APPENDIX G

Environmental risk assessment

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Appendix G Environmental risk assessment

G.1 Purpose

The purpose of this environmental risk assessment was to:

- identify key potential impacts and risks to be considered in the environmental impact assessment for the Illabo to Stockinbingal section of Inland Rail
- together with the environmental impact statement (EIS), address the requirement of the Secretary's Environmental Assessment Requirements (the SEARs) item 3 (2d) where, for each key issue identified by the SEARs, the proponent must '*identify, describe and quantify (if possible) the impacts associated with the issue, including the likelihood and consequence (including worst case scenario) of the impact (comprehensive risk assessment), the impacts of concurrent activities within the project and the cumulative impacts (parallel and sequential) with other projects*.'

Through this approach, key potential impacts for each key issue were identified for consideration as part of detailed impact assessments (technical papers), which may be in addition to those specified by the SEARs. A separate climate change risk assessment was conducted to meet the SEARs and consider the requirements outlined in the Infrastructure Sustainability (IS) Rating Scheme V1.2 (refer to Chapter 22 (Climate change risk)). As such, climate change risk is not addressed within this environmental risk assessment.

G.2 Environmental risk assessment process

G.2.1 Approach

The environmental risk assessment was undertaken in accordance with the principles of the Australian and New Zealand standard *AS/NZS ISO 31000:2018 Risk Management –Guidelines* (Standards Australia, 2018). The approach involved a preliminary desktop level risk assessment, supported by a workshop.

The steps involved:

- **Issue scoping**—identifying the scope of key potential issues under consideration as a result of constructing and operating the proposal (refer to section G.2.2.)
- **Defining risk criteria**—defining the criteria to evaluate the significance of any impact/risk identified (see section G.2.3)
- **Impact/risk identification**—describing the potential impacts and risks associated with each issue (see section G.2.4)
- **Risk analysis**—assessing the risk level of each identified impact (pre-mitigation) (see section G.2.5)
- **Risk evaluation**—consideration of the results of the risk analysis and determination of whether any additional action is required (see section G.2.6)
- **Risk treatment**—the application of mitigation measures and the determination of a new risk rating (post-mitigation) (see section G.2.7)

These steps are explained further in the following sections.

G.2.2 Issue scoping

The first step of the impact assessment process involved identifying key potential environmental issues, impacts and risks that would be subject to detailed assessment as part of the EIS. The SEARs identify the following as key issues for the EIS:

- biodiversity
- protected and sensitive lands
- transport and traffic
- flooding, hydrology and geomorphology
- water—hydrology
- water—quality
- soils
- heritage
- noise and vibration
- economic, land use and agriculture
- social
- visual amenity
- waste
- climate change and sustainability.

The SEARs specify the potential impacts to be assessed for each key issue as part of the EIS, including for construction and operation. The SEARs were informed by the scoping report, which was submitted in June 2018 to support the request for SEARs.

G.2.3 Defining risk criteria

The risk criteria for the risk assessment, including how likelihood and consequences (both positive and negative) were defined and measured and how the level of risk was determined, has been based on the ARTC Inland Rail Environmental Assessment Procedure.

The likelihood definitions are provided in Table G.1 and the consequence definitions are provided in Table G.2. The risk assessment matrix for the assignment of the risk level (from low to very high) is provided in Table G.3. The risk assessment matrix presents increasing consequence left to right and decreasing likelihood top to bottom.

TABLE G.1 LIKELIHOOD DEFINITIONS

Likelihood	Description	Frequency of occurrence	Percentile
Almost certain	Is expected to occur in most circumstances	Once per month	>90%
Likely	Will probably occur in most circumstances	Between once a month and once a year	60–90%
Possible	Might occur at some time	Between once a year and once in 5 years	30–<60%
Unlikely	Could occur at some time	Between once in 5 years and once in 20 years	10–<30%
Rare	May occur in exceptional circumstances	Once in more than 20 years	<10%

