CHAPTER 22

Cumulative impacts

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT

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

Contents

Figures

Tables

22. Cumulative impacts

22.1 Overview

This chapter provides a summary of the cumulative impact assessment (CIA) undertaken for the Helidon to Calvert Project (the Project). According to the Terms of Reference (ToR), cumulative impacts are defined as the combined impacts from all relevant sources (developments and other activities in the area). The Environmental Impact Statement (EIS) is required to consider potential cumulative impacts associated with the Project. Cumulative impacts are expected to occur at a local and regional level, changing over time to influence potential impact intensity or scale, frequency or duration. Potential cumulative impacts can occur either in isolation or combination with other known, existing or planned activities or projects.

Potential cumulative impacts may influence both environmental (land, air and/or water) and social values (community, housing and/or economics). Cumulative impacts may be exacerbated when a number of activities or projects occur within close proximity to each other, with a correlation between impact accumulation and proximity. Cumulative impacts may:

- Differ from those of an individual project when considered in isolation
- Be positive or negative
- Have a severity and duration that depend on the spatial and temporal overlap occurring in an area
- Have the potential to vary over time and over the Project's lifecycle
- Be 'sink' impacts arising from the outputs of activities (that is, dust, noise, saline water) or 'source' impacts resulting from drawing on and using the same resources as other industries (for example, skilled labour, housing, water).

Chapter 8 to Chapter 21 of the EIS have considered existing projects or activities within a wide geographic context of the Project and that have already been accounted for in the impact assessment of the Project. Therefore, this CIA chapter specifically deals with projects or activities that:

- Have been approved but where construction has not yet commenced
- Have commenced construction
- Have only recently been completed
- Are currently being assessed as coordinated projects.

For the purpose of this assessment, the CIA study area is defined as the spatial area of influence, which is determined by each of the environmental and social issues being assessed for the Project. The area of influence (AOI) types considered in the assessment are:

- Derived by assessment—the AOI is determined for each environmental value 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 geographical extent of the CIA study area extends in a radius of approximately 50 km from the Project alignment as shown in Figure 22.1.

The assessment draws on the findings of Chapter 8 to Chapter 21, as well as the impact assessments of projects within the AOIs of the issues assessed. The CIA was carried out for each environmental value using the methodology outlined in Section 22.4. This cumulative impact chapter summarises the cumulative impacts identified for each respective chapter in Table 22.23. Further details of the assessment are discussed in each of the relevant technical sections of the EIS.

Within this chapter, potential cumulative impacts were assessed against each discipline and are summarised as a potential impact across all activities using a precautionary principle (e.g. a medium and low cumulative impact at a construction or operational phase respectively). Overall, 35 cumulative impacts were identified of a 'low' residual impact significance, 16 of a 'medium' residual impact significance and none of a 'high' residual impact significance.

22.2 Scope of chapter

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

Projects included in the CIA are detailed in Section 22.5 and meet one or more of the following selection criteria (at the time of writing):

a) Are currently being assessed under Part 1 of Chapter 3 of the *Environmental Protection Act 1994* (EP Act) and, as a minimum, have an initial advice statement (IAS) available on the Queensland Department of Environment and Science's (DES) website and exist within the defined geographical extent outlined throughout the EIS chapters and in Figure 22.1.

b) Have been declared a 'coordinated project' by the Coordinator-General under the *State Development and Public Works Organisation Act 1971* (SDPWO Act) and an EIS is currently being prepared or is complete, or an IAS is available on the Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) (formerly Department of State Development, Tourism and Innovation (DSDTI))

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

d) Could potentially compound residual impacts that the ARTC Inland Rail Program (Inland Rail) may have on environmental or social values.

Projects that were excluded from the CIA include those:

- Already present within the EIS investigation corridor, having begun or completed construction at the time of this EIS. Such projects are considered part of the 'existing environment' in the EIS chapters. They have already been accounted for in the impact assessment of the Project
- Not developed to the point that the nature and timing of the Project is known, or the environmental assessment or approval process has not been made public.

22.3 Terms of Reference requirements

The Terms of Reference (ToR) relevant for potential cumulative impacts is summarised in Table 22.1. Compliance of the EIS against the full ToR is documented in Appendix B: Terms of Reference Compliance Table.

