project.

In accordance with the Draft Outline EMP (refer Chapter 23), a targeted contaminated land investigation will be undertaken during the detailed design phase (post-EIS) to determine the likelihood of contaminated land, potential risks to human health/environment and required management measures. A contaminated land management strategy has been prepared for the Project (refer Chapter 9: Land Resources). Any contaminated land encountered as a result of Project activities will be segregated and stockpiled separately in accordance with regulatory requirements pertaining to contaminated land management and procedures identified in the Project's CEMP, including the Soil Management Plan. Prior to construction, the contractor must ensure that the requirements of Chapter 5, Division 1 and Division 2, of the EP Regulation are adhered to, particularly the testing and characterisation of regulated wastes and their intended treatment or disposal.

Chapter 20: Hazard and Risk further details contaminated land that may arise as a result of the Project, providing an assessment of impacts and mitigation measures.

21.6.3.4 Spoil transport

Appendix V: Spoil Management Strategy further details the overarching principles to guide the storage, treatment, re-use or disposal of spoil generated during the construction phase of the Project.

Spoil will be transported by registered road trucks, with temporary construction access roads provided along the Project. These access roads would be used to transport tunnel spoil from the portals to embankment zones. Local spoil haulage may also involve transport on public roads.

Appendix U: Traffic Impact Assessment Technical Report provides detailed information on the haulage routes used for the Project, assuming a worst-case scenario of 1,622,504 m^3 of spoil to be transported by road to end-of-life mines located along Ipswich Rosewood Road (Ebenezer Mine and New Hope West Moreton) approximately 80 km from the furthest point of spoil generation. Both the Ebenezer Mine and New Hope West Moreton are the subject of current development proposals to allow the end-of-life mines to be used as waste and recycling facilities in future. ARTC will continue to engage with relevant parties prior to the construction of the Project to confirm these potential spoil disposal sites. Consultation undertaken with operators is further described in Chapter 5: Stakeholder Engagement.

21.6.4 Operational phase wastes

Site maintenance will be undertaken during the operational phase of the Project and will typically include site inspections, vegetation management, rail track replacement/upgrade and general upkeep. Quantities of waste would depend on operational frequencies of maintenance regimes and these details are unknown at this stage of the Project. As such, quantities of operational phase waste will be estimated during progression of the detailed design, post-EIS. The wastes anticipated to be generated during the operational phase of the Project are shown in Table 21.8. These wastes have not been further analysed, as they are expected to be typical of the current networks of freight rail and therefore not identified as significant to be managed by the contactor (refer Section 21.4.3).

TABLE 21.8: OPERATIONAL PHASE WASTES

Activity	Waste description	Waste classification
Vegetation management	Green	General (non-putrescible)
Re-profiling of landforms, e.g. embankments	Potentially contaminated solid	General (non-putrescible)
General upkeep	Debris, litter/rubbish	General (non-putrescible)
Rail track replacement/upgrade	Scrap metal	General (non-putrescible)
	Potentially contaminated solid	Regulated
Infrastructure maintenance	Waste paints and solvents	Regulated
General maintenance of rail corridor	Empty chemical containers	Regulated
Maintenance of erosion and control devices and culverts	Silt and sediment	General (non-putrescible)
Maintenance of erosion and control devices and culverts	Vegetative debris	General (non-putrescible)

21.6.5 Waste storage areas

Designated waste storage areas will be provided at each construction work front for sorting and segregating waste prior to collection by licensed contractors. Each storage area will be provided on hardstand and have a suitable containment system for the waste stream being stored. Good housekeeping and regular removal of residual waste will be practiced at waste storage areas to maintain safety, facilitate identification of reusable items and minimise opportunities for pests to proliferate the area. As these waste streams are deemed insignificant, no further analysis has been undertaken with management deferring to industry standard practice.

21.7 Potential impacts

Waste generation during the construction and operational phases of the Project may result in the following potential impacts on the identified environmental values:

- Waste disposal additional to current levels, resulting in increased consumption of existing landfill airspace and reduction of community access to waste facilities surrounding the waste and resource management study area
- Uncontrolled release of waste from the improper storage or failure of management systems resulting in contamination of receiving environments (i.e. land, surface water and air)
- Increase in the incidence of vermin, insects and pests from the inappropriate storage and handling of putrescible wastes
- Reduced visual amenity of land uses adjacent to the Project
- Transportation of waste materials on and offsite, resulting in:
  - The increase of greenhouse gas emissions due to the combustion of hydrocarbons from the operation of vehicles/plant used to transport and manage waste
  - Decreased amenity of land uses adjacent to the Project from the generation of dust and road deterioration
- Risks to human health and safety of site personnel, through the release of pollutants from the poor management of regulated wastes.

