CHAPTER 20

Hazard and Risk

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT

IR_1536

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20.1 Scope of the chapter

This chapter assesses the Gowrie to Helidon (G2H) 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

Potential risks and hazards affecting the Project (i.e. natural, Project delivery and dangerous goods) have been assessed in accordance with the Environmental Impact Statement (EIS) Terms of Reference (ToR) for the different phases of the Project, being:

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

Based on a review of the ToR and the Project description (refer Chapter 6: Project Description), the following key hazards have been identified:

- Natural hazards (e.g. flooding, wildlife, sudden subsidence or movement of soil or rocks, biosecurity, bushfire, landslide, and implications related to climate conditions)
- Construction and commissioning hazards and risk (e.g. respirable silica and other airborne contaminants such as naturally occurring asbestos, existing infrastructure, use of explosives for construction, land contamination)
- Operational hazards and risks (e.g. fatigue and heat stress, land contamination, 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

The hazard and risk assessment has considered potential impacts to people, property and the environment, either initiated or exacerbated by the Project; furthermore, the hazard and risk assessment 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 preparation of the 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, so far as is reasonably practical. This risk assessment has been conducted as part of the larger risk management process and considers risk 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 (and commissioning) and operation activities with the potential to cause health, safety and risk impacts
- Describe how the Project may potentially affect hazards outside the Project disturbance footprint and implications of climate conditions

- Demonstrate how the risk assessment process will be applied throughout the life of the Project in accordance with AS/NZ ISO 31000:2009 *Risk Management—Principles and Guidelines* (Standards Australia, 2009a) (compliant with ISO 31000:2018 *Risk Management—Principles and Guidelines*) (International Organization for Standardization (ISO), 2018)
- Discuss mitigation measures to be implemented during construction (and commissioning) and operation
- Outline the relevant emergency management plan, including consultation undertaken with relevant emergency management authorities, such as Local Disaster Management Groups (LDMG), for the Lockyer Valley and Toowoomba Regional Councils.

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. Australian Rail Track Corporation (ARTC) will continuously 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 the EIS to identify environmental values potentially affected by the Project and establishes a framework for implementing mitigation and management measures (refer Chapter 23: Draft Outline Environmental Management Plan). A detailed Construction Environmental Management Plan (CEMP), including relevant sub-plans, will also be prepared as the Project progresses. 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 continuously developed and documented throughout the detailed design and construction program, as required.

ARTC's existing hazard and risk management procedures will continue to be reviewed and applied into the operational phase.

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

Emergency management plans are described based on ARTC's existing *Emergency Management Plan* (ARTC, 2019b) considering emergency events that are possible throughout all phases of the Project including construction and commissioning, and operation phases.

20.2 Terms of Reference

This chapter has been prepared to address sections 11.142 to 11.149 and sections 11.155 to 11.157 of the Terms of Reference (ToR). A compliance check of this chapter against each of the relevant components of the ToR is presented in Table 20.1. Compliance of the Environmental Impact Statement (EIS) against the full ToR is documented in Appendix B: Terms of Reference Compliance Table.

TABLE 20.1: COMPLIANCE WITH EIS TERMS OF REFERENCE REQUIREMENTS

Hazard and Risk Terms of Reference requirements		Where addressed in the EIS
Information Requirements		
11.150	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 and 20.7.1.2
	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

Hazard and Risk Terms of Reference requirements		Where addressed in the EIS
	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	Sections 20.6 and 20.7 Estimated probabilities are inherently incorporated into likelihood assessments as part of the risk assessment included in Section 20.9.1
	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
11.151	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
11.152	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 20.4.2.5, 20.8 and 20.9
11.153	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
11.154	Outline any consultation undertaken with the relevant emergency management authorities, including the Local Disaster Management Group.	Sections 20.8.1 and 20.9.4.4 Consultation with these parties is discussed in Chapter 5: Stakeholder Engagement and Appendix D: Community Consultation
11.155	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 20.7.3.3 and 20.8
11.156	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 20.7.3.3 and 20.8
Climate		
11.162	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
11.163	Climate information should be presented in a statistical form, including long-term averages and extreme values, as necessary.	Sections 20.6.1.1 and 20.7.1 (especially Section 20.7.1.3)
11.164	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 and 20.7.1 (especially Section 20.7.1.3)

20.3 Legislation, 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. Further discussion regarding relevance of legislation to the Project and Project compliance is provided in Chapter 3: Project Approvals.

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth)
- *Work Health and Safety Act 2011* (Cth) (WHS Act)
- *Aboriginal Cultural Heritage Act 2003* (Qld)
- *Biosecurity Act 2014* (Qld)
- *Disaster Management Act 2003* (Qld)
- *Environmental Protection Act 1994* (Qld)
- *Explosives Act 1999* (Qld)
- *Fire and Rescue Services Act 1990* (Qld)
- *Fisheries Act 1994* (Qld)
- *Land Act 1994* (Qld)
- *Petroleum and Gas (Production and Safety) Act 2004* (Qld)
- *Public Health Act 2005* (Qld)
- *Queensland Heritage Act 1992* (Qld)
- *Rail Safety National Law (Queensland) Act 2017* (Qld).

Policies and guidelines of relevance to this assessment and their respective requirements are described in Table 20.2.

TABLE 20.2: POLICIES, STANDARDS AND GUIDELINES RELEVANT TO THE ASSESSMENT

Policy, standard or guideline	Relevance to the Project
Queensland State Planning Policy (SPP) (Department of Infrastructure, Local Government and Planning (DILGP, 2017b)	The 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. 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 (National Transport Commission, 2018)	The code details the technical specifications, requirements and recommendations applicable to the transportation of dangerous goods in Australia by road and rail. Taken as the basis of dangerous goods handling and considered in the development and assessment of mitigation measures.
Rail Safety Principles and Guidance 1996 (Great Britain Railway Inspectorate, 1996)	This document provides safety principles and guidelines for the construction of railways. Principles applied to risk assessment considering expected mitigation measures and approach to rail construction.
Guideline: Safety Management System (Office of the National Rail Safety Regulator (ONRSR), 2019a)	This guideline 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 (National Transport, Commission, 2017)	This standard provides guidance for rail transport operators to manage the risk and protect the safety of the public, rail employees and the environment. Specifically, the standard outlines requirements to limit the impact of individual health issues on rail safety.

Policy, standard or guideline	Relevance to the Project
Transport Noise Management Code of Practice Volume 3—Interim Guideline: Operational Railway Noise and Vibration (DTMR 2019e)	Developed by Department of Transport and Main Roads (DTMR), this interim guideline is a standard that provides assessment criteria for operational noise and vibration emissions generated by rollingstock operating on a railway, or railway tracks on other rail infrastructure.
AS ISO 31000: (2009 and 2018)—Risk Management—Principles and Guidelines (Standards Australia, 2009; ISO, 2018)	These standards describe the risk management process that can be applied throughout the life of an organisation and to a wide range of activities. Both guidelines (2009 and 2018) provide the same guidance on the identification and assessment of risk that has been applied in the methodology of this chapter.
AS/NZS ISO 45001:2018 Occupational health and safety management systems—Requirements with guidance for use (Standards Australia, 2018c)	This standard provides a framework for managing occupational health and safety risks, and opportunities, with the aim of preventing work-related injury and ill health to workers, and providing safe and healthy workplaces. Development of safety management systems is considered to be in accordance with this standard for assessment as mitigation measures.
AS 4084:2001 Occupational Health and Safety Management Systems—General Guidelines on Principles, Systems and Supporting Techniques (Standards Australia, 2001b)	This standard provides guidance on the development and the implementation of occupational health and safety management systems, and principles, and their integration with other management systems.
AS 4292:2006 Railway Safety Management (Standards Australia, 2006c)	This standard specifies railway safety requirements and management systems associated with design, specifications, operating and maintenance procedures. Considered in the assessment of mitigation measures and risk assessment associated with railway incidents.
AS 2187:2006 – Explosives – storage, transport and use (Standards Australia, 2006a)	This standard 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 1678:1993 Emergency Procedure Guide – Transport (Standards Australia, 1993)	This standard 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 (Standards Australia, 1999)	This standard provides lists of Emergency Procedure Guides (EPGs) and Group Text Emergency Procedure Guides (GTEPGs), providing 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 (Standards Australia, 2017)	This standard sets requirements for storage and handling of flammable and combustible dangerous goods Class 3. Considered in the development of mitigation measures for storage of construction chemicals.
AS 3780:2008 The Storage and Handling of Corrosive Substances (Standards Australia, 2008a)	This standard sets requirements for storage and handling of corrosive dangerous goods Class 8. 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 (Standards Australia, 2010)	This standard 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 (Standards Australia, 2011)	This standard 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:2016 Bridge Design (Standards Australia, 2016)	This standard 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.

Policy, standard or guideline	Relevance to the Project
AS 7636:2013 Railway Structures (Standards Australia, 2013)	This standard details the requirements that encourage rail organisations to use a whole-of-life approach to rail structures, and covers 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 the requirements of this standard and are considered in the assessment.
HB203:2012 Managing environment-related risk (Standards Australia, 2012)	This standard provides guidelines to help organisations manage environment-related risk.
AS 2885:2008 Pipelines—Gas and liquid petroleum (Standards Australia, 2008b)	This standard provides details requirements for management of works conducted in vicinity of pipeline infrastructure.

20.3.1 ARTC management plan and procedures

20.3.1.1 Safety management system

The ARTC Safety Management System is accredited under the *Rail Safety Act 2006* (Victoria) and is based on the promotion of continuous safety improvement. The safety management system is based on the promotion of continuous safety improvement and contains information on how ARTC maintains safe operations. This information is documented in policies, procedures, standards, work instructions and guidelines.

ARTC is undertaking action to obtain accreditation for this system under the *Rail Safety National Law (Queensland) Act 2017* (Qld). 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 the ARTC Safety Management System are shown in Figure 20.1.

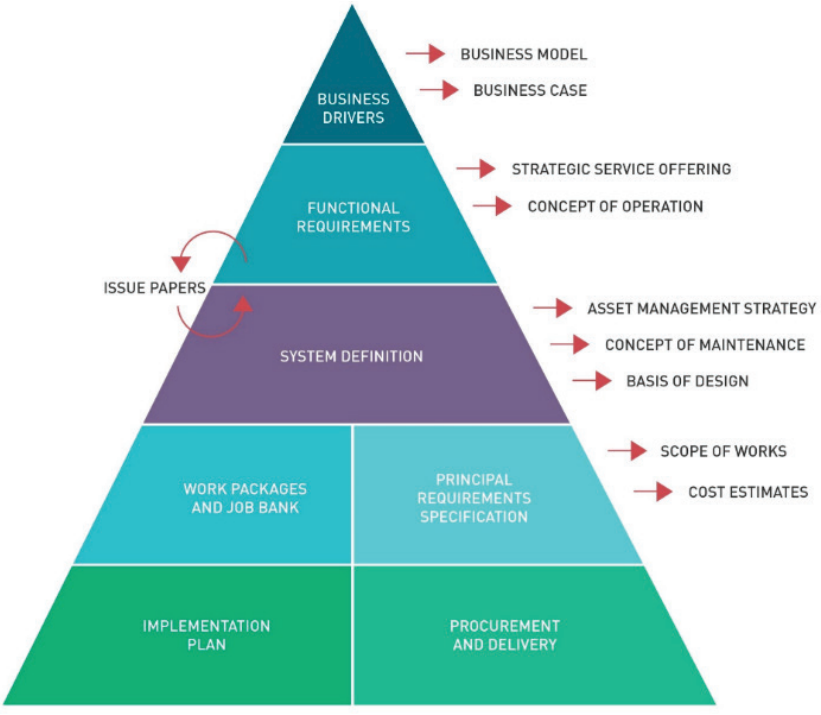

FIGURE 20.1: ARTC SAFETY MANAGEMENT SYSTEM

'No Harm' is an ARTC value, with the objective that no one is harmed at work or on the ARTC rail network. Demonstrating integration of ARTC's value of 'No Harm' into the 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 safety management systems meet the regulatory requirements and effectively prevent accidents and injury.

The ARTC 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 ARTC 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 (ARTC, 2020d) includes the following:

- 'No Harm' is an ARTC value, with the objective that no one is harmed at work or on the ARTC rail network

In order to achieve 'No Harm', ARTC is committed to a 'pathway to zero' in the following practical ways:

- 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 personal 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 continuous 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.

A copy of ARTC's Safety Policy is provided in Appendix G: Corporate Policies. 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 and severe risk program

The *Fatal and Severe Risk Program* (ARTC, 2017c), with accompanying lifesaving behaviours, is a fundamental element of ARTC's 'No Harm' value, which aims to implement 10 control protocols to manage risk areas with potentially fatal consequences. In doing so, the program establishes risk management protocols, to provide safe work practices, and establish minimum performance expectations, to manage risk and eliminate incidents, including:

- Vehicle accidents (including road rail vehicles)
- Manual handling incidents
- Rail traffic strike
- Rail traffic collision
- Mobile plant strike
- Contact with electricity incidents
- Incidents involving hazardous chemicals, hot materials and confined spaces
- Crane or lifted load crushing incidents
- Falls from height.

The *Fatal and Severe Risk Program* will apply to the Inland Rail Program and the Project, including to contract workers. Additional details on ARTC's *Fatal and Severe Risk Program* are accessible through the ARTC website.

20.4 Methodology

20.4.1 Hazard and risk study area

The hazard and risk study area is the area, including the Project disturbance footprint, with the potential to impact people, environment, and property as a result of the Project. The extent of the impacts will vary according to the nature of each hazard identified during the preliminary risk assessment, including existing environmental conditions and natural events.

Therefore, 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
- The extent of the Project disturbance footprint, including road–rail interfaces, watercourse crossings, maintenance and construction access sites, construction laydown areas and service locations.

For a description of the Project scope and key features, refer to Chapter 6: Project Description or to each chapter for the definition of the relevant discipline study area.

20.4.2 Risk assessment methodology

The risk assessment presented in Section 20.9.1 describes the potential risks to people, property and the environment associated with the Project. The risk assessment considers a variety of sensitive receptors to the Project, including people (human), sensitive ecosystems (environmental) and society (land use and infrastructure). 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 methodology adopted for this risk assessment is based on AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018) *Risk Management: Principles and Guidelines* (Standards Australia, 2009a and ISO, 2018) and HB203:2012 *Managing environment-related risk* (Standards Australia, 2012). Section 6.4.1 of ISO 31000:2018 describes risk assessment as the overall process of risk identification, risk analysis and risk evaluation.

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

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

The application of the AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018) (Standards Australia, 2009a) 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 the ARTC Safety Management System.

