CHAPTER 22

Cumulative Impacts

GOWRIE TO HELIDON ENVIRONMENTAL IMPACT STATEMENT

IR_1536

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

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22.1 Summary

This chapter provides a summary of the cumulative impact assessment (CIA) undertaken for the Inland Rail—Gowrie to Helidon Project (the Project).

Projects with spatial and/or temporal overlap can result in cumulative impacts. It is a requirement of the Terms of Reference (ToR) that the potential for cumulative impacts for this Project be considered. Section 7.3 of the ToR states:

'Cumulative impacts should be assessed over time and in combination with impacts created by the activities of other local, upstream and downstream land uses, major projects under construction, and proposed significant development progressing through the statutory assessment processes for which information is publicly available. The EIS should also propose means to suitably address predicted cumulative impacts. Outline ways in which the cumulative impact assessment and management could subsequently be progressed further on a collective basis.'

Cumulative impacts may:

- Differ in magnitude from those of an individual project, when considered in isolation
- Be positive or negative
- Differ in severity and duration depending on the spatial and temporal overlap of projects occurring in an area.

Cumulative impacts can:

- Occur at a local, regional or national level
- Accumulate over time
- Exacerbate the intensity, scale, frequency, or duration of impacts in either isolation or combination with other known existing or planned projects.

Chapters 8 to 21 have considered existing, operational projects where they are located within the defined impact assessment area for each of the chapters. Existing projects are considered to be part of the existing environment and have been accounted for in the assessment of the potential impacts of the Project, as described in each of the above chapters. Therefore, this CIA only accounts for:

- A Project that was declared a 'coordinated project' under the provisions of the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act)
- Projects that have been approved under relevant local, State and/or Commonwealth legislation but construction has not commenced
- Projects that have been approved under relevant local, State and/or Commonwealth legislation and construction has commenced.

For the purpose of this assessment, the CIA study area is defined as the spatial area of influence (AOI), which is determined by the specific nature of the environmental aspect (including social and economic aspects) being assessed.

Three types of AOI have been considered:

- Derived by assessment—the AOI is determined for each environmental aspect by the corresponding impact assessment, as undertaken to address the relevant component of the ToR
- Administrative—the AOI is determined by recognised administrative boundaries
- Designated area—the AOI is determined by the recognised physical operational extent of the Project.

The impact assessment for each environmental aspect, and the supporting technical reports, provide an assessment of each potential impact after initial and proposed mitigation measures are applied. These assessments have informed the preparation of the CIA. The CIA also draws on the impact assessments of projects within the AOIs, or with intersecting AOIs, of the environmental aspects assessed.

Further details of the assessment methodologies used to assess individual environmental aspects are presented in the relevant technical chapters and associated technical reports of this Environmental Impact Statement (EIS).

22.2 Scope of chapter

The purpose of the CIA is to present clear and concise information on the cumulative impacts on specific environmental aspects that could occur as a result of the Project's development, in conjunction with other identified existing or proposed developments. Environmental aspects include:

- Land use and tenure
- Land resources
- Landscape and visual amenity
- Flora and fauna
- Air quality
- Surface water and hydrology
- Groundwater
- Noise and vibration
- Social
- Economics
- Cultural heritage
- Traffic, transport, and access
- Hazard and risk
- Waste and resource management.

Projects included in the CIA are detailed in Section 22.5 and meet one or more of the selection criteria listed below:

a) Have been declared a 'coordinated project' by the Coordinator-General under the SDPWO Act and an EIS is currently being prepared or is complete, or an Initial Advice Statement is available on the Queensland Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) website

b) Are currently being assessed under part 1 of chapter 3 of the *Environmental Protection Act 1994* (Qld) (EP Act)—no projects of relevance to the Project and, thus, the CIA

c) May use resources located within the region (including materials, groundwater, road networks or workforces) that are the same as those to be used by the Project

d) Could potentially compound residual impacts that the Project may have on environmental aspects.

Projects that were excluded from the CIA are:

- Existing projects, with no known plans for expansion. Such projects are typically considered part of the 'existing environment', though it should be noted that the study area for the relevant environmental aspect is generally within 1 km of the Project alignment. Where relevant, these projects have been described as part of the existing environment and subsequently accounted for in the impact assessment of the Project (e.g. Toowoomba Bypass was included in the air quality assessment).
- Proposed projects that have not been developed to the point that their environmental assessment process has been made public to inform the CIA (e.g. Baillie Henderson Hospital expansion).

22.3 Terms of Reference requirements

Table 22.1 summarises the ToR requirements for the Project's CIA and where these requirements have been addressed in this chapter and the broader EIS.

TABLE 22.1: TERMS OF REFERENCE REQUIREMENTS

Terms of Reference Requirements		Where addressed in Chapter 22 and the broader EIS
6.6.	Each matter assessed in the EIS (as described in section 11 of this TOR) should include a concise summary and suitable assessment of the nature, magnitude and duration of the potential direct and indirect and cumulative impacts of the project and the measures proposed by the proponent to avoid, minimise, mitigate, manage and/or offset those impacts.	Each technical chapter (Chapters 8 to 21) provides a CIA for the particular aspect of the Project that it is addressing. This chapter summarises the outcomes of each CIA undertaken for the Project.
7.3.	Cumulative impacts should be assessed over time and in combination with impacts created by the activities of other local, upstream, and downstream land uses, major projects under construction, and proposed significant development progressing through the statutory assessment processes for which information is publicly available. The EIS should also propose means to suitably address predicted cumulative impacts. Outline ways in which the cumulative impact assessment and management could subsequently be progressed further on a collective basis.	Refer to Section 22.4 for the methodology applied to the CIA. Projects with potential overlap in impacts (either spatially or temporally) have been considered to determine the nature of the cumulative impact. Refer to Section 22.6 for commentary on cumulative impacts.
10.1.	The EIS must describe and illustrate at least the following specific information about the proposed Project: h) relationship to other coordinated projects, major projects and/or developments (which are progressing through planning and approval processes and public information is available)	Refer to Section 22.5 for a list of projects that have been considered in this CIA. The relationship of each of these projects to the Project has been identified in Table 22.7.
11.13.	The project should initially be assessed in its own right followed by an assessment of the cumulative impacts related to existing major projects and/or development that is progressing through a publicly available planning and approval process. Cumulative impacts not solely related to the project development should also be described.	Each technical chapter (Chapters 8 to 21) assesses the Project in its own right, followed by a CIA for the particular aspect that it is addressing. This chapter provides a summary of these CIA findings.
11.107.	Assess the impacts of the project on individual road/rail crossings and any cumulative impacts on the wider transport network in the context of the Queensland level crossing safety strategy.	Chapter 19: Traffic, Transport and Access addresses cumulative impacts on the wider transport network; noting that there are no public or occupational level crossings proposed as part of this Project and an existing public level crossing on the Queensland Rail (QR) network will be eliminated. Appendix U: Traffic Impact Assessment. This chapter provides a summary of these CIA findings.

Terms of Reference Requirements		Where addressed in Chapter 22 and the broader EIS
11.131.	Predict the impacts of the releases from the activity on environmental values of the receiving environment using recognised quality assured methods. The description of impacts should take into consideration the assimilative capacity of the receiving environment and the practices and procedures that would be used to avoid or minimise impacts. The impact prediction must: b) address the cumulative impact of the release with other known releases of contaminants, materials or wastes associated with existing major projects and/or developments and those which are progressing through planning and approval processes and public information is available	Where relevant, each technical chapter (Chapters 8 to 21) assesses the predicted cumulative impacts releases from the Project with other known releases of contaminants, materials or wastes associated with projects identified to have potential overlap in spatial and/or temporal impacts. This chapter provides a summary of these CIA findings.

22.4 Methodology

22.4.1 Approach

Technical chapters 8 to 21 in this EIS each include a CIA for the particular aspect of the Project they are addressing. The approach used to identify and assess potential cumulative impacts of this Project, provided in this chapter and the technical chapters of the EIS, is summarised below:

- A review of the potential impacts identified in chapters 8 to 21 and their associated technical reports. The status of the natural, built, and social environment at the time of the ToR being issued is considered to be the baseline.
- A register of assessable projects has been collated with timelines to demonstrate the temporal relationship between projects
- The register of assessable projects was assessed to identify those that meet one of the following criteria:
  - Where there is a potential overlap in impacts (either spatially or temporally), a CIA has been undertaken to determine the nature of the cumulative impact
  - Where possible, the assessment method has been quantitative in nature; however, qualitative assessment has also been undertaken for certain environmental aspects
  - Where quantitative assessment has been possible, the significance of impact has been assessed in comparison to the same criteria or guidelines adopted by the relevant technical impact assessments in chapters 8 to 21
  - Where impacts could only be expressed qualitatively, the probability, duration and magnitude/intensity of the impacts have been considered as well as the sensitivity and value of the receiving environmental conditions
- An assessment matrix method (further detailed within Section 22.4.3) has been developed and adopted by each of the projects in the Inland Rail Program, which is used to determine the significance of cumulative impacts with respect to beneficial or detrimental effects and gain consistency in approach
- Where cumulative impacts are deemed to be of 'medium' or 'high' significance, additional mitigation measures are proposed, beyond those already proposed by the relevant technical impact assessments.
- The assessment provides a level of significance for each environmental aspect based on all the projects considered in the cumulative impact assessment; however, for some environmental aspects, the level of significance has been assessed for each project or for a combination of projects (e.g. construction noise, social, traffic, transport and access).
- The final level of significance has not been reported for some environmental aspects, owing to the inherent nature of their original impact assessment; that is, the impact assessment approach has already incorporated the potential cumulative impacts of other projects into the assessment (e.g. air quality dispersion modelling, refer Chapter 12: Air Quality, hydrological modelling, refer Chapter 13: Surface Water and Hydrology, economic impact assessment, refer Chapter 17: Economics).

22.4.2 Discipline approach to cumulative impact assessment

A summary of the assessment approach adopted by each discipline in assessing cumulative impacts for the Project is presented in Table 22.2.

TABLE 22.2: DISCIPLINE APPROACH TO CUMULATIVE IMPACT ASSESSMENT

Discipline	Section	Assessment approach	Assessment matrix
Land use and tenure	Section 22.6.1	Qualitative	Inland Rail (refer Section 22.4.3.1)
Land resources	Section 22.6.2	Qualitative	Inland Rail (refer Section 22.4.3.1)
Landscape and visual amenity	Section 22.6.3	Qualitative	Inland Rail (refer Section 22.4.3.1)
Flora and fauna	Section 22.6.4	Quantitative	Inland Rail (refer Section 22.4.3.1)
Air quality (construction only)[1]	Section 22.6.5	Qualitative	Inland Rail (refer Section 22.4.3.1)
Surface water	Section 22.6.6.1	Qualitative	Inland Rail (refer Section 22.4.3.1)
Hydrology	Section 22.6.6.2	Quantitative	N/A—Included in assessment of Project impacts. The Existing Case and Developed Case modelling process is followed for all infrastructure projects that may impact the investigation; therefore, cumulative impacts have been addressed. The model outputs are provided in Appendix M: Flooding and Hydrology.
Groundwater	Section 22.6.7	Qualitative	Inland Rail (refer Section 22.4.3.1)
Noise and vibration	Section 22.6.8	Qualitative	Inland Rail (refer Section 22.4.3.1)
Social	Section 22.6.9	Qualitative	*New South Wales Social Impact Assessment Guideline* (Department of Planning and Environment (DPE), 2017) (Refer Section 22.4.3.2)
Economics	Section 22.6.10	Qualitative and quantitative	N/A—Assessed qualitatively and quantitively as part of the economic impact assessment (refer Chapter 17: Economics)
Cultural heritage	Section 22.6.11	Qualitative	Inland Rail (refer Section 22.4.3.1)
Traffic, transport, and access	Section 22.6.12	Qualitative	Inland Rail (refer Section 22.4.3.1)
Hazard and risk	Section 22.6.13	Qualitative	Inland Rail (refer Section 22.4.3.1)
Waste management	Section 22.6.14	Qualitative	Inland Rail (refer Section 22.4.3.1)

Table note:
1. Assessment of operational air quality cumulative impacts has been included in the assessment of Project impacts (refer to Chapter 12: Air Quality and Appendix P: Operational Railway Noise and Vibration)

22.4.3 Assessment matrices

22.4.3.1 Inland Rail assessment matrix

Following the identification of each potential cumulative impact, the Inland Rail assessment matrix (developed and adopted by each of the projects in the Inland Rail Program) is applied to determine the significance of cumulative impacts, with respect to beneficial or detrimental effects, and gain consistency in approach. Relevance factors (low, medium or high) were assigned to each potential impact in accordance with the assessment matrix presented in Table 22.3. Relevance factors account for:

- Probability of impact—what is the likelihood of the impact occurring?
- Duration of impact—how long will the impact occur for? For example, operation will be for a long time; therefore, it will have a high impact
- Magnitude/intensity of impact—how significant will the impact be on the sensitive receptor being considered?
- Sensitivity of receiving environment—how sensitive is the receptor being impacted? For example, is the receptor endangered?

The significance of the impact has been determined by using professional judgement to select the most appropriate relevance factor for each impact characteristic in Table 22.3 and summing the relevance factors. The sum of the relevance factors determines the impact significance and consequence, which are summarised in Table 22.4. For example, if a specific matter, such as groundwater, was considered to have a probability of impact of 2, duration of impact of 3, magnitude/intensity of impact of 1 and a sensitivity of receiving environment of 1, then the significance of impact would be (2+3+1+1 = 7) = Medium.

TABLE 22.3: ASSESSMENT MATRIX

	Relevance factor		
Impact characteristic	**Low**	**Medium**	**High**
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

TABLE 22.4: IMPACT SIGNIFICANCE

Impact significance	Sum of relevance factors	Consequence
Low	1–6	Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general Project monitoring program.
Medium	7–9	Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
High	10–12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

The outcome of the significance assessment indicates whether identified impacts can adopt standard mitigation measures (low), should develop specific mitigation measures (medium) or alternatives are to be considered (high). The key mitigation measures to reducing the potential cumulative impacts of the Project that are identified in this chapter are presented in the mitigation measures sections of Chapter 8 to Chapter 21 and in Chapter 23: Draft Outline Environmental Management Plan (Draft Outline EMP). When assessing potential impacts from other projects (refer Section 22.5) it is reasonably assumed that these projects will each comply with the conditions of their approval from the relevant regulator and so have an acceptable and similar level of impact mitigation to the Project.

22.4.3.2 NSW Social Impact Assessment Guidelines assessment matrix

The Queensland *Social impact assessment guideline* (SIA Guideline) (Department of State Development, Infrastructure and Planning, 2013b) does not include a significance or risk assessment matrix; therefore, the social risk matrix from the NSW SIA Guideline (DPE, 2017) as shown in Table 22.5 has been applied in the assessment of Project impacts (refer Chapter 16: Social).

The likelihood of social impacts and opportunities occurring has been assessed with reference to the social baseline (e.g. findings regarding community vulnerabilities), stakeholder inputs and EIS technical findings.

'Consequence', as defined in Table 22.6, has been assessed based on how the social impact may be experienced by the relevant stakeholders, considering the:

- Duration of impacts and benefits, being either short-term (during construction) or long-term (during operation)
- Sensitivity, including specific vulnerabilities and resilience to impacts
- Severity of potential effects on stakeholders and magnitude of potential benefits.

TABLE 22.5: RISK ASSESSMENT RATINGS, NSW SOCIAL IMPACT ASSESSMENT GUIDELINE

Likelihood		Consequence level				
		1 Minimal	2 Minor	3 Moderate	4 Major	5 Catastrophic
A	Almost certain	A1	A2	A3	A4	A5
B	Likely	B1	B2	B3	B4	B5
C	Possible	C1	C2	C3	C4	C5
D	Unlikely	D1	D2	D3	D4	D5
E	Rare	E1	E2	E3	E4	E5

Significance of Social Impact Ratings

Low Moderate High Extreme

Project benefits and opportunities

Source: DPE, 2017.

TABLE 22.6: CONSEQUENCE CRITERIA, NSW SOCIAL IMPACT ASSESSMENT GUIDELINES

Rating	Impact (-)	Benefit (+)
Minimal	Local, small-scale, easily reversible change on social characteristics, or the values of the community of interest, or communities can easily adapt or cope with change	Local small-scale opportunities emanating from the Project that the community can readily pursue and capitalise on
Minor	Short-term recoverable changes to social characteristics and values of the communities of interest, or the community has substantial capacity to adapt and cope with change	Short-term opportunities emanating from the Project
Moderate	Medium-term recoverable changes to social characteristics and values of the communities of interest, or the community has some capacity to adapt and cope with change	Medium-term opportunities emanating from the Project
Major	Long-term recoverable changes to social characteristics and values of the communities of interest, or the community has limited capacity to adapt and cope with change	Long-term opportunities emanating from the Project
Catastrophic	Irreversible changes to social characteristics and values of the communities of interest, or the community has no capacity to adapt and cope with change	Not applicable

Source: Adapted from Department of State Development, Infrastructure and Planning (DSDIP) (Qld) *Social impact assessment guideline* (2013b).

22.5 Assessable projects

Based on the criteria listed in Section 22.2, the projects required to be included in the CIA are summarised in Table 22.7. Projects excluded from the CIA are listed in Table 22.8.

The location of each included project is shown in Figure 22.1, while Table 22.9 presents the anticipated construction timing of each of the assessable projects in relation to the Project.