Table 21.9 identifies corresponding chapters of the EIS where the potential impacts that may arise from waste on environmental values are discussed.

TABLE 21.9: ENVIRONMENTAL VALUES POTENTIALLY IMPACTED BY THE PROJECT

Environmental value	Potential impacts	EIS chapter
Adjacent waste collection, recycling and disposal facilities	Loss of airspace and reduced community access	Chapter 8: Land Use and Tenure Section 8.5.2.6 (Current environmental authorities for environmentally relevant activities)
Adjacent land uses and productive capacity of land (i.e. its potential for use for cropping activities and animal husbandry)	Release of contaminants including litter/debris, fuels, hydrocarbons and chemicals Spread of pests and disease Reduced visual amenity	Chapter 8: Land Use and Tenure Section 8.5.2 (Land use) Chapter 9: Land Resources Section 9.6.3 (Degradation of soil resources through invasive flora and fauna) Section 9.6.7 (Creation of contaminated land) Chapter 10: Landscape and Visual Amenity Section 10.6 (Potential impacts)
Receiving environments surrounding the Project (i.e. land, surface water and air quality) and areas of recognised ecological significance	Release of contaminants including litter/debris, fuels, hydrocarbons and chemicals Loss of habitat from stockpiling of spoil and waste materials Reduced visual amenity	Chapter 9: Land Resources Section 9.6.7 (Creation of contaminated land) Chapter 10: Landscape and Visual Amenity Section 10.6 (Potential impacts) Chapter 11: Flora and Fauna Section 11.7.2.9 (Noise, dust and light impacts) Section 11.7.2.10 (Increase in litter (waste)) Section 11.7.2.11 (Aquatic habitat degradation) Section 11.7.2.12 (Erosion and sedimentation) Chapter 12: Air Quality Section 12.6.1.1 (Construction dust) Chapter 13: Surface Water and Hydrology Section 13.6.1.1 (Construction phase impacts) Section 13.6.1.2 (Operational phase impacts) Chapter 20: Hazard and Risk Section 20.7.2.3 (Safety) Section 20.7.3 (Dangerous goods and hazardous chemicals)
Health and safety of site personnel, adjacent landholders and communities	Release of contaminants including litter/debris, fuels, hydrocarbons and chemicals Spread of pests and disease	Chapter 9: Land Resources Section 9.6.3 (Degradation of soil resources through invasive flora and fauna) Section 9.6.7 (Creation of contaminated land) Chapter 20: Hazard and Risk Section 20.7.2.3 (Safety) Section 20.7.3 (Dangerous goods and hazardous chemicals)

21.8 Mitigation measures

ARTC will use a hierarchical approach to waste management from the most preferable (avoid or reduce, re-use, recycle, recover energy and treat) to the least preferable (disposal) and prioritise waste management strategies to avoid generation. Where waste cannot be avoided, waste materials will be segregated by type for collection and removal by licensed contractors.

Sustainability considerations with regards to waste and resource management are included in Table 7.2 and Table 7.4 of Chapter 7: Sustainability. Integrated processing design and co-generation of power is not applicable to the Project.

ARTC has an Inland Rail Environmental and Sustainability Policy (ARTC, 2018c), which provides sustainability-related commitments throughout design, construction and operation of the Project. The *Inland Rail Sustainable Procurement Policy* (ARTC, 2018g) also details commitments for sustainable procurement to drive positive economic and social outcomes, while providing a benefit to the environment through reduced resource use and greenhouse gas emissions. This policy is included in Appendix F: Corporate Policies.

This section outlines both the waste and resource mitigation measures included as part of the Project design and the mitigation measures that are proposed for the Project to manage predicted environmental impacts. The impacts are initially assessed with consideration of the design mitigation measures and then reassessed to determine residual risk after the inclusion of the proposed mitigation measures.

21.8.1 Design considerations

The mitigation measures and controls presented in Table 21.10 have been factored into the project design. These design measures have been identified through collaborative development of the design and consideration of environmental constraints and issues. The design measures are relevant to both construction and operational phases of the Project.