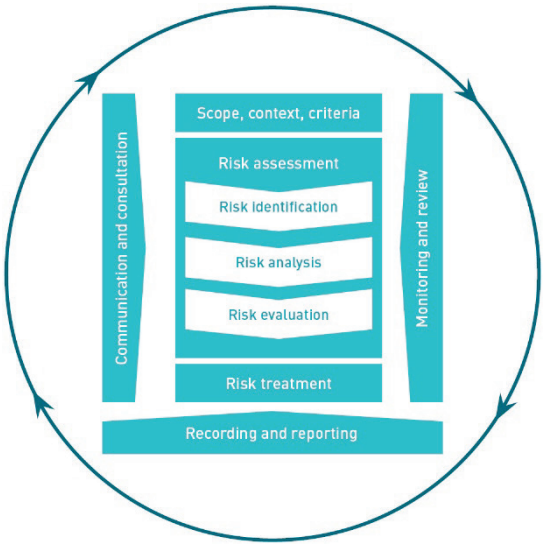

FIGURE 20.2: THE ISO 31000:2018 RISK MANAGEMENT PROCESS

Source: ISO, 2018

20.4.2.1 Risk identification

Hazard identification and risk assessment has been undertaken in accordance with the requirements of AS/NZ ISO 31000:2009 (compliant with ISO 31000:2018). The following terms are used throughout the chapter:

- Hazards: a source of potential harm or an existing situation with potential to cause loss or harm to people or damage to property and environment
- Risks: the chances of something happening that will have an impact on objectives. A risk is often specified in terms of an event or circumstance and the consequences that may flow from it. Risk is measured in terms of a combination of the consequence of an event and the likelihood of that event occurring.

The risk identification step involved identification of hazards and their potential receptors over the life of the Project. Receptors were not restricted to individuals or communities, and included sensitive environmental receptors such as land, habitat, flora and fauna.

Potential hazards identified in technical studies for this EIS, and in Project risk and Project safety in design workshops, and documented in accordance with requirements under the *Rail Safety National Law (Queensland) Act 2017* (Qld) (refer Chapter 3: Project Approvals) were considered in the risk identification process to provide breadth of assessment and to capture hazards identified during the design phase.

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

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 the ARTC 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 presented in Chapter 4: Assessment Methodology. Probabilities of events occurring have been assessed in the likelihood criteria from a qualitative view rather than quantitative.

20.4.2.3 Risk analysis

The level of risk of each hazard was 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 the ARTC risk criteria, as presented in Table 20.3. The risk ranking methodology, including criteria applied to likelihood and consequence factors, is discussed in Chapter 4: Assessment Methodology.

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

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 the approach, as presented in Chapter 4: Assessment Methodology.

20.4.2.5 Risk treatment and residual risks

Hazards ranked with a medium, high and very high risk rating require further risk treatment throughout the life of the Project. In this process, additional mitigation and controls were identified from the following hierarchy of control measures:

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment.

Treatment includes risk management through the ARTC Safety Management System. Additional options for risk treatment are explored in detail 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.

As outlined in ARTC's *Risk Management Procedure* (ARTC, 2019c), risks with a residual rank of medium will be considered tolerable if ARTC demonstrates they are reduced so far as reasonably practicable through the ARTC Safety Management System. Additional measures for risk elimination are explored in detail in Section 20.8 and Section 20.9. Consideration of risk controls has taken into account the full life of the Project, including design, pre-construction, construction, commissioning, operation and maintenance 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 strategy, and safety in design. Additionally, several detailed technical studies have been carried out for the Project and considered in the EIS. Risk assessments and disaster management plans have been developed by the local councils in the local government areas (LGAs) in which the Project is located. The following documents are particularly relevant and are referred to, where applicable, in this chapter:

- Lockyer Valley Regional Council (LVRC) *Local Disaster Management Plan 2017* (LVRC, 2017b)
- Toowoomba Regional Council (TRC) *Local Disaster Management Plan 2015* (TRC, 2015)
- Planning Schemes—Toowoomba and Gatton Shire (TRC, 2012 and LVRC, 2007)
- Climate Data—Bureau of Meteorology (BoM)
- ATRC's Infrastructure Standards Extranet (**extranet.artc.com.au**)
- Technical assessments undertaken to the inform this EIS, as documented in Chapters 7–21 and Appendix D–U and Appendix W: Geotechnical
- Design, materials selection, constructability methodologies prepared in support of the Project's current design. Design drawings are provided in Appendix C: Design Drawings.

Consultation activities, including engagement with local councils and emergency services (as discussed in Section 20.9.4.4 and Chapter 5: Stakeholder Engagement), have also 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/infrastructure). This section provides a discussion on the human, environmental, land use and infrastructure receptors identified for the Project.

20.5.1 Human receptors

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

- Residential and rural communities adjacent to the Project disturbance footprint
- Settlements associated with Toowoomba (including Gowrie and Mount Kynoch), along with Withcott, Lockyer, Postmans Ridge, Murphys Creek, Helidon Spa and Helidon
- Queensland Rail (QR) West Moreton System maintenance and rail facilities workers
- Train divers and, where applicable, passengers on the West Moreton System
- Pedestrians, motorists (commercial and private vehicles) and residents who use the roads and footpaths near or intersecting the Project disturbance footprint and haulage routes
- People working on land adjacent to, or intersected by, the Project
- Users of water resources that may be impacted by the Project
- Tourists and visitors to the Toowoomba and Lockyer Valley
- Emergency services workers
- Yuggera Ugarapul People and Western Wakka Wakka People (refer to Chapter 18: Cultural Heritage).

Workers and train drivers on the Inland Rail network, once operational, will be considered employees and are not defined as sensitive receptors for the purposes off this assessment. The risks to employees are assessed and managed through ARTC policies and procedures including *Work Health and Safety Procedure* (ARTC, 2015c).

20.5.2 Environmental receptors

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

- Areas of Indigenous cultural heritage sensitivity, as assessed during the Project Activity Assessment, or otherwise (as per the relevant cultural heritage management plans), and discussed in Chapter 18: Cultural Heritage
- Non-Indigenous heritage areas of interest, in the form of buildings, structures and other features, as identified in Chapter 18: Cultural Heritage. This includes three listed cultural heritage places and six places of potential local heritage value
- Watercourses and drainage features of Gowrie and Lockyer Creek catchments, as identified in Chapter 13: Surface Water and Hydrology. This includes Gowrie Creek, Oaky Creek, Rocky Creek, Six Mile Creek and Lockyer Creek
- Ecological assemblages, including threatened species, along with species of local and State significance and their habitat in the ecology study area, as described in Chapter 11: Flora and Fauna
- Environmentally sensitive areas, including groundwater dependent ecosystems (GDEs), threatened ecological communities (TECs), wetlands, remnant vegetation, and areas containing conservation significant species in the ecology study area, as described in Chapter 11: Flora and Fauna
- Landforms and the natural landscape, including Toowoomba Range, the Great Dividing Range Escarpment, Wards Hill and Helidon Hills
- Soils and geology setting of the Project as described in Chapter 9: Land Resources
- Groundwater resources, as identified in the Chapter 14: Groundwater. This includes groundwater, including alluvial aquifers, aquifers associated with the Main Range Volcanics and aquifers of the Great Artesian Basin.

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 (landfill)
- QR West Moreton System rail corridor, with the Project collocated with the existing rail corridor for 5.6 km. The Project also traverses over the corridor at Gowrie Junction and Helidon, and under the existing rail corridor at Cranley and Ballard, with a new connection at Gowrie
- Commonwealth land, with the Project traversing the northern portion of the former Mount Lofty Rifle Range
- Development activity, including a warehouse and transport depot, being the InterLinkSQ intermodal facility
- Helidon Hazardous Industry Precinct, which has been identified by *ShapingSEQ* (DILGP, 2017a) initiative as a special use to be protected in the long-term from encroachment by sensitive and incompatible activities
- The Gowrie to Grandchester future state transport corridor protected under the *Transport Planning and Coordination Act 1994* (Qld)
- Farming and agribusinesses, including organic production certification
- Existing utilities that are impacted by the Project (services owned by TRC, New Hope Group, Telstra, Nextgen, Energex, Ergon, Powerlink, etc.)
- Significant transport infrastructure of the State-controlled road network. Noting that road–rail interfaces are grade separated (e.g. the tunnel crosses under the Toowoomba Bypass at three locations and the New England Highway, rail over road of the Toowoomba Bypass and Murphys Creek Road) or will involve road closures, as outlined in Chapter 19: Traffic, Transport and Access
- Tourism attractions, drives and facilities, including the Toowoomba Range, where there are scenic lookouts providing views towards natural scenic amenity and supporting the region's tourism
- Notable land uses, such as the Wetalla Wastewater Treatment Plant, Baillie Henderson Hospital, Harlaxton Key Resource Area, Withcott Quarry, Withcott Seedlings, Toowoomba Kart Club and the Helidon Magazine Reserve
- The Roma Brisbane Gas Pipeline (crossing at three locations, including one in tunnel)
- Existing local council road network.

For further details on the land uses and infrastructure within and adjacent the Project disturbance footprint, refer Chapter 8: Land Use and Tenure.

20.6 Existing environment

Railways can impose risks to surrounding people, property and the environment. Conversely, the surrounding communities, land use, and environment can pose hazards or risks to the railway operation, e.g. through the interaction of people and activities within the Project disturbance footprint. Existing sources of hazards and risks have been examined as part of the risk assessment to develop an 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, land conditions and infrastructure. These existing hazards have the potential to be influenced by the Project. These hazards are discussed below in terms of:

- Existing natural hazards (climatic conditions, bushfire, flooding, cyclones, landslides, wildlife and naturally occurring asbestos)
- Existing land conditions
- Existing infrastructure.

20.6.1.1 Existing natural hazards

Natural hazards are external risks to the Project. Key natural hazards for the Project include climate conditions, bushfire, flooding, landslides, wildlife and naturally occurring asbestos. These hazards are discussed in the following sections.

Climate data

Several meteorological monitoring stations are located in relative proximity to the Project disturbance footprint. The Toowoomba Airport BoM station is located approximately 11 km south-west of Gowrie, and The University of Queensland (UQ) Gatton BoM station is located approximately 22 km east of Helidon. A summary of the climatic data recorded at the Toowoomba Airport and the UQ Gatton BoM stations is provided in Table 20.4.

TABLE 20.4: CLIMATE DATA

Parameter		Unit	Toowoomba Airport BoM station (1996 to 2019)	UQ Gatton BoM Station (1897 to 2019)
Highest mean maximum temperature		°C	28.4	31.6
Highest maximum temperature		°C	40.8	45.7
Lowest mean minimum temperature		°C	6.6	6.2
Lowest minimum temperature		°C	-1.8	-5.6
Mean monthly rainfall	Highest	mm	104.0 (December)	110.1 (January)
	Lowest	mm	26.2 (April)	26.7 (August)
Monthly rainfall extremes	Highest	mm	416.0	452.9
	Lowest	mm	0.0	0.0
Mean solar exposure	Highest	MJ/m^2	25.0	24.3
	Lowest	MJ/m^2	11.7	11.8
Maximum wind gust speed	Highest	km/h	111	131
	Lowest	km/h	78	11.0

Table note:
°C = degrees Celsius
mm = millimetres
MJ/m^2 = megajoules per square metre
km/h = kilometres per hour

The historic temperatures at the Toowoomba Airport and UQ Gatton BoM stations 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 the Toowoomba and Lockyer Valley LGAs.

Historic climate data shows that there is the potential for extreme temperatures, evidenced by the 12.4 °C difference between the highest maximum temperatures and the highest mean maximum temperatures at the Toowoomba Airport BoM station and the 14.1 °C difference at the UQ Gatton BoM station (refer Table 20.4). Furthermore, the mean number of days above 35 °C is 4.5 for Toowoomba Airport BoM station and 19.8 °C for UQ Gatton BoM Station, signalling the potential for extreme temperatures. The mean temperature differences between the Toowoomba Airport BoM station and the Gatton BoM station are the main feature for the climate data.

Historic climate data also shows up to a 350 mm difference between the highest monthly mean rainfall and the highest monthly rainfall at the Toowoomba Airport and UQ Gatton BoM stations. This indicates there is a current potential for extreme rainfall events, which can lead to an increased potential for flooding and flash flooding; the impacts of which are discussed in Section 20.6.1.1.

For further details on the climate relevant to the Project, refer to Appendix K: 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, 2019b) has predicted temperature rises relative to the climate of 1986–2005 in the East Coast region of Australia for a full range of emission scenarios. Figure 20.3 shows the modelled trend for the RCP8.5 (RCP is Representative Concentration Pathways, which refers to greenhouse gas (GHG) concentration trajectory) emissions scenario, which is representative of a future with little curbing of emissions, with a CO_2 concentration continuing to rapidly rise—reaching 940 ppm by 2100. The RCP8.5 modelling predicts the following 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 (days above 35 °C) may result in an 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 the modelled trend for the RCP8.5 emissions scenario, with the following predicted changes in predicted rainfall relative to 1995:

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

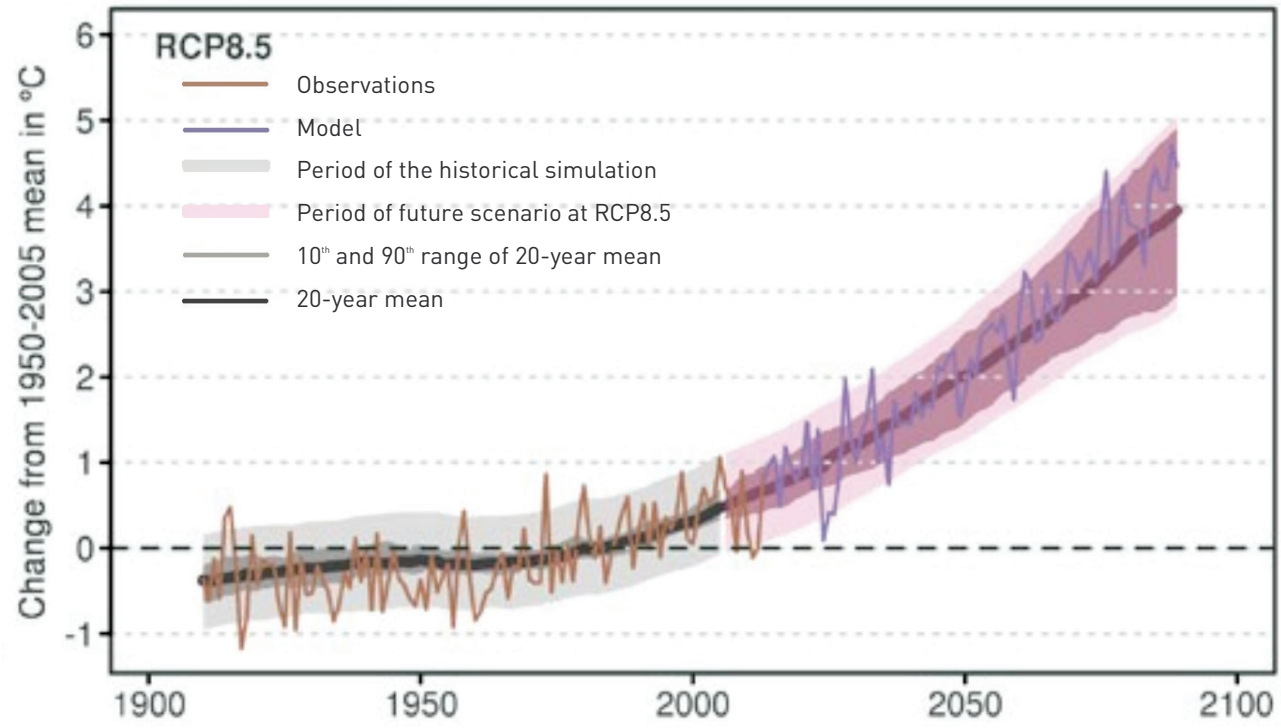

FIGURE 20.3: TIME SERIES FOR EAST COAST ANNUAL AVERAGE SURFACE AIR TEMPERATURE FOR 1910 TO 2090

Source: CSIRO, 2019b

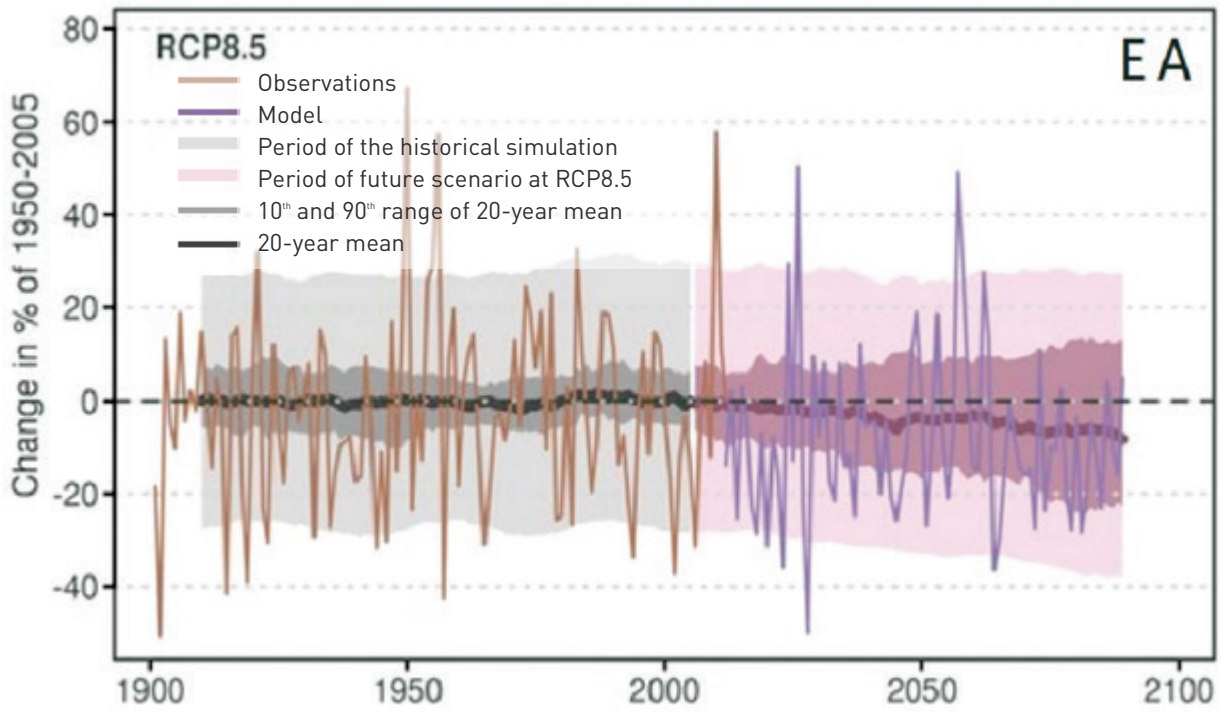

FIGURE 20.4: TIME SERIES FOR EASTERN AUSTRALIA RAINFALL ANNUAL AVERAGE

Source: CSIRO, 2015

Climate modelling from the 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 (GDR). Summer thunderstorms can be hazardous due to accompanying winds, hail, flash floods and potentially damaging lightning strikes.

Queensland's total GHG emissions have been on an upward trajectory since the mid–1990s but have fluctuated significantly due to the large contribution of the land use, land use change and forestry (LULUCF) sector to Queensland's GHG emissions (Department of Environment and Heritage Protection (DEHP), n.d.). The baseline GHG emissions projection for Queensland shows an estimated 35 per cent increase in Queensland GHG emissions to 2030—comprising a sharp increase in emissions between 2014 and 2020—followed by a more gradual rise to 2030 (DEHP, n.d.). This is largely due to increasing GHG emissions in the energy and LULUCF sectors. The projected increases in baseline LULUCF sector emissions are primarily due to an increase in land clearing. LULUCF GHG emissions are projected to rise from 25.2 million tonnes of carbon dioxide equivalents (MtCO2-e) in 2013 to 42 MtCO2-e in 2030.

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.

For more details of climate conditions as an external hazard, refer to Chapter 7: Sustainability, Chapter 13: Surface Water and Hydrology, Chapter 12: Air Quality, Appendix K: Air Quality Technical Report and Appendix M: Hydrology and Flooding.

Bushfire

Bushfires are an intrinsic part of Australia's environment. Natural ecosystems have evolved with ire, and the landscape, along with its biological diversity, has been shaped by both historic and recent fires. Many of Australia's native plants are fire prone and very combustible, while numerous species also depend on fire to regenerate. Historically, bushfires have caused loss of life and significant damage to property, along with impacts to wildlife and natural landscapes (Geoscience Australia, 2019a).

The fire intensity and speed at which a bushfire spreads will depend on ambient temperature, fuel load, fuel moisture, wind speed and slope angle.

The Project disturbance footprint includes scattered areas mapped as 'Medium and High Potential Bushfire Intensity' Bushfire Prone Area, with an area of 'Very High Potential Bushfire Intensity' occurring along the Toowoomba Range, between Jones Road and Bells Road, along with Wards Hill (DILGP, 2017b).

The bushfire season extends from mid–late winter through to early summer, with the peak period for bushfire risk usually occurring in spring and 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 show the highest recorded temperature relevant to the Project is 45.7°C, as measured at the UQ Gatton BoM station in February 2017. Mean rainfall values collected from the two stations 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 (2019b) 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 (2019b) predicts the following increases in fire danger for the Australian east coast in the RCP8.5 scenario:

- 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.

Flooding

Flooding is defined by Geoscience Australia as, '*the covering of normally dry land by water that has escaped or been released from the normal confines of: any lake, or any river, creek or other natural watercourse, whether or not altered or modified; or any reservoir, canal, or dam*'. Floods can have both positive and negative impacts. They can bring welcome relief for people and ecosystems suffering from prolonged drought but also are estimated to be the costliest natural disaster in Australia (Geoscience Australia, 2019b).

The Project interacts with two catchment areas, being the Balonne–Condamine River and Lockyer Creek catchments. The Project intersects flood hazard areas[1] identified in the *State Planning Policy* (DILGP, 2017b) for these two catchments, including Gowrie Creek, Oaky Creek, Rocky Creek, Six-Mile Creek and Lockyer Creek.

The Condamine River Basin is located on the western side of the GDR. The main rivers of the catchment, the Condamine–Balonne and the Maranoa, rise in elevated country in Queensland; however, two-thirds of the catchment is flat floodplain country, with a complex system of rivers and creeks joining and breaking away from the Balonne River across the catchment.

The Project disturbance footprint is located, in part, on the Gowrie Creek floodplain within the Condamine River Basin, from Project Chainage (Ch) -1.76 km to approximately Ch 9.00 km, with the alignment entering the tunnel at Ch 4.10 km and exiting into the Lockyer Creek catchment. Gowrie Creek runs parallel to the Project alignment, between Ch -1.76 km and Ch 3.00 km, with a new bridge structure (Gowrie Junction Road bridge) proposed over Gowrie Creek, improving the flood immunity of the local road network.

The Lockyer catchment is located west of Brisbane and east of Toowoomba, within the LGAs of Lockyer Valley, Somerset, Ipswich and Toowoomba. The catchment covers an area of approximately 3,000 square kilometres (km^2), with the main Lockyer Creek catchment surrounded by several sub-catchments (Department of Environment and Science (DES), 2015). The Lockyer catchment experiences high rainfall in the south and parts of the north. The rest of the catchment has moderate-to-low rainfall; however, due to the steep slopes in the upper reaches of the catchment, where the Project is located, many of the watercourses, including Oaky Creek, Rocky Creek and Six Mile Creek, can experience high flows despite the relatively low rainfall (DES, 2015).

The Project disturbance footprint lies within the Lockyer Creek catchment from approximately Ch 9.01 km to Ch 26.30 km. The Project alignment crosses Lockyer Creek around Ch 24.50 km and also crosses two tributaries of

1. Flood hazard areas are defined using an Annual Exceedance Probability (AEP) of 1%, which means that there is a 1 per cent risk (i.e. a likelihood of 1 in 100) of this event occurring in any one year.

Lockyer Creek, being Oaky Creek at Ch 12.00 km and Six Mile Creek at Ch 16.50 km. These crossings are all on viaducts with limited infrastructure located in the main channels or the associated floodplain.

Season variations in rainfall mean that flooding, and partially flash flooding, is more likely during the storm season between late spring into summer; noting that the local communities within these catchments have experienced major flood events that have resulted in the loss of life and damage to properties.

Chapter 13: Surface Water and Hydrology and Appendix M: Hydrology and Flooding provide further details on the existing flood conditions in the vicinity of the Project disturbance footprint.

Cyclones

In Queensland, tropical cyclones mostly form from lows within the monsoon trough and affect the northern areas of the State (BoM, 2020b). 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 two—Cyclone Oswald and Cyclone Debbie—passed through the hazard and risk study area as an ex-tropical cyclone lows in January 2003 and March 2017, respectively (BoM, 2020b). The risk of a cyclone reaching the hazard and risk study area is low; however, the likelihood of ex-tropical cyclones passing through as tropical lows is higher. The consequences of a cyclone or strong tropical low include damaging winds and rain, which can potentially cause flooding.

Apart from cyclones, localised storms are a more frequent occurrence in the region and typically occur from late spring into summer.

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 short, the volume and speed of water can cause significant damage to property and people; in addition to exacerbating erosion effects in the flow path.

Chapter 13: Surface Water and Hydrology and Appendix M: Hydrology and Flooding provide further details of the existing flood conditions in the vicinity of the Project disturbance footprint.

Landslides, sudden subsidence and movement of soil or rocks

Landslide, sudden subsidence and movement of soil or rocks is generally caused by heavy rain. 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. This often occurs where there has been previous human activity, resulting in the removal of vegetation. Landslide risk is generally attributed to slopes with a gradient of 15 per cent or greater (DILGP, 2017f).

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, e.g. where trees and plants have been removed for construction purposes.

The Project alignment traverses through rugged topography of the Toowoomba Range. The shape of the terrain, hills and valleys, are a feature of Mt Kynoch and Mt Lofty as well as the alignment straddling escarpments of the GDR. The landscape from Gowrie, approaching the GDR, consists of a gentle incline before reaching peak elevation of approximately 644.5 metres (m) Australian Height Datum (AHD), where the Project intersects the New England Highway at Mount Kynoch.

A steep drop in elevation occurs after the GDR, with periodic and isolated peaks featuring, with reducing elevation as the alignment reaches Helidon. The lowest elevation for the Project occurs at Lockyer Creek, 1 km to the west of Helidon, with an approximate elevation of 148.5 m AHD.

The landforms east of the GDR to Helidon have been developed as a result of landslides associated with escarpment regression and hillside instability. Several types of slides can be recognised on the hillsides and foothills of the Toowoomba Range eastern slopes (Great Escarpment) and near the proposed eastern portal of the Toowoomba Tunnel. Slope stability mapping by Willmott classifies a range of stability zones between the GDR and Wards Hill, with the Project overlying, or in close proximity to, the majority of these zones.

Landslips were also experienced during the construction of the Toowoomba Bypass, with the Bypass intersecting similar stability zones to the Project.

Field observations in the study area highlighted evidence of erosion on some surfaces with weak pedality; ridges and plateaux remnants on basalt with steep stony slopes; restricted lower slopes; stony interfluves; floodplains and river terraces subject to fairly regular overbank flooding; sandy banks and poorly defined levees; and cobble plains.

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 to Chapter 9: Land Resources and Appendix W: Geotechnical.

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 assemblages within and adjacent the Project disturbance footprint is provided in Chapter 11: Flora and Fauna, Appendix I: Terrestrial and Aquatic Ecology and Appendix J: Matters of National Environmental Significance.

Naturally occurring asbestos

The geotechnical investigations undertaken as part of the Project (refer Appendix W: Geotechnical) and outlined in Chapter 9: Land Resources found no naturally occurring asbestos to be present, noting that the recently completed detailed geotechnical investigations also did not encounter naturally occurring asbestos.

For more details of naturally occurring asbestos as an external hazard, refer to Chapter 9: Land Resources and Appendix W: Geotechnical.

20.6.1.2 Existing land conditions

Contaminated land

Based on the land uses in the land resources study area, and the findings of a desktop assessment, potential sources of contamination in and nearby the Project 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), agricultural landfilling
- Quarries: hydrocarbons (fuel and oil storage and use), metals/metalloids, hazardous materials
- Landfilling, waste disposal: hazardous materials, hydrocarbons, metals/metalloids, phenols, polychlorinated biphenyls, phthalates, volatiles, and pesticides and herbicides
- Existing and former rail corridors: metals, asbestos, hydrocarbons, pesticides/herbicides
- Road crossings: metals and hydrocarbons
- Housing/sheds: hydrocarbons (fuel and oil storage and use), pesticides and herbicides, lead paint and asbestos
- Unknown fill material: asbestos, metals/metalloids, hydrocarbons.

The Project overlaps 18 land parcels associated with the West Moreton System, with a number of these land parcels listed on the Environmental Management Register (EMR) or, due to the historic land use similar to sites that are on the EMR, the land should be considered contaminated. The listing is mainly associated with the historical use of arsenic and other hazardous contaminants. Contaminated land assessments have confirmed that some areas of the Project disturbance footprint are contaminated, with further discussion provided in Chapter 9: Land Resources.

The probability of the Project encountering acid sulfate soils (ASS) is generally considered low based on the mapping by the *Atlas of Australian Sulfate Soils* (CSIRO, 2014b), along with the Project's elevation in the landscape and the local geology. This mapping revealed no known occurrence along the land resources study area, from Gowrie to Wards Hill and 'low probability' of ASS occurrence throughout the remainder of the land resources study area. Geotechnical investigations (refer to Appendix W: Geotechnical) also did not encounter any ASS.

In the unlikely event ASS is present, however, disturbance/exposure can generate sulfuric acid, iron, aluminium and sometimes heavy metals. Excavation activities can expose ASS, which can cause major impacts to the environment and to infrastructure.

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

Unexploded ordnance

A search of the Department of Defence online mapping for unexploded ordnance (UXO) identified two areas of UXO categorised as 'other' within the land resources study area. One of the 'other' UXO areas features east of Ballard and the GDR, adjacent to the Toowoomba Bypass, which is described as an area potentially containing 2-inch mortar and grenades. The UXO area will intersect the Project at Ballard. The second 'other' UXO area features north of Helidon at the Queensland Government Explosives Reserve, which has been used for explosives storage during WWII to present. The UXO area is located adjacent the alignment, and does not intersect the Project footprint, with works to occur along the southern boundary of Air Force Road (east of Ch25.0).

The Department of Defence categorises 'other' UXO areas as:

> *'Land which has been used for military training but not confirmed as a site where live firing was undertaken. UXO or explosive ordnance fragments or components have not been recovered from these areas. These sites have been included for general information purposes only. Defence makes no recommendations in regards to this category'.*

If the Project footprint alters and is required to traverse identified 'Other' UXO areas or traverse directly adjacent to these areas, further assessment will need to be undertaken.

The remaining land resources study area had no identified records of UXO-related material or activities, with Department of Defence recommending:

> *'All land usage and development, within these areas, should continue without further UXO investigation or remediation'.*

The Project also traverses a portion of the former Mount Lofty Rifle, east of the eastern tunnel portal. Defence Housing Australia (DHA), the current owners of the lot, are seeking approval for a residential masterplan in the southern section of the lot. As part of the planning processes, DHA have acknowledged that there may be UXO on some areas of the lot due to its previous use as a rifle range. An independent expert has conducted on-ground inspections for UXO for the proposed masterplan area.