TABLE 22.7: PROJECTS INCLUDED IN THE CUMULATIVE IMPACT ASSESSMENT

Project and proponent	Location	Description	Source	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria^	Relationship to the proposal
Border to Gowrie Inland Rail project (B2G) (ARTC)	Rail alignment from NSW/Queensland Border to Gowrie	Approximately 146 km of new dual-gauge track and 78 km of upgraded track from the NSW/Queensland border, near Yelarbon, to Gowrie Junction, north west of Toowoomba in Queensland.	**eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Border%20to%20Gowrie/IAS/final-initial-advice-statement-final-part-1-of-5.pdf**	Proponent currently preparing EIS	2021–2026 Jobs: Peak 950 full-time equivalent (FTE)	> 50 years Jobs: Average 10–15 FTE	b) and c)	Overlap of the project's construction footprint and schedule, resulting in conflict in demand for construction resources and additional traffic on arterial roads
Helidon to Calvert Inland Rail project (H2C) (ARTC)	Rail alignment from Helidon to Calvert	The H2C project will include the following: ▸ 47 km single-track dual-gauge freight rail line to accommodate double-stacked freight trains up to 1,800 metres (m) long ▸ Tunnel through the Little Liverpool Range	**eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Helidon%20to%20Calvert/IAS/h2c-initial-advice-statement.pdf**	Proponent currently preparing EIS	2021–2026 Jobs: Peak 410 FTE	> 50 years Jobs: Average 15–20 FTE	b) and c)	Overlap of the project's construction footprint and schedule, resulting in conflict I demand for construction resources and additional traffic on arterial roads
Calvert to Kagaru Inland Rail project (C2K) (ARTC)	Rail alignment from Calvert to Kagaru	The C2K project will include 53 km dual-gauge track and a 1.1 km tunnel through the Teviot Range	**eisdocs.dsdip.qld.gov.au/Inland%20Rail%20Calvert%20to%20Kagaru/IAS/initial-advice-statement.pdf**	Proponent currently preparing EIS	2021–2026	>50 years Jobs: Average 15–20 FTE	b) and c)	Overlap of construction with G2H and C2K resulting in conflict in demand for construction resources and additional traffic on arterial roads
Kagaru to Acacia Ridge and Bromelton Inland Rail project (K2ARB) (ARTC)	Rail corridor from Kagaru to Acacia Ridge and Bromelton	Enhancing and connecting the existing rail corridor (approximately 49 kilometres (km)) from north-east of Kagaru to Acacia Ridge and from south of Kagaru to Bromelton	Application for coordinated project status currently under consideration by the Coordinator-General	Proponent awaiting coordinated project decision by the Coordinator-General	2023–2025 Jobs TBA	> 50 years Jobs TBA	c)	Potential overlap of construction for G2H and commencement for K2ARB

Project and proponent	Location	Description	Source	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria^	Relationship to the proposal
InterLinkSQ—Global Logistics Centre (InterLinkSQ)	13 km west of Toowoomba	200 hectares (ha) of new transport, logistics and business hubs. Located on the narrow-gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego, and New England Highways.	**interlinksq.com.au/**	Operational—subjection to continuing construction	2017–2037	- Jobs: 1,500	c)	Ongoing development could result in competition for construction resources and workforce. There may also be an increase in heavy vehicles using the surrounding highways.
Wellcamp Business Park (Wagner)	Wellcamp, Queensland	The park is a 500-ha industrial and commercial park that forms part of the Toowoomba Enterprise Hub. The Business Park is located in close proximity to the Toowoomba Wellcamp Airport and other major transportation infrastructure.	**wagnercorporation.com.au/business-park/the-right-home-for-business/**	Operational—subject to continuing construction and expansion	Ongoing	Ongoing	c)	Located approximately 7 km south-west of the Project alignment
Witmack Industry Park and Charlton Logistics Park (FKG Group) (part of the Toowoomba Enterprise Hub)	Wellcamp, Queensland	The Witmack Industry Park is a large industrial land development that offers large size industrial land parcels. Businesses situated within the Witmack Industrial Park include the Toowoomba Pulse Data Centre. The Charlton Logistics Park is part of the Toowoomba Enterprise Hub and provides fully serviced 2-ha sites and is well situated for potential transport and logistics operators due to its proximity to transport infrastructure.	**tsbe.com.au/sites/default/files/uploaded-content/field_f_content_file/tsb_1702093_fact_sheet_-_toowoomba_enterprise_hub_hr.pdf**	Operational—subject to continuing construction and expansion	Ongoing	Ongoing	c)	Located approximately 4 km south-west of the Project alignment

Project and proponent	Location	Description	Source	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria^	Relationship to the proposal
Toowoomba Wellcamp Airport (Wagner)	Wellcamp, Queensland	The airport operates as an international cargo hub, connecting Australia's leading primary producers and processors with growing consumer markets across the globe. The airport was constructed over 19 months from 2012 to 2014 and is the first major greenfield public airport development in Australia in over 50 years.	**wellcamp.com.au/**	Operational with expansion proposed	Ongoing	Ongoing	c)	Located approximately 8.5 km south-west of the Project. Operational impacts associated with landscape and visual amenity are likely to affect the Project region's scenic character; however, community members are likely to adapt to the landscape changes over time.
Asterion Medicinal Cannabis Facility	Wellcamp, Queensland Adjoins the Project footprint 1 km south of Toowoomba–Cecil Plains Road	A high-tech medicinal cannabis cultivation, research, and manufacturing facility. The project involves construction of a 40-ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal-grade cannabis grown at the facility will be manufactured into a range of medicinal products, including single patient packs, cannabis oils, gels, salts, and related products, destined solely for the medicinal market. This facility is anticipated to be the largest facility of its kind in the world.	**asterioncannabis.com/investors/news/index.php?content_id=68**	Under construction	2020–2021 Jobs: 800	Ongoing once complete Jobs: 150	c)	There may be a brief overlap in 2021 between the conclusion of construction for the Asterion Medicinal Cannabis Facility and the commencement of early works activities for the Project

Project and proponent	Location	Description	Source	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria^	Relationship to the proposal
Bromelton State Development Area (SDA) (Queensland Government)	Bromelton, Queensland	Delivery of critical infrastructure within the Bromelton SDA will support future development and economic growth. This includes a trunk water main and the Beaudesert Town Centre Bypass. This infrastructure provides opportunities to build on the momentum of current development activities by major landholders in the SDA.	**statedevelopment.qld.gov.au/resources/project/bromelton/bromelton-sda-development-scheme-dec-2017.pdf**	The current version of the Bromelton SDA Development Scheme was approved by Governor in Council, December 2017	2016–2031	Unknown	c) and d)	Ongoing development at the Bromelton SDA could result in competition for construction resources and workforce.
Gatton West Industrial Zone (GWIZ) (Lockyer Valley Regional Council (LVRC))	3 km north west Gatton	Industrial development including a transport and logistics hub on the Warrego Highway	**corelogic.com.au/cordell/1795307**	N/A	2019–2024 Jobs: 13.5 FTE	Unknown Jobs: 36.3 FTE	c)	May increase road traffic and the need for rail resources during both construction and operation
Defence Housing Authority Mount Lofty Development (DHA)	Toowoomba, suburb of Mount Lofty	Former rifle range redeveloped into a master-planned residential community comprising of 342 lots. Some lots will be retained by DHA, on which homes will be built for Defence members and their families, with remaining lots available for public purchase.	**dha.gov.au/development/residential/mount-lofty-toowoomba-qld**	Lodged a DA with TRC on 12 June 2018 (DA reference number MCUI/2018/2861), which has been withdrawn. The project is a controlled action (EPBC referral (2018/8198)) being assessed by preliminary documentation. On hold.	Unknown	Unknown	c)	Located approximately 1.7 km to the south of the Project. Clearing activities for both projects could have cumulative impacts on the natural landscape, including threatened species (e.g. habitat loss) and scenic amenity.

Project and proponent	Location	Description	Source	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria^	Relationship to the proposal
New Acland Coal Mine Stage 3—New Acland Coal Pty Ltd (a subsidiary of New Hope Corporation Limited)	35 km north-west of Toowoomba	Expansion of the existing New Acland open-cut coal mine to up to 7.5 million tonnes per annum	**statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/new-acland-coal-mine-stage-3-project**	Operational with ongoing expansion projects	Ongoing	Sequential development of resource areas expected to extend coal production until 2042	c)	Ongoing development could result in competition for construction resources and workforce. There may also be an increase of heavy vehicles using the surrounding highways during the construction period.
Wetalla Water Pipeline (New Acland Coal Pty Ltd)	From the Wetalla Wastewater Reclamation Facility in Toowoomba to the New Acland Mine, 35 km northwest of Toowoomba	A 45-km underground water pipeline to supply up to 5,500 megalitres (ML) of treated wastewater to the New Acland coal mine	**statedevelopment.qld.gov.au/coordinator-general/assessments-and-approvals/coordinated-projects/completed-projects/wetalla-water-pipeline-project**	EIS approved with conditions in 2008. The Wetalla Water Pipeline has been completed.	Unknown	To support water requirements for the extension of coal production at the New Acland Mine (until 2042)	c)	Associated with the New Acland Coal Mine Stage 3 expansion (New Hope). The Project directly impacts this pipeline and subject to a commercial agreement with New Hope ARTC may source recycled water from the pipeline to support construction
TRC Waste Management Facility (TRC)	Wyreema, Queensland	A new waste transfer facility that caters for the Toowoomba Region's Northern and Southern Growth Corridors. Will replace the existing Greenmount landfill and was previously a sewage treatment plant.	**tr.qld.gov.au/environment-water-waste/waste-recycling/waste-facilities-rubbish-tips**	Design is currently underway with development assessment application lodged in July/August 2019	Expected to be completed in 2022	Unknown	c)	Potential for cumulative traffic and social impacts to the region

Table notes: LVRC = Lockyer Valley Regional Council; TRC = Toowoomba Regional Council

^ - Selection criteria based on the criteria outlined in Section 22.2:

a) Have been declared a 'coordinated project' by the Coordinator-General under the SDPWO Act and an EIS is currently being prepared or is complete, or an Initial Advice Statement is available on the DSDILGP website

b) May use resources located within the region (including materials, groundwater, road networks or workforces) that are the same as those to be used by the Project

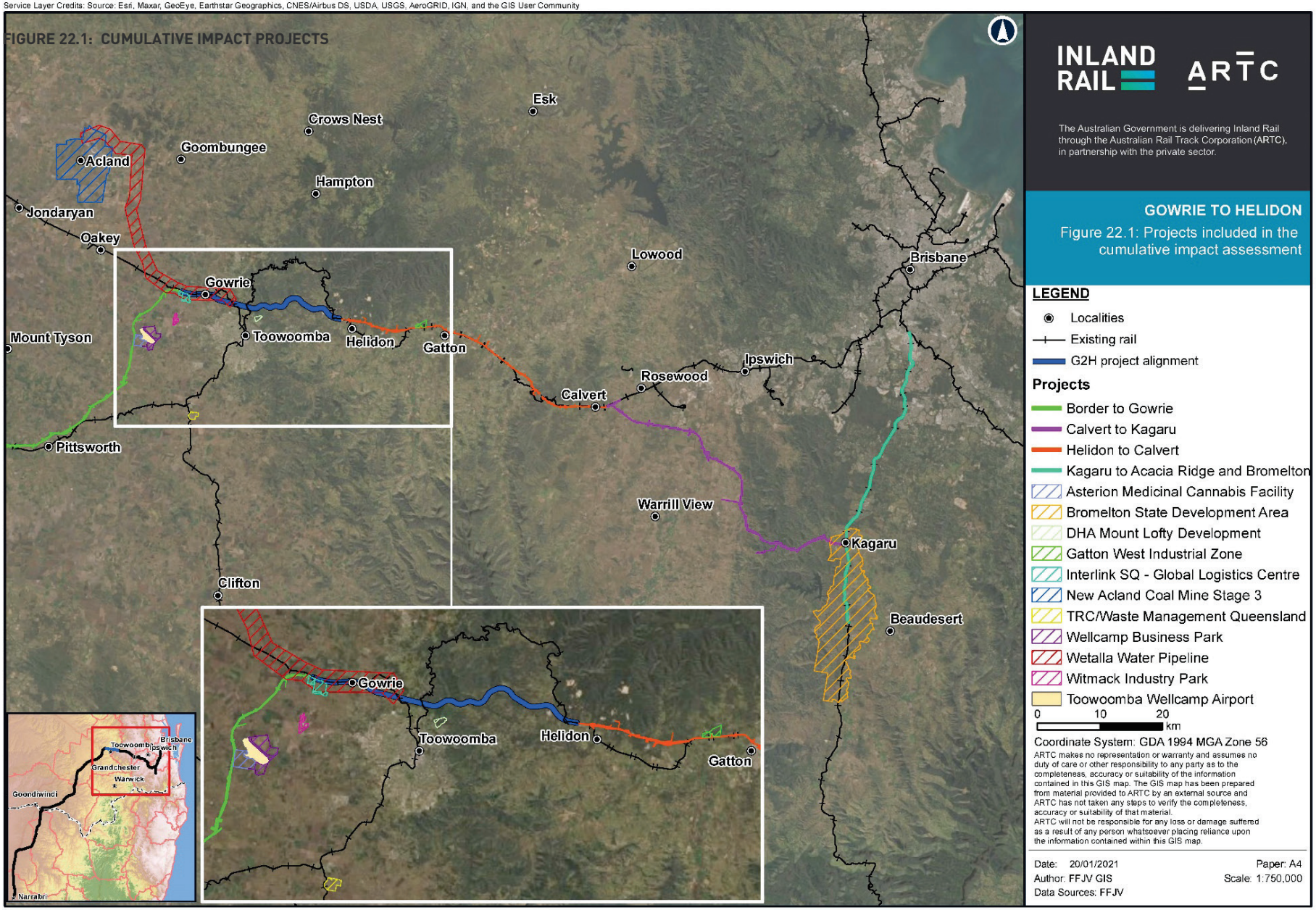
c) Could potentially compound residual impacts that the Project may have on environmental aspects.

TABLE 22.8: EXCLUDED PROJECTS

Project and proponent	Location	Description	Source	Project status	Reason for discounting from cumulative assessment
Cross River Rail (Queensland Government)	Brisbane City	A new north–south rail line connecting Dutton Park to Bowen Hills under the Brisbane River and CBD	**statedevelopment.qld.gov.au/assessments-and-approvals/cross-river-rail-project.html**	EIS Complete. New lapsed date for the Coordinator-General's Environmental Impact Statement evaluation report on 31 December 2025 at the time of writing.	Has been considered as part of the social impact analysis in Section 22.6.9 due to the similarity in project resources, along with the traffic and transport assessment (refer Section 22.6.12)
Brisbane Metro Network (Brisbane City Council)	Brisbane City	Construction of a 21 km-long turn-up-and-go service with two lines from Eight Mile Plains to Roma Street, and Royal Brisbane Women's Hospital to the University of Queensland	**brisbane.qld.gov.au/traffic-and-transport/public-transport/brisbane-metro/about-brisbane-metro**	First stage has commenced	Has only been considered as part of the social impact analysis in Section 22.6.9 due to the similarity in project resources
Gold Coast Light Rail Stage 3 (Department of Transport and Main Roads (DTMR))	Gold Coast	Stage 3 will expand the tram network to 27 km from Helensvale to Burleigh Heads	**goldcoast.qld.gov.au/gold-coast-light-rail-53512.html**	Construction due to commence 2021	Has only been considered as part of the social impact analysis in Section 22.6.9 due to the similarity in project resources
Baillie Henderson Hospital	Queensland Government	Darling Downs health is progressing the detailed business case for a new Toowoomba Hospital on the Baillie Henderson hospital campus	**health.qld.gov.au/darlingdowns/our-projects/toowoomba-hospital-redevelopment/project-information**	Detailed business case expected to be completed in 2021	Detailed business case has not been finalised. There is not enough publicly available information to consider this project.
Royal Australian Air Force (RAAF) Base Amberley future works (Department of Defence)	RAAF Base Amberley	White paper dedicated future upgrades to RAAF Base Amberley at a cost of $1 billion	**defence.gov.au/id/_Master/docs/Economic/KPMGRAAFAmberleyReport.pdf**	N/A	Not considered due to the distance of this project from the G2H Project
Remondis Waste to Energy Facility (Remondis)	Swanbank Industrial Estate	Remondis has announced plans to build a $400 million waste to energy facility in Swanbank, south of Ipswich	**statedevelopment.qld.gov.au/assessments-and-approvals/remondis-waste-to-energy-facility.html**	Proponent awaiting draft terms of reference for EIS	Not considered due to the distance of this project from the G2H Project

Project and proponent	Location	Description	Source	Project status	Reason for discounting from cumulative assessment
Pittsworth Industrial Precinct and Enabling Project	Pittsworth, Queensland 500 m to the south of the Project footprint	Road and sewerage upgrades at the Pittsworth Industrial Precinct to allow for industrial land for industries servicing agriculture and the wider region	**tr.qld.gov.au/testcat/pittsworth-industrial-precinct-enabling-project-brochure/viewdocument/1512**	Operational	Has been only considered as part of the landscape and visual impact assessment in Section 22.6.3 due to its presence within the wider LVIA study area
Yarranlea Solar	Yarranlea, Queensland Intersects the Project footprint, generally extends equally to north and south	Solar Farm that will have a generation capacity of up to 100 megawatts (MW) once completed	**yarranleasolar.com.au/yarranlea-solar-farm/**	Operational	Not considered due to the distance of this project from the G2H Project. Has been considered as part of the landscape and visual impact assessment in Section 22.6.3 due to its presence within the wider LVIA study area.

