CHAPTER 20

Hazard and Risk

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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20.1 Scope of the chapter

This chapter assesses the Calvert to Kagaru Project's (the Project) risk of adverse impacts from both natural and Project-associated hazards by:

- Evaluating the risks and hazards in the existing environment
- Identifying and assessing the potential risks to people, property and the environment that might be associated with the construction and operation of the Project
- Proposing appropriate mitigation measures to be implemented during the life of the Project.

20.1.1 Purpose

Natural, Project-related, and dangerous goods risks and hazards have been assessed, in accordance with the Terms of Reference (ToR) for the different phases of the Project:

- Design and pre-construction
- Construction and commissioning
- Operation (including maintenance).

Based on a review of the ToR the following key hazards have been identified:

- Natural hazards (e.g. flooding, wildlife, sudden subsidence or movement of soil or rocks, biosecurity, bushfire, landslide, related to climate conditions)
- Construction and commissioning hazards and risk (e.g. existing infrastructure, use of explosives for construction, land contamination)
- Operational hazards and risks (e.g. respirable silica and other airborne contaminants such as naturally occurring asbestos, fatigue and heat stress, concurrent or simultaneous operations with existing railway infrastructure)
- Other health, safety and security hazards and risks (e.g. abandoned mines, underground collieries, accidents including derailments, pedestrian safety, spillages, fire and abnormal events that may occur during all stages of the Project).

20.1.2 Approach

This hazard and risk assessment has considered potential impacts to people, property and the environment either initiated or exacerbated by the Project. Furthermore, this chapter has assessed risks on the Project from external factors such as climate conditions, subsidence or biosecurity hazards. Findings and outcomes of environmental investigations completed during the development of the Environmental Impact Statement (EIS) have been incorporated into the assessment.

Throughout the life of the Project, mitigation measures will be applied to eliminate or manage hazards and reduce risk to an acceptable level. This risk assessment will be conducted as part of the larger risk management process throughout the life of the Project.

This chapter aims to:

- Identify the relevant legislative framework associated with the risk assessment
- Identify the natural and environmental values
- Document the Project construction, commissioning and operational activities with the potential to cause health, safety and risk impacts
- Describe how the Project may potentially affect hazards away from the Project and implications of climate conditions
- Demonstrate how the risk assessment process has been applied throughout the life of the Project in accordance with AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018)
- Discuss mitigation measures to be implemented during construction, commissioning and operation and mitigation measures incorporated in the design
- Outline the relevant emergency management plan including consultation undertaken with relevant emergency management authorities such as Local Disaster Management Groups (LDMG) for the City of Ipswich, City of Logan, and Scenic Rim Regional Council.

20.1.3 Assumptions and limitations

The assessment described in this chapter has been carried out based on information available at the time of preparing the EIS. The Project will continually monitor identified risks and conduct future risk assessments to identify and mitigate emergent risks throughout the life of the Project.

A Draft Outline Environmental Management Plan (Draft Outline EMP) has been developed as part of this EIS to establish a framework for implementing mitigation and management measures (refer Chapter 23: Draft Outline Environmental Management Plan). A Construction Environmental Management Plan (CEMP) including relevant sub-plans, will also be prepared as the Project progresses towards construction. The CEMP will address all measures and requirements of the Draft Outline EMP, together with primary and secondary approval conditions and other legislative requirements from permits, licences and other project commitments, in advance of relevant Project works commencing. Additional mitigation measures will be continually reviewed, developed and documented throughout the construction program, as required.

Australian Rail Track Corporation's (ARTC) existing hazard and risk management risk procedures will be reviewed and applied during the operational phase.

The impacts from natural hazards on the Project discussed in this chapter are based on existing and historical natural events. Detailed assessments of these are referenced to the appropriate EIS chapter where applicable.

20.2 Terms of Reference

This chapter addresses the relevant hazard and risk ToR for the Project, as summarised in Table 20.1. Compliance of the EIS against the full ToR is documented in Appendix B: Terms of Reference Compliance Table.

TABLE 20.1: TERMS OF REFERENCE COMPLIANCE TABLE—HAZARD AND RISK

Terms of Reference requirements		Where addressed
Information Requirements		
11.154	Describe the potential risks to people and property that may be associated with the project in the form of a preliminary risk assessment for all components of the project and in accordance with relevant standards. The assessment should include:	
	a) Specific consideration of:	
	i) respirable silica and other airborne contaminants (e.g. naturally occurring asbestos)	Section 20.7.2.1
	ii) Sudden subsidence or movement of soil or rock	Sections 20.6.1.1 and 20.7.1.4
	iii) Flash flooding	Sections 20.6.1.1, 20.7.1.2 and 20.7.1.3
	iv) Fatigue and heat management	Section 20.7.2.1
	v) Concurrent or simultaneous operations with existing railway infrastructure	Sections 20.6.2 and 20.7.2.2
	b) Other potential hazards (including abandoned mines), accidents (including derailments), spillages, fire and abnormal events that may occur during all stages of the project, including estimated probabilities of occurrence	Estimated probabilities are inherently incorporated into likelihood assessments as part of the risk assessment included in Section 20.9.1. Abandoned mines discussed in Section 20.7.2.3; accidents including derailments in Section 20.7.2.2; spillages in Sections 20.7.2.3 and 20.7.3.2; fire in Section 20.7.1.1.
	c) Identifying all dangerous and hazardous substances (including likely volumes) to be used, stored, processed, transported or produced and the rate of usage	Section 20.7.3
	d) Potential wildlife hazards, natural events (for example, cyclone, flooding, bushfire and landslide)	Sections 20.6.1.1 and 20.7.1
	e) How the project may potentially affect hazards away from the preferred alignment (for example, changing flooding characteristics).	Section 20.7, in particular Section 20.7.1.2
11.155	Describe those measures required to ensure that the proposed project avoids the release of hazardous materials to the environment, including as a result of a natural hazard event.	Section 20.8

Terms of Reference requirements		Where addressed
11.156	Provide details on the safeguards that would reduce the likelihood and severity of hazards, consequences and risks to persons within and adjacent to the project area(s). Identify the residual risk following application of mitigation measures including any actual or potential impacts to existing fire trails and evacuation routes. Present an assessment of the overall acceptability of the impacts of the project in light of the residual uncertainties and risk profile.	Sections 20.8 and 20.9.2
11.157	Provide an outline of the proposed integrated emergency management planning procedures (including evacuation plans, if required) for the range of situations identified in the risk assessment developed in this section.	Section 20.9.4
11.158	Outline any consultation undertaken with the relevant emergency management authorities, including the Local Disaster Management Group.	Section 20.9.4.4
11.159	Identify the need for appropriate explosive licences and requirements to notify of proposed blasting prior to explosives use under the Explosives Act 1999 and relevant codes and standards including the Australian Standard AS2187— Explosives—Storage, transport and use. Any risk associated with explosives use, manufacture or storage is within an acceptable level in accordance with the Explosives Act 1999 and codes and standards including AS2187.	Sections 20.7.3 and 20.8
11.160	Detail the risk of the use of explosives in connection to the rail alignment, associated infrastructure and any proposed mitigation measures to limit this risk.	Sections 20.7.3, 20.8 and 20.9.4.1
Climate		
11.166	Describe relevant climate patterns that may influence the water, air and noise environment in the vicinity of the project.	Sections 20.6.1.1 and 20.7.1 Appendix L: Air Quality Technical Report, Section 5.1 and Appendix A Appendix M: Surface Water Quality Technical Report, Sections 5.3.1–5.3.5 Appendix P: Non-operational Noise and Vibration Technical Report, Section 3.3 Appendix Q: Operational Railway Noise and Vibration Technical Report, Section 10.5
11.167	Climate information should be presented in a statistical form, including long-term averages and extreme values, as necessary.	Sections 20.6.1.1, 20.7.1.1 and 20.7.1.3 Appendix L: Air Quality Technical Report, Section 5.1 and Appendix A Appendix M: Surface Water Quality Technical Report, Sections 5.3.1 – 5.3.5 Appendix P: Non-operational Noise and Vibration Technical Report, Section 3.3
11.168	Describe the climatic conditions that may affect management of the project. This includes a description of the vulnerability of the project area to seasonal conditions, extremes of climate (e.g. cyclones and prolonged rain events) and natural or induced hazards (including bushfire).	Sections 20.6.1.1, 20.7.1.1 and 20.7.1.3

20.3 Policies, standards and guidelines

The assessment of hazards and risks to people, property, and the environment associated with the Project has been conducted against legislative and policy-level objectives for the management of risk.

The following legislation is relevant to the assessment of hazards and risks for the Project:

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth)
- *Work Health and Safety Act 2011* (Commonwealth)
- *Aboriginal Cultural Heritage Act 2003* (Qld)
- *Biosecurity Act 2014* (Qld)
- *Disaster Management Act 2003* (Qld)
- *Explosives Act 1999* (Qld)
- *Fisheries Act 1994* (Qld)
- *Fire and Rescue Services Act 1990* (Qld)
- *Land Act 1994* (Qld)
- *Public Health Act 2005* (Qld)
- *Queensland Heritage Act 1992* (Qld)
- *Rail Safety National Law (Queensland) Act 2017* (Qld).

Further discussion regarding the above pieces of legislation, their relevance to the Project and how the Project complies is provided in Chapter 3: Project Approvals. Policies and guidelines of relevance to this assessment and their respective requirements are described in Table 20.2.

TABLE 20.2: APPLICABLE STANDARDS AND GUIDELINE CONTEXT

Policy or guideline	Relevance to the Project
Queensland State Planning Policy (SPP)	Provides guidelines to ensure the risks associated with natural hazards, including the projected impacts of climate change, are avoided or mitigated during planning and development to protect people and property and enhance the community's resilience to natural hazards. The SPP forms the basis of design decisions such as route selection and impact assessment which inform risk assessment for the development.
Australian Code for the Transport of Dangerous Goods by Road & Rail (ADG code)	Details the technical specifications, requirements and recommendations applicable to the transportation of dangerous goods in Australia by road and rail. It is taken as the basis of dangerous goods handling and considered in the development and assessment of mitigation measures.
Rail Safety Principles and Guidance 1996	Provides safety principles and guidelines for the construction of railways. The principles have been applied to the risk assessment considering expected mitigation measures and approach to rail construction.
The National Rail Safety Guideline Accreditation of Rail Transport Operators 2008	Provides requirements for being an accredited rail operator in Australia and to attest that a rail transport operator has demonstrated the competence and capacity to manage rail safety risks. The requirements have been considered in risk assessment.
The National Rail Safety Guideline Preparation of a Rail Safety Management System 2008	Provides accredited rail transport operators with guidance about legislative requirements for safety management. The assessment has considered that the system requirements will be applied to the Inland Rail Program, specifically in the context of ARTC's Safety Management System.
National Standard for Health Assessment of Rail Safety Workers 2017	Provides guidance for rail transport operators to manage the risk and protect the safety of public, rail employees and the environment. Specifically, the standard outlines requirements to limit the impact of individual health issues on rail safety.
AS ISO 31000: (2009 and 2018) Risk Management—Guidelines	Describes the risk management process that can be applied throughout the life of an organisation and to a wide range of activities. Also provides guidance on the identification and assessment of risk that has been applied in the methodology of this chapter.
AS 4801:2001 Occupational Health Safety Management Systems	Sets requirements for the formation of health and safety policy and objectives.
AS 4084:2001 Occupational Health and Safety Management Systems—General Guidelines on Principles, Systems and Supporting Techniques	Provides guidance on the development and the implementation of occupational health and safety management systems and principles and their integration with other management systems.

Policy or guideline	Relevance to the Project
AS 4292 Railway Safety Management	Specifies railway safety requirements and management system associated with design, specifications, operating and maintenance procedures. The standard has been considered in the assessment of mitigation measures and risk assessment associated with railway incidents.
AS 2187 Explosives—storage, transport and use	Sets requirements for storage, transport and use of explosives associated with their location, design, construction and maintenance. Consideration of separation distances, handling requirements and restrictions on quantities has informed the risk assessment of potential explosives activities.
AS 1678 Emergency Procedure Guides—Transport	Provides information on transport requirements for different classes of dangerous goods, specifically with respect to the actions taken and likely response procedures to be in place in the event of an incident.
AS 2931:1999 Selection of Use of Emergency Procedure Guides for Transport of Dangerous Goods	Provides lists of Emergency Procedure Guides (EPGs) and Group Text Emergency Procedure Guides (GTEPGs) and guidance on their selection, completion and use. This standard serves as a reference when selecting the appropriate EPG for particular types of dangerous goods.
AS 1940:2017 Storage and Handling of Flammable and Combustible Liquids	Sets requirements for storage and handling of flammable and combustible dangerous goods Class 3. It has been considered in the development of mitigation measures for storage of construction chemicals.
AS 3780:2008 The Storage and Handling of Corrosive Substances	Sets requirements for storage and handling of corrosive dangerous goods Class 8. It has been considered in the development of mitigation measures for storage of construction chemicals.
AS 2436:2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites	Details the requirements in assessing noise and vibration control measures of construction, demolition and maintenance sites. Mitigation measures are expected to be in accordance with requirements of this guide and are considered in the assessment.
AS 4825:2011 Tunnel Fire Safety	Provides the guidelines for fire safety in new road, rail and bus tunnels. Mitigation measures are expected to be in accordance with requirements of this standard and are considered in the assessment.
AS 5100 Set:2007 Bridge Design	Details the acceptable requirements for the design of bridges and related structures intended to support railway and pedestrian traffic loads. Mitigation measures are expected to be in accordance with requirements of this standard and are considered in the assessment.
AS 7636:2013 Railway Structures	Details the requirements that encourage rail organisations to use a whole-of-life approach to rail structures, and cover the general management requirements, material composition, manufacturing, construction, maintenance, decommissioning and disposal of rail structures used in Australian rail operations. Mitigation measures are expected to be in accordance with requirements of this standard and are considered in the assessment.
HB203:2012 Managing Environmental Related Risk	Provides guidelines to help organisations manage environment-related risk.

20.3.1 ARTC management plan and procedures

20.3.1.1 Safety management system

ARTC's Safety Management System is accredited under the *Rail Safety Act 2006* (Vic.) and is based on the promotion of continual safety improvement. ARTC is undertaking action to obtain accreditation for this system under the *Rail Safety National Law (Queensland) Act 2017*. ARTC will use this system to manage safety risks associated with construction and commissioning, and operation as relevant. The types of documents that form part of ARTC's Safety Management System are as shown in Figure 20.1.

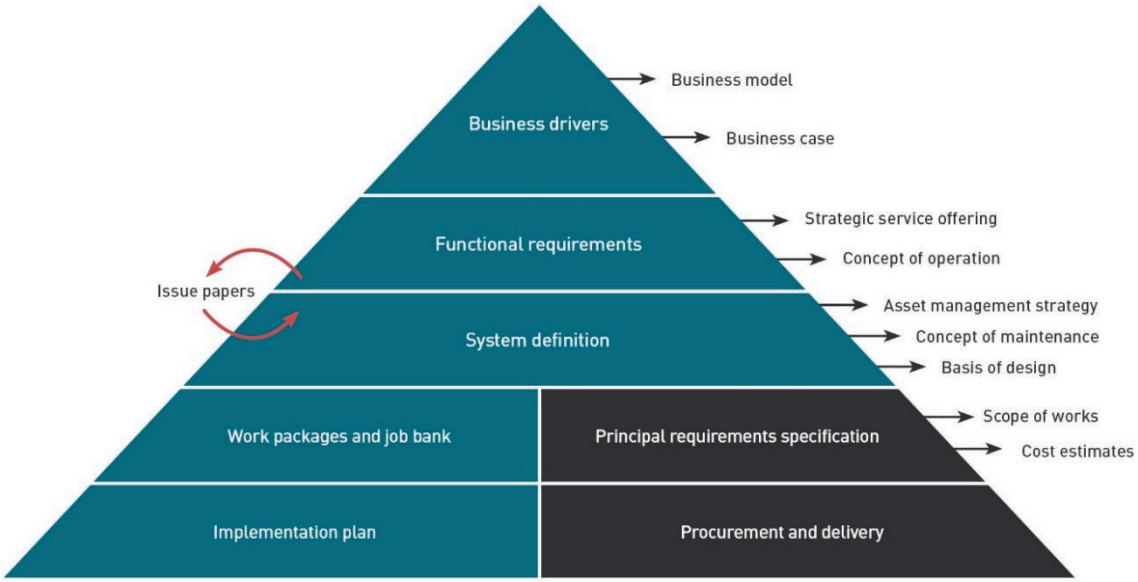

FIGURE 20.1: INLAND RAIL SAFETY MANAGEMENT SYSTEM

'No Harm' is an ARTC value, with the objective that no one is harmed at work or on ARTC's rail network. Demonstrating integration of ARTC's value of 'No Harm' into the Inland Rail management system, ARTC participates in voluntary audits with the Work Health and Safety Regulators and engages with Comcare and Office of the National Rail Safety Regulator (ONRSR), who regulate the national rail networks, to ensure ARTC systems meet the legal requirements and effectively prevent accidents and injury.

ARTC's Safety Management System documents interactive process flows for:

- Governance framework
  - Development of strategic priorities, consultation and governance requirements and review process
- Governance committees
  - Safety governance structures outline the escalation processes from the Operational Safety, Environmental and Risk Committee, through to the Chief Executive Officer and includes the Boards Safety and Environment Sub-committee.

20.3.1.2 Safety policy

ARTC will provide the basis for effective management of employee, contractor and public health throughout the life of the Project. The Safety Policy (refer Appendix F: Corporate Policies) includes the following:

- 'No Harm' is an ARTC value, with the objective that no one is harmed at work or on ARTC's rail network
- The Project is committed to achieving a strategy to reach 'No Harm', appreciating the following protocols:
  - Providing tools to support the identification of risk as appropriate to work activity
  - Establishing and maintaining communication, consultation and coordination with and between employees, contractors and relevant stakeholders
  - Providing information, instruction, and training to develop worker capabilities and competence
  - Providing plant, equipment and personnel protective equipment as suitable to undertake work
  - Establishing and maintaining measurable and achievable objectives and targets
  - Promoting safe behaviours and a positive safety culture
  - Monitoring performance and implementation of requirements to ensure continual improvements
  - Maintaining a Safety Management System that is accessible and user-friendly
  - Ensuring the processes and work practices are in line with the requirements of applicable laws.
- The policy will apply to the Inland Rail Program and the Project, including to contract workers throughout all phases of the Project.