The Project is located away from the former rifle range areas; however, to mitigate potential risks to the Project, consultation with DHA and, where applicable, Department of Defence will be undertaken to determine the level of risk of UXOs to the Project and to identify efficiencies with regard to any on-ground inspections and clearance works (DHA, 2015).

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

Asbestos contamination

Asbestos-containing materials may be present within the existing rail corridors and tie in locations for the Project; particularly within structures and rail infrastructure such 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 rollingstock brake shoes or where the Project traverses, adjoins or is adjacent to agricultural and residential housing or storage areas.

For more details on asbestos contamination as an external hazard, refer to 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 Urban Utilities, Telstra, Nextgen, Energex, Powerlink and the APT Petroleum Ltd (Roma Brisbane Gas Pipeline).

The Project traverses a network of highways, State-controlled roads and local council roads, as well as the existing train lines that are the main transport routes for the region. The Project disturbance footprint intersects with 17 public road interfaces, two of which occur on State-controlled roads managed by DTMR and 15 of which are local roads managed by local governments.

The Project is collocated with, and crosses, the Western Line at Gowrie and The Main Line at Helidon. The InterLinkSQ intermodal facility is also being constructed within the eastern extent of the Project disturbance footprint.

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

20.6.2 Safety records

Within the rail corridor, there is the potential for railway incidents including train and crossing loop collisions and derailments. In particular, it is noted that the Project intersects with and connects to the existing QR West Moreton System rail corridor, where there will be potential for railway incidents between trains. As outlined in Chapter 6: Project Description, for the purposes of the EIS, it has been assumed that the existing rail traffic operating on the West Moreton System will migrate over to the Inland Rail alignment between Gowrie and Helidon, effectively reducing the risk of any simultaneous operations.

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* (Qld), 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 rollingstock
- A collision at a railway crossing between rollingstock 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 rollingstock 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.

Since 2016, 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 (ONRSR, 2020). This period was chosen because 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 JANUARY 2016–JULY 2020 (SOURCE: ONRSR, 2020)

Statistic	2015–16	2016–17	2017–18	2018-19	201920	5 year	Unit
Running line derailment of freight train	0.464	0.457	0.489	0.423	0.421	0.451	per million km of train line
Running line derailment of passenger train	0.008	0.016	0.023	0.000	0.014	0.012	per million km of train line
Running line collisions (trains with rolling stock not involving in-service passenger trains)	0.028	0.023	0.027	0.018	0.014	0.024	per million km of train line
Collisions at crossing with road vehicle (freight train)	0.057	0.101	0.193	0.176	0.233	0.169	per million km of train line
Collisions at crossing with person (freight train)	0.000	0.000	0.034	0.000	0.024	0.013	per million km of train line
Fatalities (involving passengers, workers, public and trespass excluding suspected suicide)	0.065	0.072	0.071	0.079	0.066	0.070	per million km of train line
Signal Passed at Danger/Authority Exceeded – freight train	2.198	2.276	2.551	2.066	2.224	2.270	per million km of train line
Fire or explosion on freight train	0.395	0.379	0.387	0.305	0.460	0.386	per million km of train line
Terrorist attack	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	per million km of train line

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

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 risk identification workshops (internal and external), design reviews and impact assessments. Identified key hazards are detailed in the risk register outlined in Section 20.9. Risk levels for each hazard identified are provided in the risk assessment table (refer Table 20.11).

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* (Cth) and *Work Health and Safety Regulation 2011* (Qld), 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 the ARTC's Safety Management System and the ARTC *Fatal and Severe Risk Program* (ARTC, 2017c) as discussed above.

The following sections identify hazards and potential impacts without mitigation or appropriate design mitigations, which are discussed in Section 20.8.

20.7.1 Natural hazards

Existing natural hazards that have the potential to introduce risk to the Project are presented in Table 20.6. 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 HAZARDS

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 and rainfall events, 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. transportation and propagation of invasive weeds)	Safety Environment	Potential	Potential
Naturally occurring asbestos	Safety Environment	No	No

20.7.1.1 Bushfire

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

Rural-residential properties located in bushland adjacent to the Project, specifically in the area of 'Very High Potential Bushfire Intensity' are vulnerable to the risk of bushfires (DILGP, 2017b), along with housing located above the eastern tunnel portal, are vulnerable to the risk of bushfires. The evacuation route for some of the local residents crosses the Project corridor, which could potentially affect evacuation plans (e.g. Murphys Creek township is a Neighbourhood Safer Places).

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.

In addition to bushfires, there is also likely to be ongoing and potentially increased hazard reduction burns on the eastern escarpment, as outlined in the Toowoomba *Local Disaster Management Plan* (TRC, 2015), This may impact operations of the proposed railway line. Further discussions with the relevant LDMG will be undertaken to identify notification requirements for hazard-reduction burns specific to the operation of the railway and during construction.

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 group/s during construction and operation.

20.7.1.2 Flooding

The Project crosses a number of mapped watercourses, including Gowrie Creek, Oaky Creek, Six Mile Creek and Lockyer Creek. Construction of viaducts, bridges and rail within the floodplains and across these watercourses has the potential to affect drainage characteristics, which may impact existing dwellings, sheds, farm buildings and infrastructure, crops and roads.

The Project involves the construction of a tunnel under the Gowrie Creek floodplain, along with over 6 km of structures, including over the abovementioned watercourses and their associated floodplains effectively avoiding or minimising potential adverse impacts on the hydrologic characteristics of the catchment.

Hydrology and flooding studies (refer Appendix M: Hydrology and Flooding) identified that the Project can potentially impact flooding characteristics without mitigation or appropriate design treatments in the following ways:

- Changes in peak water levels and associated areas of inundation, including reduction in the water levels below the formation of the existing Western Line and on local roads (e.g. Paulsens Road)
- Concentration of flows, redirection of flows and/or changes to flood-flow patterns, including where the Project is collocated within the Western Line (e.g. new culverts are proposed under the Western Line)
- Increased velocities leading to localised scour and erosion, including where the Project is collocated within the Western Line, which may impact on roads, public utilities and the natural landscape
- Changes to duration of inundation trafficability of roads and tracks
- Increased depth of water affecting trafficability of roads and tracks.

The Project also has the ability to increase risk to the environment and persons that may occur during the operational phase due to the loss of containment (e.g. hydrocarbons) or damage to rail infrastructure during extreme flood events.

The Project may also be vulnerable to flooding, as major flooding events have been evident in the past 10 years in the LGAs through which the Project passes. Noting that the impacts from the January 2011 flood event on the West Moreton System between Murphys Creek and Helidon was one of the reasons for adopting the current alignment (refer Chapter 2: Project Rationale).

For further discussion of the potential impacts of flooding, refer to Chapter 13: Surface Water and Hydrology and Appendix L: Surface Water.

20.7.1.3 Climatic conditions

The potential effects of changing 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 extreme temperatures, tropical cyclones and prolonged rain events, as well as natural or induced hazards, including bushfires, which are likely to occur during periods of reduced rainfall and increased temperatures.

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.

Higher temperatures may also impact on the operation of the tunnel ventilation system, required to cool trains operating in the tunnel.

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, interruption to the tunnel ventilation system due to extreme heat and interruption to power supply or network communications from severe weather events.

Construction of the Project is expected to contribute to GHG emissions through the following:

- Fuel consumption from use of machinery and vehicles
- Electricity use at site compounds and offices
- Clearing of vegetation and the loss of its carbon dioxide sink potential
- Indirect emissions embodied in construction materials, including concrete and steel.

Operational GHG emissions for the Project are expected to be associated with the use of diesel for powering locomotives and fuel consumption through the use of machinery and vehicles for railway maintenance; however, it is estimated that transportation of freight on Inland Rail is expected to use one third of the fuel when compared to transportation of the same volume of freight via the existing road route (ARTC, 2015a).

Climate modelling from CSIRO indicates that the 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/viaducts 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
- On high temperature days (>45 °C) the tunnel ventilation system may not be able to maintain the required tunnel air temperature for train operations.

For further information refer to Chapter 7: Sustainability and Chapter 13: Surface Water and Hydrology.

20.7.1.4 Landslide, sudden subsidence, movement of soil or rocks

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 or subsidence of soil or rock potentially associated with tunnelling works (e.g. tunnel boring machine (TBM), road header for the mined tunnel, and cut and cover tunnel and blasting)
- 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.

The key area of risk is within and adjacent the eastern tunnel portal; noting that there was a large landslip in the area during the construction of the Toowoomba Bypass. A mined tunnel and cut-and-cover tunnel at the eastern tunnel portal is proposed to mitigate some of the risk (refer Chapter 6: Project Description), with detailed geotechnical investigations required to better understand the risk to and from the Project. For further discussion of the risk of landslide and the movement of soil or rocks, refer to Chapter 9: Land Resources.

The risk of subsidence and/or settlement from the Toowoomba Range Tunnel construction and operation is considered low, due to the depth of the tunnel (between 50 and 200 m below ground level) and the overlying geology (e.g. basalt associated with the Main Range Volcanics). For further information on subsidence and deformations assessment refer to Chapter 19: Traffic, Transport and Access.

As part of the detail design geotechnical investigations, 20 inclinometers were installed. Inclinometers are geotechnical instruments used to measure horizontal displacements of the ground, and also to identify the depth of the slip surface. Inclinometers are widely used to measure lateral soil and wall movements in slopes with signs of instability and deep excavations. The inclinometers will record data on the natural conditions, including ground movements.

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, vehicles or trains. Rail operations may impact fauna passages and habit connectivity.

For further information on the types of wildlife found in the vicinity of the Project, refer to Chapter 11: Flora and Fauna.

20.7.1.6 Biosecurity

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

- Transfer of biosecurity hazards into the Project 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.
- Exotic grasses can make bushfires hotter and spread faster.

For further information on biosecurity risks to and from the Project refer to Chapter 11: Flora and Fauna and Appendix I: Terrestrial and Aquatic Ecology.

Q fever (*Coxiella Burnetti*) is an airborne disease passed from animals to humans and is found in all parts of the world, but Australia is the only country that has a vaccine. People usually get infected by breathing in the Q fever bacteria that is in the air or dust (Parker and Parker, 2002). Cattle, sheep and goats are the main sources of infection; however, a wide range of animals, including domestic and feral dogs and cats, feral pigs, horses, rabbits, rodents, alpacas, camels, llamas, foxes, and Australian native wildlife (including kangaroos, wallabies and bandicoots), can also spread the bacteria to humans. Infected animals often have no symptoms. The bacteria can be found in the placenta and birth fluids (in very high numbers), urine, faeces, blood or milk of animals who are infected with or carry the bacteria. The bacteria can survive in the soil and dust for many years and be spread over several kilometres by the wind (NSW Government, 2019).

Most frequently listed occupation categories for all Q fever notifications Australia-wide are livestock farmers, veterinarians, dairy workers and abattoir workers (Rahaman et al., 2020; NSW Government, 2019). Over the period 1987–2016, a total of 6,888 confirmed Q fever cases were notified in Queensland; 231 cases were notified in 2016 (Queensland Government, 2016e). There are no known records of outbreaks along an existing rail corridor in Queensland.

Infection of Q fever normally occurs through:

- breathing in the bacteria that is in the air or dust:
  - while birthing, slaughtering or butchering infected animals (especially cattle, sheep or goats)—these activities carry a very high risk of infection
  - when handling infected animals, infected animal tissues, fluids or excretions or animal products or materials that have been infected including wool, hides, straw, manure fertiliser and clothes (e.g. washing clothes worn when birthing, butchering or slaughtering animals)
  - while herding, shearing or transporting animals
  - while mowing grass contaminated by infected animal excretions
  - when visiting, living or working in/near a high-risk industry
- direct contact with infected animal tissue or fluids on broken skin (e.g. cuts or needlestick injuries when working with infected animals)
- drinking unpasteurised milk from infected cows, sheep and goats.

These pathways are applicable to the Project, with livestock to be transported on the Project alignment (i.e. current livestock trains operating on the existing West Moreton System will operate on Inland Rail alignment). Within the brownfield sections there is no change to risk to the current operations. Within the greenfield section where there is no rail the rail alignment is a potentially new transmission source. Further it should be noted that diverting the traffic from the existing rail alignment to the Inland Rail alignment will remove or significantly reduce the risk of impact to residents along the existing rail corridor between Gowrie and Helidon (e.g. Toowoomba and Murphys Creek).

The movement of livestock will be subject to the existing protocols already in place by Biosecurity Queensland, the agricultural sector and relevant rail operators, including a movement record. The movement record is a tool used by Biosecurity Queensland to investigate where diseases may have originated from.

It is considered unlikely that the Project will exacerbate the risk of spreading Q fever. ARTC will have measures in place for the community to contact ARTC about concerns with respect to wildlife and protocols to review and manage these incidents in consultation with the rail operators and the wider supply chain, where applicable.

20.7.2 Project hazards

Activities associated with the construction and commissioning, operation and maintenance phases of the Project have the potential to cause harm to surrounding environment, community and other sensitive receptors. Construction activities, including clearing, may impact areas of sensitive environmental value; while operations on the Project 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)	Earthwork including tunnelling Land clearing Physical activity	Asset Safety Environment	Potential	Potential
	Rollingstock	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	Poor visibility Trespass	Safety	Potential	Potential
Tunnel	Tunnel environment (e.g. spill in tunnel, trespass)	Asset Safety Environment	Potential	Potential
Infrastructure and services	Underground services Overhead transmission lines	Asset Safety Environment	Potential	Potential
Contaminated land	Leaks and spills from freight and vehicles Exposure of ASS	Asset Safety Environment	Potential	Potential
Overbridges/viaducts	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)
	Explosives (e.g. blasting along the Project alignment)	Asset Safety Environment	Potential	No

20.7.2.1 Health

Project activities, if unmitigated, 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, e.g. 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 reactions to situations. 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 Project geotechnical investigations undertaken to date; however, asbestos-containing materials may be present in infrastructure within the Project disturbance footprint including sheds, houses as well as rail infrastructure (e.g. signal boxes, insulation) associated with the 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.

Crystalline silica (silica) is found in sand, stone, concrete and mortar. It is also present in a range of common construction materials, e.g. fibre board used in switching panels. Construction activities involving cutting and grinding of products that contain silica may result in the generation of dust particles that are small enough to lodge deep in the lungs and cause illness or disease, including silicosis (Safe Work Australia, 2019). 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, which 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—including the intermediate ventilation shaft—due to the high likelihood of accumulating airborne particles and the limited natural ventilation available (contractors will provide sufficient ventilation to meet contract and statutory requirements). According to the *Tunnelling roadheader 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. Although the main construction method for the tunnel is via a TBM, the silica and airborne contaminant risk is still valid. The recommended control measures, including adequate dust control, continuous 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 can be drawn deep into the lungs. Carbon monoxide reduces the amount of oxygen that can be carried by haemoglobin, which leads to a lack of blood supply to vital organs (Department of the Environment and Heritage, 2005a). Both nitrogen dioxide and particulate matter can cause respiratory problems (Department of Environment and Heritage, 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 Toowoomba Range Tunnel would cause a short-term increase in concentrations of emissions in the tunnel, and at tunnel portals, in comparison to trains moving along the Project corridor in the open air; however, the main source of emissions based on the air quality impact assessment is the idling trains at the crossing loops.

For more details of how the Project potentially impacts air quality, refer to Chapter 12: Air Quality.