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: MEF/DTH Z:\GIS\GIS_3200_G2H\Tasks\320-EAP-202002261019_Cumulative\320-EAP-202002261019_ARTC_Fig_22.1_CumulativeImpacts_v2.mxd Date: 20/01/2021 15:04

TABLE 22.9: CUMULATIVE PROJECT TIMING

Project	Estimated construction timeframe	Overlap in construction periods by project year
		1 2 3 4 5 6 7 20
The Project (Gowrie to Helidon)	2022–2026	
B2G (part of Inland Rail)	2021–2026	
H2C (part of Inland Rail)	2021–2026	
C2K (part of Inland Rail)	2021–2026	
K2ARB (part of Inland Rail)	2023–2025	
InterLinkSQ	2017–2037	
Wellcamp Business Park	Ongoing	
Witmack Industry Park and Charlton Logistics Park	Ongoing	
Toowoomba Wellcamp Airport	Ongoing	
Asterion Medicinal Cannabis Facility	Unknown— Estimated 2020 to 2021	
Bromelton SDA	2016–2031	
Gatton West Industrial Zone	2019–2024	
DHA Mount Lofty Development	2019–TBC	
New Acland Coal Mine Stage 3	Ongoing — Estimated 2022 to 2023	
Wetalla Water Pipeline	Ongoing	
TRC Waste Management Facility	Expected to be completed in 2022	

22.6 Summary of cumulative impacts and mitigation measures

The following sections present a summary of the cumulative impacts undertaken for each specific environmental aspect, with detailed assessments provided in Chapter 8 to Chapter 21 and, where applicable, the supporting technical reports.

Cumulative impacts could be temporal in nature (e.g. traffic movements) or spatial (e.g. habitat loss). The initial construction of a project is typically more likely to result in the most material impacts as the project is new to the location and the amount of disturbance and activity to get the project established is at a peak. Once a project is established and operational, new disturbance impacts are typically restricted to expansion activities. The impacts of a project once operational are often stabilised or have reached a steady state that is below that at the peak of construction. It is for this reason that this cumulative impact assessment has generally focused on the potential of the Project to contribute to cumulative impacts during construction. Exceptions to this are noted where they occur.

22.6.1 Land use and tenure

It is recognised that the Project will contribute to cumulative impacts on land use; particularly, in relation to land acquisition and changes in land use. Primarily, these impacts relate to the removal of agricultural land for development of the rail corridor.

The AOI for cumulative land use and tenure impacts was defined by placing an approximately 2-km buffer around the proposed alignment for the Project. This radius was chosen because direct and indirect land use and tenure impacts are considered to be localised to the area within which a project is occurring. Based on this criterion, nine projects have been included in the assessment of cumulative impacts on land use and tenure. These projects are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ
- Wellcamp Business Park
- Witmack Industry Park and Charlton Logistics Park
- Gatton West Industrial Zone
- DHA Mount Lofty Development
- New Acland Coal Mine Stage 3
- TRC Waste Management Facility.

There may be an overlap between the conclusion of construction for the Asterion Medicinal Cannabis Facility and the potential commencement of early works activities for the Project; however, it is anticipated that by this point the footprint for the Asterion Medicinal Cannabis Facility will have been established, so new impacts to land use and tenure from this development will no longer be occurring.

The combined land requirements of these projects have the potential to result in cumulative impacts associated with:

- Loss of Class A and Class B agricultural land, and land within an important agricultural area (IAA)
- Disruption to agricultural operations
- Impacts on accessibility within the wider road network and to private properties
- Temporary disruption to services and utilities.

Due to a lack of publicly available quantitative data on land use and tenure impacts for the projects specified above, a qualitative assessment method has been applied for assessing the cumulative impacts.

Assessment of these cumulative impacts for the potential impacts identified above is detailed in Chapter 8: Land Use and Tenure and summarised in Table 22.10. The significance of the overall cumulative impact on land use and tenure is assessed as **low**. The following factors contributed to this determination:

- The Project has been positioned to maximise the use of existing rail corridors, and the Gowrie to Grandchester future state transport corridor, and does not preclude a high-speed passenger service at a future date. This is consistent with State land-use planning expectations for the region.

- The Project provides connection between the Inland Rail and QR at Gowrie and Helidon, along with a spur line into Toowoomba. The Project also includes a 6.24 km tunnel under the localities of Cranley, Mount Kynoch and Ballard.
- InterLinkSQ is strategically located adjacent to the existing West Moreton Line and in proximity to the Warrego Highway and Toowoomba Wellcamp Airport. InterLinkSQ is not a component part of Inland Rail; however, once operational, Inland Rail will enable the operational potential of developments such as InterLinkSQ to be maximised, with the design considering tie-ins with the facility and from the facility into the QR network.

Where land is acquired for the Project by the compulsory acquisition process, in accordance with the *Acquisition of Land Act 1967* (Qld) (AL Act), the affected landholder will be compensated. Compensation will be assessed on an individual basis, based on the market value of the land as at the date of resumption. Additional compensation amounts for disturbance caused by the resumption of a property will also be payable.

The Inland Rail projects will also provide for a more efficient and modern route connecting south west Queensland and south east Queensland, which is in line with the objectives of a number of regional and local plans, and the intent of the Gowrie to Grandchester future state transport corridor.

The Project has been assessed against the intent of the *State Planning Policy* (SPP) (Department of Infrastructure, Local Government and Planning (DILGP), 2017b), *South East Queensland Regional Plan* (ShapingSEQ) (DILGP, 2017a) and the *Darling Downs Regional Plan* (DSDIP, 2013a) and has been determined to be consistent with the objectives of each (refer Chapter 8: Land Use and Tenure).

TABLE 22.10: CUMULATIVE IMPACT ASSESSMENT FOR LAND USE AND TENURE

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Loss of Class A and Class B agricultural land within an IAA	Probability of the impact	1	6	Low	Land uses of projects considered in this CIA differ from that of the Project, e.g. land use impacts differ from site-based developments compared to a linear transport infrastructure project (e.g. the Project). Consequently, land use impacts differ accordingly. There is limited potential for cumulative impacts given the relatively limited land use and tenure impacts associated with the Project. Where the permanent disturbance footprint is located within the QR West Moreton System rail corridor and Gowrie to Grandchester future state transport corridor, the Project is consistent with existing and future state land use planning for the area. In addition, where the Project is located in the proposed Toowoomba Range Tunnel, impacts to land uses aboveground are minimised. The B2G and H2C projects immediately adjoin the Project and are expected to have similar land use and tenure impacts. Land use and tenure impacts from other projects (including upgrades to existing infrastructure or large-scale major land development projects that could potentially generate a cumulative
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Disruption to agricultural operations	Probability of the impact	1	6	Low	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Impacts on accessibility to the area within the road network and to private properties	Probability of the impact	1	6	Low	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Temporary disruptions to services and utilities	Probability of the impact	1	6	Low	impact on land use and tenure) are considered to be localised. Furthermore, the implementation of mitigation measures for all projects will further minimise land use and tenure impacts. Additional mitigation is not required as the cumulative impact is considered to be low.
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			

22.6.2 Land resources

Multiple projects occurring in close proximity to the Project may potentially exacerbate impacts on the region's soil properties as well as agricultural and contaminated land. The major potential impacts identified as a result of the Project are common to all projects throughout the region and are, therefore, cumulative in nature. As a result, five projects were identified as having the potential to contribute to land resources impacts. These are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ
- DHA Mount Lofty Development
- New Acland Coal Mine Stage 3.

These projects mostly comprise of rail-related infrastructure development. The five projects were considered due to their location in relation to the Project and their potential impacts to land resources during construction and operational phases.

The potential impacts that are likely to be common for the five projects in the region, if not managed appropriately, may include:

- Soil conditions not appropriately characterised
- Leaks or spills leading to migration of contaminants
- Loss of soil resources
- Disturbance to existing contaminated land
- Disturbance of ASS
- Changes to landform and topography
- Salinity hazard
- Erosion potential—leading to increased total dissolved solids in run off
- Introduction of invasive flora and fauna.

Assessment of these cumulative impacts for the potential impacts identified above is detailed in Chapter 9: Land Resources and summarised in Table 22.11. The significance of the overall cumulative impact on land resources is assessed as **low**.

Impacts, including loss of soil resources, change to landform and topography, and erosion have been assessed as medium significance. Initial controls for the management of these potential cumulative impacts are based on the implementation of the measures prescribed in Chapter 23: Draft Outline Environmental Management Plan.

The following factors contributed to this determination:

- The Project has been aligned to be co-located with existing rail and road infrastructure, where possible, minimising the need to develop land and modify landform that has not previously been subject to disturbance for transport infrastructure purposes
- The Project design includes a 6.24-km tunnel under the localities of Cranley, Mount Kynoch and Ballard, along with a series of viaducts minimising the extent of change to the landforms of the Great Dividing Range
- The site-based developments may result in impacts to land resources; however, the nature of these impacts is likely to differ to those generated by a large-scale, linear infrastructure project
- It is assumed that adjoining projects that are yet to be constructed will achieve landform stability once established and operational.

Soil conditions across the Project footprint will continue to be characterised (at a suitable scale) with identification of potential/actual problematic soils, including: acid sulfate, reactive, erosive, dispersive, saline, acidic, alkaline and liberation of contaminant(s) by a suitably qualified soil practitioner; to ensure that the design of structures, embankments, erosion control measures (temporary and permanent), soil treatment and management, and site rehabilitation planning are reflective of site-specific soil conditions. Once obtained, the additional soil data will be used in combination with existing soils data to reassess the potential for cumulative impacts to arise.

Consultation with potentially affected landholders and other stakeholders, including QR and InterLinkSQ, which interface with this Project, may result in additional mitigation measures of relevance being identified during the detailed design process. In such instances, additional mitigation measures will be incorporated into relevant components of the Construction Environmental Management Plan (CEMP), if appropriate to do so.

TABLE 22.11: CUMULATIVE IMPACT ASSESSMENT FOR LAND RESOURCES

Potential cumulative impacts	Impact characteristics	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Soil conditions in the proposed area are not appropriately characterised to inform what the railway corridor will encounter, how it will be impacted and when it will be impacted. This includes the identification of reactive soils, erosive soils, dispersive soils, saline and sodic soils, contaminated land.	Probability of the impact	1	4	Low	Once the final disturbance footprint is known, a suitably qualified person will undertake an assessment as to whether additional soil samples will be required to meet management requirements. Will be managed by CEMP and relevant Sub-plan(s). Specific conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program.
	Duration of the impact	1			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Leaks or spills leading to migration of contaminants through surface water/soil/groundwater or increased human health risk through ingestion/dermal contact to contaminants from: ▸ Permanent/mobile fuel/chemical storage ▸ Waste storage areas/facilities ▸ Proposal infrastructure	Probability of the impact	2	6	Low	Will be managed by a Contaminated Site Management Plan and specific conditions are unlikely to be necessary. Monitoring to be undertaken as part of the Project's CEMP.
	Duration of the impact	2			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			

Potential cumulative impacts	Impact characteristics	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Permanent loss of soil resources within the permanent footprint	Probability of the impact	2		Medium	Mitigation measures are likely to be necessary and specific management and design practices are to be applied. Specific conditions are likely. Targeted monitoring program required through CEMP to identify IAA disturbance from works.
	Duration of the impact	2			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	1			
Disturbance to existing contaminated land and acid sulfate soils (ASS) (including the potential to disturb ASS)	Probability of the impact	1	6	Low	Negative impacts need to be managed by standard environmental management practices. Special conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program.
	Duration of the impact	2			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	1			
Change to landform and topography	Probability of the impact	2	7	Medium	Mitigation measure likely to be necessary and specific management practices to be applied. Specific conditions are likely. Targeted monitoring program required, where appropriate.
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Salinity hazard (insitu, soil)	Probability of the impact	2	6	Low	Negative impacts will be managed by standard environmental management practices. Special conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program.
	Duration of the impact	2			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Erosion	Probability of the impact	2	7	Medium	Will be managed by an Erosion and Sediment Control Plan. Specific conditions are unlikely to be necessary. Monitoring to be part of the general Project monitoring.
	Duration of the impact	2			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	1			

Potential cumulative impacts	Impact characteristics	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Weed management	Probability of the impact	1	4	Low	Will be managed by CEMP and relevant sub-plan(s), for example ARTC's Biosecurity Management Plan. Specific conditions unlikely to be necessary. Monitoring to be part of general Project monitoring program.
	Duration of the impact	1			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Feral animal management	Probability of the impact	1	4	Low	Will be managed by CEMP and relevant sub-plan(s), for example ARTC's Biosecurity Management Plan. Specific conditions are unlikely to be necessary. Monitoring to be part of the general Project monitoring.
	Duration of the impact	1			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			

22.6.3 Landscape and visual amenity

The Project AOI that was considered for the landscape and visual amenity (LVIA) CIA was determined to be wider than the LVIA study area presented in Chapter 10: Landscape and Visual Amenity (i.e. 10-km wide area offset from the centreline of the Project alignment), due to the potential for sequential impacts, e.g. when driving through the landscape. Consequently, the LVIA AOI extends 50 km (approximately 30 minutes' drive or more). Beyond this distance, it is considered that there would be no reasonable expectation of cumulative landscape or visual impact being registered by a receptor.

For the purposes of the LVIA, projects that are within the AOI and will have temporal overlap in construction or expansion activities are considered to have potential to result in cumulative impacts. As a result, 12 projects were identified as having the potential to contribute to LVIA impacts. These are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- C2K (Inland Rail)
- InterLinkSQ
- Wellcamp Business Park
- Witmack Industry Park and Charlton Logistics Park
- Toowoomba Wellcamp Airport
- Asterion Medicinal Cannabis Facility
- DHA Mount Lofty Development
- New Acland Coal Mine Stage 3 expansion .
- Pittsworth Industrial Precinct Enabling Project
- Yarranlea Solar.

An assessment of cumulative impacts that may arise from these projects, in combination with the Project, is detailed in Chapter 10: Landscape and Visual Amenity and Appendix H: Landscape and Visual Impact Assessment and is summarised in Table 22.12. Overall, the cumulative landscape and visual impact assessment in the region is likely to be up to medium significance. Localised enhancements, e.g. buffer planting, may enhance outcomes and minimise localised impacts on particular receptors.

The following factors contributed to this determination:

- In terms of temporal (construction) impact, it is likely that the other sections of Inland Rail (i.e. B2G and H2C), Asterion Medicinal Cannabis Facility and InterLinkSQ may have some overlap in construction periods. Collectively, these projects have the potential to result in the perception of relatively high amounts of construction activity, and views of the movement of heavy vehicles and plant in the assessment area.
- The locations in the assessment area most likely to be affected by construction cumulative activity are the Toowoomba Bypass and Warrego Highway, with the greatest activity in the western part of the Project footprint, located west of Toowoomba. The potential for cumulative impacts during construction is considered to be of low significance, as the sight of large vehicles on the highway and main roads would be common and the construction activities will be temporary.
- The Project and the adjacent Inland Rail projects will be a perceived as a continuous section of railway.

TABLE 22.12: CUMULATIVE IMPACT ASSESSMENT FOR LANDSCAPE AND VISUAL AMENITY

Potential cumulative impacts	Impact characteristics	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Construction impacts associated with increases in views of construction traffic and construction areas	Probability of the impact	2	6	Low	Mitigation measures for the Project will allow for Project-specific impacts to be minimised. Cumulative impacts will be further reduced through the incorporation of relevant mitigation measures by other projects. In terms of the spatial (operational) impacts of other linear transport infrastructure projects, the B2G and H2C projects immediately adjoin the Project (to the west and east, respectively) and the recently constructed Toowoomba Bypass, which traverses, and is also located very close to, many parts of the Project (particularly, in the east of the AOI). Consequently, some receptors will experience views of both B2G/G2H or H2C/G2H, but this Project will, in practice, be viewed as a continuous section of railway (i.e. Inland Rai). With regard to Toowoomba Bypass, some receptors will experience views of both the Project and Toowoomba Bypass, which intensifies the impact of infrastructure on the landscapes of the LVIA study area; particularly, to the east and west of Toowoomba. The tunnelling aspect of the Project minimises this cumulative impact for part of this alignment since the Project will be hidden from view through much of the tunnelled section. Due to the low level of lighting proposed for the Project, there are not anticipated to be any significant cumulative lighting impacts associated with these projects.
	Duration of the impact	1			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	2			
Operation impacts associated with views of combined, successive, and sequential views of adjoining projects	Probability of the impact	2	9	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	2			
Impacts of night lighting	Probability of the impact	Nil	Nil	Nil	
	Duration of the impact	Nil			
	Magnitude/intensity of the impact	Nil			
	Sensitivity of the receiving environment	Nil			

22.6.4 Flora and fauna

The cumulative impacts to ecological matters (e.g. vegetation communities, and flora and fauna assemblages) of multiple projects occurring in the vicinity of the Project will likely include the continued loss of biodiversity in the Brigalow Belt and SEQ bioregion. Cumulative impacts are most appropriately considered at a biologically relevant spatial scale (e.g. 50 km from the Project disturbance footprint). The major potential impacts identified as a result of the Project are common to all projects throughout the region and are, therefore, by their nature, cumulative.

Thirteen (13) projects of the 15 identified in Table 22.7 (excluded Toowoomba Wellcamp Airport and Bromelton SDA) were considered to be in the AOI for the flora and fauna CIA, and will all result in some extent of:

- Habitat loss and degradation from vegetation clearing/removal
- Fauna species injury or mortality
- Reduction in biological viability of soil to support growth due to soil compaction
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of biodiversity corridors
- Edge effects
- Habitat fragmentation
- Barrier effects
- Noise, dust, and light
- Increase in litter (waste)
- Aquatic habitat degradation
- Erosion and sedimentation.

The potential impacts range from short-term to long-term in nature and will occur to a greater or lesser extent depending on the nature of the project. The majority of the impacts will be experienced at the construction stage, but the nature of the impacts mean they will also be experienced during operation. Further, the Project overlies a diverse array of landscapes, though in the western extent, the Project is co-located within the existing West Moreton System and overlies land extensively cleared for agricultural purposes. Of the 13 projects, only 5 (including the Project) are located in the SEQ bioregion where the majority of the impacts from the Project will occur.