TABLE G.2 CONSEQUENCE DEFINITIONS

Consequence level	Definition
Extreme	▸ Multiple but localised fatalities occur ▸ Widespread long-term or permanent environmental damage—remediation required ▸ Prosecution of the company and/or its office holders ▸ More than 5 days track closure ▸ More than 5% of program budget (i.e. more than $500 million in $10 billion) ▸ More than 10% of project budget (e.g. more than $10 million in $100 million) ▸ Corporate loss of shareholder and/or customer support (tangible business impact greater than 3 years) ▸ Influences schedule more than 10% of program approved schedule period ▸ Influences schedule more than 20% of project approved schedule period
Major	▸ Single fatality occurs ▸ Considerable environmental damage—requiring remediation ▸ Prohibition notice or fine(s) ▸ More than 48 hours (hrs) to 5 days track closure ▸ More than 1.5% to 5% of program budget (i.e. more than $150 million to $500 million in $10 billion) ▸ More than 2.5% to 10% of project budget (e.g. $2.5 million–$10 million in $100 million) ▸ Strategic intervention required (more than 18 months to 3 years) ▸ Influences schedule more than 5% to 10% of program approved schedule period ▸ Influences schedule more than 10% to 20% of project approved schedule period
Moderate	▸ Serious injury occurs ▸ Localised/clustered environmental damage—requiring remediation ▸ Improvement notice or threatened action ▸ More than 24 hrs to 48 hrs track closure ▸ More than 0.5% to 1.5% of program budget (i.e. more than $50 million to $150 million in $10 billion) ▸ More than 0.5% to 2.5% of project budget (e.g. more than $500,000–$2.5 million in $100 million) ▸ Tactical (business unit/divisional) intervention required (more than 3 months to 18 months) ▸ Influences schedule more than 2.5% to 5% of program approved schedule period ▸ Influences schedule more than 5% to 10% of project approved schedule period

Consequence level	Definition
Minor	▸ Lost time injury (LTI) results OR medical treatment required ▸ Isolated environmental damage—minimal ARTC remediation required ▸ Notice to produce information ▸ >6 hrs to 24 hrs track closure ▸ More than 0.05% to 0.5% of program budget (i.e. more than $5 million to $50 million in $10 billion ▸ More than 0.1% to 0.5% of project budget (e.g. more than $100,000–$500,000 in $100 million) ▸ Management intervention required (more than 7 days to 3 months) ▸ Influences schedule more than 1% to 2.5% of program approved schedule period ▸ Influences schedule more than 2% to 5% of project approved schedule period
Not significant	▸ No medical treatment required ▸ Contained environmental damage—fully recoverable (no cost or ARTC action required) ▸ Minimal or no regulatory involvement ▸ Up to 6 hours track closure ▸ Up to 0.05% of program budget (i.e. to $5 million in $10 billion) ▸ Up to 0.1% of project budget (e.g. to $100,000 in $100 million) ▸ Isolated event able to be resolved (up to 7 days) ▸ Influences schedule up to 1% of program approved schedule period ▸ Influences schedule up to 2% of project approved schedule period

TABLE G.3 RISK ASSESSMENT 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

G.2.4 Impact/risk identification

For each key issue identified by the SEARs (see section G.2.2) potential impacts and risks were identified based on the requirements of the SEARs, results of the preliminary investigations, previous experience with other Inland Rail projects, or similar, and professional judgement.

G.2.5 Risk analysis

The risk analysis involved assessing the risk level of each identified potential impact by identifying the likelihood the impact can occur and the consequences of the impact (without mitigation), and is presented in Table G.4.

The likelihood of an impact occurring can be described in terms of probability. Overlaying this is the need to recognise the uncertainty that may be associated with the possible impacts, particularly during the initial risk assessment process. Where there is scientific uncertainty, a cautious approach will identify a higher level of risk (worst-case scenario). Each identifiable impact can be assigned likelihood between rare and almost certain (see Table G.1). In simplifying the possible impacts for the purpose of a risk assessment, an element of subjectivity is introduced. The purpose of the risk assessment is not necessarily to agree on the probability of any particular impact but to facilitate an understanding of the relative probability of different impacts.

Consequence is defined as the implication of an impact. The consequences of an impact require a degree of subjective assessment as the likely consequences of an impact may consist of several elements. For this assessment, each identifiable impact can be assigned a consequence level between not significant to extreme, depending on elements relating to safety, environment, regulatory, assets, financial, reputational and time-based impacts (see Table G.2).

Based on the assessment of likelihood and consequence, each foreseeable impact was assigned a risk level based on the matrix presented in Table G.3. This determined the significance of the environmental risk associated with a given impact.