20.3.1.3 Fatal & Severe Risk Program

The Fatal & Severe Risk Program, with accompanying lifesaving behaviours, is a fundamental element of ARTC's 'No Harm' value, which aims to implement ten control protocols to manage risk areas with potentially fatal consequences (2017b). The risk management protocol will provide safe work practices and establish minimum performance expectations to manage risk and eliminate incidents, including:

- Vehicle accidents (including road/rail vehicles)
- Manual handling
- Struck by rail traffic
- Rail traffic collision
- Struck by mobile plant
- Contact with electricity
- Hazardous chemicals, hot materials and confined spaces
- Crushed by a crane or lifted load
- Fall from height.

The Fatal & Severe Risk Program will apply to the Inland Rail Program and the Project, including to contract workers throughout all phases of the Project.

20.4 Methodology

20.4.1 Hazard and risk study area

The hazard and risk study area is defined as the area including permanent and temporary infrastructure, with the potential to impact people, environment, and property as a result of the Project. The extent of the impacts varies according to the nature and requirement of each hazard identified during the preliminary risk assessment, including existing environmental conditions and natural events. For a description of the Project scope and key features, refer Chapter 6: Project Description or each chapter for the definition of the relevant discipline study area.

The hazard and risk study area as defined for the hazard and risk assessment is described as the following:

- The natural environment directly and potentially indirectly impacted by the Project
- Extent of the proposed disturbance footprint, including road–rail interfaces, watercourse crossings, maintenance and construction access sites, construction laydown areas and service locations.

The disturbance footprint includes:

- Permanent disturbance footprint: The rail corridor, which includes the rail tracks and associated infrastructure as well as other permanent works associated with the Project (e.g. where changes to the road network are required)
- Temporary disturbance footprint: The permanent disturbance footprint and any temporary storage, laydown areas and access tracks to be used on a temporary basis during the construction phase.

20.4.2 Risk assessment methodology

The risk assessment presented in Section 20.9.1 has been prepared to describe the potential risks to people, property and the environment associated with the Project. The assessment considered sensitive receptors of the Project including population centres, environmental assets and activities conducted within and around the disturbance footprint. This provides a basis for the assessment of potential impacts and preparation of safeguards to manage and mitigate impacts that might arise from the Project.

The basic methodology for risk assessment is based on *AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018) Risk Management: Principles and Guidelines* and *HB203:2012 Managing Environmental Risk*. Section 6.4.1 *of ISO 31000:2018* describes a risk assessment as the overall process of risk identification, risk analysis and risk evaluation.

The risk management process, as shown in Figure 20.2, will be applied throughout the entire life of the Project. For the purpose of the risk assessment, the life of the Project is defined in the following phases:

- Design
- Construction and commissioning
- Operation.

The application of the AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018) provides a framework that enables ongoing identification and documentation of hazards and risk associated with the Project. The risk assessment presented in Section 20.9.1 will form part of the larger risk management process under ARTC's Safety Management System.

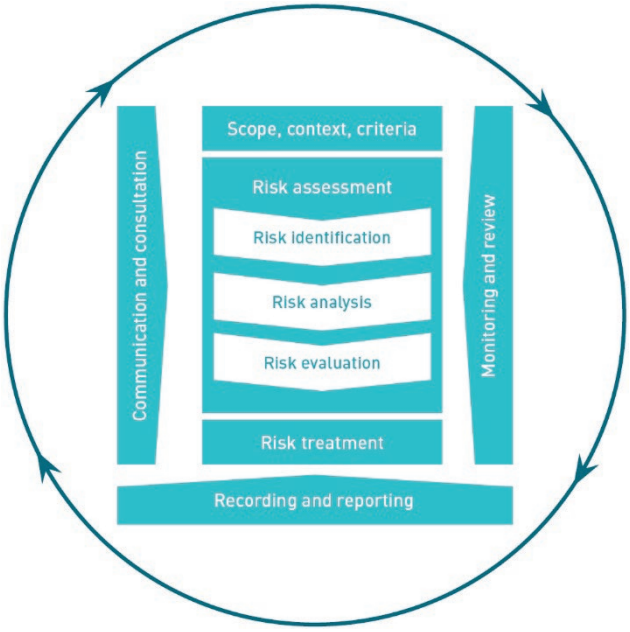

FIGURE 20.2: THE ISO 31000:2018 RISK MANAGEMENT PROCESS (INTERNATIONAL ORGANISATION FOR STANDARDISATION, 2018)

20.4.2.1 Risk identification

The risk identification involved identification of hazards and their potential receptors over the life of the Project. The Project phases included design, construction and commissioning, and operation. Receptors were not restricted to individuals or communities, and included sensitive environmental receptors such as land, habitat, flora and fauna. Potential hazards as identified in other technical studies, Project risk and Project safety in design workshops were included to provide breadth of assessment and to capture hazards identified during the design phase.

20.4.2.2 Risk criteria

The level of risk is determined as a function of potential consequence and likelihood considering the presence of any relevant risk mitigation controls. Table 20.3 shows how ARTC's risk matrix determines risk rank as a function of likelihood and consequence. The risk ranking methodology, including criteria applied to likelihood and consequence factors, is discussed in Chapter 4: Assessment Methodology. Probabilities of events occurring have been assessed from a qualitative view in the likelihood criteria rather than quantitative.

20.4.2.3 Risk analysis

Identified hazards were analysed in terms of the controls, the range of impacts in the context of those controls, and the likelihood of those impacts arising. Impacts and likelihood were combined to produce an estimated level of risk in accordance with ARTC's risk criteria, as presented in Table 20.3.

20.4.2.4 Risk evaluation

Each risk identified and assessed as part of the risk analysis was evaluated in the context of the Project in accordance with ARTC's risk criteria, as described in Chapter 4: Assessment Methodology.

20.4.2.5 Risk treatment and residual risks

Hazards ranked with medium, high and very high risk rating require further risk treatment throughout the life of the Project. Treatment includes risk management through ARTC's Safety Management System. Additional options for risk treatment such as mitigation measures and safeguards are described in Section 20.8.

The ability of the mitigation and management controls proposed to treat the risks is then evaluated by producing a residual risk evaluation from the same risk matrix used for the original evaluation. If the residual risk rank remains high or very high, the risk will not be deemed tolerable. Intolerable risks will not be accepted by the Project.

TABLE 20.3: RISK MATRIX

	Consequence				
Likelihood	**Not significant**	**Minor**	**Moderate**	**Major**	**Extreme**
Almost certain	Medium	Medium	High	Very high	Very high
Likely	Low	Medium	High	Very high	Very high
Possible	Low	Low	Medium	High	High
Unlikely	Low	Low	Low	Medium	Medium
Rare	Low	Low	Low	Low	Medium

As outlined in ARTC's Risk Management Procedure, risks with a residual rank of medium will be considered tolerable if ARTC demonstrates they are reduced so far as reasonably practicable through ARTC's Safety Management System. Additional options for risk elimination, inclusion of mitigation measures, and incorporation of safeguards have been described in Section 20.8 and Section 20.9. Risk controls have been considered the full life of the Project including design, construction and commissioning, and operation of the railway. Transfer of residual risk between the Project phases will be managed throughout the life of the Project.

20.4.3 Data sources

The Project has incorporated risk and opportunity, climate change and adaptation strategies and safety in design workshops. Additionally, several detailed technical studies have been carried out for the Project, which have informed the risk assessment. Risk assessments and disaster management plans have been developed by the relevant local council.

The following are particularly relevant and are referred to where applicable within this chapter:

- *District Disaster Management Plan*—Logan City and Ipswich City
- *Local Disaster Management Plan*—Scenic Rim Regional Council and Ipswich City
- Planning Schemes:
  - *2006 Consolidated Ipswich Planning Scheme*
  - *Scenic Rim Planning Scheme 2020*
  - *Logan Planning Scheme 2015*
- Climate data—Bureau of Meteorology (BoM)
- EIS technical reports:
  - Appendix C: Consultation Report
  - Appendix F: Corporate Policies
  - Appendix H: EMR Searches and Laboratory Certificates
  - Appendix J: Terrestrial and Aquatic Ecology Technical Report
  - Appendix L: Air Quality Technical Report
  - Appendix M: Surface Water Quality Technical Report
  - Appendix N: Hydrology and Flooding Technical Report
  - Appendix O: Groundwater Technical Report
  - Appendix P: Non-operational Noise and Vibration Technical Report
  - Appendix Q: Operational Railway Noise and Vibration Technical Report
  - Appendix R: Social Impact Assessment Technical Report
  - Appendix T: Non-Indigenous Heritage Technical Report
  - Appendix U: Traffic and Transport Impact Assessment Technical Report
  - Appendix V: Spoil Management Strategy
- EIS chapters:
  - Chapter 3: Project Approvals
  - Chapter 4: Assessment Methodology
  - Chapter 5: Stakeholder Engagement
  - Chapter 6: Project Description
  - Chapter 7: Sustainability
  - Chapter 8: Land Use and Tenure
  - Chapter 9: Land Resources
  - Chapter 11: Flora and Fauna
  - Chapter 12: Air Quality
  - Chapter 13: Surface Water and Hydrology
  - Chapter 14: Groundwater
  - Chapter 15: Noise and Vibration
  - Chapter 16: Social
  - Chapter 18: Cultural Heritage
  - Chapter 19: Traffic, Transport and Access
  - Chapter 21: Waste and Resource Management.
  - Chapter 23: Draft Outline Environmental Management Plan

Consultation activities including engagement with local councils and emergency services (refer Section 20.9.4.4 and Chapter 5: Stakeholder Engagement) have informed the Project hazard and risk assessment.

20.5 Sensitive receptors

Identification and assessment of risk requires an understanding of the potential impact of hazards on sensitive receptors. Receptors include people (human), sensitive environmental ecosystems (environmental), and society (industrial and commercial activity/ utilities).

20.5.1 Human receptors

The key human sensitive receptors potentially exposed to hazardous events associated with the Project are:

- Residential and rural communities adjacent to the Project
- Settlements of Calvert, Ebenezer, Peak Crossing and Kagaru, which are characterised by predominantly rural and rural-residential land uses, which contain remnant vegetation

- Purga to Peak Crossing with a mixture of land uses, including rural–residential properties and agricultural estates, poultry farms, Purga Quarry, Gibb Brothers farming operations and the township of Peak Crossing
- Teviot Range tunnel maintenance and rail facilities workers
- Pedestrian, motorists and residents who use the roads and footpath near the disturbance footprint and haulage routes
- Vehicle operators and passengers travelling on roads adjacent to or intersected by the Project such as the Cunningham Highway, Ipswich–Boonah Road and Rosewood–Warrill View Road
- People working on land adjacent to or intersected by the Project
- Users of water resources that may be impacted by the Project
- Tourists
- Emergency services workers
- Project construction workers.

The risks to employees are also assessed and managed through ARTC policies and procedures including WHS Procedure (WHS-PR-001).

20.5.2 Environmental receptors

The key environmental receptors that will be potentially exposed to hazardous events associated with the Project are:

- Indigenous cultural heritage sites that are within 1 km of the disturbance footprint (refer Chapter 18: Cultural Heritage for study results), stone artefacts scatters, landscape feature, resource area, grinding grooves, scarred/culturally modified trees, waterholes and rock shelters and spiritual areas
- Teviot Range (Flinders Peak Conversation Park), which is a historical estate of the Yuggera Ugarapul and Jagera People, a rugged nature terrain where there is minimal development
- Water catchment of the Bremer River and Logan River Catchment
- Water crossings of Bremer River, Bundamba Creek, Purga Creek, Reynolds Creek, Warrill Creek, Western Creek, Sandy Creek, Wild Pig Creek and Teviot Brook
- Ecological assemblages including threatened species, along with species of local and State significance and their habitat within and adjacent the disturbance footprint
- Environmentally sensitive areas including groundwater dependent ecosystems, threatened ecological communities, wetlands, remnant vegetation and areas containing conservation significance species
- Land, habitat and vegetation of environmental landmarks (including Purga Nature Reserve, Mount Perry Conservation Park and Flinders Peak Conservation Park)
- Groundwater resources within the disturbance footprint
- As identified in Appendix T: Non-Indigenous Heritage Technical Report, the non-Indigenous places of interest within 1 km of the disturbance footprint.

20.5.3 Industrial and commercial receptors and utilities

The key industrial or commercial receptors and utilities that will be potentially exposed to hazardous events associated with the Project are:

- Existing disturbed land including areas used for industrial, intensive agriculture, livestock farming, mining, storage of chemicals, gas, liquid fuel storage and waste disposal (landfills)
- Existing railway lines such as the Queensland Rail (QR) West Moreton System at Calvert and the connection to the Sydney to Brisbane Interstate Railway at Kagaru
- Commonwealth areas including RAAF Base Amberley, which is within 5 km of the disturbance footprint
- Jeebropilly and former Ebenezer Coal Mines within 3 km of the disturbance footprint
- Key Resource Area of Purga Quarry
- Agriculture estates and poultry farms
- Farming and agribusinesses, particularly those with an organic production certification
- Existing utilities that are impacted by the Project include services owned by Queensland Urban Utilities, Telstra, TPG, Nextgen, Energex, Powerlink, and Santos as well as the decommissioned Santos Moonie–Brisbane high pressure oil pipeline
- Significant transport infrastructure of the State-controlled road network
- Tourism attractions, drives and facilities where there are scenic lookouts providing views towards natural scenic amenity and supporting the region's tourism including:
  - Camp grounds (including Harding's Paddock, Camp Undulla, and Ivory's Rock Conventions and Events Centre)
  - Convention centres (including Ivory's Rock Conventions and Events)
  - Wineries (including Ironbark Ridge Vineyard)
- Existing council road network.

20.6 Existing environment

Railways can introduce risks to surrounding people, property and the environment for example the risk of land contamination due to transport of dangerous goods. Conversely, the surrounding communities, land use, and environment can pose hazards or risks to the railway operation for example through the interaction of people and activities within the disturbance footprint. Existing sources of hazards and risks have been examined as part of the risk assessment to develop the understanding of the impact the Project will have on the risk profile.

Existing hazards and risks affecting the Project are described in the relevant EIS chapters including:

- Chapter 8: Land Use and Tenure
- Chapter 9: Land Resources
- Chapter 11: Flora and Fauna
- Chapter 12: Air Quality
- Chapter 13: Surface Water and Hydrology
- Chapter 15: Noise and Vibration
- Chapter 18: Cultural Heritage
- Chapter 19: Traffic, Transport and Access
- Chapter 21: Waste and Resource Management.

20.6.1 Existing hazards

There are hazards in the existing environment (in the absence of the Project) such as natural events and infrastructure. These existing hazards have the potential to be impacted by the Project. These hazards are discussed below in terms of:

- Existing natural hazards
- Existing land conditions
- Existing infrastructure.

20.6.1.1 Existing natural hazards

Natural hazards are external risks on the Project. Key natural hazards for the Project identified include bushfire, flooding, landslides, wildlife, biosecurity, and climate conditions. These hazards are discussed in the following sections.

Climate data

Several meteorological monitoring stations are located in relative proximity to the disturbance footprint. The BoM station Amberley Aeronautical Meteorological Office (AMO) is approximately 8.5 km to the north of the disturbance footprint. A summary of the climatic data recorded at this BoM station is provided in Table 20.4.

TABLE 20.4: CLIMATE DATA FROM AMBERLEY AERONAUTICAL METEOROLOGICAL OFFICE (1941 TO 2019) (BOM 2019)

Parameter		Unit	Value
Highest mean maximum temperature		°C	31.2
Highest maximum temperature		°C	44.3
Lowest mean minimum temperature		°C	5.4
Lowest minimum temperature		°C	-4.9
Mean monthly rainfall	Highest	Mm	119.9 (February)
	Lowest	Mm	28.6 (August)
Monthly rainfall extremes	Highest	Mm	635.2
	Lowest	Mm	0.0
Mean solar exposure	Highest	MJ/m2	24.1
	Lowest	MJ/m2	11.7
Maximum wind gust speed	Highest	km/h	152
	Lowest	km/h	80

The historic temperatures at the Amberley AMO are consistent with a warm sub-tropical climate and the rainfall data shows distinct wet and dry seasons. These factors are consistent with the general climate of South East Queensland.

Historic climate data shows that there is the potential for extreme temperatures, evidenced by the 13 °C difference between the highest maximum temperatures and the highest mean maximum temperatures at the Amberley AMO (refer Table 20.4). Extreme temperatures can create two forces in the rail—compression and tension—which have the following impacts:

- **Compression**: rail will try to move sideways to lengthen to relieve compression. When the amount of compression generated in the rails exceeds the ability of the structure to hold itself in place, track movement or buckling occurs.
- **Tension**: rail will try to move sideways to shorten to relieve tensile stress. When the amount of tension generated is greater than the resistance offered by the track structure, a curve will pull in towards its centre. This is less dramatic than a buckle; however, it can be extremely dangerous if clearances are affected.

Historic climate data also shows up to a 520 mm difference between the highest monthly mean rainfall and the highest monthly rainfall that indicates the current potential for extreme rainfall events. This can lead to an increased potential for flash flooding, the impacts of which are discussed in Section 20.6.1.1.

For further details of the climate across the disturbance footprint, refer Appendix L: Air Quality Technical Report.

Climate conditions

Climatic changes observed throughout the 20th century include increases in global average air and ocean temperature, rising global sea levels, long-term sustained widespread reduction of snow and ice cover, and changes in atmospheric and ocean circulation and regional weather patterns, which influence seasonal rainfall conditions. These changes are caused by extra heat in the climate system due to the addition of greenhouse gases to the atmosphere. The additional greenhouse gases are primarily due to human activities such as the burning of fossil fuels (coal, oil, and natural gas), agriculture, and land clearing.

Climate modelling from the Commonwealth Scientific and Industrial Research Organisation (CSIRO, 2019) has predicted temperature rises relative to the climate of 1986–2005 in the east coast region for a full range of emission scenarios Figure 20.3 shows this trend with the following predicted temperature rises:

- 0.4 °C to 1.3 °C by 2030
- 2.7 °C to 4.7 °C by 2090.

Increases in temperature or number of extreme heat events may result in increased likelihood of track buckling due to thermal expansion if unmitigated.

This climate modelling also considered rainfall in eastern Australia until 2090. This predictive model has displayed a drying trend clearly evident in eastern Australia (CSIRO, 2015) and Figure 20.4 shows this trend with the following predicted changes in rainfall relative to 1995:

- -10 per cent to 5 per cent by 2030
- -25 per cent to 10 per cent by 2090.