The results of the significance assessment of the flora and fauna cumulative impacts are detailed in Chapter 11: Flora and Fauna and summarised in Table 22.13. Overall, the cumulative impacts on ecological matters (e.g. vegetation communities and flora and fauna assemblages) in the region is likely to be up to high (State Significant Ecological Constraint—threatened species).

As a result of the Project and other similar projects, the greatest potential predicted cumulative impacts in the Project CIA may be on the following, where the impact is of high significance:

- State Significant Ecological Constraint—threatened species (i.e. habitat for NC Act (only) listed species):
  - Slender milkvine (*Marsdenia coronata*)
  - Finger panic grass (*Digitaria porrecta*)
  - Glossy black cockatoo (*Calyptorhynchus lathami*)
  - Powerful owl (*Ninox strenua*)

A medium significance is predicted for the following matters:

- Loss of vegetation of local, regional and State significance
- Commonwealth significant ecological constraint (species) (i.e. Habitat for EPBC Act listed species (which may also be threatened under the NC Act):
  - *Paspalidium grandispiculatum* (a grass)
  - Brush sophora (*Sophora fraseri*)
  - Regent honeyeater (*Anthochaera phrygia*)
  - Collared delma (*Delma torquata*)
  - Red goshawk (*Erythrotriorchis radiatus*)

- Swift parrot (*Lathamus discolor*)
- Spotted-tail quoll (*Dasyurus maculatus maculatus*)
- Koala (*Phascolarctos cinereus*)
- Long-nosed potoroo (*Potorous tridactylus tridactylus*)
- Grey-headed flying-fox (*Pteropus poliocephalus*)

- Commonwealth significant ecological constraint (migratory species) (i.e. habitat for EPBC Act listed, non-threatened migratory species):
  - Black-faced Monarch (*Monarcha melanopsis*).

The potential contribution of the Project's activities to cumulative ecological impacts will be managed through:

- Refinement of the Project footprint through detailed design, to limit the extent of disturbance to sensitive environmental receptors to that required to enable safe and efficient construction, operation and maintenance of the Project
- Detailed ecological surveys of the Project footprint will be undertaken in parallel to the development of the detailed design. Where MNES or MSES are found to occur, condition assessment will be undertaken (using a BioCondition assessment approach). Data obtained from these detailed surveys will be used to refine the quantification of ecological impacts, revise the analysis of significant residual impacts and re-calculate offset requirements for the Project.
- Annual monitoring of MNES and MSES (or their habitat) retained within the Project footprint against the initial BioCondition assessment. Corrective actions to be implemented where Project-associated impacts are identified.

Mitigation measures are not possible for a number of these ecological values. An offset strategy for the Project, which also incorporates the other Queensland Inland Rail projects, has been developed to offset impacts on Matters of National Environmental Significance (MNES) and Matters of State Environmental Significance (MSES) Appendix Y: ARTC Offset Strategy. This strategy informs the development of offset delivery components, including a Detailed Environmental Offset Delivery Plan and Offset Area Management Plans. This strategy will also offset some of the cumulative impacts outlined.

TABLE 22.13: CUMULATIVE IMPACT ASSESSMENT FOR FLORA AND FAUNA

Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
EPBC Act					
Commonwealth significant ecological constraint (species)	Probability of the impact	2	9	Medium	As part of the Project's impact assessment of ecological values, a large range of mitigation measures have been proposed, including the use of biodiversity offsets for environmental mitigation. The implementation of mitigation measures for all projects will further minimise cumulative ecology impacts. Refer to Chapter 11: Flora and Fauna for further details of proposed mitigation measures.
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			
Commonwealth significant ecological constraint (migratory species)	Probability of the impact	1	8	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			

Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
VM Act					
State Significant Ecological Constraint—Remnant vegetation (REs) (Category B)	Probability of the impact	2	9	Medium	As part of the Project's impact assessment of ecological values, a large range of mitigation measures have been proposed, including the use of biodiversity offsets for environmental mitigation. The implementation of mitigation measures for all projects will further minimise cumulative ecology impacts. Refer to Chapter 11: Flora and Fauna for further details of proposed mitigation measures.
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			
State Significant Ecological Constraint—High value regrowth vegetation (HVR) (Category C)	Probability of the impact	2	8	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	2			
State Significant Ecological Constraint—Matters of State Environmental Significance (MSES) wildlife habitat* and Essential habitat	Probability of the impact	2	9	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			
State Significant Ecological Constraint—(*Nature Conservation (Koala) Conservation Plan 2017)*: ▸ Koala Priority Areas ▸ Koala Habitat Areas ▸ Koala Habitat Restoration Area—Koala Priority Area ▸ Koala Habitat Restoration Area	Probability of the impact	2	9	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			
NC Act					
State Significant Ecological Constraint—Threatened species	Probability of the impact	2	10	High	As part of the Project's impact assessment of ecological values, a large range of mitigation measures have been proposed, including the use of biodiversity offsets for environmental mitigation. The implementation of mitigation measures for all projects will further minimise cumulative ecology impacts. Refer to Chapter 11: Flora and Fauna for further details of proposed mitigation measures.
	Duration of the impact	3			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	3			
State Significant Ecological Constraint—Special Least Concern and Least Concern species	Probability of the impact	2	8	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	2			
State Significant Ecological	Probability of the impact	2	7	Medium	
	Duration of the impact	3			

Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Constraint—Priority Back on Track	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Biodiversity Planning Assessment					
State Significant Ecological Constraint (BPA): ▸ Local or other habitat values	Probability of the impact	1	6	Low	As part of the Project's impact assessment of ecological values, a large range of mitigation measures have been proposed, including the use of biodiversity offsets for environmental mitigation. The implementation of mitigation measures for all projects will further minimise cumulative ecology impacts. Refer to Chapter 11: Flora and Fauna for further details of proposed mitigation measures.
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
State Significant Ecological Constraint (BPA): ▸ State habitat for EVNT taxa, State habitat values, State Riparian corridor, State terrestrial corridor	Probability of the impact	1	8	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			
State Significant Ecological Constraint (BPA): ▸ Regional habitat values for EVNT taxa, Regional habitat values, Regional Riparian corridor	Probability of the impact	1	7	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	2			
State Significant Ecological Constraint (BPA): ▸ State significant corridor	Probability of the impact	2	9	Medium	
	Duration of the impact	3			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	3			

Project commitments, the design considerations and the Mitigation measures identified in Chapter 11: Flora and Fauna are likely to reduce the Project's contribution to cumulative project impacts in the broader region.

During Phase 2 of the Project (detailed design post-EIS), sensitive environmental receptors identified during the EIS will be subject to further investigation, in order to verify and delineate the predictive mapping and determine the magnitude of the significant adverse impacts on the identified environmental receptors, with greater accuracy. The specific mitigation measures will then be applied to ensure that the significance ratings of any potential impacts are classified as low as reasonably practicable and the more significant adverse impacts are offset.

There is the potential for some Project activities to have a cumulative, irreversible and/or permanent impact on some environmental receptors, even after the implementation of all mitigation measures. In these cases, compensation for the residual impact will need to occur. Compensation in the form of compensatory habitat, land rehabilitation and/or contribution to research can be employed (i.e. offsets) to account for the residual impacts potentially resulting from the Project. An Environmental Offsets Management Plan for the Project will be prepared during the detailed design phase in consultation with the relevant State and Commonwealth departments to comply with the relevant offsets policies (refer Appendix Y: ARTC Offset Strategy).

22.6.5 Air quality

The area of interest for cumulative air quality impacts is the air quality impact assessment (AQIA) study area, defined as the area within 2 km of the Project alignment, as described in Chapter 12: Air Quality. The AQIA study area includes a total of 2,829 sensitive receptor locations. It is at these receptor locations that air quality goals need to be met.

The AQIA (refer Appendix K: Air Quality Technical Report) has considered operational phase cumulative impacts to sensitive receptors by assessing emissions from multiple projects; being other Inland Rail projects (B2G and H2C), the Harlaxton Quarry, train traffic on the QR West Moreton System rail corridor and road traffic on the Toowoomba Bypass via detailed dispersion modelling. As such, further assessment of cumulative impacts is only required for the construction phase of the Project.

The CIA has considered existing air emission sources from other projects, such as the Harlaxton Quarry and Toowoomba Bypass, in addition to the other Inland Rail projects (i.e. B2G and H2C). The CIA has also considered projects located outside the AQIA study area that may impact sensitive receptors located in the AQIA study area. A total of 10 projects have been considered in the CIA for air quality. These projects are either currently operational or will be constructed and/or operational during the construction phase of the Project. The projects considered include:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ
- Wellcamp Business Park
- Witmack Industry Park
- Charlton Logistics Park
- Asterion Medicinal Cannabis Facility.
- GWIZ
- Toowoomba Bypass (operating)
- Harlaxton Quarry (operating).

Cumulative air quality impacts have been assessed following the methodology defined in Section 22.4.3.1. In Chapter 12: Air Quality, the assessment of cumulative impacts has been undertaken for each of the 10 projects individually. This individual project assessment has informed the assessment of the significance of cumulative impacts for the construction phase of the Project overall. The overall result of the cumulative assessment for the construction phase of the Project is presented in Table 22.14, which shows that cumulative impacts are **low** for the construction phase.

While there is potential for the construction of B2G, the Project and H2C to overlap, dust impacts are likely to be localised and managed by ARTC through approved CEMPs. Mitigation measures for air quality for the construction phase of the Project to be included in the CEMP are outlined in Chapter 12: Air Quality. Chapter 12: Air Quality also proposes mitigation measures and visual and quantitative dust monitoring for sensitive receptors near the Harlaxton Quarry to assist in managing the potential for cumulative impacts at these receptors.

With the exception of the B2G, H2C and Harlaxton Quarry projects, for which mitigation measures have been proposed, no other projects are expected to present risk of significant impacts, and no specific mitigation measures are required to address the cumulative impact of other projects.

Dust impacts will be managed by ARTC through the Air Quality Sub-plan of the CEMP (refer Chapter 23: Draft Outline Environmental Management Plan and Chapter 12: Air Quality).

TABLE 22.14: CUMULATIVE IMPACT ASSESSMENT FOR AIR QUALITY

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Potential for construction-phase air quality impacts on 2,829 sensitive receptor	Probability of the impact	2	6	Low	Additional mitigation measures further to those proposed for the Project are not required, as the
	Duration of the impact	1			

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
locations from pollutants within approximately 2 km of the Project alignment. The cumulative impact of these impacts with other projects is considered unlikely.	Magnitude/intensity of the impact	2			significance of cumulative impacts is considered to be low
	Sensitivity of the receiving environment	1			

22.6.6 Surface water and hydrology

22.6.6.1 Surface water

The cumulative impacts of multiple projects occurring in the vicinity of the Project may impact water resources, including contributing to impacts to water quality, if not managed appropriately. The majority of potential impacts identified as a result of the Project are common to all projects throughout the region and are, therefore, cumulative in nature.

The projects assessed for the surface water CIA are typically major infrastructure or primary industry operations. Of these, nine were identified as potential interacting projects for the surface water CIA, with the following four projects identified to have the highest potential for cumulative impact due to hydrological connection by watercourses intersecting the Project alignment:

- B2G (Inland Rail)—Gowrie Creek catchment
- H2C (Inland Rail)—Lockyer Creek catchment
- InterLinkSQ—Gowrie Creek catchment
- Gatton West Industrial Zone—Lockyer Creek catchment
- New Acland Coal Mine Stage 3—Oakey Creek catchment with Gowrie Creek a tributary of Oakey Creek.

The potential impacts to surface water that are likely to be common for these projects, if not managed appropriately, may include:

- Riparian vegetation loss from vegetation clearing/removal
- Potential impacts to aquatic fauna species both through impacts to water quality and barrier works
- Displacement of flora and fauna species from invasion of weed and pest species
- Reduction in the connectivity of waterways
- Increase in erosion and sedimentation in the waterways
- Increase in litter (waste)
- Saline discharge into proximal waterways
- Increase in surface salinity around alluvial waterways.

All of these projects are subject to environmental controls either through EIS assessment processes, operational licences, such as environmental authorities, under the EP Act or through the implementation of detailed EMPs. Noting that proximal projects within the cumulative area of influence have been assessed as operating/constructing as 'business-as-usual' (i.e. likelihood of occurrence of impact with standard operating procedures), the cumulative impact assessment was generated without regard for cumulative impact resulting from critical failures in other projects. The results of the significance assessment of the cumulative impacts are detailed in Chapter 13: Surface Water and Hydrology and summarised in Table 22.15. Provided that all of the assessable projects apply appropriate mitigation measures during construction, including CEMPs and salinity management plans, the significance of the overall cumulative impact on water quality is assessed as **low**, with no specific mitigation measures required to address the cumulative impact of other projects.

The following factors contributed to this determination:

- The Project design is co-located, upstream of the QR West Moreton System and the Project tunnels under the Gowrie Creek catchment
- Riparian vegetation loss from vegetation clearing/removal—loss of ecosystem service to water quality:
  - A potential exists for a cumulative impact from the loss of sensitive receptors (riparian vegetation communities) with works involving waterways and associated crossings across the projects. Impacts may be compounded with interface between the Project and other listed projects, in regard to decreased resilience to biotic and abiotic factors. Potential consequences include loss of bank stability, loss of diversity and reduction in water-quality values due to decreased performance of ecosystem services to water quality. The proximity of other projects to watercourses and inadequate rehabilitation on those projects and the Project would result in the highest risk of significant cumulative impact.
  - Interaction of impacts leading to a loss of ecosystem services or water quality are considered possible between the Project and the New Acland Coal Mine Stage 3 expansion, InterLinkSQ, Gatton West Industrial Zone, and construction of the B2G and H2C sections of Inland Rail.
- Potential impacts to aquatic fauna species both through impacts to water quality and barrier works:
  - There is potential for cumulative downstream impacts from water-quality issues associated with overland works and waterway barrier works, if not appropriately managed. Cumulative impacts would be expected to occur in relatively short spatial distances (as cumulative point-source impacts) and would be expected to 'dilute' with increasing distance downstream from point-source impact.
  - It is expected that cumulative impacts would occur between projects linked spatially and temporally during construction. As such, the current Project and B2H to H2C sections of Inland Rail are expected to generate cumulative impacts.

TABLE 22.15: CUMULATIVE IMPACT ASSESSMENT FOR SURFACE WATER

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Riparian vegetation loss from vegetation clearing and/or removal	Probability of the impact	2	7	Medium	Will be managed through: ▸ Development and implementation of a Rehabilitation and Landscaping Management Sub-plan, as a component of the CEMP for the Project ▸ Adherence to: ▸ *Riverine protection permit exemption requirements* (WSS/2013/726) (Department of Natural Resources, Mines and Energy (DNRME), 2019b) ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (Department of Agriculture and Fisheries (DAF), 2018b) ▸ Permit/approval conditions if either of the above-mentioned requirements cannot be adhered to or do not apply ▸ Monitoring of the success of riparian rehabilitation for the Project to ensure that its contribution to riparian vegetation loss is appropriately addressed.
	Duration of the impact	1			
	Magnitude/ intensity of the impact	2			
	Sensitivity of the receiving environment	2			

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Potential impacts to aquatic fauna species both through impacts to water quality and barrier works	Probability of the impact	1	5	Low	Will be managed through: ▸ Development and implementation of a Surface Water Management Sub-plan, as a component of the CEMP for the Project. Will be managed through adherence to: ▸ *Riverine protection permit exemption requirements* (WSS/2013/726) (DNRME, 2019b) ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018b) ▸ Permit/approval conditions if either of the above-mentioned requirements cannot be adhered to or do not apply
	Duration of the impact	1			
	Magnitude/ intensity of the impact	1			
	Sensitivity of the receiving environment	2			
Reduction in surface water connectivity	Probability of the impact	2	6	Low	Will be managed through adherence to: ▸ *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF, 2018b) ▸ Permit/approval conditions if either of the above-mentioned requirements cannot be adhered to or do not apply
	Duration of the impact	1			
	Magnitude/ intensity of the impact	1			
	Sensitivity of the receiving environment	2			
Increase in erosion and sedimentation of surface waters	Probability of the impact	1	5	Low	Will be managed through: ▸ Development and implementation of a Soil Management Sub-plan, including erosion and sediment control measures, as a component of the CEMP for the Project ▸ Undertake water quality monitoring during construction in accordance with the Surface Water Management Sub-plan
	Duration of the impact	1			
	Magnitude/ intensity of the impact	1			
	Sensitivity of the receiving environment	2			
Increase in surface water contamination	Probability of the impact	2	6	Low	Will be managed through: ▸ Development and implementation of a Waste Management Sub-plan and a Hazardous Materials Management Sub-plan as components of the CEMP
	Duration of the impact	1			
	Magnitude/ Intensity of the impact	1			
	Sensitivity of the receiving environment	2			

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Saline discharge into proximal surface waters (intra-catchment scope)	Probability of the impact	2	6	Low	Will be managed through: ▸ Development and implementation of a Soil Management Sub-plan, including salinity control measures, as a component of the CEMP for the Project ▸ Undertake water quality monitoring during construction in accordance with the Surface Water Management Sub-plan
	Duration of the impact	1			
	Magnitude/ Intensity of the impact	1			
	Sensitivity of the receiving environment	2			
Increase in surface salinity around alluvial surface waters	Probability of the impact	1	5	Low	Will be managed through: ▸ Development and implementation of a Soil Management Sub-plan, including salinity control measures, as a component of the CEMP for the Project ▸ Undertake water quality monitoring during construction in accordance with the Surface Water Management Sub-plan
	Duration of the impact	1			
	Magnitude/ Intensity of the impact	1			
	Sensitivity of the receiving environment	2			

22.6.6.2 Hydrology

The hydrology and flooding assessment for the Project has involved the development of hydrologic and hydraulic models for key waterways and floodplains to reflect the existing conditions (Existing Case) in these areas and to predict what affect development of the Project will have (Developed Case).