TABLE 22.1: TERMS OF REFERENCE—CUMULATIVE IMPACTS

Terms of Reference requirements		Where addressed
6.6	Each matter assessed in the EIS (as described in Section 11 of the 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.	Addressed throughout the EIS in Chapter 8 to Chapter 21 The assessment methodology is provided in Chapter 4: Assessment methodology The cumulative impact assessment is provided in this chapter Section 22.6 Mitigation measures are consolidated in Chapter 23: Draft Outline Environmental Management Plan
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 be subsequently be progressed further on a collective basis.	Sections 22.4 to 22.6 Each technical chapter includes a discussion 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)	Section 22.5
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.	Section 22.6 Chapter 11: Flora and fauna Appendix J: Matters of National Environmental Significance Technical Report Each technical chapter also includes a discussion on cumulative impacts
11.112	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	Section 22.6.12. Chapter 19: Traffic, Transport and Access Appendix U: Traffic impact assessment

22.4 Methodology

22.4.1 Approach

The approach used to identify and assess potential cumulative impacts is summarised as:

- A review of potential impacts identified within Chapter 8 to Chapter 21 of this EIS.
- A register of assessable projects was collated with timelines to identify the temporal relationship between projects. This register includes:
  - Projects outside of Inland Rail based on the criteria identified in Section 22.1
  - Inland Rail projects immediately adjacent to the Project have been included in the CIA:
    - For this Project, the Gowrie to Helidon (G2H) and Calvert to Kagaru (C2K) Inland Rail projects have been considered within each discipline (with the Border to Gowrie (B2G) and Kagaru to Acacia Ridge and Bromelton (K2ARB) considered within the social impact assessment)
- A review of the potential cumulative impacts identified within each discipline:
  - The environment at the time of the ToR is the baseline, prior impacts from past land use has not been considered
- Identification and mapping of the assessment projects and the AOI of the aspect being considered:
  - Current operational projects and commercial or agricultural operations that are in the AOI around the Project are accounted for in the corresponding technical baseline studies (e.g. air, noise, social, economic)
- Where there is a potential overlap in impacts (either spatially or temporally), a CIA was undertaken to determine the nature of the cumulative impact. This includes:
  - Assessment method has been quantitative in nature (if/as possible), with qualitative assessment also undertaken
  - For quantitative assessment—the significance of impact is assessed in comparison to the same criteria or guidelines adopted by the relevant technical assessments
  - For qualitative impacts—the probability, duration, and magnitude/intensity of the impacts is considered as well as the sensitivity and value of the receiving environment conditions
- An assessment matrix (refer Section 22.4.2) was used to determine the significance of potential cumulative impacts
- Where cumulative impacts were deemed to be of 'medium' or 'high' significance, additional mitigation measures were proposed beyond those already proposed by the relevant technical studies.

Where cumulative impacts could only be expressed qualitatively, professional judgement regarding the probability, duration and magnitude/intensity of the impact, as well as the sensitivity and value of the receiving environment, was used to assess the relevance and significance of potential cumulative impacts.

22.4.2 Assessment matrix

Following the identification of potential cumulative impacts, relevance factors (low, medium or high) were assigned to each potential impact in accordance with the assessment matrix presented in Table 22.2. 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, the operation will be for a long time; therefore, it will have a high impact.
- Magnitude/intensity of impact—how big 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?

TABLE 22.2: ASSESSMENT MATRIX

Impact characteristic	Relevance factor		
	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

The sum of the relevance factors was then used to determine the impact significance and corresponding consequence of the impact as summarised in Table 22.3.

For example, if a potential impact was considered to have a probability of impact of 1, duration of impact of 2, magnitude/intensity of impact of 1, and a sensitivity of receiving environment of 2, the significance of impact would be 6 (1+2+1+2 = 6) and the impact would be considered of 'low significance'.

TABLE 22.3: IMPACT SIGNIFICANCE

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

The outcome of the significance assessment indicates whether identified impacts can use 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 within this chapter are presented within the mitigation measures sections of Chapter 8 to Chapter 21 and within Chapter 23: Draft Outline Environmental Management Plan. When assessing potential impacts from other projects (refer Section 22.5) it is reasonably assumed that the projects will abide by the conditions of their approval from the relevant regulator and so have a similar level of impact mitigation to the Project.

22.5 Assessable projects

Based on the selection criteria listed in Section 22.1, the projects that have been included in the CIA are summarised in Table 22.4. Table 22.4 also presents the assumed temporal (timing) of each of the assessable projects in relation to the Project. The location of each project is shown in Figure 22.1.

Projects identified in each of the discipline study areas may have not been specifically included in the CIA due to:

- Their environmental assessment process has not been made public
- Timing of development, project location, or lack of available information.

Omitted projects, with the reasoning for their omission, are detailed in Table 22.5.

The social impact assessment also considered additional rail projects in southern Queensland (outside of the adopted cumulative impact study area) due to potential for cumulative impacts as a result of construction labour force demands. These additional rail projects are listed in Table 22.6 and shown in Figure 22.2.