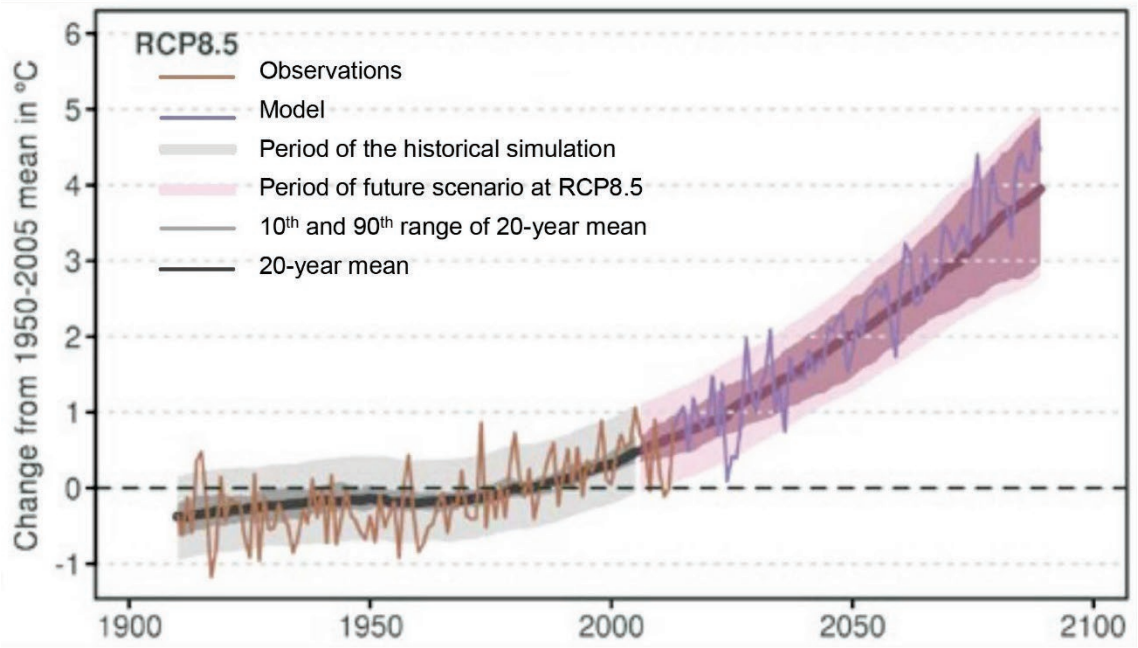

FIGURE 20.3: TIME SERIES FOR EAST COAST ANNUAL AVERAGE SURFACE AIR TEMPERATURE FOR 1910 TO 2090

Source: CSIRO (2019)

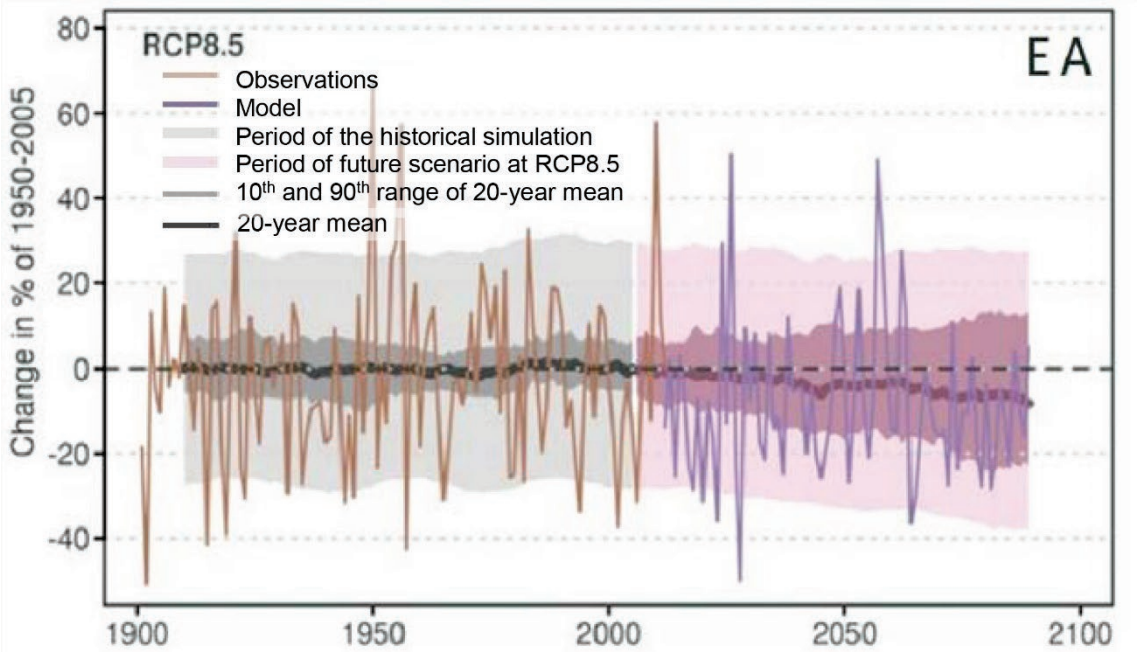

FIGURE 20.4: TIME SERIES FOR EASTERN AUSTRALIA RAINFALL ANNUAL AVERAGE

Source: CSIRO (2015)

The effects of changing climatic conditions may impact numerous environmental hazards, potentially resulting in increased severity and duration of weather activity, increased flooding extents and worsening extreme temperature events such as heat waves. Additionally, increased temperatures and lower rainfall may contribute to extended droughts and periods of dryness, which can contribute to increased fire weather risk, soil dispersion, increased salinity (and reduced asset life) and the potential for increased erosion.

Climate modelling from CSIRO indicates that the following potential impacts to the Project associated with these occurrences would be:

- Changes in the magnitude and distribution of extreme weather, which may result in the increased frequency of events that prevent the operation of double-stacked freight trains
- Changes in precipitation and increased duration of drought, which can result in soil cracking and subsidence, and lead to instability of drainage infrastructure, bridges and track
- Increased wind speeds, which could potentially result in derailments or escalate the spread of fire (either from bushfire or burning trains)
- Increased flooding resulting in inundation of track and trackside infrastructure (signalling/communications equipment and drainage basins)
- Increased incidence of extreme events (heat, rainfall and bushfire) resulting in disruption to power supply causing temporary loss of signalling and communication systems
- Increased heat events and increased temperatures leading to compression and tension, as a precursor to track buckling, and the subsequent disruption of service.

For more details of climate conditions as an external hazard, refer Chapter 13: Surface Water and Hydrology and Appendix M: Surface Water Quality Technical Report.

Bushfire

The disturbance footprint is predominately mapped as a 'Medium Potential Bushfire Intensity' Bushfire Prone Area, with an area of 'Very High Potential Bushfire Intensity' occurring between the Washpool and Undullah mountain range (Department of State Development, Manufacturing, Infrastructure and Planning, 2016). The bushfire season extends from mid–late winter through to early summer. The threat of bushfires increases with periods of reduced rainfall and increased temperatures, which can increase the amount of dry grass available to burn.

The climate statistics from the BoM show the highest recorded temperature for the disturbance footprint is +44.3 °C as measured at Amberley AMO in summer. Mean rainfall values collected from the Amberley AMO highlight the distinct wet (summer) and dry (winter) seasons experienced by the region, as well as the large variation in rainfall amounts received across the wider area.

CSIRO (2019) climate modelling predicts that the combination of increased temperature predicted, combined with the lower rainfall predicted will result in a higher drought factor and thus an increased fire weather risk in the future. CSIRO (2019) predicts the following increases in fire danger for the east coast in the Representative Concentration Pathway 8.5 case:

- Forest Fire Danger Index increases from 1995 baseline by:
  - 12 per cent by 2030
  - 30 per cent by 2090
- Number of days with severe fire danger rating increases from 1995 baseline by:
  - 45 per cent by 2030
  - 130 per cent by 2090.

Floods

A large portion of the disturbance footprint is located on a floodplain with low lying watercourses. Five major flooding events have been observed in the past 10 years in the Bremer River and Warrill Creek.

The disturbance footprint interacts with two catchment areas of the Bremer River, and the Logan River catchment area (Department of Environment and Science (DES), 2018a). The Bremer River Catchment expands to an area of approximately 2,030 km^2 with the main Bremer River channel surrounded by smaller sub-catchments. Rainfall in the catchment is considered good along its steeper sections, which are situated to the south and east, while the remainder of the catchment experiences average rainfall of under 1,000 mm/yr (SEQ Catchments, 2006). The Logan River Catchment area expands over 3,000 km^2 with an approximate 5,500 km of stream network. Rainfall in the catchment is very high especially in the eastern headwaters that, combined with good recharge of groundwater associated with basalt geology, leads to permanent flow (SEQ Catchments, 2017).

Seasonal variations in rainfall mean that flooding, and particularly flash flooding, is more likely during the storm season between late spring into summer as a result of heavy rainfall events associated with severe storms and tropical cyclones.

Chapter 13: Surface Water and Hydrology provides further details of the existing flood conditions in the vicinity of the Project.

Cyclones

In Queensland, tropical cyclones mostly form from lows within the monsoon trough and affect the northern areas of the State (BoM, 2018d). While relatively uncommon, these systems are generally formed during summer months and affect coastal areas the most. Since the year 2000, there have been seven tropical cyclones of significance in Queensland, of which one, Cyclone Debbie, passed through the hazard and risk study area as an ex-tropical cyclone low in 2017 (BoM, 2018d). While the risk of a cyclone reaching the hazard and risk study area is minimal, it is not non-existent. The likelihood of ex-tropical cyclones to pass through as tropical lows is higher. Consequences of a cyclone or strong tropical low include damaging winds and rain, which can potentially cause flooding.

The intense rainfall experienced during storms and cyclones also introduces the potential for flash flooding. Flash flooding events typically result after periods of intense rainfall, particularly in areas of saturated soil or poor soil absorptivity. Runoff from catchment areas collects in gullies and streams, resulting in large flow volumes often resulting in fast flowing torrents of water and debris. Although the duration is usually rapid, the volume and speed of water can cause significant damage to property and people, in addition to exacerbating erosion effects in the flow path.

Landslides, sudden subsidence and movement of soil or rocks

Landslides in Queensland are generally caused by heavy rain. The rain saturates the soil on a hillside past the point where any remaining vegetation can support the soil's weight against the force of gravity. Often this is as a result of human activity, for example where trees and plants have been removed for construction purposes.

The disturbance footprint consistently features regions of low to moderate high-relief terrain, becoming higher relative relief and elevation, as the alignment passes south of Flinders Peak, within the Scenic Rim mountain range. The alignment does not have any significant peaks but rather undulates with many areas of steep slopes.

Field observations highlighted evidence of erosion on some riparian banks throughout the disturbance footprint, primarily due to stock movement and access. The instance of landslides, sudden subsidence and movement of rocks could cause damage to the Project and potentially pose a safety risk to public and ARTC personnel.

For more details of landslides, sudden subsidence and movement of soil or rocks as an external hazard, refer Chapter 9: Land Resources.

Wildlife

Wildlife is an external hazard to the Project as there is the potential for wildlife to interact with the Project through:

- Animal attacks to workers
- Collisions with fauna
- Fauna adopting rail infrastructure as habitat (e.g. bats)
- Fauna carrying diseases that may pose a risk to human health
- Pests and weeds that pose a biosecurity risk
- Flora that pose a risk to human health (e.g. construction workers).

Further information on flora and fauna is found in Chapter 11: Flora and Fauna.

Naturally occurring asbestos

The geotechnical investigations undertaken within the land resources study area (an area defined within Chapter 9: Land Resources) found no naturally occurring asbestos to be present.

For more details of naturally occurring asbestos as an external hazard, refer Chapter 9: Land Resources.

20.6.1.2 Existing land conditions

Land contamination

Based on the land uses within the disturbance footprint and the findings of a desktop assessment, potential sources of contamination in the vicinity of the disturbance footprint are considered to include:

- Agricultural activities: hydrocarbons (fuel and oil storage and use), pesticides and herbicides, asbestos and lead paint, arsenic (cattle dips) and landfilling
- Quarries: hydrocarbons (fuel and oil storage and use), metals/metalloids and 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, pesticides and herbicides
- Unknown fill material: asbestos, metals/metalloids and hydrocarbons
- Existing railway lines: hydrocarbons (fuel), dangerous goods (freight).

The probability of encountering acid sulfate soils (ASS) is generally considered low for the disturbance footprint as mapped by the *Atlas of Australian Acid Sulfate Soils* (CSIRO, 2014). This mapping revealed no known occurrence with the exception of a dam to the east of the Cunningham Highway, which was mapped as having a high probability of containing ASS.

For more details on land contamination as an external hazard, refer Chapter 9: Land Resources.

Unexploded ordnance

A search of the Department of Defence online mapping for unexploded ordnances (UXO) identified a large area of 'slight disturbance' just west of Kagaru, extending into the Scenic Rim mountain range, as well as an additional extent of 'slight disturbance' just north of Peak Crossing. The Project has the potential to interact with UXO within the disturbance footprint throughout any phase of the Project if disturbed.

The Department of Defence defines areas of 'slight disturbance' as 'areas with a confirmed history of military activities that have resulted in residual UXO, but Defence considers it inappropriate to assess as substantial' (Department of Defence, 2017). The Department of Defence's advice for areas of 'slight disturbance' is 'All land usage and development, within these areas, should continue without further UXO investigation or remediation' (Department of Defence, 2017).

For more details on UXO as an external hazard, refer Chapter 9: Land Resources.

Asbestos contamination

Asbestos-containing materials may be present within the existing rail corridor and tie-in locations for the Project, particularly within structures and rail infrastructure as insulation, signal boxes, switchboxes and building fabric. Asbestos contamination may also be present near existing rail infrastructure because of the historical use of asbestos in rolling stock brake shoes.

For more details of asbestos contamination as an external hazard, refer Chapter 9: Land Resources.

20.6.1.3 Existing infrastructure

The disturbance footprint is likely to interact with existing services during construction, such as services owned by Queensland Urban Utilities, Telstra, TPG, Nextgen, Energex, Powerlink and the non-operational Santos Moonie–Brisbane high-pressure oil pipeline.

The disturbance footprint is serviced by a network of highways, State-controlled roads and local government managed roads, as well as the existing train lines that are the main transport routes for the region. The disturbance footprint intersects with 89 roads, varying from major roads, to minor roads, to road reserves and private roads/farm tracks. Existing railway lines are located at Calvert and Kagaru.

The Royal Australian Air Force (RAAF) Base Amberley is located over 5 km to the disturbance footprint. However, the Project is located within the 8 km and 13 km wildlife hazard buffer zone, and the 45 m and 90 m height restriction zone (which apply to defence airfields and joint-user airfields and may limit the height of new structures or additions to existing structures). Due to the height restriction zones, use of construction plant, placement of bridges, or operation of double-stacked freight has the potential to impact RAAF Base Amberley. The Project will not create incompatible intrusions or compromise the safety of the RAAF Base Amberley. Given the nature of the Project and its significant separation distance from the RAAF Base Amberley, the Project will not attract wildlife that will then migrate onto the RAAF Base Amberley.

For more details of existing infrastructure as an external hazard, refer Chapter 8: Land Use and Tenure, Chapter 19: Traffic, Transport and Access and Appendix U: Traffic and Transport Impact Assessment Technical Report.

20.6.2 Safety records

Within the rail corridor, there is the potential for railway incidents including train and level-crossing collisions and derailments. In particular, the Project rail line will join to the QR West Moreton System at Calvert and ARTC's Sydney to Brisbane Interstate Railway line at Kagaru, where there will be potential for railway incidents between trains.

DTMR and ONRSR publish investigation reports into rail incidents, which are available on their websites. The ONRSR is an independent body corporate established under the *Rail Safety National Law (Queensland) Act 2017*, which aims to encourage and promote national rail operations and safety.

For the purposes of analysis, the reports focus on notifiable safety occurrences including:

- A running line derailment
- A running line collision between rolling stock
- A collision at a railway crossing between rolling stock and either a road vehicle or a person
- An accident or incident that has caused significant property damage, serious injury or death
- An accident or incident involving an inadequacy in the safety management system for the railway operations that could have caused significant property damage, serious injury or death
- A fire or explosion on or in rail infrastructure or rolling stock that affects the safe carrying out of the railway operations or has endangered one or more persons
- A terrorist attack or an act or event suspected to be a terrorist attack.

Over the past six years there has been a relative decrease in the number of notifiable safety occurrences. Table 20.5 shows data from the ONRSR Rail Safety Report 2018–2019 period, chosen as Queensland joined ONRSR in July 2017. This information provides contextual reference for understanding the potential likelihood and consequence of rail-based incidents.

TABLE 20.5: AUSTRALIAN RAIL SAFETY OCCURRENCE DATA, FROM 2018—2019

Statistic	Value	Units
Running line derailment of freight train	0.423	per million km of train line
Running line collisions (trains with rolling stock)	0.018	per million km of train line
Collisions at crossing (passenger and freight train)	0.142	per million km of train line
Fatalities (involving passengers, workers, public and trespass excluding suspected suicide)	0.088	per million km of train line
Signal passed at danger /authority exceeded	2.239	per million km of train line
Fire or explosion	<0.001	per million km of train line
Terrorist attack	<0.001	per million km of train line

The nature of these incidences has informed the design in order to mitigate risks so far as is reasonably practicable. Further information on road rail interfaces for the Project are found in Chapter 6: Project Description and Chapter 19: Traffic, Transport and Access and Appendix U: Traffic and Transport Impact Assessment Technical Report.

20.7 Hazard identification and potential impacts

Hazards that have the potential to impact people, property, or the environment associated with the Project have been identified through internal risk identification workshops, design reviews and impact assessments. Identified key hazards are detailed within this section and risk levels for each hazard identified are provided in the risk assessment table (refer Table 20.11).

The Queensland Police Service (QPS), Queensland Ambulance Service, Queensland Fire and Emergency Services, Queensland Rural Fire Services, Rosewood Police Station, Harrisville Police Station and Boonah Police Station were consulted as part of the EIS engagement activities. Key aspects covered were safety and access (including tunnel operations), and implications of proposed road network alterations.

Occupational hazards will exist throughout the life of the Project. These hazards will be managed in compliance with the *Work Health and Safety Act 2011* and Work Health and Safety Regulation 2011 along with ARTC's Safety Management System, including procedures, work instructions, engineering standards and guidelines. Ongoing workplace risk assessments will be carried out in accordance with ARTC's Safety Management System and ARTC's Fatal & Severe Risk Program. For the purpose of this EIS, these occupational risks will not be documented in this chapter.

Technical studies undertaken as part of the EIS have been incorporated where applicable; reference is provided to detailed assessments and sections of the EIS as appropriate.

20.7.1 Natural hazards

Existing natural hazards within the disturbance footprint have the potential to introduce risk to Project activities and require identification and mitigation. Natural hazards relevant to the Project are presented in Table 20.4. Natural hazards include adverse weather conditions and natural events.