For cumulative impacts to arise, another project will need to be located within a sub-catchment that elements of the Project are also located in and to be located close enough to the Project footprint for an overlap in any hydrological impacts. The distance from the Project beyond which impacts are no longer expected to occur varies between floodplains; however, all modelled upstream and downstream hydrological impacts are confined to a distance of less than 1 km from the Project alignment. Based on these criteria, only 2 of the 15 initial projects have potential to result in cumulative hydrological impacts. These projects are listed in Table 22.16, with details of the catchment area that each is located in and their inclusion in Existing Case or Developed Case modelling.

TABLE 22.16 PROJECTS WITH POTENTIAL FOR CUMULATIVE HYDROLOGICAL IMPACTS

Projects with potential for cumulative hydrological impacts	Floodplain model extent in which the development is located	Model inclusion
B2G (Inland Rail)	Gowrie Creek model	Developed case
H2C (Inland Rail)	Lockyer Creek model	Developed case
InterLinkSQ	Gowrie Creek model	Not included. Not constructed and insufficient details of future landform and structures.
Toowoomba Bypass	Gowrie Creek model	Existing case and developed case

As part of the Inland Rail Program, the proposed infrastructure and landform details for the B2G and H2C projects are known to ARTC; therefore, these details have been incorporated into the development of hydrologic and hydraulic models for the Developed Case.

InterLinkSQ has not been reflected in either the Existing Case or Developed Case modelling of hydrologic and hydraulic impacts. While the location of this development is known, information on the ultimate landform and structure size and configuration are not publicly available at a level of detail that could be incorporated into modelling for the Project; therefore, the hydrological effects of this development has not been quantitatively assessed.

The hydrologic and hydraulic investigation (refer Chapter 13: Surface Water and Hydrology and Appendix M: Hydrology and Flooding) has included all existing infrastructure in the Existing Case.

The Existing Case has been used as the basis to compare the Developed Case against to determine potential impacts and then derive appropriate mitigation measures. This process has been followed for all infrastructure projects that have the potential to impact on this investigation, with projects required to mitigate and minimise impacts to acceptable levels.

The exception is the B2G and H2C projects, which are being concurrently developed. The B2G and H2C projects have been included in the Developed Case for the Project to enable cumulative impacts to be considered and addressed. As such, the cumulative impacts for hydrology have been addressed.

The significance of cumulative impacts for hydrology is anticipated to be low for the following reasons:

- Due to the nature of the projects considered in this CIA, each of these projects will be required to mitigate and minimise hydrology impacts to acceptable levels
- In relation to the adjacent H2C and B2G projects, potential impacts on hydrology will be accounted for in the design and EIS for these projects, taking into consideration the interface with the Project.

The cumulative impact on hydrology from the Project due to the stipulated design requirements will further reduce the potential for impacts on hydrology.

22.6.7 Groundwater

Cumulative impacts to groundwater are most likely to occur where multiple projects intersect and/or extract groundwater from the same shallow aquifer units. There are existing registered bores within the predicted groundwater drawdown extents; however, the predicted drawdown extents are highly localised (e.g. associated with the Toowoomba Range Tunnel, where there is no overlapping project).

The AOI for cumulative groundwater impacts considers projects and operations surrounding the Project. Due to the localised potential groundwater impacts associated with the Project, only projects and operations in close proximity to the Project have been considered. These are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ
- Asterion Medicinal Cannabis Facility
- DHA Mount Lofty Development.

Other projects are considered too distant compared to the localised nature of potential groundwater impacts and/or the scope of the surrounding projects were such that there is negligible potential to impact on groundwater. The key cumulative impacts that were considered as part of the groundwater CIA were:

- Potential impacts on shallow aquifers as a result of impacts from dewatering and cuttings
- Possible subsequent impacts on groundwater users
- Low potential for groundwater drawdown to cause settlement and damage to buildings and properties due to subsidence from drained cuttings and the Toowoomba Range Tunnel
- Potential impacts on groundwater quality through contamination (derailments, spills and leaks from machinery, drill rigs and storage of fuels).

Assessment of these cumulative impacts for the potential impacts identified above is detailed in Chapter 14: Groundwater and summarised in Table 22.17. The significance of the overall cumulative impact on groundwater is assessed as **low**. The following factors contributed to this determination:

- B2G (Inland Rail):
  - Both projects, at the point of interface, overlie the Gowrie Creek alluviums and the Main Range Volcanics (MRV) but neither of the projects require cuts with potential to encounter groundwater at this location; therefore, drawdown impacts are likely to be restricted to localised and temporary dewatering activities. As such, cumulative impacts to groundwater levels in the MRV are considered unlikely.
  - Cumulative impacts on the quality of groundwater within the Gowrie Creek alluviums and MRV may arise due to the compounding of spills and leaks from heavy machinery, drill rigs, etc.; however, if a spill or leak were to occur, the volume of contaminant in any one instance is expected to be small and, therefore, the likelihood of impact to groundwater is considered to be low.

- H2C (Inland Rail):
  - Both projects, at the point of interface, overlie the Lockyer Creek alluviums but neither of the projects require cuts with potential to encounter groundwater at this location; therefore, drawdown impacts are likely to be restricted to localised and temporary dewatering activities. As such, cumulative impacts to groundwater levels in the Lockyer Creek alluviums are considered unlikely.
  - Cumulative impacts on the quality of groundwater in the Lockyer Creek alluviums may arise due to the compounding of spills and leaks from heavy machinery, drill rigs, etc.; however, if a spill or leak were to occur, the volume of contaminant in any one instance is expected to be small and, therefore, the likelihood of impact to groundwater is considered to be low
- No anticipated impacts with the InterLinkSQ project due to no deep cuts or tunnel in proximity
- The Project predicted 5-m drawdown extent (construction phase) within the deep MRV and Koukandowie Formation is approximately 1 km from the western boundary of the proposed Mount Lofty development
- Potential overlap of construction activities from G2H with commencement of operations for Asterion. The operation of this facility is expected to require significant volumes of water.

TABLE 22.17: CUMULATIVE IMPACT ASSESSMENT FOR GROUNDWATER

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Change in groundwater levels: ▸ Potential overlap of impacts from dewatering and cuttings that intersect shallow aquifers. Potential to overlap is primarily at the start of construction activities of the projects where the Project abuts these other ARTC projects. ▸ Possible subsequent impacts on groundwater users ▸ Potential overlap of construction activities from the Project with commencement of operations for Asterion. The operation of this facility is expected to require significant volumes of water.	Probability of the impact	1	6	Low	Implementation of dewatering and water supply mitigation measures as discussed in Chapter 14: Groundwater. Implementation to the CEMP to respond effectively to groundwater level drawdown triggers. Adherence to the Groundwater Management and Monitoring Program to respond effectively to groundwater level drawdown triggers. Confirm water source for Asterion and any predicted groundwater impacts, if any.
	Duration of the impact	2			
	magnitude/ intensity of the impact	1			
	Sensitivity of the receiving environment	2			
Groundwater quality and contamination: ▸ Potential cumulative impacts on shallow aquifers from derailments and spills/leaks in tunnels, spills/leaks from heavy machinery, drill rigs and storage of fuels	Probability of the impact	1	6	Low	
Groundwater quality and contamination: ▸ Potential cumulative impacts on shallow aquifers from derailments and spills/leaks in tunnels, spills/leaks from heavy machinery, drill rigs and storage of fuels	Probability of the impact	1	6	Low	
	Duration of the impact	2			
	Magnitude /intensity of the impact	1			
	Sensitivity of the receiving environment	2			

22.6.8 Noise and vibration

22.6.8.1 Construction cumulative impacts

For the purposes of noise and vibration, projects that may be constructed simultaneously with the Project, and that are close enough to contribute to cumulative noise levels at sensitive receptors potentially affected by the Project, were considered in this CIA. These are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ
- Asterion Medicinal Cannabis Facility.

Simultaneous noise from construction works of these Projects has the potential to increase noise and vibration levels at nearby noise sensitive receptors also impacted by construction noise associated with the Project. Assessment of cumulative impacts to noise sensitive receptors is detailed in Chapter 15: Noise and Vibration and summarised in Table 22.18. The significance of the overall cumulative impact on noise and vibration during construction is assessed as **low**.

The following factors contributed to this determination:

- Simultaneous noise from construction works of adjoining Inland Rail projects has the potential to increase noise levels at nearby noise-sensitive receptors also impacted by construction noise associated with the Project; however, the modelling approach adopted for the impact assessment methodology includes simulation of simultaneous construction works, by assuming that, as a worst-case, all activities could occur at any time within a defined area, including up to the limit of the Project footprint. The noise levels due to cumulative impacts are not expected to significantly increase above the levels predicted for the Project in isolation.

  In reality, construction crews for the projects would not be able to work as close as what was modelled if the projects were constructed at the same time and in close proximity to each other.

  As a result, the noise levels due to cumulative impacts are not expected to significantly increase above the predicted levels at sensitive receptors.
- InterLinkSQ is located south of and adjacent to the Project at the tie-in to B2G. It is anticipated that the Project and InterLinkSQ will use similar construction equipment and produce construction noise emissions of similar intensity. In the case of simultaneous works, the worst-case construction noise impacts at sensitive receptors to the south of InterLinkSQ are expected to be dominated by InterLinkSQ noise emissions.

  If simultaneous construction works occur, residential sensitive receptors to the west of Gowrie have the potential to be impacted by construction noise from both projects. In this instance, the maximum increase in worst-case construction noise impacts above those predicted for the Project is 3 dBA. Such an increase is not expected to significantly increase the number or magnitude of exceedances of the *Transport Noise Management: Code of Practice Volume 2* (CoP Vol 2) (DTMR, 2015a) criteria. It should be noted that the predicted construction noise impacts at most of these residential receptors is below the CoP Vol 2 criteria. It is proposed that these cumulative impacts will be managed through:

  - Informing nearby receptors of potential construction noise impacts
  - Minimising the construction works that occur outside CoP Vol 2 standard hours
  - Consultation with InterLinkSQ, to minimise the overlap of construction works and to maximise separation distances between cumulative construction works.

Concurrent construction of the Asterion Medicinal Cannabis Facility and the Project is expected to be brief and is unlikely to result in construction noise impacts at sensitive receptors significantly greater than those predicted to result from either project in isolation. Project construction noise impacts during earthworks are predicted to be up to 7 dB(A) greater than those during earlier Project works, such as site setup. The scenario in which cumulative impacts increase early works noise impacts by, at worst, 3 dB(A), results in noise levels 4 dB(A) less than those predicted during earthworks of the Project alone.

The cumulative impact of noise would be managed as far as possible through the construction noise and vibration management plan (CNVMP) to ensure that the potential for adverse impacts at sensitive receptors is minimised. In addition, any overlap of construction works is likely to be for a limited period due to the linear nature of rail project construction.

TABLE 22.18: CUMULATIVE IMPACT ASSESSMENT FOR NOISE AND VIBRATION

Projects	Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
B2G and H2C	Simultaneous noise from construction works of B2G or H2C has the potential to increase noise levels at nearby noise sensitive receptors also impacted by construction noise associated with the Project	Probability of the impact	2	6	Low	▸ Informing nearby receptors of potential construction noise impacts ▸ Minimising the construction works which occur outside CoP Vol 2 standard hours (refer Chapter 15: Noise and Vibration) ▸ Consultation with InterLinkSQ, to minimise the overlap of construction works and to maximise separation distances between cumulative construction works ▸ Cumulative impact of noise will be managed by ARTC through the approved CEMP
		Duration of the impact	1			
		Magnitude/ intensity of the impact	2			
		Sensitivity of the receiving environment	1			
InterLinkSQ	Simultaneous noise from construction works of InterLinkSQ has the potential to increase noise levels at a limited number of sensitive receptors	Probability of the impact	2	6	Low	▸ Informing nearby receptors of potential construction noise impacts ▸ Minimising the construction works which occur outside CoP Vol 2 standard hours (refer Chapter 15: Noise and Vibration) ▸ Consultation with InterLinkSQ, to minimise the overlap of construction works and to maximise separation distances between cumulative construction works
		Duration of the impact	1			
		Magnitude/ intensity of the impact	2			
		Sensitivity of the receiving environment	1			
Asterion Medicinal Cannabis Facility	Simultaneous noise from construction works of Asterion Medicinal Cannabis Facility has the potential to increase noise levels at a limited number of sensitive receptors	Probability of the impact	1	4	Low	▸ Informing nearby receptors of potential construction noise impacts ▸ Minimising the construction works which occur outside CoP Vol 2 standard hours (refer Chapter 15: Noise and Vibration)
		Duration of the impact	1			
		Magnitude /intensity of the impact	1			
		Sensitivity of the receiving environment	1			

The cumulative impact of noise would be managed as far as possible through the Noise and Vibration Sub-plan of the CEMP to ensure that the potential for adverse impacts at sensitive receptors is minimised. In addition, any overlap of construction works is likely to be for a limited period due to the linear nature of rail project construction.

22.6.8.2 Operational cumulative impact

The Project directly links to the west with the adjoining B2G project and links directly to the H2C project section to the east. During operation, it is expected that the majority of the noise impacts experienced by the 3,910 sensitive receptors identified for the G2H operational noise assessment will be the trains as they travel on the Project alignment.

Further it is expected that sensitive receptors will perceive the operation of the Inland Rail network as a single project, acting as a single linear noise source; therefore, cumulative impacts with adjoining Inland Rail projects will be no different to those predicted for the Project in isolation.

The operation noise assessment has also considered, in part, operations on QR's West Moreton System simultaneous to the operations of the Inland Rail Project. The overall railway noise levels from all train operations within the corridor have been assessed in Appendix P: Operational Railway Noise and Vibration.

The intent at this stage is to mitigate the noise from the operation of the Inland Rail Project, noting that it has been assumed that the existing rail traffic will move over to the Inland Rail alignment in preference to the existing rail alignment. As noted in Chapter 15: Noise and Vibration, the noise levels from the existing rail operations were modelled and the predicted noise levels at all sensitive receptors were below the criteria outlined in the Interim Guideline (e.g. LAmax 87dBA). Rail movement on the existing shared corridor have been modelled as part of the Project. ARTC, as such, are not mitigating impacts associated with existing brownfield movements.

The operation of the existing alignment and triggers for appropriate mitigation measures will need to be confirmed with QR as part of bilateral mechanisms.

Further discussion is required on the acceptance of proposed mitigation measures for cumulative operational noise. This may require discussions with QR (as the Railway Manager), DTMR (as the landholder and manager of the contract lease arrangement), ARTC and OCG on the timing of determining appropriate cumulative noise impact mitigations for trains using the West Moreton System and Inland Rail in the Gowrie area.

Further consultation with QR and DTMR may be warranted regarding cumulative impacts as a result of the simultaneous operation of the railway lines should simultaneous operations occur—this includes the future timing and likely train services present. At draft EIS stage, consistent with the ARTC *Inland Rail Program Business Case* (2015a), the Project design and all ARTC coordinated project assessment works have assumed all existing movements will move over to the Inland Rail alignment.

Rail noise from the arrival and departure of the trains from the adjacent B2G and H2C project sections, and the operation of the Projects' fixed tunnel infrastructure is not expected to result in a cumulative increase in daily railway noise levels at any identified sensitive receptor relevant to the CIA.

Overall, cumulative noise impacts during operation of the Project are considered to be of **low** (refer Table 22.19).

TABLE 22.19: CUMULATIVE IMPACT ASSESSMENT FOR OPERATIONAL NOISE

Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Increased noise levels at sensitive receptors	Probability of the impact	2	6	Low	Specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through inspection and maintenance of the Inland Rail network in accordance with ARTC's network procedures.
	Duration of the impact	1			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	1			

The subjective response to the different noise levels and noise characteristics of the intermittent sources of road traffic and railway noise are such that individuals are less likely to perceive or determine impacts based on a cumulative exposure of the combined transport noise. Consequently, the ToR requires road traffic and noise, and railway noise to be assessed, and, if necessary, mitigated separately. While the policies and guidelines referenced by the ToR do not specify criteria or management objectives for combined road and railway transport noise, an overview assessment of potential cumulative transport noise has been undertaken to inform the draft EIS.

Based on the predicted existing road traffic noise levels and the assessed road traffic and railway noise with the Project, the overview assessment determined:

- In general terms, cumulative transport noise levels would generally be expected only where road traffic or railway noise is within 10 dBA of each other (where the same noise metric is applied to quantify both sources of transport noise)
- At sensitive receptors adjacent to both the railway alignment and local roads, such as Ganzer Road, Morris Road, Old Homebush Road, East Paulsens Road, Jones Road, McNamaras Road and Cattos Road, the railway noise levels during train passby events are expected to be at least 10 dBA above the road traffic noise levels. The railway noise is likely to be the dominant source of noise and an increase in transport noise from the cumulative road traffic and railway noise is not expected at the sensitive receptors.
- The road traffic movements on the realigned section of Gowrie Junction Road may contribute noise levels within 10 dBA of the predicted railway noise levels, depending on the noise metrics used to evaluate transport noise. Road traffic noise levels within 152 m of Gowrie Junction Road have been identified to potentially require a review of road traffic noise mitigation at 18 sensitive receptors. The railway noise predictions identified five sensitive receptors in the area of the upgraded road network where railway noise mitigation will need to be reviewed. A review of aerial imagery identified that some property facades facing the rail corridor will likely be more exposed to railway noise than road traffic noise; whereas, the property façades facing Gowrie Junction Road may experience higher road traffic noise levels and be less exposed to railway noise. Nonetheless, any increase in daily transport noise at these receptors from the combined road traffic and railway noise would likely be a marginal perceptible increase of less than 3 dBA. Measures implemented by the Project to mitigate road traffic and/or railway noise would assist in addressing both the daily exposure to total transport noise, as well as the shorter-term noise, in the event that trains and road vehicles pass sensitive receptors at the same time.
- At the majority of sensitive receptors close enough to both the road network and railway alignment to potentially experience cumulative transport noise, the intermittent railway noise levels during train passby events are expected to be the dominant noise contribution.