G.2.6 Risk evaluation

Following completion of the risk ratings, risks were evaluated to support decisions regarding the environmental impact assessment.

Very high impacts were considered the highest priority and were the focus of the concept design and environmental impact assessment. In general, the following was applied when scoping requirements for the environmental impact assessment.

- Very high impacts—assessment and planning is necessary to avoid these impacts to the greatest extent possible.
- High impacts—detailed specialist investigation and assessment is necessary to enable identification of appropriate management and mitigation options.
- Medium impacts—further investigation as part of the environmental impact assessment is desirable, to address some uncertainties. Impacts could be mitigated through the application of relatively standard environmental mitigation measures.
- Low impacts—may not require specialist investigations, particularly where identifiable management/mitigation guidelines exist—potentially only broad or desktop investigation is necessary. Impacts could be mitigated through other working controls (such as detailed design requirements, normal working practice, safety and quality controls).

The environmental risk analysis undertaken in this appendix found health and safety and air quality to be additional key issues to those key issues identified originally in the preliminary environmental assessment and provided in the SEARs. The following key issues were confirmed as requiring further assessment in the form of specialist studies:

- biodiversity (terrestrial and aquatic)
- transport, traffic and access
- hydrology and flooding
- water quality
- groundwater
- heritage (Aboriginal)
- noise and vibration
- social
- economic
- landscape character and visual amenity
- contaminated land (as part of soils)
- landscape and visual amenity
- air quality.

While the remaining key issues also included impacts, which were assessed as high, the impacts are well understood based on previous experience with similar projects, including other Inland Rail projects, and implementation of standard design and management measures would minimise these risks. Therefore, these impacts and risks have been assessed within chapters of the EIS. These chapters include those relating to:

- waste
- climate change risk
- sustainability
- cultural heritage (non-Aboriginal heritage)
- land use and property
- soils (other than contamination)
- health and safety.

Further technical work was conducted for sustainability as part of the design process, outside of the EIS. Soils were further assessed in the contaminated land and water quality technical papers.

G.2.7 Risk treatment

Mitigation and management measures were identified to minimise or avoid the key potential impacts identified. The aim of these measures is to protect existing environmental values and sensitive receptors, and to achieve the objectives and requirements of relevant legislation, policies and guidelines.

The SEARs also require consideration of how residual impacts would be managed or offset. For the purpose of the EIS, residual impacts are considered to be the impacts of the proposal that may remain in the medium to long term, even after the implementation of the identified mitigation measures. The residual risk rating of the potential impacts identified by the environmental risk assessment was assessed after mitigation and management measures were applied. The pre-mitigated risk level was compared to the residual risk level, to assess the effectiveness of the mitigation and management measures. A residual risk assessment is provided at the end of each of chapters 10 to 26. This includes a description of the approach to managing significant residual impacts (considered to be those rated medium or above).

TABLE G.4 RISK ASSESSMENT

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Biodiversity	Construction	Clearing of native vegetation resulting in loss of fauna habitat, habitat fragmentation and loss of connectivity.	Almost certain	Moderate	High
		Direct impacts on listed threatened flora species and endangered terrestrial ecological populations and communities.	Almost certain	Moderate	High
		Impacts on potential habitat for listed threatened fauna species.	Almost certain	Moderate	High
		Increased impacts from pest plants and animals during construction from movement of vehicles, machinery and materials in and out of site.	Possible	Minor	Low
		Indirect impacts on fauna species due to increased dust, sedimentation, and erosion, noise, light and contamination pollution.	Possible	Minor	Low
		Native fauna mortality from vehicle strikes.	Almost certain	Moderate	High
		Potential impacts on groundwater dependent ecosystems.	Unlikely	Minor	Low
		Potential impacts on aquatic ecology and threatened species, including as a result of removal of riparian vegetation and fish passage blockages during construction of waterway crossings.	Likely	Moderate	High
		Water quality impacts and changes to flow regimes, including through the removal of farm dams, affect aquatic ecosystems.	Possible	Moderate	Medium
		Potential impacts on protected and sensitive lands.	Possible	Moderate	Medium
Biodiversity	Operation	Injury and mortality of fauna from train strikes.	Possible	Moderate	Medium
		Impacts on connectivity (and associated impacts on population viability and genetics) for terrestrial fauna, as a result of the presence of the new rail corridor.	Likely	Moderate	High
		Impacts on fauna from noise, vibration and light during operation.	Unlikely	Minor	Low
		Increased potential for pest plants (including aquatic) and animals during maintenance from movements along the rail corridor.	Unlikely	Minor	Low
		Potential impacts on aquatic ecology and threatened species as a result of fish passage blockages during operation of waterway crossings.	Unlikely	Minor	Low
		Water quality impacts during operation affect aquatic ecosystems.	Unlikely	Not significant	Low