The Project also has the potential to generate or change the risk profile of hazards to the natural environment through interactions with existing sensitive environmental receptors. These risks are discussed in the following sections and include impacts to sensitive environmental receptors through construction and operation.

TABLE 20.6: IDENTIFIED POTENTIAL IMPACTS ARISING FROM NATURAL EVENTS

Potential hazards	Impact category	Construction	Operation
Bushfire	Asset Environment Safety	Potential	Potential
Flooding	Asset Environment Safety	Potential	Potential
Climate conditions (e.g. increase in temperature, rainfall events and heat waves)	Asset Environment Safety	Potential	Potential
Landslide, sudden subsidence, movement of soil or rocks	Asset Environment Safety	Potential	Potential
Wildlife	Safety Environment	Potential	Potential
Biosecurity (e.g. propagation of invasive pests and transport of biohazards)	Safety Environment	Potential	Potential
Naturally occurring asbestos	Safety Environment	No	No

20.7.1.1 Bushfire

Project activities have the potential to escalate the risk of bushfire by introducing ignition sources such as welding. Construction activities, in particular the use of temporary facilities, can increase the severity of fire incidents by providing additional fuel such as combustible liquids storage. Leaks and spills from freight and other machinery can also increase the potential for bushfires.

Residential housing within and adjacent to the hazard and risk study area, specifically within the area of 'very high potential bushfire intensity' occurring between the Washpool and Undullah mountain range, are vulnerable to the risk of bushfires. It is also acknowledged that other assets, including infrastructure (e.g. Powerlink transmission lines, the Santos Moonie–Brisbane high-pressure oil pipeline), rural-residential properties, agricultural estates, and farming assets are exposed and vulnerable to damage or destruction by bushfire.

Increased bushfire frequency has the potential to result in environmental damage, as well as potential safety and asset loss impacts. The increased temperature predicted combined with the lower rainfall predicted in eastern Australia for the years 2030, 2050, 2070 and 2090 (CSIRO, 2015) results in a higher drought factor and thus an increased fire weather risk in the future.

The Project also provides some benefits in the case of a bushfire, such as: improved access to the area, acting as a firebreak and providing the opportunity to potentially involve the local disaster management groups during construction and operation.

20.7.1.2 Flooding

The Project crosses a number of mapped watercourses including Western Creek, Bremer River, Warrill Creek, Purga Creek, Upper Tributary Purga Creek and Teviot Brook. Construction of bridges and rail in the vicinity of water crossings has the potential to affect drainage characteristics, which may impact existing dwellings, sheds, farm buildings and infrastructure, crops and roads.

Appendix N: Hydrology and Flooding Technical Report identified that the Project can potentially impact flooding characteristics in the following ways:

- Changes in peak water levels and associated areas of inundation
- Concentration of flows, redirection of flows and/or changes to flood flow patterns
- Increased velocities leading to localised scour and erosion
- Changes to duration of inundation
- Increased depth of water affecting trafficability of roads and tracks.

The Project also has the ability to increase risk to the environment and persons during extreme flood events that may occur in the operational phase as there is the potential for spread of dangerous goods from loss of containment of freight dangerous goods.

For further discussion of the potential impacts of flooding, refer Chapter 13: Surface Water and Hydrology and Appendix M: Surface Water Quality Technical Report.

20.7.1.3 Climatic conditions

The potential impacts of climatic conditions that may affect the management of the Project are generally associated with variability of temperature, wind, rainfall and flooding. As discussed in Section 20.6.1.1, the Project is subject to a warm sub-tropical climate and is vulnerable to seasonal conditions consistent with the general climate of South East Queensland (i.e. wet and dry seasons). The Project may, therefore, be vulnerable to extremes of climate including tropical cyclones and prolonged rain events which, while relatively uncommon, is not non-existent in QLD, as well as natural or induced hazards including bushfires that are likely to occur during periods of reduced rainfall and increased temperatures. The Project may also be vulnerable to flooding as major flooding events have been evident in the past 10 years in the vicinity of the Project.

Climate modelling from CSIRO projects an increase in intensity of heavy rainfall events. The heaviest rainfall events usually occur in summer, which is strongly influenced by the easterly trough, an elongated zone of low-pressure forms as a result of strong surface heating west of the Great Dividing Range. Summer thunderstorms can be hazardous due to accompanying winds, hail, flash floods and potentially damaging lightning strikes. During the operational phase of the Project, potential impacts of climatic conditions include tracks buckling due to increased heat events (e.g. heat waves), inundation of tracks and trackside infrastructure from increased flooding and interruption to power supply or network communications from severe weather events.

For more details of the potential impacts of climatic conditions including that impacts on flooding regime under climatic conditions to 2090 through considering an increase in rainfall intensity as per the Australian Rainfall and Runoff guidelines (Ball et al., 2016), refer Chapter 13: Surface Water and Hydrology.

20.7.1.4 Landslide, sudden subsidence, movement of soil or rocks

Construction of the Project can impact soil and geology to increase the consequence and/or the likelihood of landslides, sudden subsidence, or movement of soil or rocks such as:

- Cracking and/or settlement of structures including sudden subsidence due to the high potential for shrinkage and swelling of the black soils and cracking clays. Cracking may also result from the removal of vegetation with roots in these soils
- Slope instability including sudden subsidence requiring stabilisation of cut faces
- Sudden movement of soil or rock potentially associated with tunnelling works
- Erosion due to the loamy soils on alluvial plains and terraces
- Rock fall onto track due to colluvial loose scree on existing slopes or weathering
- Risks of landslides, slump features and mass wasting due to some instability issues including the erodibility of the Marburg Subgroup.

For further discussion of the impact of landslide, sudden subsidence, movement of soil or rocks, refer Chapter 9: Land Resources.

20.7.1.5 Wildlife

Land clearing for construction and the rail operation can potentially increase wildlife interactions, including the potential for wildlife to be struck by plant equipment or vehicles. Rail operations may impact fauna passages and habitat connectivity.

For further discussion of the types of wildlife found in the disturbance footprint, refer Chapter 11: Flora and Fauna.

20.7.1.6 Biosecurity

The Project has the potential to negatively impact land use and biodiversity within the area through:

- Transfer of biosecurity hazards into the disturbance footprint and surrounding areas. This includes hazards that may be transported with goods during operations. Dispersion and potential encouraged growth of weeds during construction activities by exposing soil and clearing vegetation
- Proliferation of weed and pest species can also result in damage to native vegetation and impact wildlife. Weeds can affect the ecological diversity and balance by competing with native flora and reducing available food sources, while pest species can impact native vegetation and wildlife through grazing, digging, trampling and predation. Specifically, the disturbance footprint will traverse areas contained within fire ant biosecurity zones
- Exotic grasses can make bushfires hotter and spread faster.

For further discussion of how the Project potentially impacts biosecurity, refer Chapter 11: Flora and Fauna and Appendix J: Terrestrial and Aquatic Ecology Technical Report.

20.7.2 Project hazards

Activities associated with the construction and operation phases of the Project have the potential to cause harm to surrounding environmental, community and other sensitive receptors. Construction activities including clearing may impact areas of sensitive environmental value, while operations on the rail alignment may impact nearby communities.

Potential hazards are identified in Table 20.7.

TABLE 20.7: IDENTIFIED POTENTIAL IMPACTS ARISING FROM THE PROJECT

Potential hazards	Potential cause	Impact category	Construction	Operation
Health (e.g. fatigue, asbestos, respirable silica, noise, vibration,)	Earthworks including tunnelling Land clearing Physical activity	Asset Safety Environment	Potential	Potential
	Rolling stock	Asset Safety Environment	No	Potential
Road incident	Construction traffic Detours Changing traffic condition	Safety	Potential	Potential
Rail incident	Interface with live rail Concurrent operation	Safety	Potential	Potential
Pedestrian safety	Level crossing Poor visibility Trespass	Safety	Potential	Potential
Tunnel	Tunnel environment (e.g. spill in tunnel, trespass)	Asset Safety Environment	Potential	Potential
Infrastructure and services	Interface with services or overhead transmission lines	Asset Safety Environment	Potential	Potential
Gas and petroleum pipelines	Interface with pipelines	Asset Safety Environment	Potential	Potential
Contaminated land	Exposure of acid sulfate soil Leaks and spills from freight and vehicles	Asset Safety Environment	Potential	Potential
Overbridges	Structural failure Derailment at elevated track	Asset Safety	Potential	Potential
Emergency access	Restricted access for emergency evacuation Restricted emergency vehicle route Restricted fire trail	Safety	Potential	Potential
Abandoned mines and underground collieries	Abandoned mines and underground collieries	Asset Safety	Potential	No
Dangerous goods	Storage, handling, use and transport	Asset Safety Environment	Potential	Potential (freight)
	Explosive (e.g. potential blasting for tunnel construction)	Asset Safety Environment	Potential	No

20.7.2.1 Health

Project activities have the potential to impact the health of site workers and the local community.

Fatigue and heat stress

Heat stress can lead to cramps, dizziness, disorientation, exhaustion and, in severe cases, death. Fatigue can increase the risk of incidents, for example errors during equipment operation or misjudging the speed and distance of approaching traffic. The onset of fatigue can lead to poor decision making, lack of alertness, and slower reaction to a situation. In this way, fatigue and heat stress can impact surrounding communities through escalation of incidents initiated by the Project.

Asbestos

Disturbance of asbestos containing materials can result in the release of airborne fibres. Asbestos fibres are carcinogenic and have significant potential health impacts over the long term. Asbestos fibres released into the environment are persistent and can result in contamination of soil.

Impacts associated with asbestos release are generally limited to the local environment; however, the extent of potential impacts are influenced by the quantity and type of asbestos containing material and weather conditions during disturbance. The inappropriate handling of asbestos material, such as improper disposal and transport, can also contribute to widespread impacts.

No naturally occurring asbestos has been found to be present during geotechnical investigations undertaken to date; however, asbestos-containing materials may be present in infrastructure within the disturbance footprint including sheds, houses as well as rail infrastructure (e.g. signal boxes, insulation) associated with the QR West Moreton System.

Dust, respirable silica and other airborne contaminants

Earthworks and truck movements over unpaved surfaces during construction (e.g. land clearing and blasting) result in the disturbance of surface material, which may generate airborne contaminants (e.g. silica) affecting sensitive receptors including flora downwind. High levels of silica exposure can lead to the development of lung cancer, acute and accelerated silicosis, kidney disease, and chronic obstructive pulmonary disease (Cancer Council, 2019). For the general community, the risk of exposure to respirable crystalline silica is very low; however, low levels of silica dust exposure can lead to chronic silicosis that causes fibrotic nodules and shortness of breath if the exposure is repeated for a long period.

The risk of silica and other airborne contaminants is particularly dangerous with regards to tunnel construction due to the high likelihood of accumulating airborne particles and the limited natural ventilation available (contractors must provide sufficient ventilation to meet contract and statutory requirements). According to the *Tunnelling road header operations: dust conditions and their control* report (Workplace Health and Safety Queensland, 2010), there is a potential respirable crystalline silica (RCS) exposure risk for all workers involved in tunnelling operations, and a significant potential risk for all road header operators, particularly open cab road header operators. The *Occupational Disease Strategy 2007–2010* program highlighted the importance of control measures including adequate dust control, continual mandatory use of respiratory protective equipment (RPE), implementation of corrective controls by operators, constant review of dust concentrations and health surveillance of long-term workers in tunnelling operations (Workplace Health and Safety Queensland, 2010).

Other aerosol emissions from construction activities include combustion products from the operation of diesel engines. These pollutants include carbon monoxide, nitrogen dioxide and particulate matter, which make up a large proportion of airborne dusts and that can be drawn deep into the lungs. Carbon monoxide reduces the amount of oxygen that can be carried by haemoglobin that, therefore, leads to a lack of blood supply to vital organs (Department of the Environment and Heritage (DEH), 2005a). Both nitrogen dioxide and particulate matter can cause respiratory problems (DEH, 2005b). Some airborne contaminants can also possibly impact sensitive receptors by entering sources of water open to the air such as personal water tanks.

Erosion of exposed areas such as cleared vegetation, uncovered stockpiles and haul roads have the potential to generate dust depending on the prevailing meteorological conditions.

Dust can be generated during operation due to dust creation from the train movement or loss of containment of transported materials such as coal.

Trains moving through the Teviot Range Tunnel would cause a short-term increase in concentrations of emissions at tunnel portals in comparison to along the alignment in the open air.

For further information of how the Project potentially impacts air quality, refer Chapter 12: Air Quality and Appendix L: Air Quality Technical Report.

Noise and vibration

Exposure to loud noise and vibration over an extended period are expected to result in human discomfort including:

- Disturbance to sleep pattern and quality
- Reduction in level of concentration and slower reaction times
- Increase in stress and depression level affecting mental wellbeing.

Additionally, vibration can cause damage to infrastructure, which can lead to asset damage of both the Project infrastructure and surrounding infrastructure sensitive receptors. Damaged infrastructure has the potential to physically harm humans.

Noise and vibration will be acute and temporary during the construction phase due to the requirement of construction plant, vehicles, equipment (including earth moving machinery, vibratory rollers, and hydraulic hammers) and activities such as piling, tunnelling and blasting. Train and freight movements will also be a potential source of noise pollution and vibration during the operations phase.

For detailed discussion of noise and vibration impacts associated with the Project, refer Chapter 15: Noise and Vibration, Appendix P: Non-operational Noise and Vibration Technical Report and Appendix Q: Operational Railway Noise and Vibration Technical Report.

20.7.2.2 Accidents

Accidents that could potentially occur within, or in the vicinity of, the disturbance footprint arise from increased traffic on roads, concurrent operation of trains, trespassing and interactions at level crossings. Further information regarding traffic interactions and assessment of conditions can be found in Chapter 19: Traffic, Transport and Access.

Road incidents

Increased light and heavy vehicle traffic on the Cunningham Highway and other roads in the area surrounding the Project is expected during the construction phase of the Project. Vehicles used during construction and maintenance include graders, loaders and light vehicles. Construction and maintenance vehicles operating on roads and access roads around the disturbance footprint can create interface conflict with local roads and access roads.

Altered traffic conditions such as detours, restricted lane widths and temporary access points may also potentially result in accidents during the construction phase. Changes in road access, including increased road–rail interface, has the potential to decrease the accessibility and increase travel times associated with accessing key destinations, facilities and community services for local residents.

Road routes can be interrupted by minor motor vehicle accidents or interactions with wildlife. Major road interruptions usually arise from heavy vehicle use or accidents involving vehicles carrying hazardous chemicals. Heavy vehicles can also potentially increase the risk of accidents occurring that could cause serious injury or death. The consequence of this type of accident could affect the capacity of emergency and essential services and cause disruption to essential road freight networks for the supply of goods.

Refer Chapter 19: Traffic, Transport and Access and Appendix U: Traffic and Transport Impact Assessment Technical Report for more information regarding the interactions of traffic with trains.

Rail incidents

Increased frequency of rail movements during the operational phase will increase the potential for rail incidents, including derailment. The impact of rail incidents increases significantly when considering the freight of dangerous goods. Derailments can result in significant damage to people, property, and the environment, depending on the location of an incident and the contents of the freight train involved.

As shown in Table 20.5, derailments are possible events. Historical incident data indicates a potential annual frequency of 0.464 per million freight train kilometres based on 2015 to 2019 four years average data (ONRSR, 2019). Other events include vehicle strikes at level crossings, running line collisions with rolling stocks and trespassing.

The disturbance footprint includes areas of steep grade and a tunnel. Areas of steep grades introduce the potential for uncontrolled movement and excessive speeding of trains due to gravity, which can increase the potential for derailment or train collisions. Additionally, trains could potentially be stopped and subsequently deplete their air brakes, which can lead to uncontrolled movement along a grade or in a tunnel. The likelihood of uncontrolled movements is low and requires failure of on-board systems such as speed controls and brakes.

There is additional risk of rail incidents as the Project connects with the QR West Moreton System at Calvert and ARTC's Sydney to Brisbane Interstate Railway line at Kagaru. The potential incidents that may occur between existing rail infrastructure and the Project include rail collisions and derailments.

Refer Chapter 19: Traffic, Transport and Access for more information regarding the interactions between operating trains including the QR West Moreton System.

Road–rail interfaces

The Project includes 26 public road–rail interfaces (including 8 level crossings and 11 grade-separated interfaces) and 27 unformed road reserves interfaces. Level crossings can introduce dangerous points at which trains, cars and pedestrians meet.

Within areas of agricultural land use, interactions between stock and farm equipment and operating trains are also a potential risk. Improper access to the rail track by trespass, during movement of farm equipment or by travelling stock have the potential to result in rail incidents such as train strikes.

The majority of level-crossing incidents are classified as 'near miss' incidents between trains, road vehicles, and pedestrians. While rare, actual collisions can occur at level crossings, which can cause property damage, service disruptions, impact to adjacent infrastructure, injury and, in most traffic cases, death.

While the assessment recognises that human factors and influence on road-user behaviours contribute to level-crossing incidents, the number of tracks and the speed of trains approaching crossings are also prominent factors that determine the potential impacts and are all considered as part of a national system called Australian Level Crossing Assessment Model (ALCAM).

Tunnel

The Project crosses areas of steep slopes, specifically Peak Crossing, which requires significant cuttings and the use of the Teviot Range tunnel.

The tunnel will reduce the risk of landslips and provide an efficient route through Peak Crossing; however, tunnels introduce other hazards associated with the risk of trespass, fire, explosion, flooding and subsidence. The fire prevention and access strategy will require specific consideration to address the event of emergencies.

A serious accident in the tunnel would potentially involve temporary closure and significant expenditure for repair.

The construction of the tunnel may involve blasting activities using explosives. The risks associated with such activities are further described in Section 20.7.3.3.

20.7.2.3 Safety

Underground and overhead services

All utilities and pipelines located within the disturbance footprint have been identified as potentially impacted. The Project will potentially have interactions with 182 existing utilities and services and one non-operational high-pressure pipeline (Santos) within the disturbance footprint. Construction activities around existing services introduce a risk of service strikes to underground utilities during excavation (e.g. underground gas pipelines) or collision of plant and equipment with aboveground services (e.g. transmission lines). Other risks to existing services include vibration from tunnelling, piling and blasting activities, along with the movement of construction equipment.

Interactions with existing services could pose a risk to public safety and the natural environment and habitat. Damage to or contact with services during construction could result in service outage to nearby communities.