TABLE 21.10: INITIAL MITIGATIONS OF RELEVANCE TO WASTE AND RESOURCE MANAGEMENT

Aspect	Initial mitigation measures
Waste	▸ Optimisation of the disturbance footprint width to reduce the quantity of spoil material generated ▸ Disturbance footprint limited to the extent required for construction to reduce clearing requirements ▸ Cut and fill balance and minimisation of transport requirements for import/disposal of spoil considered.

21.8.2 Proposed mitigation measures

In order to manage Project risks during construction, a number of mitigation measures have been proposed for implementation in future phases of Project delivery, as presented in Table 21.11. These proposed mitigation measures have been identified to address to Project specific issues and opportunities, address legislative requirements, accepted government plans, policy and practice.

Table 21.11 identifies the relevant Project phase, the aspect to be managed, and the proposed mitigation measure, which is then factored into the assessment of residual risk in Table 21.13.

Chapter 23: Draft Outline EMP provides further context and the framework for implementation of these proposed mitigation and management measures.

While initial consultation has been undertaken, further liaison with operators of waste receival facilities will be undertaken during the detailed design process (post-EIS) to inform the construction approach regarding staging of works and the assignment of waste disposal destinations from construction work fronts. This information will also be used in the development of the Waste Management Plan for the Project.

As discussed in Section 21.6.3, the Project will result in approximately 4,237,167 m^3 of cut material (including 824,534 m^3 of rock) that is expected to be compliant with the ARTC Earthworks Material Specification (ETC-08-03) and therefore suitable for immediate re-use as general earth fill for the construction of zoned embankments. This leaves approximately 1,622,504 m^3 of spoil derived from the Project that is expected to be non-compliant with the ARTC Earthworks Material Specification (ETC-08-03) and therefore not appropriate for immediate re-use as general earth fill for the construction of zoned embankments. This does not mean that the material is unsuitable for any use, rather, it does not meet the requirements for embankment construction and may be suitable for redistribution within the disturbance footprint for non-structural purposes.

TABLE 21.11: PROPOSED WASTE AND RESOURCE MANAGEMENT DESIGN OBJECTIVES AND MITIGATION MEASURES

Delivery Phase	Aspect	Proposed design objectives and mitigation measures
Detailed design	Waste	Cut and fill balance and minimisation of transport requirements for import/disposal of spoil to be further refined during detailed design by implementing the spoil management hierarchy presented in Appendix V: Spoil Management Strategy. Establish waste reduction targets for design and construction. A waste reduction review will be undertaken to identify opportunities to meaningfully achieve the waste reduction targets through detailed design and construction of the Project. Consideration of alternative approaches to materials used, construction and operational techniques and maintenance of a process to achieve a less resource intensive and more efficient process, in accordance with relevant design standards. For example, material specifications should consider aspects such as use of prefabricated materials, percentage of recycled content and percentage of material rejection to reduce waste generation from the Project. Establish waste reporting requirements for the pre-construction, construction and commissioning phases of the Project for incorporation into the Waste Management Plan.
Pre-construction	Waste	Develop a Waste Management Plan as part of the CEMP, which complies with the Project conditions of approval and relevant regulatory requirements, including: ▸ Waste targets (or waste reduction targets) to be achieved for the Project ▸ Waste reporting requirements ▸ General protocols and performance objectives for keeping the work site clean and tidy ▸ Describe potential waste impacts, waste streams and estimated volumes ▸ Identify temporary waste storage areas and disposal locations on and off site (including stockpiles and landfilling) ▸ Waste disposal at third-party disposal sites is undertaken in line with regulatory requirements including the requirement for sites to be operating under a current environmental authority ▸ Requirements for waste segregation e.g. green waste, spoil, construction and demolition waste, general waste, regulated waste and recyclables ▸ Requirements for secure temporary storage, collection frequency and disposal/recycling requirements ▸ Effluent management for construction staff amenities ▸ Procedures and reporting/documentation requirements for ensuring waste transporters and receivers are appropriately licensed according to the type of waste ▸ Requirements for training, inspections, audits, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction.
	Hazardous waste	Waste from the Project works must be tested, treated and managed in accordance with the EP Act. A contaminated and hazardous material survey will be undertaken prior to demolition of structures. In the event that asbestos or other hazardous materials are identified in these structures, a Contaminated and Hazardous Materials Management Plan will be developed and implemented as part of the Waste Management Plan.