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Transport and traffic	Construction	Impacts to road safety as a result of increased road use and turning movements at intersections and construction site access gates.	Likely	Moderate	High
		Construction traffic impacts, including temporary delays to local and regional traffic due to road closures and diversions.	Likely	Moderate	High
		Impacts to condition of rural roads due to construction traffic.	Possible	Moderate	Medium
		Impacts on access to private properties.	Likely	Moderate	High
		Impacts to emergency services through delays in access due to works.	Unlikely	Major	Medium
		Changes to road network performance due to additional construction vehicles.	Likely	Minor	Medium
		Reduced pedestrian and cyclist access.	Possible	Minor	Low
		Loss of parking spaces in towns near construction areas.	Almost certain	Minor	Medium
		Impacts to road safety as a result of increased road use and turning movements at intersections and construction site access gates.	Likely	Moderate	High
		Impact of construction work on existing rail operations during the tie-in to the north and south ends of the project area.	Possible	Minor	Low
		Realignment of Burley Griffin Way resulting in detours and change to traffic control.	Almost certain	Moderate	High
		Impacts to bus routes and services as a result of increased road use and diversions due to road realignment.	Almost certain	Minor	Medium
		Impacts to livestock highways as a result of increased construction traffic.	Likely	Minor	Medium
		Rural roads unsuitable for construction traffic (e.g. size and land use).	Possible	Moderate	Medium
		Increase to road use as a result of cumulative infrastructure projects in the vicinity of the proposal.	Unlikely	Moderate	Low
Transport and traffic	Operation	Increase in travel times due to introduction of new level crossings, resulting in wait times associated with length and frequency of trains.	Almost certain	Minor	Medium
		Increases in travel distances due to changes (realignments or closures) to the local public road network.	Possible	Minor	Low
		Realignment of Burley Griffin Way resulting in change to road conditions.	Almost certain	Not significant	Medium
		Impacts on access to private properties.	Likely	Moderate	High

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Hydrology and flooding	Construction	Temporary impact to the behaviour of local surface water systems during construction due to the presence of construction features, including erosion and sedimentation control structures.	Possible	Moderate	Medium
		Changes to flow patterns and altered hydrology due to construction in watercourses.	Possible	Moderate	Medium
		Impact of flooding on unprotected areas during construction resulting in washouts or erosion.	Possible	Moderate	Medium
		Sedimentation and changes to geomorphology in watercourses.	Possible	Moderate	Medium
Hydrology and flooding	Operation	Impacts on upstream and downstream drainage due to the introduction of built structures such as embankments, culverts and bridges.	Possible	Major	High
		Potential changes to road overtopping frequencies and levels impacting emergency service management.	Possible	Moderate	Medium
		Presence of, or change to, structures associated with the proposal could impact upstream and downstream local flood behaviour.	Likely	Moderate	High
		Presence of structures associated with the proposal and track height could impact upstream and downstream regional flood behaviour.	Unlikely	Not significant	Low
		Changes to flood characteristics as a result of impacts on the hydraulics of the catchment.	Possible	Moderate	Medium
		Flooding impacts on proposal infrastructure and immunity during operation.	Likely	Moderate	High
Groundwater	Construction	Extraction of groundwater may cause drawdown of the groundwater table, impacting sub-surface flows and water availability.	Possible	Major	High
		Potential for bulk excavations to intersect the water table and lead to groundwater level drawdown, impacting nearby groundwater bores, groundwater dependent ecosystems, and watercourse base flow.	Possible	Moderate	Medium
		Changes to soil moisture content causing compression or settlement.	Possible	Major	High
		Degradation of water quality through the movement of potentially existing contamination plumes within the groundwater environment.	Rare	Moderate	Low