Contaminated land

Construction activities in the QR West Moreton System rail corridor, and potentially the former rail corridors have the potential to generate contaminated waste as a product of demolition of existing services, excavations and drainage construction. Connection to existing railways of the QR West Moreton System and Sydney to Brisbane Interstate Railway line are expected to produce asbestos-containing waste material (e.g. signal boxes), from upgrading activities associated with track infrastructure. As the disturbance footprint traverses the former Ebenezer Mine, there is also the potential to encounter abandoned mine shafts, mine waste, materials, acid mine drainage and hydrocarbon pollution.

The probability of encountering ASS is generally considered low (no known occurrence with the exception being a dam to the east of the Cunningham Highway, which has a high probability of containing ASS). However, in the unlikely event that ASS is present, disturbance/exposure can generate sulphuric acid, iron, aluminium and sometimes heavy metals. Excavation activities can expose ASS and cause major impacts to the environment and to infrastructure.

The construction activities will also introduce the production of waste either as waste from construction materials or domestic waste from works. Domestic waste can attract vermin, while hazardous waste can pollute water resources (surface or ground). Construction can also cause contamination as a result of spills or leaks from construction equipment and site compounds.

There is also the potential for contamination to occur during operation, as a result of fuel or oil spills, leaks from trains or transportation of hazardous materials. The extent and severity of land contamination will be dependent on the type of incident and where it is in the landscape (e.g. crossing loops over waterways); however, leaks and minor spills are generally expected to have limited extent and will generally be confined to areas within the rail corridor.

Chapter 9: Land Resources presents further discussion on the potential impacts that the Project can have on land contamination, and Appendix H: EMR Searches and Laboratory Certificates provides the searches of the Environmental Management Register (EMR) and Contaminated Land Register (CLR) searches to determine existing land uses that may have caused contaminated land. Appendix M: Surface Water Quality Technical Report and Appendix O: Groundwater Technical Report present further details on the potential impacts of contamination to water.

Bridges

The Project alignment consists of 27 new bridges, 24 of which are for rail use:

- 16 are rail over watercourse
- 5 are rail over watercourse and road
- 3 are rail over road, including the Cunningham Highway and Ipswich –Boonah Road.

The remaining three are road over rail bridges.

Structural failures of bridge crossings have the potential to impact major transport corridors, along with the local road networks and could result in significant harm to motorists, railway workers and where applicable railway passengers. As the bridges could be used for freight transport of dangerous goods, collapse or damage to rail bridges can lead to freight falling from elevated tracks and subsequently causing loss of containment and spills of hazardous materials resulting in environmental damage.

Emergency access

The disturbance footprint crosses rural residential areas, large-lot grazing areas and the Teviot Range (Flinders Peak Conservation Park). The increase in the number of construction vehicles and oversize machinery along the construction corridor has the potential to impact the existing fire trails within the vicinity of these locations, reducing access to bushfire response.

Additionally, construction activities may also introduce obstruction and congestion on adjacent (existing) public roads, which could impact private landholder evacuation during emergency incidents (e.g. bushfire). Failure to accommodate for emergency access or the provision of poor access can result in interface with emergency vehicles, delay in response or rescue time and even fatality in the event of emergency.

During the operational phase, events such as wildlife entering the Teviot Range tunnel, tunnel subsidence, inundation of the tracks and structural failure can trap trains inside the tunnel. In the event of such an incident, personnel trapped in the tunnel need to be able to immediately identify tunnel escape and emergency evacuation routes.

Similarly, for the 21 rail over watercourse bridges (16 rail over watercourse and 5 rail over watercourse and road), there is the potential to increase the extent or duration of flooding of local roads within Bremer River and Warrill Creek, which could lead to road closure and restrict movement of emergency vehicles.

Abandoned mines and underground collieries

While no abandoned mines have been discovered in the disturbance footprint, there is a potential to cause harm if the Project is constructed above an abandoned mine without knowledge. This could lead to collapsing of the underground mine and thus damaging the local environment, potentially causing harm if persons are within the area of the mine collapse.

Within the land use and tenure study area, there is one known recorded underground historical colliery located at Ebenezer. Historical mapping provided by DNRME indicate the abandoned underground mine workings of the Rosemount No. 2 Colliery, which may include an underground tunnel, are located within Lot 162 on SP28500 and Lot 156 on CH3159. Underground mine workings associated with the colliery may also be located within the adjoining Lot 157 on CH3159 and Lot 3 on RP176310. A review of historical aerial imagery of the EIS investigation corridor provided within Chapter 9: Land Resources did not indicate the presence of any infrastructure or vegetation clearing associated with underground collieries. However, there is still potential for unrecorded historic underground collieries to exist within the Calvert, Lanefield, Lower Mount Walker and Ebenezer localities.

Despite these findings, unrecorded historic underground collieries may still exist along the disturbance footprint. There is, therefore, the potential for the Project to be unknowingly constructed above an underground colliery, leading to a collapse of the colliery either during construction or operation. This could potentially lead to asset damage of construction plant, track, or locomotives as well as personnel or public injury if not identified and mitigated through geotechnical surveys conducted during detailed alignment design and construction.

Chapter 9: Land Resources presents further discussion on the potential impacts from abandoned mines.

20.7.3 Dangerous goods and hazardous chemicals

Specific hazards and risks associated with hazardous chemicals or dangerous goods were identified. The two main aspects for this include:

- The storage and use of dangerous goods and hazardous materials for the purposes of constructing the Project
- The transportation of dangerous goods and hazardous chemicals as freight on the Project.

While the transport of non-dangerous and dangerous goods freight will be separately regulated, the general hazards of freight will be assessed based on the freight of dangerous goods to account for the worst-case scenario. The assessment of hazards and risks associated with dangerous goods and hazardous chemicals for the purpose of construction has applied the following process:

- Reviewing the types and quantity of dangerous goods and hazardous chemicals to be stored and handled during construction (e.g. explosives for tunnel blasting)
- Identifying risk of physical or chemical reaction of dangerous goods and hazardous chemicals and ensuring the stability of goods and chemicals intended for storage
- Incorporating dangerous goods and hazardous chemicals management into emergency plan if the quantity of a class of dangerous good hazardous chemical at a workplace exceeds the manifest quantity.

The assessment of hazards and risks associated with dangerous goods and hazardous materials for the purpose of freight during operation has applied the following process:

- Identifying specific design risks related to freight transport (e.g. dangerous goods fire incident in tunnel)
- Controlling ignition sources and accumulation of flammable and combustible substances.

The risks associated with dangerous goods have been qualitatively assessed based on the expected types and quantities.

20.7.3.1 Construction and operation chemicals

The construction, operational and decommissioning phases of the Project will involve the use and storage of hazardous chemicals including fuel, lubricant, oil, solvents, degreaser, concrete and other cleaning agents. Chemicals used during decommissioning activities are expected to be similar in type and usage to construction requirements. The storage and handling of hazardous chemicals introduces potential impacts associated with material properties such as flammability, corrosiveness and toxicity. Significant releases of hazardous chemicals can impact nearby sensitive receptors, particularly sensitive environmental areas and communities.

The expected list of chemicals used throughout the life of the Project, along with their purpose and dangerous goods details or status, are in Table 20.8. The majority of chemical requirements are Class 3 flammable liquids and combustible liquids such as diesel fuel that have the potential to cause fires or escalate the risk of bushfires, although their high flash points (temperature at which the chemical will ignite in air) reduce the potential for small incidents to create significant consequences. Generally, low volumes of hazardous chemicals would be stored in laydown areas within the disturbance footprint for construction near to points of use. The quantities stored will be equivalent to the demand for activities within that area of the Project.

Constructability investigations have identified proposed chemical storage locations and quantities to be stored throughout the construction phase based on the planned execution of works within the disturbance footprint. Predictions of operational chemical requirements are based on expectations for rail activities across similar projects. While the chemical quantities may change due to operational requirements and refinement during detailed design, the types and indicative quantities identified below are considered to represent the usage requirements.

During the construction phase, the following facilities are expected to be provided, which includes facilities for the storage and distribution of construction chemicals:

- Laydown areas are proposed to be located at each bridge and throughout the disturbance footprint, which will include small quantities of lubricants and oil (e.g. drum and Intermediate Bulk Container package stores)
- Diesel fuel depots have the potential to be located in association with large construction laydown areas along the disturbance footprint, which could include volumes of up to 40 kilolitres (kL) bulk storage of diesel
- Concrete batching plants proposed to be located within the vicinity of tunnel construction which will include storage and usage of concrete batching chemicals
- Minor storages including gas bottles (oxygen and acetylene), grease etc.

Although dangerous goods incidents are not expected to occur during construction, incidents would generally be limited to the local area of storage, although there is the potential for incidents to spread via drainage lines and overland flow pathways.

The locations of the laydown areas have been chosen to avoid areas that are within the 1% annual exceedance probability (AEP) floodplains, where possible. However, by virtue of the requirement of laydown areas for constructing bridges, some laydown areas must be within floodplains and watercourses. While the Project cannot preclude the storage of hazardous materials in laydown locations within the 1% AEP, contractors will be required to prepare and implement a Contamination and Hazardous Materials Management Plan as a component of the CEMP and locate laydown areas in suitable locations e.g. away from residential housing and remnant vegetation.

Operational usage of chemicals is expected to be required throughout the rail corridor and will typically involve the temporary storage of limited quantities during specific maintenance activities.

Indicative chemical storage and usage details are provided in Table 20.8.

TABLE 20.8: INDICATIVE LIST OF DANGEROUS GOODS AND HAZARDOUS SUBSTANCES

Chemical type	Typical chemicals	Design life cycle stage	Purpose/ use	Dangerous goods class	Indicative rate of use	Expected storage method
Fuel oil	Diesel	Construction Operation	Fuel for mobile equipment	Combustible liquid (C1)*	40 kL/2 weeks	40 kL bulk storage (fuel depots)
Grease	Rocol Rail Curve Grease	Construction Operation	Lubricate plant and equipment	Combustible liquid (C2)**	Limited	Package storage
	Caltex 904Grease	Construction Operation	Lubricate plant and equipment	Combustible liquid (C2)**	Limited	Package storage
	Shell GADUS Gauge Face Curve Grease	Construction Operation	Lubricate plant and equipment	Combustible liquid (C2)**	Limited	Package storage
	RS Claretech Biodegradable Grease	Construction Operation	Lubricate plant and equipment	Combustible liquid (C2)**	Limited	Package storage
Explosives	Ammonium Nitrate[1]	Construction	Land clearing and tunnel construction	Oxidising substances (5.1)	As required for construction	Not stored for Project
	Blast caps, detonators, boosters etc	Construction	Land clearing and tunnel construction	Explosives [(1)]	As required for construction	Not stored for Project
Concreting	Concrete and concrete residue	Construction	Concreting for slab construction	N/A	As required for construction	N/A
	Concrete Curing Compound	Construction	Concreting for slab construction	N/A	As required for construction	N/A

Chemical type	Typical chemicals	Design life cycle stage	Purpose/ use	Dangerous goods class	Indicative rate of use	Expected storage method
Welding gases	Oxygen	Construction	Welding	Non-flammable, non-toxic gases (2.2)/ Oxidising substances (5.1)	As required for construction	Cylinder storage
	Acetylene	Construction	Welding	Flammable gases (2.1)	As required for construction	Cylinder storage
Pesticides	Australian Pesticides and Veterinary Medicines Authority Approved Pesticides	Construction Operation	Pests and weeds control	Toxic substances (6.1) or Miscellaneous dangerous substances and articles (9)	As required	Not stored for Project

Table notes:

1. Product is a security sensitive explosive defined under Schedule 7 of the Explosives Regulation 2017.

* Class C1—a combustible liquid that has a flashpoint of 150 °C or less.

** Class C2—a combustible liquid that has a flashpoint exceeding 150 °C.

20.7.3.2 Freight of dangerous goods

The Project will enable freight transport as part of the larger Inland Rail Program. The design of the freight system, including tunnels, allows for the transport of dangerous goods. ARTC has indicated that the rail corridor is intended to be used for the freight of all classes of dangerous goods excluding explosives. ARTC cannot provide an exhaustive list of the types and quantities of dangerous goods that will be transported; however, explosives will not be included and transportation of any other dangerous goods will be managed under the Australian Dangerous Goods Code.

Operational transport of dangerous goods associated with freight activities has a risk of loss of containment during incidents such as derailment. Loss of containment of dangerous goods could have severe consequences depending on the location and type of goods. Minor leaks and spills are expected to be limited to within the rail corridor.

Where the Project traverses areas of environmental sensitivity, such as watercourses, there is the potential for loss of containment events to significantly damage the environment through release of toxic, corrosive or flammable materials.

Fires and the release of harmful chemicals can result in injuries and fatalities. Other potential loss of containment from flammable liquid, solid or gas and toxic chemicals, can also create major incidents such as pool fire, jet fire, explosion or toxic release.

The Queensland Explosives Regulation 2017 defines security sensitive explosives as:

a) a blasting explosive, or

b) a propellant powder, or

c) a firework other than an unrestricted firework, or

d) a pyrotechnic substance used in a firework, or

e) security sensitive ammonium nitrate which is defined as:

- *i) ammonium nitrate, or*
- *ii) a solid substance that—*
  1. *consists of a mixture of ammonium nitrate and another substance if the mixture contains more than 45% ammonium nitrate by mass, and*
  2. *is not classified as a Class 1 explosive.*

f) ammunition, other than small arms ammunition, that contains explosives.

Although explosives are not intended for freight, ammonium nitrate may be transported as a Class 5.1 dangerous good. When mixed with fuel, such as diesel, ammonium nitrate can explode with similar effects to that of Class 1 explosives. Additionally, ammonium nitrate is at risk of explosion if exposed to a heat source or ignition source, especially when in a confined space. Ammonium nitrate is considered an explosive under the Queensland Explosives Regulation 2017 if it is defined as security sensitive explosive. Security sensitive explosives including ammonium nitrate or any Class 1 explosive will not be freighted during the operational phase.

Consequently, the tunnel has been designed to allow for the carriage of all classes of dangerous goods, excluding the freight transport of Class 1 explosives. It is noted that audible track warning devices (which contain Class 1 explosives) will be used. These devices will be used in very small quantities and therefore do not require specific design considerations.

ARTC does not own or operate rolling stock; however, the transportation of dangerous goods on the Project by independent operators will require authorisation by ARTC. The quantities and types of dangerous goods that may be present as freight, and the allowance of bulk and packaged dangerous goods, will be managed in accordance with the requirements of the Australian Dangerous Goods Code.

Based on the variability of potential types and quantities of dangerous goods, there is the potential for freight activities to have a significant impact on people, property and the environment surrounding the disturbance footprint. Accidents involving dangerous goods freight trains have the potential to create hazards for people and the environment associated with the properties of dangerous goods including flammability, toxicity (people and environmental) and corrosiveness.

20.7.3.3 Explosives

Explosive are classified as Class 1 dangerous goods. It is expected that security sensitive explosives (which includes ammonium nitrate) will be used for the construction of the tunnel through the Teviot Range. Ammonium nitrate explosives are hazardous by nature and may result in harm to the environment and people during storage, handling or transport in the event of inadvertent detonation. Blasting activities associated with construction work also introduces hazards to the surrounding environment through noise and vibration. Noise and vibration impacts are discussed in detail in Chapter 15: Noise and Vibration.

Three techniques are being considered for tunnel construction: the use of road headers, a tunnel boring machine, and/or the drill and blast method.

The use of explosives for drill and blast activities can create dust, noise, vibration, fly-rock and air-blast effects. Fly-rock and air blast effects can cause serious personnel injury if not controlled. Additionally, the failure of explosive substances to properly or completely detonate could result in potential blasting misfire and the creation of unexploded ordnance hazards.

The generation of dust from poorly managed blasting can create dust clouds that may contain high concentration of dust particulates. This can cause health impacts to the construction workers as well as nearby communities. Further information is presented in Chapter 12: Air Quality.

Conversely, blasting activity at the existing Jeebropilly Coal Mine, located 3 km from the Project, has the potential to impact on the Project. During the operational phase, runaway reactions from explosive transportation, use or handling as part of mine operations have the potential to escalate the risks associated with dangerous goods freight and damage to rail infrastructure, including rail power supplies. Altered traffic conditions during construction phases of the Project could also affect mine explosive transport routes and if not appropriately managed could potentially result in interface conflicts.

Explosives require specific storage and handling procedures and licensing, such as those described by the *Explosive Act 1999* .The specific 'Licence to use explosives' form must be completed in line with the *Explosive Act 1999* and 'Notice of the proposed blasting' form needs to be lodged with DTMR at least 7 days before blasting works commence, in line with the Explosives Regulation 2017. Construction methodologies are being evaluated and have considered the requirements for explosives use.

20.8 Potential mitigations

20.8.1 Design considerations

The mitigation measures and controls presented in Table 20.9 have been incorporated into the designs for the Project. These design measures have been identified through collaborative development of the design and consideration of environmental constraints and issues, including proximity to sensitive receptors. These design measures are relevant to both construction and operational phases of the Project.

TABLE 20.9: INITIAL MITIGATION THROUGH DESIGN RESPONSE

Aspect	Initial design mitigations
Natural hazards	
Flooding	▸ The design of the Project has been developed to comply with ARTC standards such as: ▸▸ *Engineering Practice Manual for Track Drainage—Inspection and Maintenance* ▸▸ *Engineering Practice Manual for Track Drainage—Design and Construction* ▸▸ *Engineering Practice Manual—Flooding* ▸▸ *Engineering Practice Manual—Structures* ▸▸ *Engineering Code of Practice—Flooding and Automatic Rainfall Monitoring.* ▸ The Project has been designed to achieve a 1% AEP flood immunity and at the same time to minimise unacceptable impacts on the existing flooding and drainage regime, with the exception of connections to existing infrastructure that has an existing lower immunity. ▸ Key strategies that have been incorporated into the design include: ▸▸ Use of bridge and culvert structures to maintain existing flow paths and flood flow distributions ▸▸ Locating and sizing bridge and culvert structures to avoid unacceptable increases in peak water levels, velocities and duration of inundation ▸▸ Inclusion of scour and erosion protection measures in areas at risk. ▸ Local and regional flooding events—Drainage design has been undertaken to control cross flow and longitudinal flow from local and regional catchments to ensure the rail alignment has the required immunity and there are minimal impacts upstream.
Climatic conditions	▸ The design of the Project has been developed to comply with ARTC standards. Operation and maintenance practices according to ARTC Standard ETM-06-08 Managing Track Stability (and associated standards) provide the means for managing buckling force by establishing and re-establishing, if necessary, the correct stress-free temperature and managing the track resistance to buckling. ETM-06-08 includes preparation of Track Stability Management Plans (TSMP), required for each section of track, which outline the activities to ensure track stability during hot weather. The plans are reviewed at the end of the high temperature season each year at which time the trigger temperature for imposing speed restrictions and undertaking inspections is re-evaluated. Yearly review of the TSMP will provide a currency in management practice through changes in seasonal conditions. The track structure design has allowed for temperature-based adjustment in operation particularly with regard to rail stress, to minimise chance of buckling incidents. This is an ongoing procedure that provides adequate track management in changing seasonal conditions.