Delivery Phase	Aspect	Proposed design objectives and mitigation measures
Construction and commissioning	Waste	Where practicable, spoil will be re-used within the disturbance footprint through treatment, amelioration or drying and any material that cannot be treated for appropriate re-use may then be disposed offsite. Identify opportunities to achieve waste reduction targets appropriate to the scope of the Project works. Reduce the amount of spoil generated through construction methodology. For example, the use of roadheader in tunnelling construction allows for accurate cut while maintaining efficient spoil management. Implement the Construction Spoil Management Plan described in the Land Resources Management Plan (refer Table 23.6 of Chapter 23: Draft Outline Environmental Management Plan). All cut material suitable for reuse will be stockpiled separately and reused onsite where possible. Careful specification of construction material requirements to avoid overestimation. Source good quality construction materials, in accordance with relevant design standards. Purchase construction materials in bulk to minimise packaging waste. Develop and implement administrative controls on the transportation of waste materials from the Project, within the disturbance area and offsite. Ensure plant and equipment utilised in the Project is appropriately maintained. Construction maintenance activities, refuelling, concrete washout will be carried out in defined locations with appropriate measures in place to reduce the potential for impacts to waterways, aquatic habitats, and groundwater. Portable toilets and amenities to be serviced and maintained to ensure efficient operation and minimise environmental risks associated with their operation and decommissioning. Contractors to adhere to the practices of the WRR Act waste and resource management hierarchy, which sets out an order of preference for options for managing waste from avoiding, to reusing, recovering, treating and disposing of waste. Appropriate waste bins, facilitating segregation of waste, to be located at key site compounds to facilitate segregation and prevent cross contamination. Comply with the waste reporting requirements established in the Waste Management Plan.
	Hazardous waste	Contaminated waste must be classified and disposed in accordance with the Waste Management Plan. Hazardous or dangerous waste (e.g. asbestos, chemicals, oils) to be correctly stored, managed and disposed of by a licensed contractor or facility and in accordance with the relevant occupational health and safety legislative and regulatory obligations, including wastes generated as a result of demolition.
Operation	Waste	Maintenance activities during operations to adhere to the practices of the WRR Act waste and resource management hierarchy, which sets out an order of preference for options for managing waste from avoiding, to reusing, recovering, treating and disposing of waste.

The Project will seek to re-use as much cut material as possible during the detailed design process (post-EIS), in accordance with the spoil management hierarchy presented in Appendix V: Spoil Management Strategy. Spoil re-use as opposed to spoil disposal is preferable from a social, environmental and financial perspective. Spoil disposal to licensed facilities is costly due to transportation and landfill gate fees. The licensed facilities may accept clean soil materials for use as day and intermediate covers and/or capping soils if deemed suitable. However, acceptance is likely to attract a landfill gate fee that, at current commercial rates, is in the order of $75/m^3. Therefore, due to the significant associated costs, it is unlikely that the 1,622,504 m^3 of spoil will be disposed offsite, as opportunities for re-use will be explored.

Proposed management of Project waste types is further detailed in Table 21.12 as per the waste management hierarchy shown in Figure 21.2.

TABLE 21.12: MANAGEMENT OF PROJECT WASTE TYPES

Waste/resource description	Waste classification	Avoid/reduce	Re-use/recycle/recover	Treat/dispose
Cleared vegetation	Green	Where practical minimise disturbance and clearing required	Re-use logs, stumps and mulch in rehabilitation areas or deliver to a licensed facility for recycling	Not suggested
Concrete	Construction and demolition	Detailed design for infrastructure to carefully specify material requirements to avoid overestimation Source good quality materials	Crushed concrete may be used as aggregate for fill, construction pads/laydown areas or road base	Not suggested
Topsoil	General (non-putrescible)	Where practical minimise disturbance footprint	Topsoil may be re-spread over batters/used for revegetation Direct placement of topsoil is preferred to long-term (i.e. greater than 2 years) stockpiling	Where practicable, topsoil will be re-used within the disturbance footprint through treatment, amelioration or drying, and any material that cannot be treated for appropriate re-use may then be disposed offsite
Spoil	General (non-putrescible)	Reduce the amount of spoil being generated through design and construction methodology	Re-use in the broader Inland Rail project to fill embankments and mounds within short haulage distance of source Re-use in native vegetation rehabilitation projects Re-use for fill embankments and mounds on projects within an economic transport distance from site Re-use for land reclamation or remediation works Re-use to cap completed landfill cells	Where practicable, spoil will be re-used within the disturbance footprint through treatment, amelioration or drying, and any material that cannot be treated for appropriate re-use may then be disposed offsite