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 buildings and infrastructure. Damaged infrastructure has the potential to physically harm humans.

Noise and vibration sources will be localised 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 and blasting.

Ground-borne noise from tunnel activities will persist for longer periods, given that the tunnel activities are 24-hours a day and 7-days a week, and slow (potentially 10.5 m/day). The impacts will also extend up to 390 m on a diagonal distance from the TBM operating face.

Train and freight movements will also be a potential source of noise pollution and vibration during the operations phase. Other potential noise sources during operations include the tunnel ventilation system and associated infrastructure (e.g. intermediate ventilation building at Cranley).

For detailed discussion of noise and vibration impacts associated with the Project, refer to Chapter 15: Noise and Vibration, Appendix O: Construction Noise and Vibration and Appendix P: Operational Railway Noise and Vibration.

20.7.2.2 Accidents

Accidents that could potentially occur within, or in the vicinity of, the Project disturbance footprint arise from increased traffic on roads, concurrent operation of trains, and trespassing. Further information can be found in Chapter 19: Traffic, Transport and Access and Appendix U: Traffic Impact Assessment.

Road incidents

Increased light and heavy vehicle traffic on the Warrego Highway, Toowoomba Bypass, 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 Project 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. Some of the roads that will be changed as a result of the Project or have been identified as construction routes are also known school bus routes.

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 result 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 and food.

Refer to Chapter 19: Traffic, Transport and Access and Appendix U: Traffic Impact Assessment 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 of rail incidents, including derailment. The potential 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 0.451 per million freight train kilometres based on 2016 to 2020 five year's average data (ONRSR, 2020). Other events include running line collisions with rollingstock and trespassing.

The Project 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. The Project also include elevated structures and double-stacked trains where wind severance may pose a risk to the shifting of loads or, potentially, loss of containment.

Additionally, there will be a risk of rail incidents at crossing loops and where the Project connects with the existing West Moreton System rail corridor. The potential incidents that may occur between existing rail infrastructure and the Project include rail collisions and derailments.

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

Road–rail interfaces

The Project includes 13 public road–rail interface locations. In line with the *Queensland Level Crossing Safety Strategy 2012–2021* (DTMR, 2012a) and the ONRSR Policy Level Crossings (ONRSR, 2019b), there are no proposed at-grade road–rail interfaces, and the Project has removed an existing level crossing. Removal of at-grade or level crossings eliminates dangerous points at which trains, cars and pedestrians meet. Additionally, removal of at-grade crossings will minimise potential impacts on emergency service response times.

The construction routes identified for the Project will, however, bring construction vehicles associated with the Project into contact with trains at a number of level crossings. Further consultation with QR, DTMR and local councils is warranted once the construction routes are confirmed on such matters as traffic management and safety plans, temporary and permanent changes to intersections in relation to level crossings.

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

Tunnel

The Toowoomba Range Tunnel extends 6.24 km east from the Boundary Street Toowoomba Bypass Interchange at Gowrie Junction, traversing under Cranley, Mount Kynoch and Ballard and exiting on the eastern side of the Toowoomba Range near Mt Kynoch.

The tunnel will reduce the risk of landslips and interactions between built infrastructure, and will provide an efficient route through the Toowoomba Range; however, tunnels introduce other hazards associated with the risk of trespass, fire, explosion, flooding and subsidence. The fire prevention and access strategy will provide measures to address the risk of these emergencies.

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

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

20.7.2.3 Safety

Underground and overhead services

One hundred and eighty-four (184) existing utilities and service interactions have been identified within the Project disturbance footprint (refer Chapter 6: Project Description and Chapter 8: Land Use and Tenure). Consultation has commenced with all the utility providers and asset owners regarding their specific asset interface requirements. Such consultation will continue during detailed design and construction. Details of consultation to support development of the reference design and EIS are included in Appendix D: Community Consultation.

Construction activities around existing services introduce a risk of service strikes of underground utilities (e.g. underground gas pipeline, asbestos cement sewer mains) during excavation, or collision of plant and equipment with aboveground services (e.g. powerlines). Other risks to existing services include vibration from tunnelling, piling and blasting activities, along with the movement of construction equipment. Activities during operation of the Project also have the potential to impact existing utilities and services, such as track vibrations or derailments, causing damage. Interactions with existing services could pose a risk to public safety and the natural environment. Damage to, or contact with, services during construction could result in service outage to nearby communities and land uses.

Of significance, is the existing Roma to Brisbane Gas Pipeline. The Project alignment traverses the pipeline at three locations, including the tunnel, while a number of haulage routes will also interact with the pipeline easement. Interface with the rising sewer main and water pipelines in the Gowrie area are also significant.

Unscheduled contact or disturbance to utilities has the potential to result in the following impacts:

- Electricity:
  - Serious injury or death to workers due to contact with high-voltage live electrical source
  - Power outage to individuals or communities, resulting in potential disruption in provision of critical community services (e.g. health care and emergency services) and safety controls (e.g. electrical signalling)
- Communications:
  - Disruption in ability for communities to access critical services (e.g. emergency services) in a timely manner
- Gas:
  - Serious injury or death to workers due to release of pressurised gas and/or subsequent ignition of released gas
  - Serious injury or death to members of the community in proximity to a significant gas leak or explosion
- Water:
  - Disruption in the provision of potable water to individuals or communities. Over an extended period, this disruption in service has potential to impact the provision of healthcare services and result in issues relating to hygiene and sanitisation.
- Sewage:
  - Health impacts to workers or members of the community, due to contact with raw sewage
  - Environmental impacts, such as contamination of land and water, due to loss of sewage.
- Asbestos cement services/pipes:
  - Release of asbestos fibres with health impacts to workers (limited, short-duration exposure)
  - Contamination of surrounding areas.

The significant number of service relocations introduces exposure risks to the construction workforce; however, the relocation of the services will reduce ongoing operation risks by eliminating potential rail–utility interactions, such as overhead service strikes.

Land contamination

Construction activities in the 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, excavation and drainage construction. This includes the potential for asbestos-containing waste material (e.g. signal boxes), which may also be encountered during demolition works.

As outlined in Section 20.6.1.2 and described in Chapter 9: Land Resources, land within the Project disturbance footprint is confirmed as being contaminated, including parts of the existing rail corridor and some of the road reserves. There is also the risk of UXOs being present in some areas of the Project disturbance footprint.

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 construction waste can pollute surface water and groundwater resources and ecosystems if not appropriately managed. 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. Although leaks are not expected to occur as part of normal operations, the extent and severity of any resultant land contamination would be dependent on the type of incident and where it is in the landscape (e.g. crossing loops over waterways or near Withcott). Leaks or minor spills that did occur would be expected to be confined to areas within the rail corridor.

There is also the risk of leachate from the landfill above the tunnel migrating into the groundwater inflows, though this risk is considered low.

Chapter 9: Land Resources presents further discussion on land contamination and Appendix N: Groundwater Technical Report presents further details on contamination of groundwater.

Bridges/viaducts

The Project crosses areas of steep slopes, specifically within the Rural Uplands zone when traversing through the Toowoomba Range at Ballard, Withcott and Lockyer, which requires significant earthworks and structures.

The Project consists of 13 new bridges/viaducts, 11 of which are for rail use (refer Chapter 6: Project Description):

- Three waterway crossings—rail
- Three terrain and waterway crossings—rail
- Four terrain, road and waterway crossings—rail
- One road, rail and waterway crossing—rail
- One road-over-rail-and-waterway crossing
- One road-over-rail crossing.

Structural failures of bridge crossings have the potential to impact major transport corridors (e.g. Toowoomba Bypass and West Moreton System rail corridor), along with the local road networks, and could result in significant harm to motorists, railway workers and, where applicable, passengers. As the bridges could be used for freight transport of dangerous goods, collapse or damage to rail bridges/viaducts can lead to freight falling from elevated tracks and subsequently causing loss of containment and spills of hazardous materials, resulting in environmental damage. The risk of derailment may potentially escalate, with double-stacked containers on bridges and viaducts during extreme weather and high wind conditions.

Emergency access

The Project disturbance footprint crosses grazing land, areas of land that are largely vacant (e.g. residual native cover where the Project traverses the Toowoomba Range) as well as land used for residential, waste treatment and disposal, cropping, irrigated cropping and irrigated seasonal horticulture. The increase in the number of construction vehicles and oversize machinery during the construction period has the potential to impact the existing fire trails in the vicinity of these locations, reducing access for 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 an emergency.

During the operational phase, events such as fires, inundation of the tracks, train malfunction, and structural failure could trap trains along the alignment. In the event of such an incident, personnel and emergency services need to be able to immediately identify and access emergency evacuation routes.

Abandoned mines and underground collieries

While no abandoned mines have been recorded in the EIS investigation corridor, there is a potential to cause harm if the Project is constructed above an abandoned mine without knowledge. Proposed works for the Project could lead to collapsing of the underground mine, thus damaging the local environment; potentially causing harm if persons are in the area of the mine collapse. This could also 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 design and construction.

No abandoned mines and underground collieries were detected during the field investigations, including the recently completed detailed geotechnical investigations or from discussions with landholders and key stakeholders.

Chapter 8: Land Use and Tenure presents further discussion on the potential impacts from abandoned mines.

20.7.3 Dangerous goods and hazardous chemicals

Dangerous goods are substances and articles that have explosive, flammable, toxic, infectious or corrosive properties. If stored, handled or used incorrectly, they pose a risk to public safety, property or the environment. Dangerous goods substances and articles are allocated to one of nine classes.

Specific hazards and risks associated with hazardous chemicals or dangerous goods were identified. The two main aspects 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 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 in accordance with the *Work Health Safety Act 2011* (Qld) and Regulation, the relevant Australian Standards and the requirements of chemical safety data sheets as part of the CEMP.

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 the 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 maintenance chemicals

The construction and operational 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 chemicals used throughout the life of the Project, along with their purpose and dangerous goods details or status are presented in Table 20.8. The majority of chemical requirements are Class 3 flammable liquids and combustible liquids, such as diesel fuel, which 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 temporary construction disturbance footprint near points of use. The quantities stored will be equivalent to the demand for activities in 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 Project 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 will include facilities for the storage and distribution of construction chemicals:

- Laydown areas are proposed to be located at each tunnel portal, bridge/viaduct and throughout the temporary construction 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 Project disturbance footprint, which could include volumes of up to 40 kilolitres (kL) bulk storage of diesel
- Concrete batching plants proposed to be located near the tunnel portals, 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% 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 Hazardous Materials Management Sub-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 and transport 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	Fuel for mobile equipment	Combustible liquid (C1)*	40 kL/2 weeks	40 kL bulk storage (fuel depots)
		Operation	Back-up generators	Combustible liquid (C1)*	Limited	With generator
Grease	Rocol rail curve grease	Construction Operation	Lubricate plant and equipment	Combustible liquid (C2)**	Limited	Package storage
	Caltex 904 grease	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	Construction	Earthworks and tunnel portals	Oxidising substances (5.1)	As required for construction	Not stored for Project
	Blast caps, detonators, boosters, etc.	Construction	Earthworks and tunnel portals	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
Welding gases	Oxygen	Construction Operation	Welding	Non-flammable, non-toxic gases (2.2)/Oxidising substances (5.1)	As required for construction or operation	Cylinder storage
	Acetylene	Construction Operation	Welding	Flammable gases (2.1)	As required for construction or operation	Cylinder storage

Chemical type	Typical chemicals	Design life cycle stage	Purpose/use	Dangerous goods class	Indicative rate of use	Expected storage method
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 the Project

Table notes:
1 = Product is a security sensitive explosive defined under Schedule 7 of the Explosives Regulation 2017
*C1 = a combustible liquid that has a flashpoint of greater than 60 °C and no greater than 93 °C
**C2 = a combustible liquid that has a flashpoint exceeding 93 °; or has been excluded from being a flammable liquid by any of the criteria for sustaining combustion

20.7.3.2 Freight dangerous goods

The Project will enable freight transport as part of the larger Inland Rail Program. The design of the freight transport system, including the tunnel, allows for the transport of dangerous goods. ARTC has indicated that the rail corridor is intended to be used for the freight transport 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 the transportation of any dangerous goods will be managed under the *Australian Dangerous Goods Code* (National Transport Commission, 2018).

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 damage the environment through release of toxic, corrosive or flammable materials.

Incidents involving dangerous goods in the tunnel have potentially significant safety risks for train operators, passengers, workers at the buildings and the public. Fires and the release of harmful chemicals can result in injuries and fatalities. Other potential losses 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 a Class 1 explosive. 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 a 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. The explosives used in these devices are in very small quantities and, therefore, do not require specific design considerations.

ARTC does not own or operate rollingstock; however, the transportation of dangerous goods on the Project by independent operators will require authorisation. 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* (National Transport Commission, 2018).

Based on the variability of potential types and quantities of dangerous goods, there is the potential for freight activities to have significant impact on people, property and the environment surrounding the Project alignment. 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

Explosives 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 Toowoomba 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 if not managed properly. 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.

Explosives are hazardous due to their mass explosion characteristic, projectile motion and radiant heat intensity; however, the severity of these hazards is dependent on the quantity and loading density. Hazards associated with the use of explosives, either for, or in proximity to, the Project include:

- Inadvertent detonation
- Residual geotechnical instability
- Generation and emission of projectiles
- Dangerous noise levels
- Damaging vibration levels.

Construction methodologies that require the use of explosives are evaluated by the Explosives Inspectorate against the requirements under the *Explosives Act* 1999 (Qld) and *AS 2187.2-2006—Explosives—Storage, transport and use, Part 2: Use* of *explosives* (Standards Australia, 2006a). Explosives must be stored, handled and transported by a licensed person as stipulated by the *Explosives Act 1999* (Qld). Additionally, a range of explosive-related activities require notification under the *Explosives Act 1999* (Qld), including:

- Before undertaking a blast
- Before importing or exporting explosives
- When storing or interacting with stored explosives at explosive storage facilities and government activities
- When there are changes to buildings and vehicles related to the storage or transport of explosives
- After conducting an explosive trial.

The construction methodology for the Toowoomba Range Tunnel is based on a shielded TBM, with blasting potentially required for substations. A cut-and-cover and mined tunnel will initially be used at the eastern tunnel portal prior to the TBM. The intermediate tunnel ventilation shaft that will be located at Cranley, is proposed to be excavated using a conventional shaft sink. There are 14 major cuts on the Project and the preferred excavation technique may include blasting, with this to be confirmed following detailed geotechnical investigations.

The use of explosives for drill and blast activities, including those where cuttings are constructed, can create dust, noise, vibration, fly-rock and air-blast effects. Fly-rock and air blast effects can cause serious personal 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 UXO hazards.

The generation of dust from poorly managed blasting can create dust clouds, which 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.

The Project will be adjacent to the Helidon explosive reserve, which includes the transport of explosive ordinance from the facility. The future expansion of the Harlaxton Quarry may result in blasting activities within 500 m of the eastern tunnel portal, with further consultation with the quarry operator required.