Aspect	Initial design mitigations
Landslide, sudden subsidence, movement of soil or rocks	▸ Design and ratings of earthwork and geotechnical structures including culverts and bridges has been developed in accordance with geotechnical investigation findings and slope design. ARTC existing requirements that the Project complies with include: ▸ *Engineering Code of Practice—Earthworks* ▸ *Engineering Code of Practice—Structures* ▸ *AS 5100 Bridge Design* ▸ *AS 7636 Railway Structures and other applicable Australian Standards*.
Project hazards	
Airborne contaminants	▸ The design of the tunnel has ensured sufficient natural ventilation is achieved considering the presence of diesel exhaust and dust generation associated with freight (e.g. coal freight). ▸ Air quality modelling has been performed to ensure that the tunnel ventilation is appropriately designed such that it does not significantly impact surrounding areas.
Rail incidents	▸ The elements of the railway including railway radius curves and vertical grades has been designed to prevent uncontrolled movement. ▸ Rolling stock has been designed in accordance with ARTC's *Engineering Code of Practices* that nominate the applicable industry and Australian Standards.
Road rail interfaces	▸ The appropriate road rail interface treatment has been assessed case-by-case for design purposes, with consideration given to current and future usage, its location relative to other crossings of the rail corridor and the road and rail geometry at the crossing location. ▸ In the development of the proposed treatments, ARTC have taken into consideration State and national guidelines and strategies. ▸ Treatments for public road–rail interfaces have been categorised as: ▸ Grade separated crossings—road and rail cross each other at different heights so that traffic flow is not affected. ▸ Level crossings—road and rail cross each other at the same level. Level crossings have either passive or active controls to guide road users: ▸ Passive—have static warning signs (e.g. stop and give way signs) that are visible on approach and are unchanging with no mechanical aspects or light devices ▸ Active—flashing lights with or without boom barriers for motorists, and automated gates for pedestrians. These devices are activated prior to and during the passage of a train through the level crossing. ▸ To assess potential level crossings locations, ARTC used a national system called ALCAM, which considers factors such as future road traffic numbers, vehicle types, train numbers, speeds and sighting distances. ▸ The Project will be fenced with three- or four-strand barbed wire fence except where fauna fencing or superior fencing is specified. The fencing is reflective of the largely agricultural land use of the Project and seeks to ensure that stock and people do not enter the railway line. It is also consistent with fencing used in other sections of the railway line. Where superior fencing is required near roads or where trespass is likely to occur, a 1.8 m chain wire fence is proposed.
Tunnel	▸ The design of the Teviot Range tunnel has been based on geotechnical assessment and detailed ground modelling. Parameters such as space proofing, cross section, structure, design life and tunnel linings will meet the requirement of relevant Australian Standards. ▸ The tunnel has been designed with natural ventilation for management of heat, particulate matter, and gases. Key design considerations include maintaining air quality parameters below the Time Weighted Average and Short-Term Exposure Limit.
Underground and overhead services	▸ Site investigations of the corridor have been undertaken to identify underground and overhead service hazards. Inspections have focused on identifying soil conditions, trenches, pits, bores, standing water and any potentially dangerous obstruction, in accordance with ARTC Underground/Overhead Electrical and Other Services Work Method Statement.

Aspect	Initial design mitigations
Gas and petroleum pipelines	▸ The Project design adopted a risk-based approach to assessment of utility and pipeline clashes, with consideration of the asset location, Project design at the clash location (cut or fill), time, cost and operational requirements with regards to access. ▸ Discussions with Santos in relation to pipeline assets in the Project area have resulted in the development of an approach to management and associated treatment of clashes identified during the design process.
Bridges	▸ Risk of ballast dropping from rail over road bridges, such as Ipswich–Boonah Road, has been mitigated by incorporating ARTC's Construction Specification into the track design, such as ARTC's Engineering Code of Practice—Ballast. This code requires that ballast profile for concrete sleepers or timber sleepers achieve sufficient height and width for their corresponding nominal freight speed. ▸ Design upholds the following ARTC and Australian Standards: ▸ *Engineering Code of Practice—Earthworks* ▸ *Engineering Code of Practice—Structures* ▸ *AS 5100 Bridge Design* ▸ *AS 7636 Railway Structures and other applicable Australian Standards*. ▸ Limit the height of structures to comply with the 45 m and 90 m 'height restriction zones' (which apply to Defence airfields and joint-user airfields such as RAAF Base Amberley).
Abandoned mines and underground collieries	▸ The initial design of the alignment has considered the surrounding land uses and geological investigation in regard to known abandoned mines and underground collieries. ▸ Mapping provided by DNRME has been investigated to determine areas where abandoned mines or underground collieries may exist. This mapping indicates the abandoned underground mine workings of the Rosemount No. 2 Colliery, which may include an underground tunnel, are located within Lot 162 on SP28500 and Lot 156 on CH3159. Lot 156 on CH 3159 intersects the disturbance footprint, however mapping (refer Chapter 8: Land Use and Tenure) shows the mine workings do not intersect the disturbance footprint. Underground mine workings associated with the colliery may also be located within the adjoining Lot 157 on CH3159 (lot intersects the disturbance footprint) and Lot 3 on RP176310. ▸ Historical aerial imagery of the EIS study area was reviewed and did not indicate the presence of any infrastructure or vegetation clearing associated with underground collieries. However, there is still potential for unrecorded historic underground collieries to exist within the Calvert, Lanefield, Lower Mount Walker and Ebenezer localities. ▸ Due to the investigation of land use and existing infrastructure associated with the hazard and risk study area, the risk of an unknown mine or colliery being underneath the alignment is considered highly unlikely; however, due to the high consequences of a mine or colliery on the Project, it will be considered.
Dangerous goods and hazardous chemicals hazards	
Freight dangerous goods	▸ The rail corridor is intended to be used for the freight of all classes of dangerous goods, excluding explosives (Class 1) as the railway passes through a tunnel. The design of the tunnel accounts for the presence of dangerous goods in the specification of safety features.

20.8.2 Proposed mitigation measures

To manage Project risks, a number of mitigation measures have been proposed for implementation in future phases of Project delivery, as presented in Table 20.10. These proposed mitigation measures have been identified to address Project specific issues and opportunities including legislative requirements and accepted government plans, policies and practices. Table 20.10 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/significance in Table 20.11.

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

TABLE 20.10: PROPOSED MITIGATION MEASURES

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detailed design	Natural	Bushfire	Design to maintain appropriate access during construction and operation, ensuring local roads allow emergency access, first response firefighting, access to water supply for firefighting purposes, and safe evacuation routes.
	Natural	Flooding and flash flooding	Continue to refine project design in response to hydraulic modelling. This includes consideration of peak water levels, flow distribution, velocities and duration of inundation. This will inform bridge lengths, culvert sizing and numbers, scour and erosion protection measures for both rail, road and other permanent project infrastructure. Review flood risk assessment to inform the siting and scale of temporary construction areas (including stockpiles, construction compounds, access roads, laydown areas etc). Locate plant and equipment maintenance activities and fuel storage facilities in accordance with AS1940:2017.
	Natural	Landslide, sudden subsidence, movement of soil or rocks	Incorporate batter slopes and scour protection into design.
	Natural	Climatic conditions	The design will implement safety measures for the potential damage of tracks and assets as a result of extreme hot weather events, such as considering the use of elastic fasteners or heavier sleepers to reduce the risk of track buckling, selection of materials and colour to reduce heat load on trackside equipment. The design will be developed to achieve a design life of 100 years. In doing so, designs for formation, track and structures will be developed in accordance with ARTC's Codes of Practice. The management of temperature fluctuation would be assured by sourcing components that have the assurance from manufacturers that the components maintain integrity at the required or envisaged temperatures. Factor for the potential increase in flood risk arising from any increase in extreme rainfall as a consequence of climate conditions. Adaption strategies such as installing an early flood warning system to alert ARTC to impending flood risks and requirements for suspension of local operations, locating critical electrical systems (signalling, communications huts, etc.) above potential flood zones and considering the use of solar and battery devices to ensure uninterrupted operation of signalling and network communication in the event of power failure to be considered for incorporation into the detailed design. Design for future climate, including consideration of existing ARTC protocols for operating in extreme temperatures. Sustainability initiatives, particularly in relation to energy consumption and savings throughout the Project lifecycle will be incorporated in detailed design.
	Project	Underground and overhead services	The Project will comply with the clearance distance as specified in ARTC's *Engineering Standard for Requirements—Electric Aerials Crossing ARTC Infrastructure* to ensure sufficient clearance and prevent contact with live electricity. Design to confirm that the construction methods will not infringe on the Defence air space restrictions.
	Project	Gas and pipelines	The Project design will comply with the clearances or agreed risk mitigation design treatments developed through consultation with Santos.
	Project	Road–rail interfaces	Any physical controls such as boom gates and warning lights that have been determined necessary from ALCAM will be detailed in the project design. Detailed design of 1.8 m chain link fencing is required near roads or where trespass risk is identified.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detailed design (continued)	Project	Emergency access	Emergency access will be addressed by the development of an access strategy. Consideration of the use of the rail maintenance access road (RMAR) by emergency vehicles will be made when evaluating the position of corridor access points. To facilitate emergency egress, multiple access points into and out of the rail corridor will be provided. This will include the consideration for the access of three Pumpers, one Rescue/Incident Control appliance, one Urban Rescue Tender and one Urban Hazmat Medium in the event of a major train tunnel incident (QFES, 2018). Safe corridor access and vehicle turnaround points will be provided for maintenance work to ensure sufficient setback while working adjacent to live railway. Maintenance and emergency access roads will be designed such that it will allow separation to prevent interaction between trains and vehicles without impeding escape or rescue activities.
	Project	Tunnel	Tunnel design to incorporate fire and life safety mitigation measures including limiting the amount of combustible materials used in construction, providing fire detection systems, preventing derailed trains from entering the tunnel, and systems to prevent trains that are on fire from stopping in the tunnel.
	Project	Abandoned mines and underground collieries	Continue to engage with the Abandoned Mines Program in DNRME to identify potential risk of disturbance footprint interacting with abandoned or disused mines or underground collieries.
Pre-construction	Project	Underground and overhead services	The Project will identify known services that require relocation prior to construction, with the exception of enabling works as discussed in Chapter 23: Draft Outline Environmental Management Plan, Section 23.3.4. Overhead transmission lines and buried telecommunication cables will be identified before construction to ensure that construction and operation do not interfere or damage the utilities as per the requirements of the *Electrical Safety Act 2002* and subordinate legislation and Safe Work Australia's *Model Code of Practice—Managing Electrical Risk in the Workplace* (Safe Work Australia, 2018b). The Project has considered alignment to minimise the potential interference with these overhead utilities. The Project will lodge a 'Dial Before You Dig enquiry prior to excavation or drilling work, which provides information about underground services on the worksite. Procedural control for the Project will ensure that excavation work will comply with Safe Work Australia's *Model Code of Practice—Excavation Work* (Safe Work Australia, 2018c).
	Project	Contaminated land	Undertake contaminated land assessments and investigations for land identified as having known or suspected contaminated areas and prepare a Contaminated Site Management Plan to document management controls for works on the relevant contaminated areas and outline the process to identify, document and manage each of the contaminated sites.
	Project	Asbestos	Older infrastructure and previously disturbed land within the disturbance footprint may contain asbestos. The Project will adhere to the *Model Code of Practice—How to Manage and Control Asbestos in the Workplace* (Safe Work Australia, 2018d) and the *Model Code of Practice—How to Safely Remove Asbestos* (Safe Work Australia, 2018a). Survey of infrastructure that will be removed or disturbed by the Project will be conducted to potentially identify asbestos containing materials. Construction activities likely to disturb asbestos will review the presence and requirement for specific controls. The Project will engage with competent contractors who are appropriately licensed for asbestos disturbance work.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction (continued)	Project	Bridges	Ground surveys will be carried out with boreholes at all pier locations and abutments during construction early works to mitigate against bridge collapse.
	Project	Abandoned mines and underground collieries	In the event an interface with abandoned mines or underground collieries is determined, develop a construction management strategy to minimise risk in consultation with DNRME.
	Project	Road rail interfaces	Roads will only be closed where the impact of diversions or consolidations is considered acceptable, or the existing location is not considered safe and cannot reasonably be made safe. Approval for closures, where required, will be progressed in accordance with the requirements of the relevant legislation and road closure permits.
Construction and commissioning	Natural	Bushfire	High fire risk activities such as hot works including flash-butt welding will be carried out in accordance with ARTC's *Fire Prevention Management Procedure* and *Total Fire Bans Procedure*. These procedures establish processes to manage hot work/high fire risk activities, including observation of relevant QFES directives, check extent of work site vegetation prior to hot work, and ensure appropriate firefighting equipment and trained personnel are available.
	Natural	Flooding and flash flooding	Construction staging to include construction of drainage structures before embankment sections to mitigate flooding potential during construction. Locate laydown areas away from creeks (such as the Bremer River, Bundamba Creek, Purga Creek, Reynolds Creek, Warrill Creek, Western Creek, Sandy Creek, Wild Pig Creek and Teviot Brook).
	Natural	Landslide, sudden subsidence, movement of soil or rocks	Implement a Soil Management Plan to manage the topsoil onsite such that it can be reused in rehabilitation and landscaping activities. Soil stockpiles are to be managed in accordance with ESCPs. Regular earthworks inspections will be implemented to identify defects and conditions that may affect or indicate problems with the stability of earthworks. The period that soil is exposed will be minimised through progressive ground cover revegetation to minimise erosion. Temporary construction facilities will be sited to avoid flood areas, overland flow paths and minimise clearance of established vegetation where possible.
	Natural	Climatic conditions	Consider opportunities to minimise of greenhouse gas generation during construction. Construction water will be obtained from appropriate sources, with the necessary water entitlement, water allocation, water licence or water permit.
	Natural	Wildlife	Project works will be undertaken in accordance with a Flora and Fauna Sub-plan.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Natural	Biosecurity	Develop and implement a Biosecurity Management Plan as part of the CEMP to include: ▸ Requirements for pre-clearing surveys to determine the risk of weeds or pest animals being present ▸ Maps of the existing extent and severity of weed infestation and weed management requirements ▸ Pest animal management (including fire ants in fire ant biosecurity zones) ▸ Site hygiene and waste management procedures to deter pest animals ▸ Weed surveillance and treatment during construction and rehabilitation activities ▸ Requirements in relation to pesticide and herbicide use and documentation, including any limitations on use, such as, restrictions on use in sensitive environmental areas, drainage lines that flow to waterways and aquatic habitats, and ensuring that broad scale use does not result in an increased erosion and sediment risk ▸ Vehicle, machinery and imported fill hygiene protocols and documentation ▸ Erosion and sediment control risks associated with broad scale weed removal or treatment.
	Project	Fatigue and heat stress management	Ensure Construction management plans, systems, workplace conditions and facilities align with requirements of *the Work Health and Safety Act 2011* (Qld). Follow Safe Work Australia's *Guide for Managing the Risks of Working in Heat to Manage Heat Stress* (Safe Work Australia, 2020).
	Project	Asbestos	Depending on the type and amount of asbestos containing materials, if they are disturbed by the Project, the Project will engage with a Class A or Class B licensed asbestos removalist for the handling and disposal of asbestos. In the event there is uncertainty as to whether exposure standards will be exceeded, or work will generate airborne fibres by any method, air monitoring will be carried out by appropriately qualified personnel.
	Project	Dust, respirable silica and other airborne contaminants	Direct construction worker exposure to respirable silica and other airborne contaminants will be controlled through application of appropriate source controls and the use of appropriate personal protective equipment. Where sensitive receptors, agricultural land uses or protected vegetation are near Project works, or visible dust is generated from vehicles using unsealed access roads, road watering or other appropriate controls are to be implemented. Cover vehicles transporting potentially dust and/or spillage generating material to and from the construction site immediately after loading (prior to traversing public roads). Visually inspect vehicles entering/exiting the site and implement and maintain additional controls such as wheel wash and or rumble grids. Limit clearing to the Project disturbance footprint. Where practical, stage clearing and grubbing and construction activities to minimise exposure to erosive processes. Implement controls to prevent and/or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast (i.e. use water sprays or water carts for dust suppression as required). Avoid ground-disturbing activities during windy conditions (i.e. winds >10m/s) or when prevailing winds are likely to result in dust impacts to sensitive receptors. Implement additional dust suppression controls prior to the onset of adverse weather including covering or stabilisation of temporary stockpiles and additional treatment of access roads. Longer term material stockpiles will be suitably treated to prevent risk of windborne erosion and dust.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Project	Noise and vibration	The Project will develop and implement a Noise and Vibration Management Plan as part of the CEMP. Noise and vibration sources from construction involving heavy machinery will incorporate appropriate noise mitigation equipment and devices including mufflers and acoustic barriers. The Project will reduce and manage noise as much as is possible through a range of noise management measures. Noise disruption from night works are kept to a minimum and work will be undertaken as quickly and efficiently as possible.
	Project	Roads	A Traffic Management Plan will be developed and implemented to identify the impacts that construction traffic is likely to have on transport infrastructure and detail ameliorative measures required to mitigate all identified impacts of the development. Specific hazard control measures that will be applied include clearly defined access for vehicles and pedestrians along the rail corridor and the provision of fencing and gating for all corridor access points to prevent unauthorised entry. Access roads and laydown areas established for construction that will have no permanent use will be decommissioned following construction, unless otherwise agreed with relevant landholders. Storage areas and equipment laydowns will be maintained in good condition to maintain visibility for vehicles.
	Project	Tunnel	Tunnel construction will likely require blasting work. The use of explosive substance will comply with the *Explosives Act 1999* (Qld).
	Project	Underground and overhead services	Procedural control for the Project will ensure that excavation work will comply with Safe Work Australia's *Model Code of Practice—Excavation Work* (Safe Work Australia, 2018c).
	Project	Gas and pipelines	Procedural control for the Project will ensure that excavation work will comply with Safe Work Australia's *Model Code of Practice—Excavation Work* (Safe Work Australia, 2018c) and other construction safety and clearance measures as agreed with Santos.
	Project	Contaminated land (including unexploded ordnances)	Construction personnel involved in ground-disturbing works will be trained in the identification of potential contaminated soil/material and the relevant controls that will be put in place in the event of its discovery. Waste generation from construction activities can potentially contaminate the surrounding land and will be managed in accordance with the Waste Management Plan. A Contaminated and Hazardous Materials Management Plan will be developed and implemented as part of the Waste Management Plan. Identification of unexploded ordnance will be subject to a risk assessment. Where there is a risk of encountering known or possible unexploded ordnance, a suitably qualified person will assess and identify management options. Implementation of the Contaminated Site Management Plan if contaminated land is suspected.
	Project	Emergency access	The maintenance of emergency access will be managed through the development and implementation of a project access strategy. Access for emergency vehicles during construction of the Project will be discussed with contractors during development of the strategy. In instances where construction phase emergency access is affected, use of the RMAR by emergency vehicles may be appropriate. Multiple access points into and out of the rail corridor will be provided. A Project Traffic Management Plan will be implemented minimise impacts to surrounding land users.
	Project	Abandoned mines and underground collieries	If an unrecorded historic colliery is encountered during construction, the measures outlined under the unexpected finds protocol/procedure in the CEMP will be followed. Noting this risk will be controlled during construction such that construction above collieries or abandoned mines will be avoided, leading to a removal of the risk in the operational phase.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction and commissioning (continued)	Dangerous goods and hazardous chemicals	Chemicals spillage and loss of containment	Construction facilities where hazardous materials may be used or stored will be located outside of floodplains and away from areas of social and environmental receptors in accordance with the Queensland SPP. Additionally, the locations of construction facilities where vehicle maintenance and refuelling activities are expected to occur, will be selected to achieve appropriate separation to riparian vegetation and waterways. During the construction phase of the Project, dangerous goods will be required at construction sites and facilities. Licensed transporters operating in compliance with *Australian Code for the Transport of Dangerous Goods by Road & Rail* will be utilised for dangerous goods deliveries. Construction chemicals stored and handled will be managed in accordance with the *Work Health and Safety Act 2011* (Qld) and Regulation, the relevant Australian Standards and the requirements of chemical safety data sheets. Safety data sheet information will be obtained from the supplier of these chemicals and stored in an easily accessible location.
	Dangerous goods and hazardous chemicals	Explosives	Where explosives are used during construction, the works will be undertaken by licensed shotfirers in accordance with the *Explosive Act 1999* and *AS 2187—Explosive—Storage, Transport and Use* Where explosives are used during construction, a Blast Management Plan will be developed as part of the Noise and Vibration Plan within the CEMP. At all times, the handling and use of explosives will follow procedures to: ▸ Prevent misfire ▸ Minimise the risk associated with material projected by a blast ▸ Minimise adverse effects of ground vibration and shock waves caused by a blast ▸ Ensure explosives are not used after either the manufacturer's recommended shelf life or the approved, extended shelf-life ▸ Ensure public safety, vehicular access and security ▸ Identify other activities within proximity of explosive use ▸ Identify the environment of explosive use, including flood, bushfire, landslide zones. WH&S Management Plans to include appropriate measures to manage risk associated with blasting such as consultation with contractors, compliance with separation requirements and access controls, exclusion zones, trails, and buffers.
Operation	Natural	Bushfire	Existing ARTC management plans and strategies including *Engineering (Track and Civil) Code of Practice—Section 17 Right of Way, Fire Prevention Management* and *Total Fire Ban Engineering Procedures* will be applied throughout the Project lifecycle to minimise damage to property, disruption to operations and maximise the safety of people. ARTC's *Engineering (Track and Civil) Code of Practice—Section 17 Right of Way: Vegetation Management* will be implemented to minimise fire risk within the rail corridor, which includes specifications for vegetation management/fire hazard reduction within the corridor. Local fire authorities and local emergency services will be consulted to ensure appropriate operational actions are taken, such as providing feedback on the firefighting vehicles accessibility, Fire Prevention Plans and cooperation on burning-off activities.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)	Natural	Flooding and flash flooding	In line with ARTC's *Engineering (Track & Civil) Code of Practice*, inspections and maintenance will be carried out to identify defects and conditions that may affect waterway and drainage system capacity or indicate increased risk of flooding such as scour, blockages from debris, indication of floods overtopping a structure, and culvert or drain damage or collapse. Established site safety protocol (procedures, warnings, depth, indicators, etc). Inspections and assessments will be carried out regularly to identify mud holes and other drainage defects that impact the operation of the Project.
	Natural	Landslide, sudden subsidence, movement of soil or rocks	Regular embankment inspections and stability inspections will be implemented to determine defects and conditions that may affect or indicate problems with the stability of engineered formations.
	Natural	Climatic conditions	Operations on the corridor will comply with ARTC's *Route Access Standard General Information Route Standards: Speed Restrictions During Hot Weather.* Operational Track Buckling Emergency Management and Mitigation Plan will be employed to ensure integrity of the track during increased extreme heat events. The Track Stability Handbook (ENT-06-01) will be used as a guide for track buckling mitigation plans through managing track stability. These will ensure regular rail inspection, maintenance, and de-stressing of the rail to maintain track stability during both seasonal and annual temperature fluctuations. The track structure design has allowed for temperature based adjustment in operation.
	Natural	Wildlife	Stock fencing, fauna fencing and wildlife permeability structures will be inspected and maintained as per ARTC *Engineering (Track and Civil) Code of Practice—Section 17 Right of Way: Inspection and Assessment*.
	Natural	Biosecurity	Undertake weed and biosecurity management with the rail corridor or ARTC facilities in accordance with ARTC, including equipment hygiene procedures and reasonable measures to avoid the spread of pest species.
	Project	Noise and vibration	Noise and vibration sources from maintenance work involving heavy machinery will incorporate appropriate noise mitigation equipment and devices including mufflers and acoustic barriers. Application of ARTC's Asset Management System will maintain equipment in good working order to reduce the potential for offensive noise.
	Project	Fatigue and heat stress management	ARTC has an existing *Fatigue Policy* and the Project will adhere to ARTC's *Work Health and Safety Work Instruction for Fatigue Management* to ensure conditions of work of personnel align with requirements of *the Work Health Safety Act 2011* (Qld). For any work that is required outside the hours specified in ARTC's *Hours of Work Guidelines*, the likely level of additional risks involved will be assessed and appropriate risk control measures will be identified. Follow Safe Work Australia's *Guide for Managing the Risks of Working in Heat to Manage Heat Stress* (Safe Work Australia, 2020).
	Project	Asbestos	Adhere to ARTC's *Work Health and Safety Work Instruction for Asbestos*, along with Safe Work Australia's *Model Code of Practice—How to Manage and Control Asbestos in the Workplace* (Safe Work Australia, 2018d) and Safe Work Australia's *Model Code of Practice—How to Safely Remove Asbestos* (Safe Work Australia, 2018a).