Waste/resource description	Waste classification	Avoid/reduce	Re-use/recycle/recover	Treat/dispose
Debris and litter	General (non-putrescible)	Buy in bulk to minimise packaging waste	Reduce, re-use or recycle wastes where possible	Collection in covered bins/containers with appropriate signage Service regularly to avoid vermin and pests Transportation of waste by appropriately qualified personnel to licensed facility
Hazardous substances (i.e. coolant, paint, solvents and chemicals)	General (non-putrescible)—regulated	Avoid spills through implementation of standard operating procedures Segregate in suitable bunded bins/containers with appropriate signage Ensure staff are trained for the correct use of equipment	Not suggested	Waste tracking systems to be maintained for the disposal of regulated waste Transportation of waste by appropriately qualified personnel to licensed facility
Waste oil, including absorbent materials, containers, filters and rags	General (non-putrescible)—regulated	Avoid spills through implementation of standard operating procedures Segregate in suitable bunded bins/containers with appropriate signage Ensure staff are trained for the correct use of equipment	Not suggested	Waste tracking systems to be maintained for the disposal of regulated waste Transportation of waste by appropriately qualified personnel to licensed facility
Recyclable materials (i.e. aluminium, cardboard and glass)	General (non-putrescible)	Buy in bulk to minimise packaging waste	Provide separate recyclable materials receptacle near site offices Transportation of recyclable materials by appropriately qualified personnel to licensed facility for recycling	Not suggested
Metal	Construction and demolition	Detailed design for infrastructure to carefully specify material requirements to avoid overestimation Source good quality materials	Salvage reusable metal, including stakes, drums and wire, where practical Segregate and store onsite in designated areas for removal by appropriately qualified personnel to licensed facility for recycling	Not suggested
Timber	Construction and demolition	Detailed design for infrastructure to carefully specify material requirements to avoid overestimation Source good quality materials	Re-use or repurpose for applications onsite Segregate and store onsite in designated areas for removal by appropriately qualified personnel to licensed facility for recycling	Not suggested

21.9 Impact assessment

Potential impacts associated with waste and resource management from the Project in the construction and operational phases are outlined in Table 21.13. These impacts have been subjected to a risk assessment, as per the methodology detailed in Chapter 4: Assessment Methodology.

The initial risk assessment is undertaken on the assumption that the design considerations (or initial mitigations) are factored into the Project design phase.

Proposed design objectives and mitigation measures presented in Table 21.11 were then applied as appropriate to the phase of the Project to reduce the level of potential impact.

The residual risk level of the potential impacts was then reassessed after the proposed mitigation measures defined in Table 21.11 were applied. The outcomes of this assessment are presented in Table 21.13.

TABLE 21.13: IMPACT ASSESSMENT FOR POTENTIAL IMPACTS ASSOCIATED WITH WASTE AND RESOURCE MANAGEMENT

Potential impact	Phase	Initial risk (pre-mitigated)			Residual risk (mitigated)		
		Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Waste disposed to landfill (additional to current levels)	Construction	Likely	Minor	Medium	Possible	Not Significant	Low
	Operation	Possible	Minor	Low	Unlikely	Not Significant	Low
Uncontrolled release of waste (may cause contamination)	Construction	Possible	Minor	Low	Unlikely	Minor	Low
	Operation	Possible	Minor	Low	Unlikely	Minor	Low
Increase in greenhouse gas emissions arising from waste transportation activities	Construction	Likely	Not Significant	Low	Likely	Not Significant	Low
	Operation	Likely	Not Significant	Low	Likely	Not Significant	Low
Decrease in air quality due to waste traffic increases	Construction	Possible	Minor	Low	Unlikely	Minor	Low
	Operation	Unlikely	Minor	Low	Rare	Minor	Low
Release of pollutants and risks to human health and safety	Construction	Possible	Minor	Low	Unlikely	Minor	Low
	Operation	Possible	Minor	Low	Unlikely	Minor	Low

21.10 Cumulative impacts

The construction of the Project will generate a number of waste streams that will be managed by maximising opportunities to avoid or reduce, re-use and recycle using standard industry practice. However, there will be waste streams for which this cannot be achieved, and they will be disposed of within appropriately licensed facilities.