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Water—quality	Construction	Increased sediment loads during rainfall events and from discharge of sediment-laden wastewater.	Possible	Major	High
		Increased alkalinity and pH of watercourses due to runoff from concrete batching plant operations.	Unlikely	Major	Medium
		Increased sediment loads due to changes in surface water flow from the presence of construction infrastructure.	Unlikely	Major	Medium
		Litter from construction activities polluting downstream watercourses.	Unlikely	Moderate	Low
		Erosion and sediment transport downstream due to works in watercourses.	Possible	Major	High
		Impacts on water quality from contamination from spills and leaks during construction.	Unlikely	Major	Medium
		Contamination of groundwater from construction activities.	Possible	Major	High
Water—quality	Operation	Potential for pollution of watercourses due to operation (freight materials, contaminants from train operation).	Rare	Moderate	Low
		Introduction and/or modification of drainage infrastructure and culverts resulting in water quality impacts.	Likely	Moderate	High
		Impact to surface water quality and receiving environments due to increased runoff from increase in impervious surfaces.	Likely	Moderate	High
		Impacts on water quality from contamination from spills and leaks during operation.	Unlikely	Moderate	Low
		Contamination of groundwater from maintenance procedures during the operational phase (GW chapter).	Unlikely	Major	Medium

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Soils (including site contamination, salinity and acid sulfate soils)	Construction	Erosion as a result of the disturbance of soils during construction, particularly in soil landscapes characterised by dispersive soils, given their susceptibility to erosion.	Possible	Not significant	Low
		Disturbance of soils and subsequent loss or degradation of soil quality during earthworks at construction compound site.	Possible	Not significant	Low
		Disturbance of landforms during earthworks reducing the stability of landforms.	Possible	Not significant	Low
		Potential to disturb contaminated soils during construction and mobilise contamination.	Possible	Moderate	Medium
		Contamination of soils/groundwater due to spills and leaks during construction.	Likely	Minor	Medium
		Exposure of acid sulfate soils (ASS) or saline soils and subsequent erosion.	Possible	Moderate	Medium
		Potential to disturb hazardous materials during the demolition of buildings and structures.	Possible	Moderate	Medium
		Potential for direct contact exposure by construction workers to soils associated with dumped materials and stockpiles or machine storage and maintenance.	Possible	Moderate	Medium
Soils (including site contamination, salinity and acid sulfate soils)	Operation	Erosion during operation maintenance works.	Possible	Moderate	Medium
		Contamination of soils/groundwater due to spills and leaks during maintenance works.	Unlikely	Moderate	Low
		Changes to surface, including vegetation removal and creation of embankments, increasing potential for erosion, or exacerbation of salinity hazards in proposal site and sedimentation down-gradient.	Possible	Moderate	Medium
		Potential for direct contact exposure by future maintenance workers to soils associated with dumped materials and stockpiles or machine storage and maintenance areas.	Possible	Minor	Low
		Contamination of land due to leaks and spills from train operations.	Possible	Moderate	Medium
Heritage (Non-Aboriginal)	Construction	Potential direct impacts on heritage listed sites located within the proposal site and any potential heritage items located within/near the proposal site.	Unlikely	Major	Medium
		Disturbance of known or unidentified items or places of non-Aboriginal heritage significance.	Unlikely	Major	Medium
		Impacts to heritage items from vibration during construction.	Unlikely	Moderate	Low
		Design that detracts from the heritage significance of nearby items.	Unlikely	Moderate	Low
		Impacts on listed heritage items or items of heritage values due to demolition, altered historic arrangements and access, visual amenity, landscape and vistas, curtilage, subsidence and architectural noise treatment.	Possible	Moderate	Medium