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)	Project	Dust and other airborne contaminants	If coal is to be transported in future operational scenarios, the potential for coal dust generation would be managed in accordance with a coal dust management plan, similar in requirements to Aurizon's *South West Supply Chain Coal Dust Management Plan.*
	Project	Road rail interface	ARTC will conduct routine inspections of crossing infrastructure, in accordance with ARTC *Engineering (Track and Civil) Code of Practice—Section 17 Right of Way: Inspection and Assessment* and will regularly review crossing performance and incident information to identify and remedy potential hazards. Training of personnel through desktop and simulated test exercises will be designed to ensure that individually and collectively the Incident Management Plan adequately address the requirements for emergency management. ARTC is committed to continued delivery of railway safety messages to the community, through the awareness activities, community engagement activities and campaigns to increase public awareness. In the event of trespass or environmental vandalism on ARTC's rail corridor, ARTC security patrols and trackside staff will be empowered to instruct intruders to leave the corridor immediately. As required, incidents will be reported to the QPS for assistance and resolution.
	Project	Rail incidents	Trackside monitoring systems, which will detect faults in the wheel set and monitor rail wheel condition and defects.
	Project	Bridges	Safety elements for double stack freight trains such as loading requirements, centre of gravity and inspections for rolling stock are required to meet ARTC's *Rolling Stock Outlines and Loading Requirements* to ensure stability and prevent excessive movements of loads and containers during train movements or severe weather events. Inspections and assessments will be carried out regularly to identify mud holes, wet spots, sleeper condition, and excessive track vibration which indicate potential defects that may affect the integrity of the track structure and ballast profile.
	Project	Tunnel	Uphold fire and lifesaving controls for the tunnel in accordance with tunnel operating procedures.
	Project	Emergency access	Training of personnel through desktop and simulated test exercises will be designed to ensure that individually and collectively the Incident Management Procedures adequately address the requirements for emergency management. Local fire authorities and local emergency services will be consulted to ensure appropriate operational actions are taken.
	Project	Contaminated land	Hazardous (regulated) waste such as hydrocarbons and hydrocarbon contaminated products (e.g. oily waste or oil filters) that could potentially be generated during operation (either from maintenance operations or from freight spillages) will be collected and disposed of by a licenced waste transporter. Implementation of the Contaminated Site Management Plan if contaminated land is suspected.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation (continued)	Dangerous goods and hazardous chemicals	Freight dangerous goods	Emergency information holders must be readily available containing Initial Emergency Response Guide, dangerous goods transport and consignment documents. The freight transportation of dangerous goods on the Project will be in accordance with the *Australian Dangerous Goods Code*. Freight carts will be required to display appropriate Hazchem Signage, including placards, and carry appropriate spill containment equipment to be used by emergency services personnel in the event of an emergency. Train operators will comply with ARTC's *Inspecting Trains Policy*, such that inspections of dangerous goods loading (e.g. restraining of packages, segregation of dangerous goods), brake conditions and train integrity are compliant with ARTC's *Train Operating Conditions manual*, before and during travel on ARTC's Network. Details of the train's consist (a sequence of train carriages or cars) and content will also be provided to ARTC's Network Control.
	Dangerous goods and hazardous chemicals	Explosives	WH&S Management Plans will seek to minimise interruption to mine explosive transport routes, by communicating with mine management in regard to the schedule and activities of the Project.

20.9 Impact assessment

20.9.1 Risk assessment

Potential impacts to people, property and the environment associated with the Project in the construction and commissioning, and operation phases are outlined in Table 20.11. These impacts have been subjected to a risk assessment as per the methodology detailed in Section 20.4 and Chapter 4: Assessment Methodology.

The initial risk assessment is undertaken based on the design measures in Table 20.9 being incorporated into the Project design.

Proposed mitigation measures, listed in Table 20.10, were then developed and 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 were applied. The pre-mitigated risk levels were compared to the residual risk levels in order to assess the effectiveness of the mitigation and management measure

TABLE 20.11: IMPACT ASSESSMENT FOR POTENTIAL IMPACTS ASSOCIATED WITH HAZARD AND RISK

			Initial risk with initial design mitigation Table 20.9			Residual risk with proposed mitigation in Table 20.10		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Bushfire	Damage to infrastructure, injury to workers or public from bushfire	Construction	Possible	Moderate	Medium	Possible	Moderate	Medium
		Operation	Possible	Moderate	Medium	Possible	Moderate	Medium (through to 2090)
Flooding	Damage to infrastructure, potential for impacts to freight goods caused by flooding events	Construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Major	High	Unlikely	Major	Medium
Climatic conditions	Increased temperatures, leading to failure of infrastructure/derailment accidents i.e. track buckling or too dangerous conditions for dangerous goods, caused by climatic conditions (extreme weather events)	Construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Major	High	Unlikely	Major	Medium
Landslide, sudden subsidence, movement of soil or rocks	Damage to infrastructure and worker/public injury from landslide, sudden subsidence, movement of soil or rocks	Construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Minor	Low	Unlikely	Minor	Low
Wildlife	Wildlife injury or deaths from impact with Project or worker injury from wildlife	Construction	Likely	Minor	Medium	Possible	Minor	Low
		Operation	Likely	Minor	Medium	Possible	Minor	Low

			Initial risk with initial design mitigation Table 20.9			Residual risk with proposed mitigation in Table 20.10		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Biosecurity	Damage to biosecurity of surrounding environment due to propagation invasive species	Construction	Likely	Minor	Medium	Possible	Minor	Low
		Operation	Likely	Minor	Medium	Possible	Minor	Low
Noise and vibration	Disruption to public from noise and vibration	Construction	Likely	Minor	Medium	Possible	Minor	Low
		Operation	Likely	Minor	Medium	Possible	Minor	Low
Fatigue and heat stress management	Worker injury from fatigue and heat stress	Construction	Almost Certain	Moderate	High	Possible	Moderate	Medium
		Operation	Likely	Moderate	High	Possible	Moderate	Medium
Asbestos	Health impacts from asbestos	Construction	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operation	Possible	Moderate	Medium	Unlikely	Moderate	Low
Dust, respirable silica and other airborne contaminants	Impacts from dust, respirable silica and other airborne contaminants	Construction	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operation	Possible	Minor	Low	Unlikely	Minor	Low
Rail incidents	Rail accidents caused by increased rail movements	Construction	N/A	N/A	N/A	N/A	N/A	N/A
		Operation	Possible	Extreme	High	Unlikely	Extreme	Medium
Road rail interface	Road accidents caused by increased vehicles required for the Project (e.g. traffic from construction, maintenance, or decommissioning)	Construction	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operation	Unlikely	Extreme	Medium	Unlikely	Extreme	Medium
Road rail interface	Accidents due to increased number of road rail interface	Construction	N/A	N/A	N/A	N/A	N/A	N/A
		Operation	Likely	Major	Very High	Possible	Major	Medium
Tunnel	Accidents due to construction of and rail use through the tunnel	Construction	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operation	Possible	Extreme	High	Unlikely	Extreme	Medium
Bridges	Bridge collapse or falling object strikes	Construction	Unlikely	Major	Medium	Unlikely	Major	Medium
		Operation	Unlikely	Major	Medium	Unlikely	Major	Medium
Overhead and underground services	Worker injury from services strike at existing infrastructure and underground and overhead services	Construction	Possible	Extreme	High	Unlikely	Extreme	Medium
		Operation	Possible	Extreme	High	Unlikely	Extreme	Medium

			Initial risk with initial design mitigation Table 20.9			Residual risk with proposed mitigation in Table 20.10		
			Likelihood	Consequence	Risk	Likelihood	Consequence	Risk
Contaminated land	Health impacts to workers and public and environmental impact from contaminated land	Construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Minor	Low	Unlikely	Minor	Low
Abandoned mines and unrecorded underground collieries	Collapse of mine shaft or colliery leading to asset damage and/or injury	Construction	Unlikely	Major	Medium	Unlikely	Major	Medium
		Operation	N/A	N/A	N/A	N/A	N/A	N/A
Emergency access	Impaired emergency access resulting in escalation of incident	Construction	Possible	Major	High	Unlikely	Major	Medium
		Operation	Possible	Major	High	Unlikely	Major	Medium
Chemicals spillage and loss of containment	Loss of containment of dangerous goods during storage and handling	Construction	Possible	Moderate	Medium	Unlikely	Moderate	Low
		Operation	N/A	N/A	N/A	N/A	N/A	N/A
Freight dangerous goods	Loss of containment of freight dangerous goods and hazardous chemicals	Construction	N/A	N/A	N/A	N/A	N/A	N/A
		Operation	Possible	Extreme	High	Rare	Extreme	Medium
Explosives	Damage to infrastructure or injury or fatality caused by explosives incidents during blasting during construction or by adjacent operators	Construction	Possible	Extreme	High	Rare	Extreme	Medium
		Operation	Unlikely	Extreme	Medium	Rare	Extreme	Medium

20.9.2 Residual risks

From the assessment conducted (refer Table 20.11) risks that remain with a medium residual risk ranking include potential incidents related to:

- Bushfire
- Flooding or severe weather events
- Natural events exacerbated by climatic conditions
- Landslide, sudden subsidence, or movement of rocks or soil (construction)
- Employee fatigue and/or heat stress
- Rail accidents caused by increased rail movements
- Increased use of road vehicles for the Project
- Operating live trains in the disturbance footprint (operations)
- Increased number of interfaces between live trains and road users including pedestrians and land users
- Construction and use of the Teviot Range tunnel
- Interaction with existing services underground and overhead
- Health and environmental impacts from contaminated land (construction)
- Bridges
- Interference with emergency access
- Transport of dangerous goods freight (operations)
- Potential use of explosives for construction (particularly the Teviot Range tunnel).

Other potential risks assessed as a low residual risk ranking include potential incidents related to:

- Wildlife hazards
- Biosecurity threats
- Natural events
- Disturbing asbestos
- Dust, respirable silica and other airborne contaminants (including operational dust from transporting materials such as coal)
- Noise and vibration impact to sensitive receptors
- Disturbing or contributing to contaminated land
- Use of dangerous goods (including storage) during construction actives.

No risks were assessed as having a high residual risk ranking, with all remaining risks having either a low or medium residual risk ranking. As outlined in ARTC's *Risk Management Procedure*, risks with a residual rank of low are considered tolerable, and a residual rank of medium is considered tolerable if reduced so far as reasonably practicable given the low frequency of occurrence (or probability or likelihood) or minor impact associated in the event of such incidents occurring following the proposed mitigations.

For these residual risks, the Program Safety Management System will include monitoring activities to ensure the ongoing effectiveness of the risk controls, and identification of risk opportunities for further improvement. This includes the specific management plans listed in Section 20.9.3.

20.9.3 Specific management plans

Both the CEMP and ARTC's Operational Environmental Management Plan (Operational EMP) will include requirements for managing hazardous substances and dangerous goods (refer Chapter 23: Draft Outline Environmental Management Plan and Chapter 9: Land Resources). These plans will cross-reference and/or be supported by other specific management plans that will be developed to further enhance environmental, health and safety values as the Project progresses.

Some of these may be sub-plans to the CEMP and Operational EMP, and others may be standalone plans focusing on a particular aspect of proposed activities. Sub-plans to support the CEMP will include but not be limited to:

- Flora and Fauna Sub-plan (refer Chapter 11: Flora and Fauna)
- Air Quality Management Sub-plan (refer Chapter 12: Air Quality)
- Surface Water Management Sub-plan (refer Chapter 13: Surface Water and Hydrology)
- Groundwater Management Sub-plan (refer Chapter 14: Groundwater)
- Noise and Vibration Management Sub-plan (refer Chapter 15: Noise and Vibration)
- Heritage Management Sub-plan (refer Chapter 18: Cultural Heritage)
- Waste and Resource Management Sub-plan (refer Chapter 21: Waste and Resource Management).

Other plans that will be developed, as required, will include but not be limited to:

- Social Impact Management Plan (refer Chapter 16: Social)
- Traffic Management Plan (refer Chapter 19: Traffic, Transport and Access)
- Reinstatement and Rehabilitation Plan (refer Chapter 9: Land Resources)
- Biosecurity Management Plan, includes species and habitat management plans (refer Chapter 11: Flora and Fauna)
- Soil Management Plan, includes erosion and sediment control plans (refer Chapter 9: Land Resources)
- Contaminated and Hazardous Materials Management Plan (refer Chapter 9: Land Resources).