The assessment has identified the potential for noise-related impacts as a result of cumulative noise to be minimal. The Project is investigating specific measures to control road traffic and railway noise consistent with the ToR and assessment criteria applied on the Project. Consequently, further measures to manage or mitigate cumulative transport noise are not likely to be required in areas where the Project's rail alignment crosses, or is adjacent to, the future local road network.

Operational road-traffic noise impacts will be iteratively re-assessed during the detailed design process, in accordance with *Transport Noise Management Code of Practice Volume 1—Road Traffic Noise* (CoP Vol 1) (DTMR, 2013b), to confirm the receptors at which noise criteria may be exceeded.

Where CoP Vol 1 criteria may be exceeded at a sensitive receptor, the following potential mitigation measures for both upgraded and new road sections will be investigated for effectiveness, and incorporated into the detailed design, as appropriate:

- A noise barrier in the form of a landscaped earth mound and/or a noise fence
- Pavement surface treatment
- Provision of acoustic façade treatments to affected sensitive receptors.

A combination of mitigation measures may be appropriate.

22.6.9 Social

As the Project is part of the larger Inland Rail Program, cumulative social impacts were considered at local and regional levels. Both positive and negative cumulative social impacts are possible. The approach for the social cumulative impact assessment is different to the other disciplines, as outlined in Section 22.4.3.

22.6.9.1 Local impacts

The local AOI for the assessment of cumulative social impacts is defined as an approximately 5-km buffer around the alignment. This is the area where the physical interface of multiple projects, and the potential for noise and connectivity issues, is most likely to result in material impacts.

Social impacts may occur where the effects of the Project combine with those of other major projects to affect:

- Connectivity:
  - The Project links directly with the adjoining B2G project to the west, approximately 2.5 km south-east of Kingsthorpe. There is potential for the coincidence of works for the two projects to cause temporary traffic delays on Kingsthorpe Tilgonda Road/Drapers Road. There are also two flash-butt welding sites, one within the B2G project area and one within the Project disturbance footprint, which will receive deliveries of track sections and may contribute to increased traffic volumes on these roads while track construction is underway. This is unquantifiable but, if it eventuates, will need to be considered in relation to driver safety and emergency services access.
  - The H2C project will adjoin the Project in an area approximately 400 m north of Helidon Spa and 1.1 km north-west of Helidon. Neither project interfaces with roads within Helidon Spa and Helidon; however, roads through Helidon are haulage routes for the projects and are also used by traffic associated with the Helidon Magazine (explosives) Reserve. There is potential for road works for the Project and Inland Rail's H2C project (if they coincide) to result in cumulative impacts on travel times to and from the Helidon State School, requiring consideration of the scheduling of Project works and H2C project works, and, in each project's TMP, to minimise the potential for cumulative impacts that could result in traffic delays and/or increased travel times for families' or school buses' trips to and from the Helidon State School.
  - If construction works for the Project and H2C coincide in the Helidon area, there is potential to disrupt access to the Helidon to Ravensbourne Trail circuit through the Lockyer National Park, where access to the trail section along Airforce Road may be affected during construction of the Project, and access to the trail section along Seventeen Mile Road may be affected during construction of H2C.
  - Incremental increases in traffic on Project region roads are also expected as a result of a combination of construction for projects such as InterLinkSQ, the Wellcamp Business Park and Witmack Industry Park and Charlton Logistics Park.
- Community and wellbeing:
  - Residents may be concerned about the potential risks to community safety relating to increased numbers of non-local workers, including 'stranger danger' and traffic safety, with any cumulative demands for non-local labour likely to increase this concern
  - There is also potential for cumulative traffic increases as the result of workers' commuter vehicles or heavy vehicles impacting on traffic safety at the local or regional level. More information regarding this issue is discussed in Chapter 19: Traffic, Transport, and Access.
  - The recent construction of the Toowoomba Bypass has resulted in community fatigue for populations in the Project region, which may discourage residents from participating in Project engagement processes, and exacerbate any anger and stress felt as a result of Project impacts
  - While there is potential for the construction of H2C, the Project and B2G to overlap, dust impacts are likely to be localised to the site locations and managed by ARTC through Project CEMPs
- Amenity and character:
  - Noise from construction activities being undertaken simultaneously on the adjoining H2C and B2G projects has the potential to increase noise levels at nearby sensitive receptors for the Project; however, the expected noise due to cumulative construction activities is not expected to significantly increase the predicted noise levels
  - The presence of laydown areas, earthworks and roadworks associated with construction of the Project, and the adjacent B2G and H2C projects, is likely to affect the scenic character of the local roads and highways where works are located. These are likely to detract from the scenic character of the Draper Road/Paulsens Road area while track laying is occurring.
  - With regards to the ongoing cumulative impacts of other land development projects, InterLinkSQ, Toowoomba Wellcamp Airport, Wellcamp Business Park, and the Toowoomba Enterprise Hub (Charlton and Logistics Park and Witmack Industry Park) lie close to the Project and the combined impacts from these projects may result in the perception of development intensification; however, this is anticipated as part of Council and regional plans

- Assessment of rail noise from the operation of the adjacent B2G and H2C project sections did not predict a cumulative increase in daily railway noise levels at the sensitive receptors adjacent to the Project
- Operational impacts associated with views of combined, successive, and sequential views of adjoining projects were identified as of medium residual significance

- Population, housing, and accommodation:
  - The Project expects to draw the majority of its construction workforce from within the Project region and other nearby local government areas (LGAs), with personnel returning each night. As such, a change to the size or composition of the population is not expected during construction and a significant influx of personnel requiring housing in local communities is not expected. If cumulative demands for labour result in local shortages and the Project needs to draw workers from further afield, a contribution to cumulative demands on housing and accommodation is also possible. Any influxes of non-local personnel seeking rental accommodation due to cumulative labour demands could put pressure on rental housing stocks in local communities, with the potential to deplete rental housing stocks and increase rental costs, which could impact on low-income households. Potential housing demands relating to the coincidence of several projects' construction periods would be spread across several LGAs and are not quantifiable, but could be significant in the context of the limited rental housing availability, if rental vacancy rates remained low and if demand were concentrated in local communities or centres such as Toowoomba.
- Use of and access to social infrastructure:
  - A cumulative increase in construction workers in local communities has the potential to affect demands for policing and emergency services with respect to traffic management, site security (e.g. responding to incidents of theft from work sites), road safety policing and, potentially, community protests against Inland Rail or other projects
  - Government funding for police, fire and ambulance services available to local communities may require review by the relevant departments to ensure cumulative project demands do not impact on local community access to services
  - As personnel's health service requirements would primarily be met in their home communities, cumulative demands on health services are less likely but there is potential for workers to be transported to major hospitals in Toowoomba or Ipswich if treatment is required. This is not expected to be a significant drain on major hospitals' services.
- Workforce:
  - In combination, projects listed in Table 22.7 have the potential to provide significant employment and business opportunities for local residents during the next 5–10 years. This includes significant construction employment opportunities related to the construction of Inland Rail projects, the Asterion Medicinal Cannabis Facility, Toowoomba Enterprise Hub projects and the new Toowoomba Hospital.
  - Transport, logistics and industrial hubs are not part of the Project, requiring private investment and separate approvals; however, the Project is likely to catalyse industrial development by facilitating the development of intermodal freight facilities such as the Bromelton SDA and InterLinkSQ, at the Toowoomba Enterprise Hub.
  - It may also catalyse development at the GWIZ, which, as noted in ShapingSEQ, will involve the development of 600 acres of industrial land at Gatton and is one of the few remaining areas within two hours of Brisbane that allows for various forms of heavy industry
  - These opportunities may be further enhanced by the strategic link that would be provided between Inland Rail and the interstate railway line operated by QR; potentially serving to attract rail-dependent industries to the region
  - Collectively, the operation of Inland Rail projects and intermodal freight facilities would contribute to long-term employment opportunities for the residents of potentially impacted communities.

22.6.9.2 Regional impacts

This section refers primarily to cumulative impacts that may be experienced in the Project region as a whole, which encompasses the Toowoomba and Lockyer Valley LGAs, acknowledging that employment opportunities, supply opportunities and cumulative demand for labour are also relevant to other Queensland regions. Social impacts may occur where the effects of the Project combine with those of other major projects to affect:

- Connectivity:
  - The coincidence of construction of projects listed in Table 22.9 will have cumulative impacts on traffic volumes, and potentially lead to traffic delays during the construction period, throughout the Project region.
  - Excess spoil that cannot be re-used (by the Project or other local projects) will be transported to other sites with the intention to maximise use of the State road network, including the Warrego Highway and Toowoomba Bypass
  - The transport of spoil may increase traffic volumes on key routes with potential to affect Levels of Service or traffic safety
- Workforce:
  - The Project has potential to contribute to significant cumulative increases in employment opportunities in the Project region, both directly through construction employment opportunities and through involvement of local businesses in the supply chain
  - Inland Rail projects are currently scheduled to commence construction in 2021 (H2C, C2K and B2G), 2022 (this Project) and 2023 (K2ARB), and it is unlikely that all workforce peaks would coincide; however, the SIA considers this possibility. If the Project was constructed simultaneously with Inland Rail's H2C and C2K projects, and all workforce peaks coincided, a peak workforce of up to 1,626 construction personnel would be required across the Toowoomba, Lockyer Valley, Ipswich, and Scenic Rim LGAs. If Inland Rail's B2G project labour force also peaked during the same period, an additional requirement for approximately 950 personnel would result, focused in the Toowoomba and Goondiwindi LGAs. The construction workforce requirement for Inland Rail's K2ARB project is estimated at approximately 100 personnel, so the cumulative total peak (Maximum Case) for the five Inland Rail projects could see a requirement for approximately 2,676 personnel working across the Goondiwindi, Toowoomba, Lockyer Valley, Ipswich, Scenic Rim, Logan and Brisbane LGAs. In the context of SEQ's large construction and trades labour force, this is unlikely to cause a significant adverse impact on other industries' access to labour.
  - The construction periods from Cross River Rail, Brisbane Metro and Gold Coast Light Rail Stage 3A may overland with Inland Rail construction phases. Coincidence of the peak requirements for these three SEQ rail projects is unlikely given the variance in their construction periods; however, if it occurred, based on Cross River Rail's stated peak construction workforce estimate of 2,200 personnel, and estimates of 2,600 construction personnel required for Brisbane Metro and 760 personnel required for Gold Coast Light Rail Stage 3A, a peak requirement for approximately 5,560 construction personnel could result. In the very unlikely event that all peak requirements for Inland Rail projects' construction also coincided with these projects' workforce peaks, up to approximately 8,200 personnel would be required. This represents a 'Maximum Case' estimate in relation to the demands on labour and in relation to employment opportunities. In combination, the cumulative impacts of railway construction projects in SEQ, including non-Inland Rail projects, could lead to significant demands for construction personnel (including civil engineering professionals, construction project managers, and construction trades and machinery operators) and to contribute to skills shortages, affecting access to tradespeople for residents, businesses and other industries.
- Population, housing, and workforce accommodation:
  - Project contributions to cumulative impacts on population size and composition are not anticipated but there is a possibility that cumulative project demands will result in the need for rental housing for non-local personnel, and that they will seek housing in towns and centres within the Project region along with construction personnel from other major projects. This could result in regional-level impacts, e.g. exacerbation of the current shortage of rental housing in the Toowoomba and Lockyer Valley LGAs and, potentially, displacement of low-income households.

- Cumulative demands for short-term accommodation, such has hotels and motels, may also be experienced in the Toowoomba or Lockyer Valley LGAs and/or in adjacent LGAs. If the coincidence of several major projects' construction phases strains the capacity of the construction labour force in the Project region, this may lead to a requirement for large numbers of non-local personnel to stay locally.
- The Project's contribution to cumulative demands for short-term accommodation is expected to be small; however, the Project's Accommodation Management Plan (AMP) will include measures to monitor the Project's potential demands for short-term accommodation and enable corrective action, if required, to reduce Project demands

- Use of and access to social infrastructure:
  - The Project's contribution to cumulative demands on health and emergency services relates primarily to an increase in the day-time population of the Project region during construction
  - There is also potential for the cumulative impacts of other concurrent projects, including Cross River Rail, Brisbane Metro, Inland Rail, other major infrastructure projects, and coal mines (such as the Carmichael Coal Mine and Rail Project) to require significant construction workforces within a similar timeframe, leading to cumulative demands on construction labour across Queensland and NSW, and potentially nationally.

22.6.9.3 Significance rating

Potential social cumulative impacts are evaluated in Table 22.20. Note that short-term impacts on accommodation and amenity have been assessed in relation to the local AOI; however, impacts on skilled construction labour could occur within the local and/or regional AOIs, as could the cumulative benefits of employment and business supply opportunities.

Table 22.20 is presented in a slightly different format to the other disciplines as the assessment was based on the approach outlined in Section 22.4.3.2. Mitigation measures are proposed to be implemented based on the initial potential impact to address the issues initially rather than post-residual impact. Further information on the mitigation measures to address social aspects can be found in the Social Impact Management Plan (SIMP) in Appendix Q: Social Impact Assessment.

TABLE 22.20: CUMULATIVE IMPACT ASSESSMENT FOR SOCIAL IMPACTS

Projects	Potential cumulative impact	Likelihood (A–E) and Consequence (1–5)	Proposed mitigation measures	Residual significance	Residual impact significance
Construction					
G2H and adjacent Inland Rail projects	Combined impacts of rail construction (presence of laydown areas, earthworks and roadworks including potential for two flash-butt welding laydown areas in the Gowrie Junction area) and increased traffic on rural character near Helidon, Helidon Spa, Postmans Ridge, Gowrie, and Kingsthorpe	C3	Traffic Management Plans (TMPs) for the Inland Rail projects will consider potential cumulative impacts on traffic and coordinate traffic management accordingly. Design of the landscape earthworks and planting to screen and integrate the Project wherever practicable	C2	Medium (negative)

Projects	Potential cumulative impact	Likelihood (A–E) and Consequence (1–5)	Proposed mitigation measures	Residual significance	Residual impact significance
G2H and adjacent Inland Rail projects [continued]	Construction works to Cattos Road (for G2H) and Airforce Road (for H2C), along with use of key roads in Helidon as construction routes, may result in traffic delays for residents and motorists travelling to and from Helidon, including access to the Helidon State School. Potential changes to roads level of service.	B2	TMPs for the Inland Rail projects will consider potential cumulative impacts on traffic and coordinate traffic management accordingly	B1	Medium (negative)
	Disrupted access to Helidon to Ravensbourne Trail circuit	C2	Consideration of the trail's connectivity in the TMP to minimise disruption to access	C1	Low (negative)
B2G, G2H, H2C, C2K, K2ARB	Cumulative demand for skilled trades and civil construction labour, affecting access by businesses, industries, and households	C3	Inland Rail Skills Academy Consultation with councils and business chambers to monitor labour draw and enable corrective action, e.g. refinement of recruitment strategies	C2	Medium (negative)
	Project region businesses would benefit from Project and personnel expenditure of the combined Inland Rail projects	B3	Inland Rail Skills Academy	B3	High **(positive)**
	Increase in demands for policing and emergency services	B2	Cooperation with Queensland Health, Queensland Police Service (QPS), Queensland Ambulance Service (QAS) and Queensland Fire and Emergency Services (QFES) to advice on workforce ramp-up and construction activities	B1	Medium (negative)
	Potential to provide significant employment opportunities for local residents	B3	Inland Rail Skills Academy	B3	High **(positive)**

Projects	Potential cumulative impact	Likelihood (A–E) and Consequence (1–5)	Proposed mitigation measures	Residual significance	Residual impact significance
B2G, G2H, H2C, C2K, K2ARB [continued]	Transport of spoil and other construction material may increase traffic volumes on key routes with potential to affect the roads level of service or traffic safety	C Unknown	To be determined as part of TMP and CEMP in the detailed design phase	C Unknown	Unknown
Any/all construction projects	Cumulative demand for skilled trades and civil construction labour, affecting access by businesses, industries and households	B3	Inland Rail Skills Academy Consultation with Councils and business chambers to monitor labour draw and enable corrective action, e.g. refinement of recruitment strategies	B2	**High (negative)**
	Potential for cumulative demands on rental housing, which is currently in short supply, and/or short-term accommodation, but with minimal Project contributions to impacts expected	C3	AMP required of contractors for all Inland Rail projects	C2	Medium (negative)
	Potential for cumulative increases in construction traffic leading to safety concerns and local drivers' fatigue or frustration with road works and traffic congestion	C3	TMPs for the two projects will consider potential cumulative impacts on traffic and coordinate traffic management accordingly	C2	Medium (negative)
	Community concern relating to increased numbers of non-local workers, including 'stranger danger' and traffic safety	C2	Workforce Code of Conduct required of all Inland Rail project contractors	C1	Low (negative)
	Increased demands on health and emergency services leading to reduced access for other residents	C2	Cooperation with Queensland Health, QPS, QAS and QFES to advice on workforce ramp-up and construction activities	D1	Low (negative)
	Potential for stresses associated with construction projects to increase local demands for support services	C3	Mental health partnership with PHNs	C2	Medium (negative)

Projects	Potential cumulative impact	Likelihood (A–E) and Consequence (1–5)	Proposed mitigation measures	Residual significance	Residual impact significance
Any/all construction projects [continued]	Expansion in the construction sector would support additional flow-on demand through the construction industry supply chain	B3	Not required—local business participation strategies outlined in the Local Business and Industry Participation Plan	B3	High (positive)
Operations					
B2G, H2C, InterLinkSQ, Wellcamp Business Park, Toowoomba Enterprise Hub, Toowoomba Wellcamp Airport, Asterion Medical Cannabis Facility	Operational impacts associated with views of major projects are likely to affect the Project region's scenic character, however community members are likely to adapt to landscape changes over time	B2	Develop and implement Reinstatement and Rehabilitation Plan for areas within the Project disturbance footprint that do not form part of the permanent works	B2	Medium (negative)
Any/all projects	The operation of Inland Rail projects and intermodal freight facilities would contribute to long-term employment opportunities for the residents of potentially impacted communities	B4	Not required	B4	High (positive)

22.6.10 Economics

The cumulative economic impact assessment refers to the potential impact of cumulative stimulus to the economy, resulting from a set of existing or planned projects within or adjacent to the study area. Cumulative impacts may result from the spatial and/or temporal interaction between these projects. The cumulative assessment applied as part of the economic impact assessment does not align with the approached outlined in Section 22.4 and is based on the methodology outlined below and detailed in Appendix R: Economic Impact Assessment and outlined in Chapter 17: Economics.