TABLE 22.4: PROJECTS INCLUDED IN THE CIA FOR EACH DISCIPLINE

Project (and proponent)	Location	Description	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria	Relationship to the proposal
G2H (ARTC)	Rail alignment from Gowrie to Helidon	26 km single-track dual-gauge freight railway as part of Inland Rail	Draft EIS being prepared by ARTC	2021–2026 Jobs: Peak of 596 FTE, average of 264 FTE	>50 years Jobs: ~20 FTE	b) & c)	Overlap of construction with Helidon to Calvert (H2C) and other Inland Rail projects, resulting in conflict in demand for construction resources and additional traffic on arterial roads. Operational impacts associated with the road network from the operation of Inland Rail.
C2K (ARTC)	Rail alignment from Calvert to Kagaru	53 km single-track dual-gauge freight railway as part of Inland Rail	Draft EIS being prepared by ARTC	2021–2026 Jobs: Peak of 620 FTE, average of 271 FTE	>50 years Jobs: ~20 FTE	b) & c)	Overlap of construction with H2C and other inland rail projects, resulting in conflict in demand for construction resources and additional traffic on arterial roads. Operational impacts associated with the road network from the operation of Inland Rail.

Project (and proponent)	Location	Description	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria	Relationship to the proposal
Bromelton State Development Area (SDA) (Queensland Government)	Bromelton	Delivery of critical infrastructure within the Bromelton SDA will support future development and economic growth—and provide opportunities to build on the momentum of current development activities by major landowners in the SDA. This includes a trunk water main and the Beaudesert Town Centre Bypass.	The current version of the Bromelton SDA Development Scheme was approved by Governor in Council in December 2017.	2016–2031 Jobs: unqualified	>50 years Jobs: TBA	c) & d)	Ongoing development at the Bromelton SDA could require deconfliction of construction resources. There may also be an increase of heavy vehicles using the surrounding highways during both construction and operation, resulting in road network impacts.
Ipswich Motorway Upgrade Rocklea to Darra (Stage 1 and remaining sections) (Department of Transport and Main Roads)	Western Brisbane	Addressing congestion and extensive delays in the Ipswich Motorway corridor by a range of road upgrades along 7km of Ipswich Motorway between Rocklea and Darra	Project listed on Queensland Infrastructure Initiative List—Proponent to complete business case development (Stage 3 of Infrastructure Australia's Assessment Framework)	2016/17–2020/21 Jobs: unqualified	TBA Jobs: TBA	c)	Construction periods may overlap, resulting in conflict in demand for construction resources and additional traffic on arterial roads.
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	N/A	2016–2022 Jobs: 7,000	>50 years Jobs: TBA	c)	Ongoing development at RAAF Base Amberley may see increase in road traffic with heavy vehicles and further increase as the H2C construction occurs.
Gatton West Industrial Zone (GWIZ) (Lockyer Valley Regional Council)	3 km north west Gatton	Industrial development including a transport and logistics hub on the Warrego Highway	N/A	2019–2024 Jobs: 13.5 FTE	>50 years Jobs: Approximately 37	c)	May increase road traffic and increase need for rail resources during both construction and operation.
InterLinkSQ (InterLinkSQ)	13 km west of Toowoomba	200 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	N/A	2017–2037 Jobs: unqualified	>50 years Jobs: 1,500	c)	Ongoing development could require deconfliction of construction resources. There may also be an increase in heavy vehicles using the surrounding road network.

Table notes:

TBA = unavailable or yet to be advised.

Selection criteria based on the criteria outlined in Section 22.1:

b) Has 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 IAS is available on the DSDMIP website.

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 ARTC Inland Rail Project.