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Heritage (Non-Aboriginal)	Operation	Visual impacts on heritage items and close to the proposal site.	Unlikely	Moderate	Low
		Impacts on heritage items from vibration during operation.	Unlikely	Moderate	Low
		Change to the values of a heritage conservation area.	Unlikely	Moderate	Low
Heritage (Aboriginal)	Construction	Potential impacts on registered Aboriginal heritage items/sites in the proposal site.	Possible	Major	High
		Impacts on unrecorded Aboriginal sites and/or areas of archaeological sensitivity or cultural value.	Possible	Major	High
		Impacts on areas predicted to have moderate to high archaeological potential.	Possible	Major	High
		Indirect impacts on registered Aboriginal sites outside the proposal site by the movement of vehicles and/or construction machinery.	Unlikely	Moderate	Low
		Indirect impacts to Aboriginal heritage items from construction of the project such as visual setting or settlement.	Unlikely	Minor	Low
Heritage (Aboriginal)	Operation	Visual impacts on heritage items and close to the proposal site.	Possible	Moderate	Medium
		Impacts on heritage items from vibration during operation.	Possible	Moderate	Medium
		Impacts to adjacent heritage items.	Unlikely	Moderate	Low
Noise and Vibration	Construction	Noise impacts on sensitive receivers from construction activities, particularly during work outside the Interim Construction Noise Guideline (ICNG) (2009) standard working hours.	Almost certain	Moderate	High
		Noise impacts on sensitive receivers from construction traffic.	Almost certain	Minor	Medium
		Human comfort vibration (amenity) impacts on sensitive receivers as a result of works close to receivers.	Possible	Moderate	Medium
Noise and vibration	Operation	Noise impacts on sensitive receivers from the movement of trains along the new rail line.	Almost certain	Moderate	High
		Human comfort vibration (amenity) impacts on sensitive receivers the movement of trains along the new rail line.	Possible	Moderate	Medium
		Noise impacts from warning signals and horns at level crossings.	Likely	Minor	Medium
		Noise impacts on sensitive receivers from maintenance activities.	Possible	Minor	Low
		Noise impacts on sensitive receivers from traffic on realigned sections of road.	Likely	Minor	Medium
		Damage to structures, including heritage structures close to the proposal site, from vibration caused by the movement of trains along the new rail line.	Possible	Minor	Low
		Damage to structures, including heritage structures close to the proposal site, from vibration caused by other proposal operations.	Possible	Minor	Low

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Land use and agriculture (including property)	Construction	Effects on access to and within properties as a result of changes to private access roads and internal access arrangements.	Almost certain	Major	Very High
		Indirect impacts on agricultural land use/production and livestock from construction activities, including impacts from changes to access, noise and air pollution.	Likely	Minor	Medium
		Temporary changes to land use as a result of the proposal's land requirements during construction—temporary leasing of additional areas outside the operational footprint to facilitate construction negatively affects the availability of land for other uses.	Almost certain	Moderate	High
		Disruption to forestry practices as a result of works within state forests.	Unlikely	Moderate	Low
		The movement of construction machinery and materials introduces biosecurity risks, including the spread of weeds.	Possible	Moderate	Medium
		Effects on access to and along travelling stock reserves.	Possible	Minor	Low
		Effects on mining leases and licences, such that viability is affected.	Unlikely	Minor	Low
		Impacts on agricultural land use from construction activities including impacts from reduced access, noise and air pollution.	Likely	Minor	Medium
		Impacts on land use as a result of property acquisition.	Likely	Moderate	High
		Impacts on other infrastructure during construction including utilities and existing rail lines.	Possible	Minor	Low
Land use and agriculture (including property)	Operation	Severance of properties resulting in smaller lot sizes that may affect existing use and/or development potential.	Almost certain	Moderate	High
		Severance of properties resulting in changes to the arrangement of properties that may affect agricultural use and productive capacity.	Almost certain	Moderate	High
		Effects on access to and within properties as a result of changes to private access roads and internal access arrangements.	Almost certain	Moderate	High
		Land permanently required for the proposal affects the productive capacity of individual properties.	Possible	Major	High
		Land permanently required for the proposal results in a change to land use in the study area, negatively affecting the availability of land for non-transport related uses (including changes to the availability of agricultural and forestry zoned land).	Possible	Moderate	Medium
		Impacts due to changes in infrastructure, including increased waiting times at level crossings and safe holding distances for large vehicles affecting agricultural land access.	Likely	Minor	Medium