Explosives require specific storage and handling procedures, and licensing, such as those described by the *Explosive Act 1999* (Qld). The specific 'license to use explosives' form must be completed in line with the *Explosive Act 1999* (Qld) 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 mitigation

20.8.1 Design considerations

The mitigation measures and controls presented in Table 20.9 have been incorporated into the design 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 OF RELEVANCE TO HAZARD AND RISK

Aspect	Initial design mitigation
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* (ARTC, 2006b) ▸ *Engineering Practice Manual for Track Drainage—Design and Construction* (ARTC, 2013a) ▸ *Engineering Practice Manual—Flooding* (ARTC, 2011a) ▸ *Engineering Practice Manual—Structures* (ARTC, 2017d) ▸ *Engineering Code of Practice—Automatic Rainfall Monitoring* (ARTC, 2010b). ▸ The Project has been designed to achieve a 1% AEP flood immunity and to minimise unacceptable impacts on the existing flooding and drainage regime, with the exception of connections to existing infrastructure where there is an existing lower immunity ▸ Key strategies that have been incorporated into the design include: ▸ All high-risk watercourse crossings involved viaducts limiting the infrastructure in the main channel or the associated floodplain ▸ 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 that both the existing and the future rail alignment has the required immunity and there are minimal impacts upstream ▸ The tunnel has been designed to achieve 1 in 10,000 AEP event flood immunity ▸ A new bridge over Gowrie Creek is proposed, which will maintain connectivity during a 1% AEP event. The design also improves the flood immunity for a number of roads and the Western Line during a 1% AEP
Bushfire	▸ The Project will improve access and evacuation routes in the hazard and risk area ▸ The Project infrastructure will act as a firebreak
Wildlife	▸ The design has been developed to minimise disturbance to waterways, minimising the number of waterway crossings, and aiming to avoid permanent waterway diversions ▸ Bridges, viaducts and culverts are included in the design, to accommodate fish passage and terrestrial fauna movements

Aspect	Initial design mitigation
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* (ARTC, 2017e) (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. Annual review of the TSMP, in line with current ARTC review cycles, will provide 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 the chance of buckling incidents. This is an ongoing procedure that provides adequate track management in changing seasonal conditions.
Landslide, sudden subsidence, movement of soil or rocks	▸ Design and ratings of earthwork and geotechnical structures including culverts, viaducts, and bridges has been developed in accordance with geotechnical investigation findings and slope design. ARTC and Australian design requirements that the Project will comply with include: ▸ *ARTC Engineering Code of Practice—Earthworks* (ARTC, 2018c) ▸ *ARTC Engineering Code of Practice—Structures* (ARTC, 2017d) ▸ AS 5100 *Bridge Design* (Standards Australia, 2016) ▸ AS 7636 *Railway Structures* (Standards Australia, 2013) and other applicable Australian Standards
Project hazards	
Airborne contaminants	▸ The ventilation system for the Toowoomba Range Tunnel has been designed such that locomotive emissions that occur in the tunnel are exhausted via the tunnel portals rather than via the intermediate ventilation shaft ▸ Air quality modelling has been performed to ensure that the tunnel ventilation is appropriately designed, to ensure that trains can operate, including passenger services
Rail incidents	▸ The elements of the railway, including railway radius curves and vertical grades have been designed to prevent uncontrolled movement ▸ Rollingstock has been designed in accordance with ARTC Engineering Code of Practices, which nominate the applicable industry and Australian Standards ▸ The design includes mixed-gauge turnouts at locations where the Project interfaces with existing rail networks or infrastructure, to enable QR rollingstock to join and exit the Inland Rail network ▸ Design spacing allows for the two rail tracks to operate autonomously during construction and operations
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, the 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 has taken into consideration State and national guidelines and strategies ▸ Public road–rail interfaces are all grade-separated crossings—road and rail cross each other at different heights so that traffic flow is not affected ▸ Existing level crossing elimination has been incorporated into the design at Gowrie Junction ▸
Tunnel	▸ The design of the Toowoomba 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 requirements of relevant Australian Standards. ▸ The tunnel has been designed with natural and mechanical ventilation for management of heat, particulate matter and gases. Key design considerations include maintaining air quality, to minimise impacts to sensitive receptors. ▸ For emergency situations, a smoke control ventilation building at each portal, and at the intermediate shaft, is proposed. These ventilation buildings will include three large axial fans and air nozzles to control the direction of smoke and heat in the event of a tunnel fire.
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 obstructions, in accordance with ARTC *Underground/Overhead Service (Electrical and Other Services) Work Method Statement* (ARTC, 2016c).

Aspect	Initial design mitigation
Utilities	▸ Subsurface utility investigations have been completed, or are scheduled to be completed, to inform the Project. Investigations are to confirm the presence, location and orientation of utilities within the Project disturbance footprint. ▸ Minimum design requirements have been established for the Project to guide the treatment through design of utility clashes. The design requirements have been developed to be consistent with recommendations in *AS 4799:2000 Installation of underground utility services and pipelines within railway boundaries* (Standards Australia, 2000). ▸ Consultation with owners of licensed petroleum and gas pipeline assets located in the Project disturbance footprint has commenced and will continue throughout the Project in accordance with the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) and AS 2885 *Pipelines – Gas and liquid petroleum* (Standards Australia, 2008b) ▸ The Project has been designed to avoid structures in the APA's Roma Brisbane Gas Pipeline at Lockyer Creek ▸ The Project has been designed to avoid substantial earthworks over high-risk underground assets; therefore, avoiding the need to relocate such utilities. Examples include APA's Roma-Brisbane Gas Pipeline. ▸ Consultation with owners of all impacted utilities has been undertaken to confirm whether the works will be undertaken by the asset owner or ARTC (e.g. relocation of asset or protected measures) ▸ The Project's vertical alignment has been established to avoid direct impact to Powerlink's overhead transmission line asset
Contaminated land	▸ Potential sources of contamination, including registered sites, hazardous facilities and known areas of dryland salinity and ASS risk, have been identified within the corridor and mapped using GIS

Bridges/ viaducts	▸ Risk of ballast dropping from rail-over-road bridges/viaducts, such as at Murphys Creek Road, will be avoided by incorporating ARTC's Construction Specification into the track design, such as the ARTC *Engineering Code of Practice – Ballast* (ARTC, 2012). 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:
	  ▸ ARTC *Engineering Code of Practice—Earthworks* (ARTC, 2018c)
	  ▸ ARTC *Engineering Code of Practice—Structures* (ARTC, 2017d)
	  ▸ AS 5100 *Bridge Design* (Standards Australia, 2016)
	  ▸ AS 7636 *Railway Structures* (Standards Australia, 2013) and other applicable Australian Standards
	▸ Bridge clearances have been established in consultation with the owners of existing assets over which the bridge structures span, i.e. DTMR and local governments

Emergency access	▸ The tunnel provides a Longitudinal Egress Passage as a conventional evacuation passage for passengers, drivers and crew, to provide access for operational maintenance activities and to provide communication facilities to contact the operator at the Network Control Centre ▸ The parking facilities and access tracks have been designed to accommodate the vehicles requested by QFES ▸ Viaduct design considers access for relevant emergency vehicles ▸ The Project proposes to eliminate any existing level crossings, while also upgrading East Paulsens Road, providing all weather access. The realigned Gowrie Junction Road will also provide better flood immunity across Gowrie Creek
Abandoned mines and underground collieries	▸ The design of the alignment has considered the surrounding land uses and geological investigations in regard to known abandoned mines and underground collieries ▸ From 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 (i.e. there is no evidence of historic mining in the area based on Department of Resources mapping, along with a review of historical imagery and past land uses); however, due to the high consequence, this will be considered in the risk assessment. ▸ The reliability of mapping for both accuracy and completeness cannot be readily established, and the possibility of unrecorded mine workings cannot be ruled out. As such, any activity in the Project disturbance footprint will include a preliminary ground inspection for open shafts/adits and any other working mine features, as a precaution

Aspect	Initial design mitigation
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 has evaluated the presence of dangerous goods in the specification of safety features. ▸ There is no alteration to the design of Airforce Road, which is a known transport route for the Helidon Explosive Reserve and a number of sandstone quarries. The Project is also looking at relocating the existing Cattos Road/Airforce Road intersection, which is currently on a bend

20.8.2 Proposed mitigation measures

In order to manage Project risks, a number of additional 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.

The draft Outline EMP (refer 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: HAZARD AND RISK MITIGATION MEASURES

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detailed design	Natural	Bushfire	▸ The design will 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 ▸ The landscaping design will include a wide strip of land on either side of the tracks to be clear from vegetation, to provide a suitable fire break
	Natural	Flooding and flash flooding	▸ ARTC will work with stakeholders, including directly impacted landholders, relevant community stakeholders, local councils, State departments and local flood specialists to inform and refine assessments and design ▸ 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 in the detailed design phase. ▸ 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 refuelling facilities in accordance with a risk assessment, at an appropriate distance from riparian vegetation and waterways, with appropriate measures in place to avoid impacts to waterways and aquatic habitats as per water quality management plans. The Project is located in the upper reaches of most catchments and elevated structures are designed where the Project intersects floodplains
	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ Incorporate batter slopes and scour protection into design ▸ The geotechnical data collected from the construction of the Toowoomba Bypass allows for a greater understanding of the geotechnical profile for the design of the tunnel ▸ Site-specific investigation to establish colluvium characteristics, depths and extents ▸ Rigorous inspection of slopes to map out slope stability ▸ Cut-and-cover tunnel and mined tunnel to be adopted at the eastern tunnel portal.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Detailed design [continued]	Natural	Climatic conditions	▸ Optimise tunnel ventilation to reduce energy requirements during operation ▸ Continue to refine the cut/fill balance for earthworks, to minimise material transport requirements ▸ The Project 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 has been developed to achieve a design life of 100 years. In doing so, designs for formation, track and structures have been developed in accordance with the ARTC 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 result of climatic conditions. Adaption strategies, such as installing an early flood warning system to alert ARTC to impending flood risks; 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 will be incorporated 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 into the detailed design

	Project	Rail incidents	▸ Track detailed design will incorporate trackside monitoring systems, which will detect faults in the wheel set and monitor rail wheel condition and defects at locations (e.g. shifting of freight containers in the tunnel) deemed necessary by the design team
			▸ ARTC has undertaken, and will continue to undertake, technical meetings with QR and DTMR in regard to interfaces between the Project and the West Moreton System, with the aim of resolving measures/process during construction and operation, including such items as:
			  ▸ Design elements, such as track spacing, rail-over-rail structures and tie-ins
			  ▸ Operational elements, such as signalling and control integrations, communications protocols, etc.
			  ▸ Disruptions to existing rail traffic and maintenance operations during construction
			  ▸ Tenure arrangements and responsibilities within the future rail corridor, including Network Rules and Procedures, Rail Safety processes in each company's (ARTC, QR) Safety Management Systems

	Project	Road–rail interfaces	▸ Detailed design of 1.8-m chain fencing will be provided near roads or where trespass is likely to occur

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 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 ▸ 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	▸ The fire and life safety controls for the tunnel will include detailed design fire resistance level (load bearing elements) to achieve 120-minute structural adequacy when exposed to the Rijkswaterstaat temperature time curve, while non-load bearing elements will be designed to achieve a Fire Resistance Level of -/120/120, safety equipment and devices, such as emergency phones, emergency exits, emergency lighting, fire doors, hydrants and extinguishers. ▸ The tunnel design will incorporate fire and life safety mitigation measures, to ensure appropriate facilities are available. These mitigation measures include limiting the amount of combustible materials used in construction, providing fire detection systems, preventing derailed trains from entering the tunnel, and preventing trains that are on fire from stopping in the tunnel.
	Project	Abandoned mines and underground collieries	▸ Further mapping and surveys will be undertaken to investigate and identify any collieries ▸ The Project will continue to engage with the Abandoned Mines Program in the Department of Resources (formally Department of Natural Resources, Mines and Energy (DNRME)). In the event an interface is determined, a construction management strategy will be developed to minimise risk and identify rehabilitation opportunities and responsibilities.
Pre-construction	Project	Underground and overhead services	▸ The Project has identified (and will continue to confirm) known services that require relocation or protection prior to construction, and has commenced in consultation with the relevant service provider ▸ Overhead transmission lines and buried telecommunication cables will be identified before construction to ensure that construction and operation does not interfere with, or damage, the utilities as per the requirements of the *Electrical Safety Act 2002* (Qld) and subordinate legislation and *Safe Work Australia Model Code of Practice–Managing Electrical Risk in the Workplace* (Safe Work Australia, 2018c). The Project alignment has been located to minimise interference with these overhead utilities.
	Project	Underground and overhead services	▸ 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 Model Code of Practice–Excavation Work* (Safe Work Australia, 2015). ▸ Consultation with APT Petroleum Pipelines Pty Ltd has commenced with respect to the Roma to Brisbane Pipeline (PPL 2). In relation to service disruptions during construction, procedures will be developed and implemented to minimise the potential for service interruptions. Affected businesses and residences will be notified in advance of any planned interruptions.
	Project	Contaminated land	▸ Contaminated land assessments and investigations for land identified as having known or suspected contaminated areas will be undertaken (noting some preliminarily assessment have commenced), and a Contaminated Site Management Sub-plan will be prepared, 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.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Pre-construction [continued]	Project	Existing infrastructure and utilities	▸ The Roma to Brisbane gas pipeline is to be considered in collaboration with pipeline operators to minimise the risk of loss of containment of gas or flammable atmospheres. Ongoing consultation with pipeline operators will be conducted throughout the Project. Consultation will also be undertaken in accordance with the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) and *AS 2885 Pipelines–Gas and liquid petroleum* (Standards Australia, 2008b) standards during Project activities
	Project	Asbestos	▸ Older infrastructure and previously disturbed land within the disturbance footprint may contain asbestos. The Project will adhere to *Safe Work Australia Model Code of Practice–How to Manage and Control Asbestos in the Workplace 2016* (Safe Work Australia, 2018a) and *Safe Work Australia Model Code of Practice–How to Safely Remove Asbestos 2018* (Safe Work Australia, 2018b) ▸ Survey of infrastructure that will be removed or disturbed by the Project will be conducted to potentially identify asbestos-containing materials. For the existing West Moreton Rail System, consultation with Queensland Rail will also inform asbestos management strategies. ▸ Construction activities likely to disturb asbestos will review the presence and requirement for specific controls ▸ The Project will engage competent contractors and sub-contractors who are appropriately licensed for asbestos disturbance work
	Project	Bridges/ viaducts	▸ 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	▸ A preliminary ground inspection for open shafts/adits and any other working mine features will be conducted as a precaution. Additionally, geotechnical surveys are conducted during detailed design and construction. ▸ Measures for encountering unrecorded historic collieries or abandoned mines will be developed under the 'Unexpected Finds Protocol/Procedure' as part of the CEMP; noting that no collieries or abandoned mines were detected during the two rounds of geotechnical investigations, during ecological surveys, were noted by landholders or were detected from historical imagery
	Project	Road–rail interfaces	▸ Crossing consolidation, relocation, diversion or realignment—existing road–rail interfaces may be closed, consolidated into fewer crossing points, relocated or diverted. 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	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* (ARTC, 2018d). These procedures establish processes to manage hot work/high fire-risk activities (including observation of relevant Queensland Fire and Emergency Service directives); check extent of work site vegetation prior to hot work; and ensure appropriate firefighting equipment and trained personnel are available