Chapter 23: Draft Outline Environmental Management Plan provides further detail on these plans and sub-plans.

20.9.4 Emergency management

ARTC's existing *Emergency Management Procedure (RLS-PR-044)*, which provides a systematic approach to incident response and recovery or incident investigation on ARTC's network, will be applied to the Inland Rail Program and the Project. As such, an Incident Management Plan will be developed for the Inland Rail Program to detail the procedures and resources with which emergencies related to the risks identified in Table 20.11 will be responded to and managed. The *Emergency Management Procedure (RLS-PR-044)* itself will be used for emergency management including emergency response and emergency planning. The procedures required to manage incidents and emergencies are the responsibilities of ARTC and rail operators (ARTC 2018c).

Security and crisis management will be developed for the Inland Rail network and will be in line with business continuity plans, which will be issue-specific.

20.9.4.1 Incident management plan

The Inland Rail Program will develop an Incident Management Plan, which will detail the response procedures and available resources to manage emergencies. The Incident Management Plan will be in accordance with ARTC's *Emergency Management Procedure* and will consider the requirements in relation to training, availability of resources and communication interfaces with relevant emergency organisations.

The Incident Management Plan will address the incident scenarios identified in Table 20.11. An outline of the information that will be provided in the incident management plan for each incident is outlined in Table 20.12.

TABLE 20.12: OUTLINE MANAGEMENT OF INCIDENTS IDENTIFIED

Aspect	Incident	Incident Management Outline
Bushfire	Damage to infrastructure, injury to workers or public from bushfire	▸ Follow ARTC's *Fire Prevention Management Procedure (PP0167)*. ▸ Operations (including construction works) to stop in areas affected by bushfire. ▸ Construction workers to have access to firefighting equipment. ▸ Trains to be equipped with firefighting equipment. ▸ Emergency phones provided on trains to ensure drivers can reach emergency services in the event of a bushfire.
Flooding	Damage to infrastructure, potential for impacts to freight goods caused by flooding events	▸ Follow ARTC's *Code of Practice: Flooding*. ▸ Operations (including construction works) to stop in areas affected by flooding. ▸ Emergency phones provided on trains to ensure drivers can reach emergency services in the event of flooding.
Climatic conditions	Failure of infrastructure / derailment accidents i.e. track buckling resulting in loss of dangerous goods freight	▸ Follow ARTC's *Track Stability Handbook (ENT-06-01)* for track buckling incident management through managing track stability. ▸ Follow ARTC's *Accidents or Derailments—Actions to be Taken (SMP 03)* in the event of a derailment. ▸ Emergency phones provided on trains to ensure drivers can reach emergency services in the event of derailment.

Aspect	Incident	Incident Management Outline
Landslide, sudden subsidence, movement of soil or rocks	Damage to infrastructure and worker/public injury from landslide, sudden subsidence, movement of soil or rocks	▸ Regular earthworks inspections will be implemented to determine defects and conditions that may affect or indicate problems with the stability of earthworks.
Wildlife	Wildlife injury or deaths from impact with Projector worker injury from wildlife	▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services in the event of an animal attack. ▸ If safe to do so, leave area where animal attack occurred. ▸ Contact the applicable Council (Ipswich City, Logan City, or Scenic Rim Regional Council) for animal control services.
Biosecurity	Damage to biosecurity of surrounding environment due to propagation invasive species	▸ Notify an inspector of a biosecurity notifiable incident under the *Biosecurity Act 2014* (Qld).
Noise and vibration	Disruption to public from noise and vibration	▸ Noise and vibration sources from construction or maintenance work involving heavy machinery will incorporate appropriate noise mitigation equipment and devices including mufflers and acoustic barriers. ▸ Noise disruption from night works are kept to a minimum and work will be as quickly and efficiently as possible. ▸ Follow ARTC's Asset Management System by maintaining equipment in good working order to reduce the potential for offensive noise.
Fatigue and heat stress management	Worker injury from fatigue and heat stress	▸ Follow ARTC's *Fatigue Policy and Work Health and Safety Work Instruction for Fatigue Management*. ▸ Follow Safe Work Australia's *Guide for managing the Risks of Working in Heat to Manage Heat Stress* (Safe Work Australia, 2020). ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services.
Asbestos	Health impacts from asbestos	▸ Follow ARTC's *Work Health and Safety Work Instruction for Asbestos*, along with Safe Work Australia's *Model Code of Practice—How to Manage and Control Asbestos in the Workplace* (Safe Work Australia, 2018d) and Safe Work Australia's *Model Code of Practice—How to Safely Remove Asbestos* (Safe Work Australia, 2018a). ▸ The Project will engage with competent contractors who are appropriately licensed for asbestos disturbance work.
Dust, respirable silica and other airborne contaminants	Impacts from dust, respirable silica and other airborne contaminants	▸ Inform relevant stakeholders with sufficient information to enable them to understand the likely nature, extent and duration of dust and emissions impacts.
Rail incidents	Rail accidents caused by increased rail movements	▸ Emergency phones provided on trains to ensure workers can reach emergency services. ▸ Follow ARTC's *Accidents or Derailments—Actions to be Taken (SMP 03)* in the event of a derailment.
Road incidents	Road accidents caused by increased vehicles required for the Project	▸ Emergency phones provided on construction sites to ensure workers can reach emergency services.
Road rail interface	Accidents due to increased number of road rail interface	▸ Emergency phones provided on trains to ensure workers can reach emergency services.
Tunnel	Accidents due to construction of and rail use through the tunnel	▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services. ▸ Comply with Safe Work Australia's *Guide for Tunnelling Work* (Safe Work Australia, 2013).

Aspect	Incident	Incident Management Outline
Bridges	Bridge collapse or falling object strikes	▸ Report the incident to ARTC's Network Control. ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services.
Overhead and underground services	Worker injury from services strike at existing infrastructure and underground and overhead services	▸ Inform the owner of the service impacted as soon as possible. ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services in the event of services strike. ▸ Lodge a 'Dial Before You Dig' enquiry prior to excavation or drilling work. ▸ Comply with Safe Work Australia's *Model Code of Practice—Excavation Work* (Safe Work Australia, 2018c).
Contaminated land	Health impacts to workers and public and environmental impact from contaminated land	▸ Notify the regulator as required, undertake an impacted site review, report site contamination to authorities as required, record the site contamination on ARTC Contaminated Site Register, and develop and implement an action plan.
Abandoned mines and unrecorded underground collieries	Collapse of mine shaft or colliery leading to asset damage and/or injury	▸ Provide a site map that indicates where abandoned mines and/or underground collieries may be present, and plan evacuation assembly points where possible. ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services.
Emergency access	Impaired emergency access resulting in escalation of incident	▸ Plan and develop alternative means of access for use in emergencies. ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services.
Chemicals spillage and loss of containment	Loss of containment of dangerous goods during storage and handling	▸ Workers to assess the risk and respond appropriately. ▸ Leaders to assess severity of events and confirm relevant stakeholders are aware as appropriate. ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services. ▸ Follow ARTC's *Work Health and Safety Work Instruction for Chemicals (WHS-WI-214)*.
Freight dangerous goods	Loss of containment of freight dangerous goods or hazardous chemicals	▸ Report the incident to ARTC's Network Control. ▸ Incident response to protect people and the environment based on type of dangerous goods or hazardous chemicals freighted.
Explosives	Damage to infrastructure or injury or fatality caused by explosives incidents during blasting during construction or by adjacent operators	▸ Report the incident to ARTC's Network Control. ▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services.

20.9.4.2 Emergency response

Throughout the life of the Project, emergency management will adhere to ARTC's *Emergency Management Procedure*. Where sources of emergency and disruption are foreseeable, the coordinated approach to the management of incident response will be based on the following components:

- A structured approach for initiating and implementing incident assessment, escalation and response
- The availability of trained and capable response personnel
- Appropriate and timely communications and decision making between site and ARTC management
- Debriefing sessions for incidents with participating organisation.

In the event of an incident or imminent threat, the nominee from which the information was reported and ARTC management will assess the incident as Level 1, 2, 3 or 4. The categories of incidents are determined based on impact level following the incident:

- Level 1—An occurrence which has been classified as an emergency, requiring a sustained response, by Police or Fire Services.
- Level 2—An occurrence that involves or affects operations on the network, which has resulted in or has the potential to result in death or serious injury to a person, significant impact/damage to the environment, property or infrastructure. These incidents will require external resources, control and sustained coordinated response.
- Level 3—An occurrence where minor injury, disruption, damage or environmental impact to the network, has occurred. These incidents will not require a sustained response from other organisations or outside resources and will be managed and investigated by the line manager or the organisation involved.
- Level 4—An occurrence that has resulted in a small impact on ARTC's network. These incidents are nominally routine operational incidents and unsafe acts identified during safety observations.

The Incident Management Team will be available to manage threats including large scale natural disasters and other type of incidents involving medical emergencies, such as electric shock, burn, height rescue, snake and insect bites, hazardous chemical spill and threats in accordance with ARTC's Emergency Management Procedure. An appropriately trained Incident Management Team will be triggered to coordinate site restoration, unless Emergency Services are present.

Emergency Services organisations may be in attendance depending on the nature and magnitude of the incident. These services may take charge of an incident site. Where more than one Emergency Services attends, the site will be under the overall command of the QPS, except in the event of a fire or dangerous goods spill, where the Queensland Fire and Emergency Services will take charge. ARTC and Network Operators will work with these services, and as directed by them.

Following an incident, an incident investigation team will commence investigation of the incident. The incident investigation team will have the authority to take action to preserve any evidence that may be required to assist in the investigation, including requesting sections of the incident site to be quarantined from entry, delaying the restoration work until the completion of incident investigation and instigating interviews with personnel involved in the incident. All relevant data and information will be collected in a clear and concise manner to complete an investigation report.

Figure 20.5 illustrates the overview of ARTC's incident management and investigation.

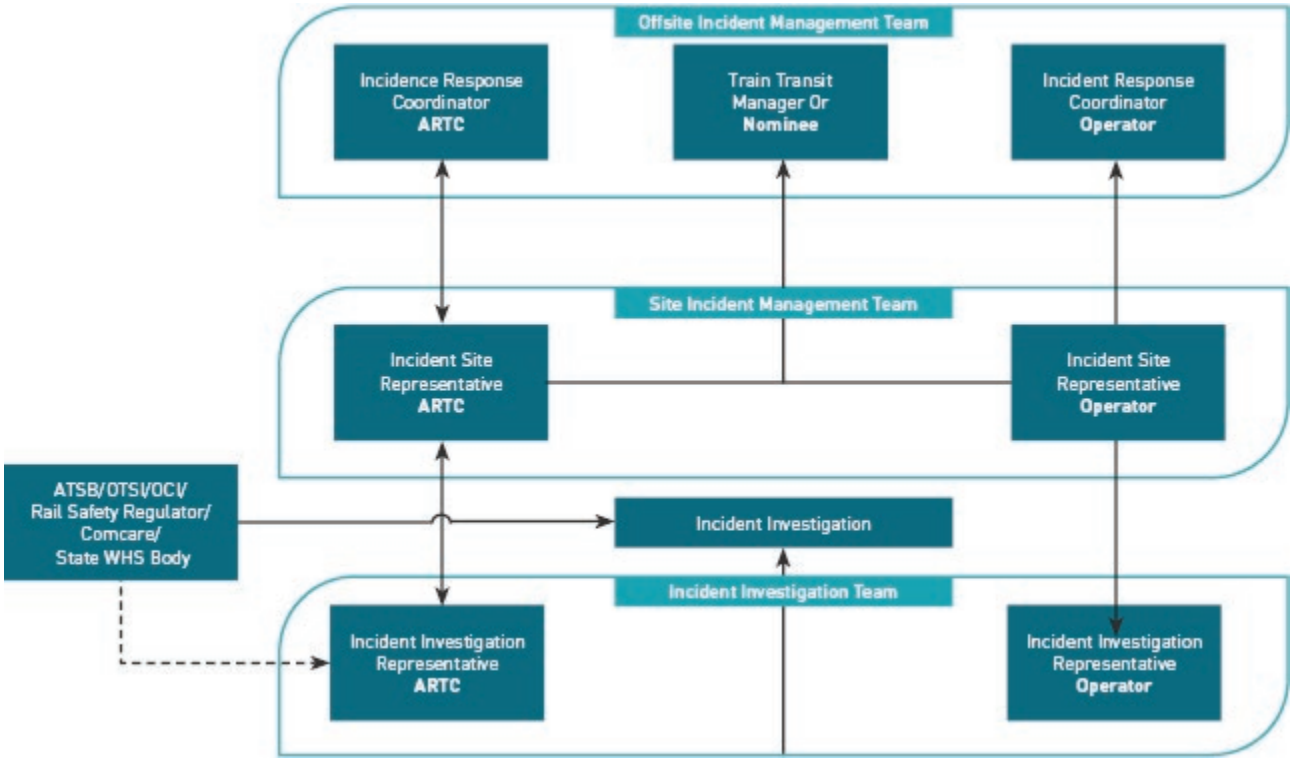

FIGURE 20.5: AUSTRALIAN RAIL TRACK CORPORATION EMERGENCY MANAGEMENT OVERVIEW

Source: ARTC (2018c) Emergency Management Procedure RLS-PR-044

20.9.4.3 Emergency planning

Emergency procedures will be tested to evaluate the effectiveness of emergency preparedness and response. Emergency procedure testing will involve desktop scenarios and procedural tests, through to complete organisation-wide simulated incident exercises involving emergency services, dependent on relevant emergency risk potential. Desktop test exercises will take place only when an actual event involving parties has not occurred within a two-year period.

Rail operators will obtain approval from ARTC prior to any exercise on the network with the potential to affect network operations. This includes activities conducted on adjacent rail networks with potential impacts on ARTC's network such as the QR West Moreton System. A safety plan will be prepared for all exercises involving full-size equipment on the network.

Desktop and simulated test exercises will be designed to ensure that individually and collectively the Incident Management Procedures adequately address the requirements for emergency management and that the procedures are effectively integrated. The exercise will nominally evaluate communications response time, interface working relationship recovery mechanisms, procedures response and training needs which will then be used to amend the Incident Management Plan where required. Pre-incident planning with external emergency responders will be undertaken.

Competency of ARTC personnel in emergency response roles will be ensured through competency training.

Appropriate, compliant and maintained first aid equipment, consumables, trained personnel, facilities and medical support will be available to minimise any adverse impact on the health and safety of people or operations.

Incident management personnel will be visibly identifiable onsite to assist in the recovery and restoration in the event of an emergency. Urgent medical or emergency capabilities, including warning, communication and evacuation, will be provided in accordance with ARTC's Emergency Management Procedure.

The business-level ARTC Emergency Management Procedure will be used as guidance for an asset specific integrated emergency management plan for the Project. This will be developed in later stage of the Project, closer to the construction of the asset.

20.9.4.4 Consultation

The Project has been and will continue to be developed in consultation with relevant emergency management authorities to ensure that external support will be provided by these services in an event of an emergency. These include:

- Logan and Ipswich District Disaster Management Groups
- Scenic Rim Regional Council, Ipswich City, and Logan City Local Disaster Management Groups

- Emergency Services including:
  - Ipswich Hospital
  - Rural Fire Services (e.g. Warrill View, Flinders Peak, Roadvale, Ripley Valley)
  - Queensland Fire and Emergency Services
  - QPS (e.g. Rosewood, Harrisville, Boonah)
  - Queensland Ambulance Services (e.g. Rosewood, Harrisville, Kalbar)
  - Queensland State Emergency Services.

Consultation and engagement activities focusing on engaging with the local community including landholders, Councils and regional community groups have been ongoing since 2017. Consultation activities have included providing information and gathering feedback from stakeholders and the local community allowing ARTC to gain an understanding of the issues and opportunities across the disturbance footprint.

Refer Chapter 16: Social, Chapter 5: Stakeholder Engagement, Appendix C: Consultation Report and Appendix R: Social Impact Assessment Technical Report for more detail of emergency management consultation.

20.10 Cumulative impacts

In relation to hazard and risk the projects considered to have a potential for cumulative impacts with the Project have been identified as the adjacent Inland Rail projects—Kagaru to Acacia Ridge and Bromelton (K2ARB) and Helidon to Calvert (H2C).

Given the similar nature of the K2ARB, H2C and C2K projects, the key risks considered in the cumulative impact assessment are:

- Loss of containment of dangerous goods during freight transport
- Impacts on the local environment and future projects from the potential use of explosives for tunnel construction.

Chapter 22: Cumulative Impacts provides an assessment of the potential cumulative impacts of these two activities and concludes that they are of low significance.

20.11 Conclusion

The development of railway infrastructure has hazards and risks that must be identified and managed throughout the lifecycle of a Project through design, construction and commissioning, and operation. The Project has incorporated risk identification and assessment practices throughout the design development phase and ARTC have a strong commitment to implementing and maintaining appropriate safety practices throughout operations.

A preliminary risk assessment has been conducted for the Project in Section 20.9.1, complying with ToR 11.154. This risk assessment was a result of hazard and impact identification (refer Section 20.7) and formation of potential mitigations (refer Section 20.8).

The implementation of ARTC risk management policies and procedures, as described in Section 20.8 and Chapter 23: Draft Outline Environmental Management Plan are anticipated to effectively reduce most of the residual risks associated with the Project to a low to medium level. As outlined in ARTC's Risk Management Procedure, risks with a residual rank of low are considered tolerable, and a residual rank of medium is considered tolerable if reduced so far as reasonably practicable. The residual risks that remain medium includes potential incidents related to:

- Bushfire
- Flooding or severe weather events
- Natural events exacerbated by climatic conditions
- Impacts of project on greenhouse gas emissions
- Landslide, sudden subsidence, or movement of rocks or soil (construction)
- Employee fatigue and/or heat stress
- Rail accidents caused by increased rail movements
- Increased use of road vehicles for the Project
- Operating live trains in the disturbance footprint (operations)
- Increased number of interfaces between live trains and road users including pedestrians and land users
- Construction and use of the Teviot Range tunnel
- Interaction with existing services underground and overhead
- Health and environmental impacts from contaminated land (construction)
- Bridges
- Interference with emergency access
- Transport of dangerous goods freight (operations)
- Potential use of explosives for construction (particularly the Teviot Range Tunnel).

For these residual risks, the Program Safety Management System will include monitoring activities to ensure the ongoing effectiveness of the risk controls, and identification of risk opportunities for further improvement.