The study area for the economic impact assessment is the Toowoomba and Lockyer Valley LGAs, while the Toowoomba labour market is defined as the Toowoomba Statistical Area by the Australian Bureau of Statistics, which includes Toowoomba City and the Gatton area of Lockyer Valley.

The cumulative impact assessment has two components:

- **Inland Rail Program in Queensland**—a quantitative assessment of the cumulative macroeconomic impact of the Inland Rail Program on the economy, resulting from the construction of the Queensland sections of the Inland Rail Program. The cumulative impacts are outlined in Section 22.6.10.1.
- **Broader cumulative assessment**—a qualitative assessment of cumulative impact of other significant projects (that have been identified by ARTC as having a relationship to the Project) on local and regional labour markets, the supply chain and local businesses. These projects are listed in Table 22.21 with a description of the potential for cumulative impacts to arise, with the boarder economic assessment outlined in Section 22.6.10.2.

Mitigation measures for the macroeconomic and broader cumulative impacts on labour markets, the supply chain and local businesses are addressed in Appendix R: Economic Impact Assessment and are incorporated into the SIMP (refer Appendix Q: Social Impact Assessment), therefore Table 22.21 presents the impact and characteristics only with further analysis in Section 22.6.10.1 and Section 22.6.10.2.

TABLE 22.21: PROJECTS WHERE BROADER CUMULATIVE IMPACTS MAY OCCUR AND DESCRIPTION OF THESE IMPACTS

Impact	Impact characteristic
B2G (Inland Rail)	▸ Potential labour draw from the study area (peak 950 FTE during construction period) ▸ Potential draw on construction materials from the regional economic catchment ▸ Businesses in the catchment area (e.g. in Gowrie Junction area) are likely to benefit from the Project as a result of increased local expenditure from construction personnel of the combined Inland Rail projects ▸ Employment opportunities and regional development in relation to the Toowoomba Enterprise Hub
H2C (Inland Rail)	▸ Potential labour draw from the regional economic catchment (peak 410 FTE during construction period) ▸ Potential draw on construction materials from the regional economic catchment ▸ Businesses in the catchment area (e.g. in Helidon area) are likely to benefit from the Project as a result of increased local expenditure from construction personnel of the combined Inland Rail projects
C2K (Inland Rail)	▸ Potential labour draw in SEQ may reduce labour availability for more specialised roles (peak 660 FTE during construction period] ▸ Potential regional development opportunities across SEQ's south-west industrial corridor and in the Western Gateway Regional Economic Cluster
K2ARB (Inland Rail)	▸ Potential labour draw in SEQ may reduce labour availability for more specialised roles
InterLinkSQ—Global Logistics Centre and Industrial Park	▸ Design includes tie-ins between the projects, allowing for movement of freight between the Inland Rail and the intermodal terminal ▸ Requirement for civil construction labour, resulting in cumulative demand for skilled trades and civil construction labour; however, development likely to be incremental over a longer period, with relatively modest labour draw ▸ Potential regional development opportunities across SEQ' s south-west industrial corridor and in the Western Gateway Regional Economic Cluster
Wellcamp Business Park	▸ Requirement for civil construction labour, resulting in cumulative demand for skilled trades and civil construction labour; however, development likely to be incremental over a longer period, with relatively modest labour draw ▸ Potential regional development opportunities across SEQ' s south-west industrial corridor and in the Western Gateway Regional Economic Cluster
Witmack Industry Park and Charlton Logistics Park	▸ Requirement for civil construction labour, resulting in cumulative demand for skilled trades and civil construction labour; however, development likely to be incremental over a longer period with relatively modest labour draw ▸ Potential regional development opportunities across SEQ' s south-west industrial corridor and in the Western Gateway Regional Economic Cluster
Asterion Medicinal Cannabis Facility	▸ Where construction schedules overlap, potential labour draw from the regional economic catchment
Bromelton State Development Area	▸ Potential labour draw from the regional economic catchment
Gatton West Industrial Zone	▸ Where construction schedules overlap, potential labour draw from the regional economic catchment (peak 13.5 FTE during construction period)
Defence Housing Australia, Mount Lofty development	▸ Where construction schedules overlap, potential labour draw from the regional economic catchment
New Acland Coal Mine—Stage 3	▸ Potential labour draw from the regional economic catchment
Toowoomba Regional Council Waste Management Facility	▸ Where construction schedules overlap, potential labour draw from the regional economic catchment ▸ Potential draw on construction materials from the regional economic catchment
Cross River Rail	▸ Potential labour draw in SEQ may reduce labour availability for more specialised roles (1,500 direct and indirect FTE each year during construction)

22.6.10.1 Inland Rail Program in Queensland

The construction phases of the Queensland sections of the Inland Rail Program have been jointly simulated to analyse the cumulative economic impacts of these projects. Table 22.22 and Table 22.23 summarise the cumulative macroeconomic impacts of the Queensland sections of the Inland Rail Program. Under the assumption of 'slack' labour markets, the incremental economic impacts of the Queensland sections include an increase in real Gross State Product (GSP) of $1.75 billion (measured in 2019 dollars) and an increase in the average number of jobs over the construction period of 2,059[1]. If labour markets are 'tight', the incremental benefits are smaller, with real GSP increasing by $0.83 billion and the average number of jobs increasing by 485.

The sections of the Inland Rail Program that are located in the Toowoomba regional economic catchment area are the Project and the western portion of the H2C section. Construction activities related to these sections will directly impact the Toowoomba[2] economy. The remaining Queensland sections of the Inland Rail Program, which are located in the Greater Brisbane, and Darling Downs and Maranoa regions, will impact the Toowoomba labour market region indirectly.

The previous section reported the results of simulations when the Project was considered in isolation. In that context, the direct and indirect increment to jobs in the Toowoomba economy was estimated to be 1,027 under the assumption of slack labour markets and 225 under the assumption of tight labour markets. When all the Queensland projects are considered jointly, the analogous increment to jobs (direct and indirect) in Toowoomba labour market region increases to 1,071 (under a slack labour market scenario) and 258 (under a tight labour market scenario). In the joint scenario, the increment to jobs in the Toowoomba labour market region peaks in 2022 at 2,106 and 523 jobs under slack and tight labour market conditions, respectively. As discussed in the regional impact analysis, the labour market conditions expected to prevail in the Toowoomba economy over the period 2021 to 2025 will be most consistent with those assumed in the slack' labour market scenarios that have been simulated. The labour market conditions in other regional economies in Queensland over the Inland Rail construction phase period will generally be much closer to the slack than to the tight characterisation.

TABLE 22.22: SUMMARY OF QUEENSLAND-WIDE ECONOMIC IMPACTS—SLACK LABOUR MARKETS

		Jobs (persons)		
	GRP/GDP ($ 2019)	Average (Annual)	Peak	Year of Peak
Greater Brisbane	$595 million	703	1,610	2022
Darling Downs—Maranoa	$314 million	290	722	2022
Toowoomba labour market region	$821 million	1,071	2,106	2022
Remainder of Queensland	$24 million	-5	16	2022
Queensland	*$1,754 million*	*2,059*	***4,455***	***2022***
Remainder of Australia	$23 million	-335	-39	2020
Australia	$1,777 million	1,724	3,835	2022

Source: KPMG

Table Notes:
GDP and average employment should add up to totals (with some leeway for rounding).
Peak employment doesn't necessarily add up. From the modelling, peak employment was the maximum employment reached in a regional labour market over the period 2020–2025—so there is likelihood that the peak period in one region does not coincide with the peak in another region.

1. Gross State Product (GSP) for Queensland is an aggregate measure of the total economic production of goods and services, including international and interstate trade, during a quarterly period
2. The cumulative impacts assessment has been undertaken prior to the refinements made to the construction program. The impact of this refinement would have a minor effect on the economic benefits identified. This change to program timing explains any inconsistencies between the construction program identified in the economic analysis and those identified within the body of this report.

TABLE 22.23: SUMMARY OF QUEENSLAND-WIDE ECONOMIC IMPACTS—TIGHT LABOUR MARKETS

		Jobs (persons)		
	GRP/GDP ($ 2019)	Average (Annual)	Peak	Year of Peak
Greater Brisbane	$285 million	153	370	2022
Darling Downs—Maranoa	$147 million	69	175	2022
Toowoomba labour market region	$370 million	258	523	2022
Remainder of Queensland	$31 million	5	23	2022
Queensland	***$832** million*	***485***	***1,090***	***2022***
Remainder of Australia	$277 million	86	249	2022
Australia	$1,109 million	572	1,339	2022

Source: KPMG

Table Notes:
GDP and average employment should add up to totals (with some leeway for rounding).
Peak employment doesn't necessarily add up. From the modelling, peak employment was the maximum employment reached in a regional labour market over the period 2020–2025—so there is likelihood that the peak period in one region does not coincide with the peak in another region.

Further information on the economic benefits of the Inland Rail Program is provided in Chapter 2: Project Rationale.

22.6.10.2 Broader cumulative impacts

Labour market impacts

The concurrent construction of interacting projects has the potential to increase the demand for labour in the local and regional economy, particularly for workers with trade and construction skills/knowledge. The demand for construction workers within a similar timeframe will lead to cumulative demands on construction labour, not only in the local and regional economy, but also across Queensland and, potentially, nationally.

The results of the regional economic impact assessment indicate that it is reasonable to assume that the regional labour market will have the capacity to supply a portion of the workforce requirements of the Project, without major disruption; however, these conditions may change in the context of cumulative labour market demand. Prior to the COVID-19 shock, the major infrastructure projects in the adjacent and surrounding areas, including those associated with Inland Rail, had the potential to put some pressure on labour markets if inopportune scheduling resulted in cumulative and competing demand for trades and construction labour; however, the overall labour demands of the interacting projects were modest and scheduling could be optimised to minimise market impact.

The prevailing trends in the Toowoomba labour market, and the ability of workers to mobilise to project locations, suggested that the risks of labour market disruption were limited. In the current economic environment, this risk has now been further reduced.

There may be benefits from having additional infrastructure projects in the adjacent and surrounding areas around the same time as the Project. These benefits come in the form of lowered mobilisation costs and transfer of labour experience and skills to projects; particularly those constructed in the period leading up to, and the period following, the Project's construction phase.

Impact on local businesses

The expansion in construction activity and regional employment (with a subsequent increase in temporary and non-resident population) has the potential to increase demand for a range of local infrastructure and services, including housing, health care, childcare and education. Further, spending on consumer-orientated products by the construction workforce has the potential to benefit local businesses by increasing their trading levels. Importantly, some businesses may need to scale up their current capacity to support cumulative demand, while also understanding the temporary nature of the construction period for the relevant projects and adjust capacity accordingly.

Supply chain impacts

Cumulative supply chain impacts are likely to be realised where construction timeframes occur concurrently and comparable material is required, e.g. the adjacent Inland Rail projects. Opportunities to supply these projects may include supply of fuels, equipment, borrow and quarried material. Where materials are sourced within the surrounding regions, increased local expenditure is likely to increase local and regional economic activity.

Should the demand for material surpass supply, however, resulting in a shortage of available material, input costs to the Project may increase (due to increased prices of materials) driving up the total construction cost and negatively impacting on the economic return of the Project.

The Project will result in a number of economic impacts, with potential economic benefits realised at a local and regional level. In order to maximise the positive outcomes of the Project, a number of strategies to avoid, reduce or mitigate the negative economic impacts, and enhance and facilitate the capture of positive impacts, have been identified in the SIMP, refer Appendix Q: Social Impact Assessment.

There are a number of economic impacts identified in the economic impact assessment, which are not addressed in the SIMP. Where these impacts cannot be avoided, a range of measures have been proposed by ARTC to carefully manage and mitigate these impacts. For example, measures include working with individual landholders to develop suitable solutions based on individual farm management practices; rehabilitating land as close as possible to pre-construction conditions; and consulting with tourism associations to develop a strategy to ensure that generalised impacts on tourism values are reduced, wherever possible.

22.6.11 Cultural heritage

The potential for cultural heritage cumulative impacts emerges when concurrent or consecutive activities bring about incremental change to heritage places and values. These changes may not be captured in an assessment for any single project, and instead need to be considered on a wider physical and temporal scale (International Council on Monuments and Sites (ICOMOS), 2011).

A description of the Indigenous and non-Indigenous heritage relevant to the Project is provided in Chapter 18: Cultural Heritage and Appendix S: Non-Indigenous Cultural Heritage.

22.6.11.1 Indigenous Heritage

In 2018, Cultural Heritage Management Plans (CHMP) with the Yuggera Ugarapul People and Western Wakka Wakka People, were developed in accordance with the requirements of Part 7 of the *Aboriginal Cultural Heritage Act 2003* (Qld) (ACH Act) and the Cultural Heritage Management Plan Guidelines (Department of Aboriginal Torres Strait Islander Partnerships (DATSIP), 2005), and approved by the Chief Executive of DATSIP in 2018 (CLH017009). The resulting CHMPs (CLH017009) entered into with the Aboriginal Parties will allow for the identification, assessment and management of Aboriginal cultural heritage in the plan area (as defined in the CHMP) throughout all Project delivery phases.

The potential for impacts to Aboriginal cultural heritage, including cumulative impacts, will be identified, assessed and managed under the approved Project CHMPs (CLH017009).

22.6.11.2 Non-Indigenous Heritage

In relation to non-Indigenous heritage, the projects most relevant to the CIA are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ.

The Project is adjoined by B2G in the west and H2C in the east, and overlaps InterLinkSQ west of Gowrie. Of the two adjoining projects, B2G is largely comprised of greenfield development and overlaps with the Project at Charlton in a greenfield area. Conversely, the Project joins H2C northwest of Helidon in a brownfield area. The areas of overlapping boundaries are expected to be constructed primarily within previously disturbed land that is currently rail corridor, road reserves or immediately adjacent, within pre-disturbed areas (e.g. cropping land).

An investigation of the cumulative impacts of the Project in relation to the adjoining B2G and H2C projects, and InterLinkSQ is discussed in Chapter 18: Cultural Heritage and Appendix S: Non-Indigenous Cultural Heritage, with the results summarised in Table 22.24. The significance of the overall cumulative impact on non-Indigenous heritage is assessed as **medium.** This determination has been largely driven by the understanding that it is highly probable that places of cultural interest will be impacted by adjoining Inland Rail projects and that these impacts may be permanent in nature.

For G2H, there were nine non-Indigenous heritage sites (three listed sites and six potential local heritage sites) identified in the cultural heritage study area for the Project (refer Chapter 18: Cultural Heritage) with 30 per cent being impacted. This compares favourably with the B2G project, where a total of 34 non-Indigenous heritage sites were identified, with 61 per cent being directly impacted. Likewise, a total of 79 non-Indigenous heritage sites were identified on the H2C project, with 31 per cent being impacted. The G2H and H2C Inland Rail projects have a similar extent of impact, while the B2G projects impact more sites, although it is noted that these sites are generally of low heritage value. Depending on the type of mitigation measures implemented, cumulative impacts may result in a change to the heritage character of the region through a reduction in the number and type of historic places, and/or a reduction in the number and diversity of cultural heritage places within the region.

InterLinkSQ is a new development of mixed brownfield and greenfield areas but is unlikely to have a significant impact on surrounding local heritage items.

The impacted sites will be subject to a range of potential mitigation measures. Mitigation measures that can be implemented across all of the projects listed to minimise the potential cumulative impacts from project interactions on non-Indigenous cultural heritage aspects include:

- Avoidance
- Minimisation
- Archival recording
- Relocation
- Archaeological survey and/or excavation
- Archaeological surface collection.

The results of cumulative impact assessments undertaken for cultural heritage sites and places must be interpreted with caution, because they are based (in part) on heritage datasets that are inevitably incomplete and contain various inconsistencies and errors. Godwin (2011) has questioned the value of cumulative impact assessments to cultural heritage management in Australia, arguing that the 'fundamentals' necessary for undertaking such assessments simply do not exist. The fundamentals Godwin is referring to are robust regional and national data sets for measuring proposed impacts and the determination of acceptable scientific and cultural impact thresholds.