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
Social and economic	Construction	Potential constraint in local short-term accommodation market (during site visits by ARTC-managed technical specialists), restricting access for other community needs.	Possible	Moderate	Medium
		Restriction on people's ability to move around their community as a result of traffic restrictions and delays at level crossings.	Likely	Minor	Medium
		Decreased perceptions of safety resulting from anti-social behaviour in local townships due to temporary construction workforce.	Possible	Moderate	Medium
		Restricted access to community services and facilities due to increased demand from the construction workforce.	Possible	Major	High
		Impeded access across the rail corridor for emergency services, specifically during times of high bushfire risk.	Possible	Major	High
		Stress and anxiety resulting from potential harm to identified sites of Aboriginal cultural heritage around the proposal site.	Unlikely	Extreme	Medium
		Adverse changes to community cohesion and perception of safety in relation to anti-social behaviour exhibited by temporary construction workforce.	Possible	Moderate	Medium
		Adverse mental health impacts predominantly for directly affected landowners as a result of the land access and acquisition process of negotiations over a long period of time.	Possible	Major	High
		Adverse mental health impacts (frustration, impatience) and cessation of engagement with ARTC due to the protracted design and planning process.	Possible	Major	High
		Changes in rural amenity and character, which may affect people's sense of place, including adverse changes to existing visual amenity for three residential sensitive receivers in the local study area.	Likely	Moderate	High
		Potential health and wellbeing impacts associated with amenity impacts in the local study area (noise and dust).	Likely	Moderate	High
		Loss of local and regional agricultural production felt by individual landowners and regional producers.	Likely	Moderate	High
		Adverse impact on agricultural businesses from land acquisition leading to severance.	Likely	Moderate	High
Social and Economic	Operation	Changes to traffic movements and access for people moving around their communities including minor delays at new public level crossings.	Likely	Minor	Medium
		A permanent change to the rural sense of place and identification to the land, experienced more acutely by landowners directly affected by the proposal, but also by residents of townships in the local study area.	Almost certain	Minor	Medium
		Concerns around safety of people and livestock, and disturbance to farming operations from the impact of potential flooding on accessibility and safety around underbridges.	Possible	Major	High

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
		Ongoing mental health impacts from that experienced during the construction phase. This accumulated sense of frustration, impatience and occasional mistrust of the process may affect future interactions between ARTC and affected landowners.	Possible	Moderate	Medium
		An altered sense of enjoyment of the rural landscapes from changes to the existing visual amenity leading to potential frustration.	Likely	Moderate	High
		Sleep disturbance or ongoing exposure to air-borne noise for sensitive receivers along the proposal site due to train activity, leading to a change to the level of enjoyment of the rural lifestyle that is highly valued by local residents.	Likely	Moderate	High
		Ongoing health and wellbeing impacts for one residential receiver due to noise impacts associated with the realignment of Burley Griffin Way.	Possible	Major	High
		Ongoing stress and anxiety associated with the longer term effects of property impacts on individual landowners relating to the land acquisition process, as well as the ongoing impact on economic livelihoods.	Possible	Major	High
Visual amenity	Construction	Light impacts from out-of-hours work during construction.	Unlikely	Minor	Low
		Temporary visual impacts on sensitive visual receivers in the vicinity of construction work and from areas with views of the proposal site.	Possible	Minor	Low
		Adverse impacts on landscape character during construction, particularly in greenfield areas.	Possible	Minor	Low
Visual amenity	Operation	Visual impact of operational lighting.	Unlikely	Minor	Low
		Permanent visual impacts on sensitive visual receivers as a result of the introduction of new infrastructure visible from a number of viewpoints (including new rail overbridges, crossing loops, ancillary infrastructure and access road).	Likely	Moderate	High
		Introduction of double-stacked trains into the landscape.	Possible	Minor	Low
Waste	Construction	Generation of excess spoil that cannot be reused onsite (unsuitable for reuse or insufficient space) and needs to be disposed of.	Possible	Moderate	Medium
		Inappropriate management of waste generated during construction, resulting in environmental, health and amenity impacts, including contamination, water quality impacts, odour and dust.	Possible	Minor	Low
		Inappropriate management of waste generated during construction, resulting in excessive waste being directed to landfill.	Unlikely	Moderate	Low
		Increased resource consumption.	Likely	Not significant	Low
Waste	Operation	Inappropriate management of waste generated during operation resulting in environmental, health and amenity impacts, including contamination, water quality impacts, odour and dust.	Unlikely	Moderate	Low