Cumulative impacts arising from waste management activities on surrounding environmental values and sensitive receptors will largely be the product of waste disposal adversely affecting airspace consumption of local waste management infrastructure, thereby reducing the local community's access to such services.

The projects considered to have a potential for cumulative impacts relating to waste and resource management are those with an overlapping construction timeframe and potential for shared demand on existing waste management facilities. In this context, the projects that may result in cumulative impacts have been identified as:

- Kagaru to Acacia Ridge and Bromelton (K2ARB)—potential for construction and operational phase interactions
- Helidon to Calvert (H2C)—potential for construction and operational phase interactions
- Remondis Waste to Energy Facility —potential for construction and operational phase interactions.

The K2ARB and H2C projects are part of the broader Inland Rail Program. Therefore, despite the potential for cumulative impacts on receiving waste management facilities, ARTC will be able to liaise with the relevant operators to negotiate appropriate waste disposal arrangements across the three Inland Rail projects. Therefore, the risk of cumulative impacts from the interaction of these projects is considered to be of **low significance.**

Waste generation during construction of the Remondis Waste to Energy Facility is anticipated to be dominated by construction wastes (negligible demolition is anticipated) and in the context of SEQ construction and demolition waste generation, the volume is expected to be insignificant (<5 per cent). As the construction workforce is expected to be locally sourced, a negligible increase in municipal waste generation would be anticipated. A benefit of the proposed Remondis Waste to Energy Facility is that it reduces the volume of waste entering the pre-existing infrastructure (e.g. landfill) and will therefore be reducing pressure on existing landfill airspace constraints. As a result, cumulative impacts related to waste are considered to be **negligible** or **insignificant**.

21.11 Conclusions

This chapter has described the potential impacts and relevant mitigation measures in relation to waste and resource management during the different phases of the Project.

The assessment of significance indicates that spoil represents a (pre-mitigated) medium risk of adversely affecting existing practices and infrastructure to manage this material. It should be noted that the production of spoil for the Project has assumed a worst-case scenario, that spoil is unable to be repurposed in other parts of the Inland Rail Program and 1,622,504 m^3 of spoil will be transported by road to end-of-life mines. In practical terms, this is unlikely to occur and re-use within the Inland Rail Program will be pursued as the highest and best use of spoil material arising from the Project. Appendix V: Spoil Management Strategy further details management options for spoil material from the Project.

As identified in Table 21.6, with the exception of spoil, which will arise during construction, no significant waste streams have been identified for the project. As waste streams are not considered significant, they have been categorised at a broad level and will be managed in accordance with standard industry practice and accommodated within the capacity of existing waste management arrangements that exist in the Project locality.

In combination with the application of mitigation measures, wastes generated during operation of the Project are expected to be typical of the current networks of freight rail and assumed to be of insignificant quantities when compared to wastes generated during construction of the Project.

The identified waste streams will be managed through waste avoidance and mitigation strategies to minimise potential impacts on surrounding environmental values and sensitive receptors, in accordance with the WRR Act as listed below in the preferred order to be considered:

a) Avoid or reduce

b) Re-use

c) Recycle

d) Recover energy

e) Treat

f) Dispose.

The relevant waste and resource management commitments for the Project include:

- Integration of waste management strategies into the detailed design of the Project
- Preparation and implementation of a Waste Management Plan, including key objectives of Appendix V: Spoil Management Strategy for the management of spoil material
- All wastes that are generated will be stored, handled and transferred in a proper and efficient manner to mitigate against potential environmental impacts on the surrounding environment and sensitive receptors.

In summary, all attempts will be made to reduce the impact of the generated waste streams on the environment during handling, storage and transport by considering mitigation measures throughout the lifecycle of the Project. As a result, and on the basis of spoil re-use measures being implemented across the Inland Rail Program more broadly, the analysis suggests that the Project does not pose significant waste generation and management risks to the surrounding environment and sensitive receptors.

The volume of waste generated by each of the waste streams will be further refined during detailed design (post-EIS) to more accurately assess the receiving waste management facilities and waste disposal options for the Project.