TABLE 22.24: CUMULATIVE IMPACT ASSESSMENT FOR CULTURAL HERITAGE

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Loss of non-Indigenous cultural heritage sites	Probability of the impact	3	9	Medium	Mitigation measures that can be implemented across all projects to minimise the potential cumulative impacts from Project interactions include: ▸ Design will be developed and refined in response to the outcomes of additional heritage surveys undertaken through the detail design phase, to avoid direct impacts to identified items or sites of heritage significance, where possible and practical to do so ▸ Development and implementation of a Cultural Heritage Management Sub-plan as a component of the CEMP for the Project ▸ Archival photographic recording of sites or places that will be directly impacted by the Project in accordance with the *Guideline: Archival Recording of Heritage Places* (Department of Environment and Heritage Protection (DEHP), 2013b) ▸ Archaeology survey and/or excavation ▸ Archaeological surface collection ARTC to ensure that compatible management measures are applied across projects within the Inland Rail Program.
	Duration of the impact	3			
	Magnitude/ intensity of the impact	2			
	Sensitivity of the receiving environment	1			

22.6.12 Traffic, transport, and access

Traffic generation from other developments in the region at the planning, design or construction stage have been considered for the traffic, transport and access CIA. Twelve projects located within the AOI, and with overlapping construction schedules with the Project, have been included in the cumulative impact assessment on traffic, transport and access. These are:

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ
- Wellcamp Business Park
- Witmack Industry Park and Charlton Logistics Park
- Gatton West Industrial Zone
- DHA Mount Lofty Development
- New Acland Coal Mine Stage 3
- Toowoomba Regional Council/Waste Management Facility
- Cross River Rail
- Asterion Medicinal Cannabis Facility.

In relation to the Remondis Waste to Energy Facility, an overlap in construction schedules occurs but the impact of this construction traffic (i.e. construction traffic routes and estimated construction traffic volumes) cannot yet be determined as the proponent is awaiting preparation of the project's draft terms of reference.

If construction transportation tasks for the abovementioned projects occur simultaneously to transportation tasks for the Project, then a cumulative increase in traffic volumes on the local road network may occur. Generally, the following impacts may arise because of the increased number of vehicle movements on the existing road network during construction:

- Increased journey times on road linkages used by construction traffic
- Reduced level of service on road links used by construction traffic
- Increased waiting time at intersections used by construction traffic
- Accelerated degradation of road pavements due to increased volume of traffic and greater axle load.

Noting that the Inland Rail projects will provide interoperability across the QR and ARTC networks and will benefit the local and regional road networks through the reduction in number of heavy vehicles using these road networks. Further details of the benefit of the Inland Rail Program are provided in Chapter 2: Project Rationale.

The assessment of the significance of cumulative impacts on traffic, transport and access is detailed in Chapter 19: Traffic, Transport and Access and summarised in Table 22.25.

As each of the projects identified above may have an overlap in construction schedules and potentially proposed construction routes, the cumulative traffic and transport impacts on the wider transport network has been assessed as **medium** (refer Table 22.25). The following factors contributed to this determination:

- The assessment has only considered the potential for cumulative impacts above and beyond those that have already been factored into the traffic impact assessment for the Project. A linear growth rate of 2 per cent was applied to the annual average daily traffic volumes of roads nominated for use by construction traffic to determine future background traffic volumes for the traffic impact assessment. This means that the addition of Project construction traffic has already been assessed against a future background traffic scenario that includes allowance for growth in road usage.
- When establishing the scale of the construction task for the Project, buffer factors were applied to derive vehicle movement numbers for each of the foreseeable construction transportation activities. These buffer factors allow for additional journeys that may be required to deliver the Project; however, these factors also provide contingency in the traffic impact assessment for the addition of background traffic volumes that may be marginally greater than the forecast future scenario.

The traffic impact assessment will be updated and finalised during the detailed design phase, in accordance with the process specified in the *Guide to Traffic Impact Assessment* (DTMR, 2017a), to reflect the detailed design, construction method (including material sources and quantities) and the finalised construction traffic routes. Other developments and activities in the region that may contribute to background traffic volumes over the construction period for the Project will be identified and confirmed in consultation with Toowoomba and Lockyer Valley regional councils and DTMR. These volumes will be incorporated into the revised traffic impact assessment.

This revised traffic impact assessment will be used to develop a Traffic Management Plan (TMP) and a Road Use Management Plan (RUMP) for the Project, for implementation during construction.

TABLE 22.25: CUMULATIVE IMPACT ASSESSMENT FOR TRAFFIC, TRANSPORT AND ACCESS

Project	Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
B2G	These projects will have cumulative impacts on traffic volumes, congestion and potentially lead to delays during the construction period	Probability of the impact	2	8	Medium	Both projects are expected to be reliant on use of roads in the Gowrie area and northern Toowoomba, along with the Warrego Highway, including the Toowoomba Bypass. The shared use of these roads could occur for a large portion of the construction period for the Project. The potential for the Project to contribute to increased traffic volumes on the local road network will be managed through: ▸ Development and implementation of a RUMP and Traffic Management Sub-plan ▸ Consultation with DTMR, TRC and QR where applicable through the construction planning and construction phases of the Project to identify newly occurring issues and risks to the road network used by Project traffic ▸ Subject to construction contract arrangements, investigate opportunities to nominate laydown locations that can be shared between this Project and the B2G project. This would enable optimisation of the number of delivery movements and routes to/from the construction sites for both projects.
		Duration of the impact	2			
		Magnitude/ intensity of the impact	2			
		Sensitivity of the receiving environment	2			
H2C	These projects will have cumulative impacts on traffic volumes, congestion and potentially lead to delays during the construction period. Disruption to the existing West Moreton System supply chain and business as usual activities	Probability of the impact	2	8	Medium	Both projects are expected to be reliant on use of roads in the Helidon area and the Warrego Highway, including the Toowoomba Bypass. The shared use of these roads could occur for a large portion of the construction period for the Project. The potential for the Project to contribute to increased traffic volumes on the local road network will be managed through: ▸ Development and implementation of a RUMP and Traffic Management Sub-plan ▸ Consultation with DTMR, LVRC, and QR where applicable through the construction planning and construction phases of the Project to identify newly occurring issues and risks to the road network used by Project traffic ▸ Subject to construction contract arrangements, investigate opportunities to nominate laydown locations that can be shared between this Project and the B2G project. This would enable optimisation of the number of delivery movements and routes to/from the construction sites for both projects. Both projects are co-located with the West Moreton System and there is the potential to disrupt services during construction. Further consultation with QR is required to optimise any track possession works and impacts on level crossings
		Duration of the impact	2			
		Magnitude/ intensity of the impact	2			
		Sensitivity of the receiving environment	2			

Project	Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
InterLinkSQ	These projects will have cumulative impacts on traffic volumes, congestion and potentially lead to delays during the construction period. Disruption to the existing West Moreton System supply chain and business as usual activities	Probability of the impact	2	8	Medium	▸ Both projects are expected to be reliant on use of roads in the Gowrie area and northern Toowoomba, along with the Warrego Highway, including the Toowoomba Bypass. The shared use of these roads could occur for a large portion of the construction period for the Project. The potential for the Project to contribute to increased traffic volumes on the local road network will be managed through: ▸ Development and implementation of a RUMP and Traffic Management Sub-plan ▸ Consultation with DTMR, TRC and QR where applicable through the construction planning and construction phases of the Project to identify newly occurring issues and risks to the road network used by Project traffic ▸ Subject to construction contract arrangements, investigate opportunities to nominate laydown locations that can be shared between this Project and the B2G project. This would enable optimisation of the number of delivery movements and routes to/from the construction sites for both projects. The Project design allows for an interface between this project and both the QR and Inland Rail Networks. Consultation with QR to confirm the timing of measure t minimise the disruption to the supply chain.
		Duration of the impact	2			
		Magnitude/ intensity of the impact	2			
		Sensitivity of the receiving environment	2			
Wellcamp Business Park Witmack Industry Park and Charlton Logistics Park		Probability of the impact	2	6	Low	As part of the Project impact assessment of traffic and transport, a large range of mitigation measures have been proposed at local and state levels for construction and operation of the Project. To further mitigate potential cumulative impacts, the other assessable projects will also have to successfully implement similar mitigation measures. Mitigation measures proposed for the Project relating to safety, intersection impacts, link road impacts, pavement impacts, and road rail interface
		Duration of the impact	1			
		Magnitude/ intensity of the impact	1			

Project	Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
DHA Mount Lofty Development Gatton West Industrial Zone New Acland Coal Mine Stage 3 TRC Waste Management Facility Cross River Rail		Sensitivity of the receiving environment	2			impacts would suffice in order to mitigate for the cumulative impacts as a result of these projects. Specific mitigation measures that can be implemented across all of the projects to minimise the potential exacerbation of impacts on traffic and transport values as a result of interactions between the projects include: ▸ Construction traffic management plans ▸ Ongoing consultation with affected parties ▸ Road use management plans ▸ Travel demand management campaigns. It is noted that during the detailed design stage of the Project, it may be feasible to consolidate routes between the Project and other Inland Rail packages. This will be required to be reassessed by the construction contractor in consultation with DTMR and the relevant local councils at the detailed design stage of the Project.

22.6.13 Hazard and risk

In relation to hazard and risk, the projects considered to have a potential for cumulative impacts with the Project have been identified as B2G and H2C.

Given the similar nature of the B2G, H2C and G2H projects, the key risks considered in the CIA 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
- The other risks identified in Chapter 20: Hazard and Risk were considered in the CIA in other technical areas, e.g. potential flooding impacts are presented in Section 22.6.6.

22.6.13.1 Loss of containment of dangerous goods

Due to the nature of the potential risks associated with hazardous chemicals, storage of these chemicals can have offsite impacts, depending on the quantities and types of materials to be stored.

Potential cumulative impacts arising from loss of containment of dangerous goods on the surrounding environment and community will be largely the product of:

- Temporal construction impacts: the requirements for dangerous goods laydown areas, sensitivity of environmental conditions (e.g. extreme weather or potential bushfire events) and an increase in workforce machinery operating on adjoining projects at the same time
- Spatial operational impacts: the cumulative impact of freighting dangerous goods on Inland Rail to sensitive receptors.

During construction, the expected quantities of hazardous chemicals are not considered sufficient to introduce significant offsite impacts or have the potential to contribute to cumulative impacts at the local, regional, or national levels. Impacts associated with construction storage of hazardous chemicals are expected to be localised to the area of use for the expected quantities and types of dangerous goods.

The hazard and risk AOI, with respect to the risk of loss of containment of dangerous goods, is considered to be limited to within, or in close proximity to, the G2H rail corridor. As such, the non-ARTC projects listed in Table 22.7 are considered to be outside of the AOI; therefore, the significance of the cumulative impact assessment of loss of containment of dangerous goods associated with the project is also likely to be **low** (refer Table 22.26).

22.6.13.2 Blasting and explosion

The potential use of explosives for construction of the tunnel through the Toowoomba Range has potential cumulative impacts to the environment. The amount of explosive used, and the timing and duration of blasting, are critical to ensure safe and controlled blasting works.

For instance, blasting failures and improperly conducted blasting works have the potential to create unstable land and may cause damage to surrounding structures, including road and rail assets. The presence of controls described in Chapter 20: Hazard and Risk will limit the potential for blasting failures and control the risk of cumulative impacts. A number of non-ARTC projects could potentially coincide during the construction phase of the project; however, due to the anticipated construction dates, and the distance between non-ARTC projects and the Project, the cumulative impacts are considered to be **low** (refer Table 22.26).

Cumulative mitigation measures are presented in Table 22.26; however, the mitigation measures associated with hazards and risk aspects are assessed in the context of the Project specifically. Ongoing analysis will be undertaken as the Project progresses, however, and into the operational phase, in line with ARTC's operational requirements.

TABLE 22.26: CUMULATIVE IMPACT ASSESSMENT FOR HAZARD AND RISK

Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Loss of containment of dangerous goods	Probability of the impact	1	5	Low	Will be managed through: ▸ Class 1 explosives will not be transported on the Inland Rail network ▸ Dangerous goods must be loaded, labelled, and marshalled in accordance with the Australian Code for the Transport of Dangerous Goods by Road & Rail (National Transport Commission, 2018) ▸ Adherence to Inland Rail emergency management procedures ▸ The development and implementation of network-wide Incident Management Plan. ▸ Rail operations will be managed by ARTC's existing safety and environmental management procedures, with further integration between the Inland Rail and QR Network wot be finalised during detailed design
	Duration of the impact	2			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
Impacts on the local environment and future projects from the potential use of explosives for tunnel construction	Probability of the impact	1	5	Low	Chemicals stored and handled as part of construction activities will be managed in accordance with relevant legislation and where applicable: ▸ AS 2187.2:2006: Explosives – Storage, transport and use (Standards Australia, 2006a) ▸ Australian Code for the Transport of Explosives by Road and Rail, 3rd edition (Australian Government, 2009).
	Duration of the impact	1			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	1			

22.6.14 Waste and resource management

The construction of the Project will generate a number of waste streams that will be managed by maximising opportunities to avoid or reduce, re-use and recycle using standard industry practice; however, there will be waste streams for which this cannot be achieved and these will be disposed of in appropriately licensed facilities. A description of the waste and resource management is provided in Chapter 21: Waste and Resource Management.

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

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

- B2G (Inland Rail)
- H2C (Inland Rail)
- InterLinkSQ.

The time overlap of the above projects can provide an opportunity to improve resource efficiency across all projects.

B2G and H2C projects are both Inland Rail projects and, despite the potential for cumulative impacts on receiving waste management facilities, ARTC will liaise with the relevant operators to negotiate appropriate waste disposal arrangements across the three Inland Rail projects. There is an opportunity to consolidate supply material reuse across all Inland Rail projects. Spoil material, and construction and demolition waste, such as concrete, from these projects can be crushed up and used as an aggregate or fill, if determined to be geotechnically suitable. This will reduce the need to borrow material from quarries, thereby reducing the overall environmental impact of the Project.

The construction period for InterLinkSQ, may extend to 2037 reducing the potential construction phase overlap with the Project construction timeframe; therefore, the risk of cumulative impacts from the interaction of these projects is considered to be **low** (refer Table 22.27).

Mitigation measures associated with waste management are project specific and included in Chapter 21: Waste and Resource Management, though some of the proposed mitigation measures may mitigate the potential cumulative impacts and are included in Table 22.27.

TABLE 22.27: CUMULATIVE IMPACT ASSESSMENT FOR WASTE MANAGEMENT

Potential cumulative impacts	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Recommended mitigation measures
Airspace consumption of local waste management infrastructure, thereby reducing the local community's access to such services	Probability of the impact	2	5	Low	Will be managed during construction through: ▸ Opportunities for material reuse and recycling across projects are to be identified and assessed for feasibility ▸ ARTC to secure agreements with owners and operators for disposal of waste at licensed waste-disposal facilities once the construction schedule for both Inland Rail projects is confirmed ▸ ARTC to ensure that construction contract documentation for adjoining projects have consistent clauses regarding waste management, including reduction targets ▸ ARTC to ensure that Waste Management Sub-plans (or equivalent) are prepared for both adjoining Inland Rail projects, and that these sub-plans are complementary and are consistent with the Inland Rail Environment and Sustainability Policy, the Inland Rail Sustainable Procurement Policy and the Inland Rail Environmental Management System.
	Duration of the impact	1			
	Magnitude/intensity of the impact	1			
	Sensitivity of the receiving environment	1			
	Duration of the impact	1			
	Magnitude/intensity of the impact	2			
	Sensitivity of the receiving environment	1			

22.7 Conclusions

The CIA for the Project considered 15 additional projects within a wide geographic extent as possibly contributing to cumulative impacts. Spatial AOIs as well as temporal overlaps of project activities were considered for various environmental, social, and economic aspects. The assessment concludes that the unmitigated impacts from the Project, combined with other existing and proposed projects, have cumulative impacts of up to high significance in the various environmental and socio economics aspects that were considered. Following the application of mitigation measures, all residual cumulative impacts were considered to be **low,** with the exception of potential cumulative impacts on the following environmental aspects:

- Landscape and visual amenity, due to the operational impacts associated with views of combined, successive, and sequential views of adjoining projects, which raised the significance rating up to a medium
- Flora and fauna, due to the impacts of habitat loss from vegetation clearing; reduction in biological viability of soil to support growth due to soil compaction; displacement of flora and fauna species from invasion of weed and pest species; reduction in the connectivity of biodiversity corridors, edge effects, habitat fragmentation and barrier effects; which, combined, raised the significance rating to high for State Significant Ecological Constraint—threatened species (i.e. habitat for NC Act (only) listed species). Other ecological matters had a rating of medium.
- Social impacts due to the combined effects of adjoining projects on social matters, including the labour force, traffic volumes, land acquisition, traffic safety, and rural amenity for landholders, which raised the significance rating to medium
- Traffic, transport, and access, due to the impacts of construction traffic on local traffic volumes and the extent to which adjoining projects may intensify these effects, raising the significance rating to medium.

The potential impacts associated with loss of biodiversity and social impacts identified as a result of the Project are common to all the projects throughout the region and are, therefore, by their nature, cumulative. Similarly, the projects are all likely to exacerbate impacts from the Project in relation to loss of landscape and visual amenity values and operational impacts through combined, successive, and sequential views of adjoining projects.

Several of the projects considered in this cumulative impact assessment may also have overlapping construction schedules, which is likely to lead to increased traffic and congestion on certain roads within the AOI and the availability of skilled labour in the region in the short term.

The avoidance, mitigation and management strategies provided in each of the impact assessment sections in this EIS were developed to address both the potential impact of the Project and the effects of cumulative impacts. With regard to the cumulative impacts associated with land resources, landscape and visual amenity, flora and fauna, social impacts, and traffic, transport and access, specific mitigation measures have been outlined in the relevant EIS chapters to further mitigate these impacts, and have been summarised in Chapters 8 to 21 and within Chapter 23: Draft Outline Environmental Management Plan.

Due to the nature of the projects considered in this CIA, it is anticipated that this process of assessment will occur for all projects that have the potential to result in cumulative assessment, i.e. each of these projects will be required to mitigate and minimise these potential cumulative impacts to acceptable levels.