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
		Inappropriate management of waste generated during construction resulting in excessive waste being directed to landfill.	Unlikely	Moderate	Low
Sustainability	Construction	Increased demand on local and regional resources during construction.	Almost certain	Minor	Medium
	Operation	Increased electricity and fuel use during construction and operation.	Almost certain	Minor	Medium
Air quality	Construction	Emissions from vehicles or plant during construction.	Likely	Minor	Medium
		Generation of dust during construction (from exposed soil/stockpiles, excavation and vehicle movements) and impacts on sensitive receivers.	Likely	Minor	Medium
		Odours/emissions from disturbance of contaminated soils or other sources such as asphalt laying during road modification works.	Unlikely	Minor	Low
		Fugitive emissions (e.g. VOCs) from fuel/chemicals storage and handling.	Possible	Minor	Low
Air quality	Operation	Impacts on local air quality during operation from train emissions including idling trains at crossing loop locations.	Possible	Moderate	Medium
		Emissions from vehicles or plant and generation of dust during maintenance works.	Possible	Minor	Low
Health and safety (including hazardous materials)	Construction	Potential for environmental damage resulting from a bushfire passing through the site (e.g. explosion of fuel storages/tanks, vehicles and machinery.	Possible	Moderate	Medium
		Damage to infrastructure, potential for impacts to freight goods caused by flooding events.	Possible	Moderate	Medium
		Increased temperatures, leading to failure of infrastructure, caused by climate change (extreme weather events).	Likely	Minor	Medium
		Damage to infrastructure and worker/public injury from landslide, sudden subsidence, movement of soil or rocks.	Unlikely	Moderate	Low
		Disruption to public from noise and vibration.	Likely	Minor	Medium
		Worker injury from fatigue and heat stress.	Possible	Moderate	Medium
		Health impacts from asbestos.	Unlikely	Moderate	Low
		Impacts from dust, respirable silica and other airborne contaminants.	Possible	Moderate	Medium
		Road accidents caused by increased vehicles required for the construction of the proposal.	Likely	Moderate	High
		Pedestrian interactions at level crossings.	Unlikely	Major	Medium
		Bridge collapse or falling object strikes.	Unlikely	Major	Medium
		Worker injury from services strike at existing infrastructure and underground and overhead utilities.	Possible	Major	High

			Pre-mitigated risk		
Key Issue	**Phase**	**Potential impact/risk**	**Likelihood**	**Consequence**	**Risk rating**
		Health impacts to workers and public and environmental impact from contaminated land.	Unlikely	Major	Medium
		Impaired emergency access resulting in escalation of incident.	Possible	Major	High
		Loss of containment of dangerous goods during storage and handling.	Possible	Moderate	Medium
		Damage to infrastructure or injury or fatality caused by explosives incidents during blasting during construction or by adjacent operators.	Possible	Extreme	High
Health and safety (including hazardous materials)	Operation	Damage to infrastructure, injury to workers or public from bushfire.	Possible	Major	High
		Damage to infrastructure, potential for impacts to freight goods caused by flooding events.	Possible	Moderate	Medium
		Increased temperatures, leading to failure of infrastructure, caused by climate change (extreme weather events).	Likely	Minor	Medium
		Damage to infrastructure and worker/public injury from landslide, sudden subsidence, movement of soil or rocks.	Unlikely	Minor	Low
		Disruption to public from noise and vibration.	Likely	Minor	Medium
		Health impacts from asbestos.	Unlikely	Moderate	Low
		Impacts from dust, respirable silica and other airborne contaminants.	Unlikely	Moderate	Low
		Rail accidents caused by increased rail movements.	Rare	Extreme	Medium
		Rail interactions with farm equipment and travelling stock from adjacent stock routes/crossings.	Possible	Extreme	High
		Road accidents caused by increased vehicles required for the proposal (e.g. traffic from construction, maintenance, or decommissioning).	Unlikely	Major	Medium
		Accidents due to increased number of road–rail interface.	Possible	Major	High
		Pedestrian interactions at level crossings.	Possible	Extreme	High
		Bridge collapse or falling object strikes.	Unlikely	Major	Medium
		Worker injury from services strike when maintaining infrastructure and underground and overhead utilities.	Unlikely	Extreme	Medium
		Health impacts to workers and public and environmental impact from contaminated land.	Unlikely	Minor	Low
		Impaired emergency access resulting in escalation of incident.	Possible	Major	High
		Loss of containment of freight dangerous goods and hazardous chemicals.	Possible	Major	High