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction [continued]	Natural	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 Gowrie Creek, Rocky Creek, Six Mile Creek, Upper Lockyer Creek and Oaky Creek) ▸ Overland drainage modifications will be incorporated, as required, at the western portal of the Toowoomba Range Tunnel
	Natural	Landslide, sudden subsidence, movement of soil or rocks	▸ A Soil Management Plan will be implemented to manage topsoil within the Project disturbance footprint such that it can be reused in rehabilitation and landscaping activities. Soil stockpiles will be managed in accordance with erosion and sediment control plans ▸ 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 ▸ Rigorous inspection of slopes prior to construction and, where applicable, instrumentation and monitoring before and during construction ▸ The geotechnical data collected from the construction of the Toowoomba Bypass allows for a greater understanding of the geotechnical profile for the construction of the tunnel
	Natural	Climatic conditions	▸ Opportunities for the reduction of GHG generation during construction will be considered as per the Sustainability Management Plan developed during the detailed design/pre-construction phases ▸ Laydown areas have been nominated along the length of the Project and at strategic locations, such as near the tunnel portals and bridge structures. These will act as a centralised point for material storage, with some storing hazardous materials such as fuel. The locations of laydown areas have been chosen to avoid areas that are within the 1% AEP floodplains, where possible; however, by virtue of the requirement of laydown areas for constructing bridges, some laydown areas must be within flood plains and near water sources ▸ ARTC will work towards minimising future risk in emergencies and engage with local councils and the local Disaster Management Groups for Toowoomba and Lockyer Valley ▸ Weather station environmental monitoring for all areas especially those subject to high winds ▸ Construction water will be obtained from sustainable sources, with the necessary water entitlement, water allocation, water licence or water permit. Current water demand can be met through the use of existing water sources; however, further options may need to be investigated depending on engagement with water resource owners and water availability
	Natural	Wildlife	▸ Construction works will be undertaken in accordance with a Flora and Fauna Sub-plan

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction [continued]	Natural	Biosecurity	A Biosecurity Management Plan will be prepared 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) ▸ Project works 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
	Natural	Biosecurity	▸ 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	▸ Construction management plans, systems, workplace conditions and facilities will align with requirements of the *Work Health Safety Act 2011* (Qld) and will follow Safe Work Australia's *Guide for managing the risks of working in heat* (*Safe Work Australia,* 2017).
	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 of any 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.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction [continued]	Project	Dust, respirable silica and other airborne contaminants	▸ Direct construction worker exposure to respirable silica, and other airborne contaminants, will be controlled through the use of appropriate personal protective equipment ▸ Where sensitive receptors, agricultural land uses or protected vegetation are located within 150 m of construction works, or visible dust is generated from vehicles using unsealed access roads, road watering or other appropriate controls will be implemented ▸ Vehicles transporting potentially dust and/or spillage generating material to and from the construction site will be covered 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, clearing, grubbing and construction activities will be undertaken 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 of temporary stockpiles and additional treatment of access roads ▸ Longer term material stockpiles will be treated with temporary organic or biodegradable cover (such as mulch, grass seeding/hydro-mulch, soil binder, etc.) to prevent risk of windborne erosion and dust
	Project	Noise and vibration	▸ The Project will develop and implement a Noise and Vibration Management Sub-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 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 ▸ Sensitive receptors with the potential to be affected by noise will be notified prior to the commencement of relevant works ▸ Construction progress and upcoming activities will be regularly communicated to local residents/stakeholders, particularly when noisy or vibration-generating activities are planned, such as vibratory compaction and piling
	Project	Road incidents	▸ A Traffic Management Plan will be developed under the CEMP 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 will be applied, including 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 landowners ▸ Storage areas and equipment laydowns will be maintained in good condition to maintain visibility for vehicles

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction [continued]	Project	Rail incidents	▸ QR's written approval will be obtained prior to commencement of work in accordance with section 255 of the *Transport Infrastructure Act 1994* (Qld) to ensure coordination between ARTC and QR is established for reduction of rail incidents between the operations ▸ If construction of Project components within the existing rail corridor is completed during a temporary possession of the rail corridor, then works will be completed in accordance with the conditions of the temporary possession and/or wayleave agreement granted to ARTC by QR ▸ All works carried out on QR property will be in accordance with the requirements of QR's *Civil Engineering Technical Requirement: Work in or about Queensland Rail Property* (CIVIL-SR-002) (QR, 2016a) ▸ All work performed on QR property, or when directed by QR, will be under the supervision of a Possession Protection Officer or Protection Officer and will be carried out only at times authorised by QR or the QR-appointed project manager
	Project	Tunnel	▸ Tunnel portal, shaft and cut construction may require blasting work. If blasting occurs as part of the detailed design construction methodology, the use of explosive substance will comply with the *Explosive Act 1999* (Qld). ▸ The geotechnical lessons learnt from the Toowoomba Bypass will be reviewed and applied, as relevant, for the Project
	Project	Underground and overhead services	▸ Procedural control for the Project will ensure that excavation work will comply with *Safe Work Australia Model Code of Practice – Excavation Work* (Safe Work Australia, 2015). ▸ The ARTC *Engineering Standard for Requirements—Electric Aerials Crossing ARTC Infrastructure* (ARTC, 2005b) requires that all structures supporting a span of electric aerials over ARTC railway track or sidings be located so that, in the event of failure, no part will fall within 1.8 m outside of any railway track
	Project	Contaminated land (including UXO and land contamination)	▸ 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 Sub-plan and ARTC *Environmental Policy* (policy provided in Appendix G: Corporate Policies) ▸ Identification of UXO will be subject to a risk assessment. Where there is a risk of encountering known or possible UXO, a suitably qualified person will assess and identify management options ▸ Implementation of the Contaminated Land Management Plan if contaminated land is suspected
	Project	Existing infrastructure and utilities	▸ Consultation with owners of licensed petroleum and gas pipeline assets located in the Project footprint (APA's Roma Brisbane Gas Pipeline) will continue throughout the Project in accordance with the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) and *AS 2885 Pipelines—Gas and liquid petroleum* (Standards Australia, 2008b) to ensure that there is no unsafe incident during Project activities ▸ ARTC and APA have evaluated the risk associated with the five interactions between the Project alignment and the Roma to Brisbane Gas Pipeline, and proposed specific design and construction mitigations for each interaction location

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction [continued]	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 service providers during development of the strategy. In instances where construction-phase emergency access is affected, use of the rail maintenance access roads (RMARs) by emergency vehicles may be appropriate. Multiple access points into and out of the rail corridor will be provided. ▸ A Traffic Management Plan will be implemented as part of the CEMP to minimise to 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
	Dangerous goods and hazardous chemicals	Chemicals spillage and loss of containment	▸ Construction facilities where hazardous materials may be used or stored have been located outside of floodplains and away from areas of social and environmental receptors, in accordance with the Queensland *State Planning Policy* (DILGP, 2017b). Additionally, the locations of construction facilities where vehicle maintenance and refuelling activities are expected 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* (National Transport Commission, 2018) will be us for dangerous goods deliveries. ▸ Construction chemicals stored and handled will be managed in accordance with the *Work Health 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.

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Construction [continued]	Dangerous goods and hazardous chemicals	Explosives	▸ Where explosives are used for significant cuttings during construction, the works will be undertaken by licensed shotfirers in accordance with the *Explosive Act 1999* (Qld) and *AS 2187:2006 Explosives—Storage, Transport and Use* (Standards Australia, 2006a) ▸ The shotfirer or blasting contractor must provide the Hazardous Material Management Sub-plan to the Explosive Inspectorate as part of the notification process of blasting activity at least seven days before the proposed blasting activity is carried out ▸ Chemicals stored and handled as part of construction activities will be managed in accordance with: ▸ *AS 2187.2: 2006 Explosives—Storage, Transport and Use* for explosives use (Standards Australia, 2006a) ▸ *AS 2187.1: 1998 Explosives—Storage, transport and use storage* for explosives storage (Standards Australia, 1998) ▸ *Australian code for the transport of explosives by road and rail—3rd edition* for explosives transport by road and rail (Australian Government, 2009). ▸ Develop and implement a Blast Management Plan as part of the Noise and Vibration Management Sub-plan in 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 in proximity of explosive use ▸ Identify the environment of explosive use, including flood, bushfire, landslide zones ▸ WH&S Management Plans will include appropriate measures to manage risk associated with blasting, such as consultation with service providers, comply with separation requirements and access controls, exclusion zones, trails, and buffers. Additionally, 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

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation	Natural	Bushfire	Existing ARTC management plans and strategies including: ▸ *Fire Prevention Management* (ARTC, 2006a) and *Total Fire Ban Procedure* (ARTC, 2018d) will be applied throughout the Project lifecycle to minimise damage to property, disruption to operations and maximise the safety of people ▸ Vegetation management as per ARTC's *Engineering (Track and Civil) Code of Practice—Section 17 Right of Way* (ARTC, 2013b): will be implemented to minimise fire risk within the rail corridor, which includes specifications for vegetation management/fire hazard reduction within the Project corridor ▸ Local fire authorities and local emergency services, and where applicable the local disaster management groups, will be consulted to ensure appropriate operational actions are taken, such as providing feedback on the firefighting vehicles accessibility, Fire Prevention Management (ARTC, 2006a) and cooperation on burning-off activities
	Natural	Flooding	▸ In line with ARTC's *Engineering (Track and Civil) Code of Practice – Section 10: Flooding* (ARTC, 2011a), 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 ▸ Establish site safety protocols (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 ▸ A flyover crossing Gowrie Creek Road will improve emergency service access during flooding
	Natural	Cyclones	▸ Extreme weather warnings provided from BoM to Network Control ▸ Appropriate mitigations are applied to operations based on the warning received, e.g. red alert warns drivers of a Condition Affecting Network (CAN) and black alert stops trains
	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 ▸ Provide a site map that indicates slope stability zones and risks (e.g. Willmott, 1984) ▸ Exclusions zones for quarrying activities (i.e. Harlaxton Quarry) consider the risk of landslips, along with issue around fly rock and vibration impacts on the tunnel
	Natural	Climatic conditions	▸ Operations on the corridor will comply with the ARTC *Route Access Standard General Information Route Standards: Speed Restrictions During Hot Weather* (ARTC, 2018e) ▸ 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)* (ARTC, 2017f) will be used as 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* (ARTC, 2013b)

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation [continued]	Natural	Biosecurity	▸ Pest and weed management will be carried out within the rail corridor in accordance with the ARTC *Engineering (Track and Civil) Code of Practice—Section 17 Right of Way: Vegetation Management* (ARTC, 2013b) ▸ ARTC does not own or operate rollingstock; however, the transportation of freight on the Inland Rail by independent operators will require authorisation by ARTC and must adhere to quarantine rules and regulations
	Project	Noise and vibration	▸ Adhere to the Noise and Vibration Management Sub-plan as part of the CEMP. 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 the ARTC 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 (ARTC, 2016b) 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 *Fatigue* policy (ARTC, 2016b), 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* (2017)
	Project	Asbestos	▸ Adhere to ARTC's *Work Health and Safety Work Instruction for Asbestos* (ARTC, 2016d), along with *Safe Work Australia How to Manage and Control Asbestos in the Workplace 2018* (Safe Work Australia, 2018a) and *Safe Work Australia How to Safely Remove Asbestos 2018* (Safe Work Australia, 2018b)
	Project	Dust, respirable silica and other airborne contaminants	▸ Measures that may be used to eliminate, minimise or manage air quality impacts include: ▸ Managing train operations, such as optimising train speed based on wagon class and axle loading ▸ Ensuring freight operators adhere to regulatory standards and/or industry practice for transportation of cargo likely to impact air quality. 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 QR's South West Supply Chain Coal Dust Management Plan. ▸ Removing dust from ballast and tracks ▸ Ensuring tunnel ventilation designs meet technical standards ▸ Communicating with the community and stakeholders to raise awareness of dust-reduction initiatives ▸ Wagon washing to reduce dust during unloaded return trips ▸ Correctly operating and maintaining vehicles and equipment

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation [continued]	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* (ARTC, 2013b) 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 Procedures adequately address the requirements for emergency management. ▸ ARTC is committed to continued delivery of railway safety messages to the community, through awareness and community engagement activities and campaigns ▸ In the event of trespass or environmental vandalism on the ARTC rail corridor, ARTC Security Patrols and ARTC trackside staff can instruct anyone on railway land without permission to leave immediately, or to take any other necessary action. As required, incidents will be reported to the Queensland Police Service for assistance and resolution.
	Project	Rail incidents	▸ Trackside monitoring systems will be implemented, which will detect faults in the wheel set and monitor rail wheel condition and defects at locations (e.g. shifting of freight containers within the tunnel)
	Project	Bridges/ viaducts	▸ Safety elements for double-stacked freight trains, such as loading requirements, centre of gravity and inspections for rollingstock will be provided to meet the ARTC *Route Access Standard Appendix A: Rolling Stock Outlines and Loading Requirements* (ARTC, 2020c) 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 ▸ The operational control of weather stations will be conducted to identify high wind or severe weather ▸ Slower speed control on inclines ▸ Brake wagons and braking system B3*/B4** to prevent runaway trains and derailment along bridges/viaduct. *B3 = Westinghouse WF2 or Davies and Metcalfe ESR type triple valve (relayed) **B4 = Westinghouse WF4 or WF5 triple valves (relayed)
	Project	Tunnel	▸ Uphold fire and lifesaving controls for the tunnel in accordance with tunnel operational procedures ▸ Air quality monitoring
	Project	Emergency access	▸ Training of personnel through desktop and simulated test exercises will be designed to ensure that, individually and collectively, the Incident Management Plans 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	Overhead and underground services	▸ The Project will also comply with the clearance distance as specified in the ARTC Engineering Standard *Requirement for Electric Aerials Crossing ARTC Infrastructure* (ARTC, 2005b) to ensure sufficient clearance and prevent contact with live electricity

Delivery phase	Hazard type	Aspect	Proposed mitigation measures
Operation [continued]	Project	Existing infrastructure and utilities	▸ Consultation with owners of licensed petroleum and gas pipeline assets located in the Project footprint (APA's Roma Brisbane Gas Pipeline) will continue throughout the Project in accordance with the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) and *AS 2885 Pipelines—Gas and liquid petroleum* (Standards Australia, 2008b) to ensure that there is no unsafe incident during Project activities
	Project	Contaminated land (including land contamination)	▸ 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 licensed waste transport contractor ▸ Reporting of environmental incidences as specified in ARTC's *Pollution Incident Response—Public Extract* (ARTC, 2019a) ▸ Implementation of the Contaminated Land Management Plan if contaminated land is suspected
	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* (National Transport Commission, 2018). 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 the ARTC *Inspecting Trains policy* (ARTC, 2015d), such that inspections of dangerous goods loading (e.g. restraining of packages, segregation of dangerous goods), brake conditions and train integrity are compliant with the ARTC *Train Operating Conditions Manual* (ARTC, before and during travel on the ARTC Network. Details of the train's consist (a sequence of train carriages or cars) and content will also be provided to the ARTC 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 presented in Table 20.11. These impacts have been subjected to a risk assessment as per the methodology detailed in Section 20.4.2 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.

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
- Impacts of Project on GHG 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 (operation)
- Construction and operation of the Toowoomba Range Tunnel
- Bridges/viaducts
- Interaction with existing underground and overhead utilities
- Health and environmental impacts from contaminated land (construction)
- Interference with emergency access
- Transport of dangerous goods freight (operation)
- Potential use of explosives for construction.

In some instances, a residual risk ranking of 'medium' is reflective of the high potential consequence of an impact, despite a range of design and mitigation measures, which are effective in reducing likelihood. In most instances, the likelihood and consequence of these risks are influenced by factors that are outside ARTC's control (e.g. latent conditions, human behaviour, etc.).

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

			Initial risk with initial design mitigation in Table 20.9			Residual risk with proposed mitigation in Table 20.10		
Aspect	**Potential impact**	**Phase**	**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
Climatic conditions	Impact of Project on GHG emissions	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
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

			Initial risk with initial design mitigation in Table 20.9			Residual risk with proposed mitigation in Table 20.10		
Aspect	**Potential impact**	**Phase**	**Likelihood**	**Consequence**	**Risk**	**Likelihood**	**Consequence**	**Risk**
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	Eliminated – Public road–rail interfaces are designed to be all grade separated crossings					
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/viaducts	Bridge/viaduct 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	Unlikely	Extreme	Medium	Unlikely	Extreme	Medium
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	Rare	Major	Low
		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

			Initial risk with initial design mitigation in Table 20.9			Residual risk with proposed mitigation in Table 20.10		
Aspect	**Potential impact**	**Phase**	**Likelihood**	**Consequence**	**Risk**	**Likelihood**	**Consequence**	**Risk**
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

For these residual risks, opportunities to further reduce the level of risk will be investigated through the detailed design process in accordance with the following hierarchy of controls:

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment.

Where opportunities to further reduce risk are identified, these will be captured and documented in detailed design drawings, environmental design drawings, the CEMP or the Operation EMP, as appropriate.

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
- Collapse of mine shaft or colliery
- Use of dangerous goods (including storage) during construction activities.

One potential risk was completely eliminated due to the proposed removal of all level crossings:

- Increased number of interfaces between live trains and road users including pedestrians.

No risks were assessed as having a high residual risk ranking. As outlined in ARTC's *Risk Management Procedure* (ARTC, 2019c), 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 ARTC Safety Management System discussed in Section 20.3.1.1 will include monitoring activities to ensure the ongoing effectiveness of the risk controls, and identification of risk opportunities for further improvement for the Program. This includes the specific management plans presented in Section 20.9.3.

20.9.3 Specific management plans

Both the CEMP and ARTC's Operational Environmental Management Plans 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 or programs that will be developed to further enhance environmental, health and safety values as the Project progresses.

Specific programs, plans and sub-plans that support the draft Outline EMP, the CEMP and the Operational EMP include but are not limited to:

- Air Quality Management Sub-plan; refer Chapter 12: Air Quality
- Surface Water Management Sub-plan; refer Chapter 13: Surface Water and Hydrology
- Groundwater Management and Monitoring Program; refer Chapter 14: Groundwater
- Noise and Vibration Management Sub-plan; refer Chapter 15: Noise and Vibration
- Hazardous Materials Management Sub-plan (including spill response plan)
- Heritage Management Sub-plan; refer Chapter 18: Cultural Heritage
- Waste and Resource Management Sub-plan; refer Chapter 21: Waste and Resource Management

- 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
- Landscape and Rehabilitation Management Plan; refer Chapter 9: Land Resources
- Biosecurity Management Plan; refer Chapter 11: Flora and Fauna
- Flora and Fauna Sub-plan (includes species and habitat management plans); refer Chapter 11: Flora and Fauna
- Soil Management Plan; refer Chapter 9: Land Resources
- Contaminated Land Management Plan; refer Chapter 9: Land Resources
- Erosion and sediment control plan; refer Chapter 9: Land Resources
- Land resources management plan; refer Chapter 9: Land Resources.
- Hazard and risk (Incident) management plan; refer to Section 20.9.4.1.

20.9.4 Emergency management

ARTC's existing *Emergency Management Procedure* (ARTC, 2019a), which provides a systematic approach to incident response and recovery or incident investigation on the ARTC network, will be applied to the Inland Rail Program and the Project. Further details on the response to, and investigation of, incidents and emergencies is provided in Chapter 23: Draft Outline Environmental Management Plan.

The procedures required to manage incidents and emergencies are the responsibilities of ARTC and the network operators.

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* that will detail the response procedures in the event of foreseeable emergency scenarios. The *Incident Management Plan* will be in accordance with the ARTC *Emergency Management Procedure* (ARTC, 2019a) and will identify the necessary resources, training and communication interfaces with relevant emergency organisations, to ensure effective emergency response for the Inland Rail Program and the Project.

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* (ARTC, 2006a) procedure ▸ 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* (ARTC, 2011a) ▸ 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

Aspect	Incident	Incident Management Outline
Climatic conditions	Failure of infrastructure/derailment accidents, i.e. track buckling or to dangerous conditions for dangerous goods	▸ Follow ARTC's *Track Stability Handbook* (ARTC, 2017f) for track buckling incident management, through managing track stability ▸ Follow ARTC's *Accidents or Derailments—Actions to be Taken* (ARTC, 2005a) in the event of a derailment ▸ Emergency phones provided on trains to ensure drivers can reach emergency services in the event of derailment
Climatic conditions	Severe storms and winds	▸ Network control receives extreme weather warning through an arrangement with BoM. An appropriate mitigation is applied to operations based on the warning received, e.g. red alert is to warn drivers (where the process is to issue a CAN Notice (Condition Affecting the Network)) and black alert is stop trains running
Landslide, sudden subsidence, movement of soil or rocks	Damage to infrastructure and worker/public injury from landslide, sudden subsidence, movement of soil or rocks	▸ Provide a site map that indicates slope stability zones and risks (e.g. Willmott, 1984) ▸ Regular earthworks inspections will be implemented to determine defects and conditions that may affect or indicate problems with the stability of earthworks ▸ Exclusions zones for quarrying activities (i.e. Harlaxton Quarry) consider the risk of landslips, along with issue around fly rock and vibration impacts on the tunnel
Wildlife	Wildlife injury or deaths from impact with Project or 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 local council (Lockyer Valley or Toowoomba) 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 completed 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

Aspect	Incident	Incident Management Outline
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* (ARTC, 2016c) ▸ Follow Safe Work Australia's *Guide for managing the risks of working in heat* (Safe Work Australia, 2017) ▸ 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 Model Code of Practice—How to Manage and Control Asbestos in the Workplace 2016* (Safe Work Australia, 2018a) and *Safe Work Australia Model Code of Practice—How to Safely Remove Asbestos 2018* (Safe Work Australia, 2018b) ▸ 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. ▸ Rail safety processes in each company's (ARTC, QR) Safety Management Systems ▸ Network Rules and Procedures (ARTC, 2020b)
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 in the event of services strike ▸ Comply with *Safe Work Australia Guide for Tunnelling Work* (Safe Work Australia, 2013) ▸ ARTC's Network Control Centres operating accordance with ARTC *Network Rules and Procedures* (ARTC, 2020d)
Bridges/ viaducts	Bridge/viaduct collapse or falling object strikes	▸ Emergency phones provided on trains and at construction sites to ensure workers can reach emergency services in the event of services strike

Aspect	Incident	Incident Management Outline
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 Model Code of Practice—Excavation Work* (Safe Work Australia, 2015)
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
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 access	Impaired emergency access resulting in escalation of incident	▸ Plan and develop alternative means of access for use in emergencies
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 ▸ Follow ARTC's *Work Health and Safety Work Instruction for Chemicals* (ARTC, 2016a).
Freight dangerous goods	Loss of containment of freight dangerous goods and hazardous chemicals	▸ Report the incident to ARTC's Network Control ▸ Follow ARTC's *Work Health and Safety Work Instruction for Chemicals* (ARTC, 2016a)
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

20.9.4.2 Emergency response

Throughout the life of the Project, emergency management will adhere to the ARTC's *Emergency Management Procedure* (ARTC, 2019b). 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 the relevant emergency management authorities, as listed in Section 20.9.4.4.

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 that 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 the ARTC network. These incidents are nominally routine operational incidents and unsafe acts identified during safety observations.

An Incident Management Team will be available to manage threats during construction and operation, 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* (ARTC, 2019b). 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 Service attends, the site will be under the overall command of the Police Service; except in the event of a fire or dangerous goods spill, where the Fire Service will take charge. ARTC and network operators will work with these services and be 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 the ARTC's incident management and investigation.

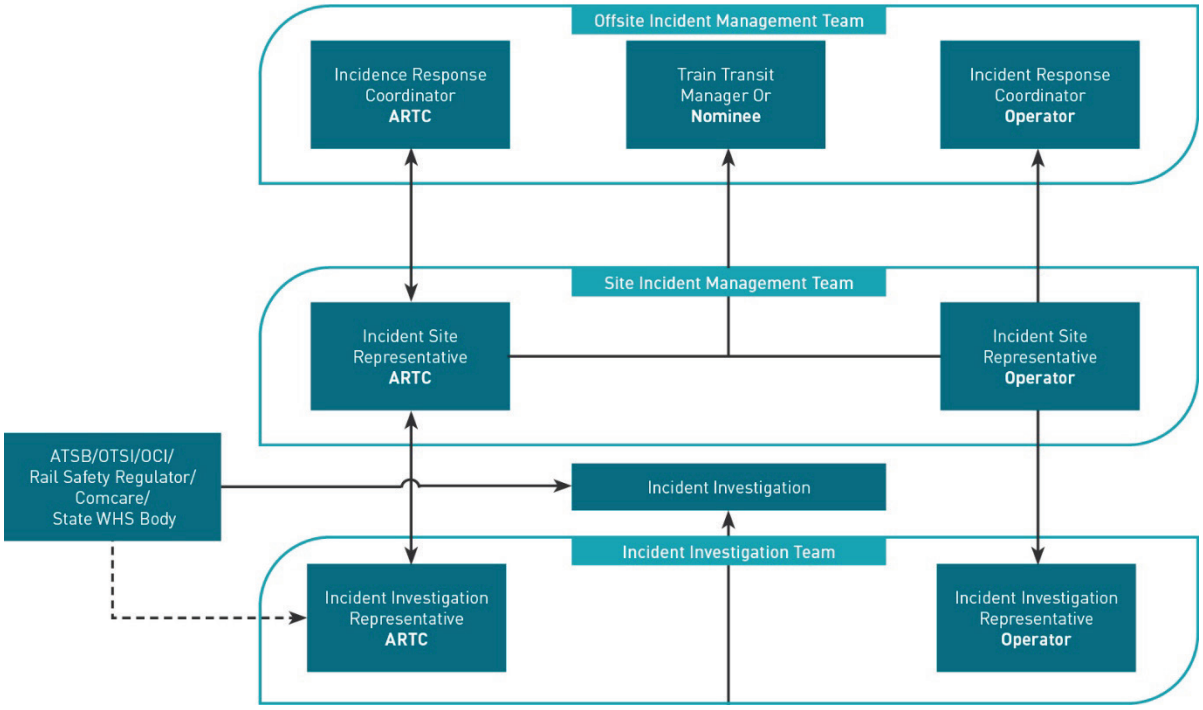

FIGURE 20.5: AUSTRALIAN RAIL TRACK CORPORATION EMERGENCY MANAGEMENT OVERVIEW

Source: ARTC Emergency Management Procedure (ARTC, 2019b)

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 in a two-year period.

Network 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 the ARTC network such as the 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 Plans* adequately address the requirements for emergency management and that the procedures are effectively integrated. The exercise will nominally evaluate communication 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 the *Emergency Management Procedure* (ARTC, 2019b).

The business-level ARTC *Emergency Management Procedure* (ARTC, 2019b) will be used as guidance for an asset-specific integrated emergency management plan for the Project. This will be developed in a 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 the event of a hazard and risk incident.

Consultation to date, in relation to emergency management, has included:

- Discussions with the Lockyer Valley Local Disaster Management Group regarding bushfire management, access to fire trails (including private) during and post construction and evacuation routes
- QFES has provided recommendations on the design, though it is unclear on whether this information can be disclosed. Some of the information includes:
  - Western tunnel portal to be the primary QFES access
  - Western tunnel portal to have parking for a minimum of four QFES Type 3 appliances and a turning bay to accommodate a QFES BA/Hazmat appliance
  - Bunds, liquid waste storage tanks or drains for contaminated firefighting water or Liquid Hazardous Material run off is not to affect LEP access, both internal and external, and must be contained upon exiting the tunnel
  - External venting of smoke and other hazardous materials needs to be addressed so as not to effect access points to LEPs
  - QFES advise that all train tunnels and LEPs are required to be Government Wireless Network compatible
  - Signage may be required to show directions to the eastern portal
  - Any potential creek crossings to have a minimum of a concrete causeway, with entry and exit to the causeway being bitumen and of a suitable length for QFES vehicles to negotiate any slopes
- QAS and QPS have also been contacted regarding potential impediments the Project, including the proposed changes to the local road network, may have on emergency services.

Details of engagement conducted to date and key outcomes are discussed in Chapter 5: Stakeholder Engagement, Appendix D: Community Consultation and Appendix Q: Social Impact Assessment. Future stages of the Project will build on these existing relationships with:

- Lockyer Valley and Toowoomba Local Disaster Management Groups
- Emergency Services, including:
  - Toowoomba Hospital
  - Queensland Fire and Emergency Services, including:
    - Rural Fire Service (e.g. South Western Region Headquarters, Charlton fire station, Gowrie Little Plain Rural fire brigade, Helidon fire station, Murphys Creek rural fire brigade, Withcott Rural Fire Brigade, Toowoomba fire station and Gatton fire station)
    - Queensland State Emergency Services
  - Queensland Police Services (e.g. Toowoomba police station, Highfields neighbourhood police beat, Wilsonton police beat, Harlaxton police beat, Helidon police station and Gatton police station)
  - Queensland Ambulance Services (e.g. Fairview ambulance station, Highfields ambulance station, Toowoomba ambulance station and Gatton ambulance station).

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 to Chapter 16: Social, Chapter 5: Stakeholder Engagement, Appendix D: Community Consultation and Appendix Q: Social Impact Assessment for more detail of emergency management consultation.

20.10 Cumulative impacts

It is a requirement of the ToR for this Project that the potential for cumulative impacts be considered. This section provides a discussion on the potential for cumulative impacts in relation to hazards and risks. Further details on the potential for cumulative impacts to arise as a result of the Project, in combination with others, is presented in Chapter 22: Cumulative Impacts. Details on the assessment methodology for cumulative impacts is presented in Chapter 4: Assessment Methodology.

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—Queensland/New South Wales Border to Gowrie (B2G) and Helidon to Calvert (H2C).

The types and quantities of hazardous chemicals that are expected to be used for the construction or operation, and maintenance of other projects are not considered to be sufficient to introduce the potential for significant offsite impacts or the potential to contribute to cumulative impacts at the adjacent, regional and national level.

Given the similar nature of the B2G, H2C and G2H 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 need to be identified and managed throughout the lifecycle of the Project, through design, construction and commissioning, and operation. The Project has incorporated risk identification and assessment practices throughout the design development phase and ARTC has a strong commitment to implementing and maintaining appropriate safety practices throughout operations.

A preliminary risk assessment has been conducted for the Project, which included hazard and impact identification and formation of potential mitigation measures.

The implementation of ARTC risk management policies and procedures is anticipated to effectively reduce all of the initial risks associated with the Project to a low to medium residual risk level. As outlined in ARTC's *Risk Management Procedure* (ARTC, 2019c), 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 mitigation.

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 the Project on GHG 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)
- Construction and operation of the Toowoomba Range Tunnel
- Bridges/viaducts
- Interaction with existing services underground and overhead
- Interference with emergency access
- Transport of dangerous goods freight (operations)
- Potential use of explosives for construction.

For these residual risks, opportunities to further reduce the level of risk will be investigated through the detailed design process in accordance with the following hierarchy of controls:

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. Personal protective equipment.

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.