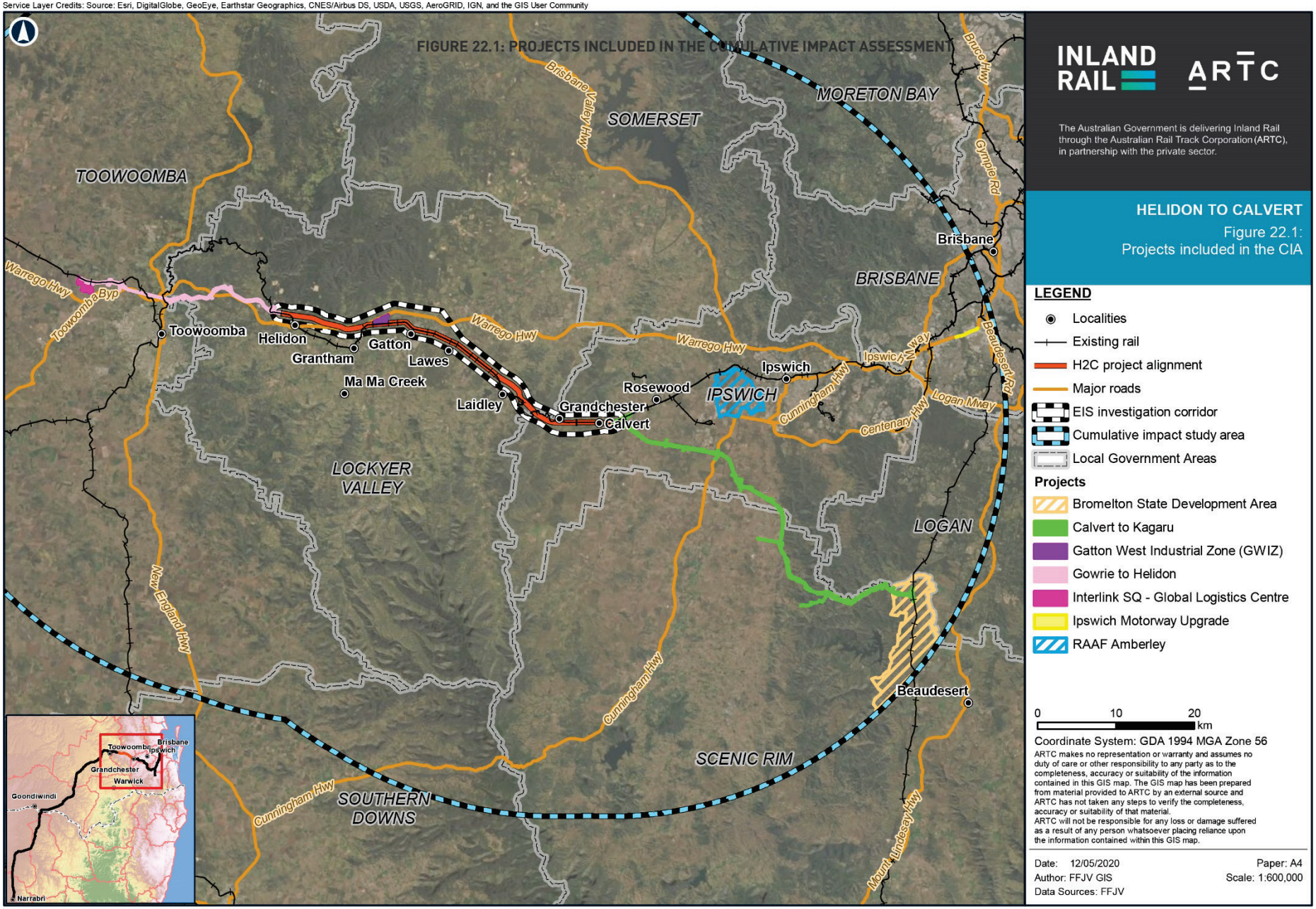
d) Could potentially compound residual impacts that Inland Rail may have on environmental or social values.

There are no projects identified within the defined geographical extent outlined in Figure 22.1 and which are currently being assessed under Part 1 of Chapter 3 of the *Environment Protection Act 1994* (Qld) with an Initial Advice Statement or EIS available on the Department of Environment and Science's website.

TABLE 22.5: OMITTED PROJECTS

Project (and proponent)	Location	Description	Source	Project status	Reason for discounting from CIA
Salisbury to Beaudesert Rail Connection (Department of Transport and Main Roads)	Salisbury to Beaudesert	The Salisbury to Beaudesert Rail Corridor Protection alignment (approximately 54 km) is located between Salisbury and Beaudesert in Brisbane's south-west region. The initiative proposes future essential public transport infrastructure for development areas in the Greater Brisbane South-West urban growth corridor.	**dsdmip.qld.gov.au/infrastructure/infrastructure-australia.html**	Project listed on Queensland Infrastructure Priority List—environmental studies not yet initiated. Will not be constructed before 2026.	Minimal information available and is a strategic initiative, not a defined project. Anticipated construction timeframes will not conflict with the construction of the Project.
Cunningham Highway—Yamanto to Ebenezer (Department of Transport and Main Roads)	Cunningham Highway near Yamanto and Amberley	Upgrade of the Yamanto and Amberley intersections with the Cunningham Highway, and construction of a new two-lane deviation off the highway, connecting with the northern end of Amberley Road. In addition, a range of safety works will be undertaken along the route that could include safety barriers, channelised right turn intersection upgrades, wide centreline treatment to separate opposing traffic, and overtaking lanes.	**tmr.qld.gov.au/Projects/Name/C/Cunningham-Highway-Amberley-Intersection-Upgrade**	Project listed on Queensland Infrastructure Priority List—environmental studies not yet initiated. Not funded.	Minimal information available and is, at this point in time, an initiative, not a defined 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.	The potential location of this facility south of Ipswich is far enough from the Project alignment that possible conflicts over construction resources or workforce availability is unlikely to impact either project.
Asterion Medicinal Cannabis Facility	Wellcamp, Queensland 1 km south of Toowoomba–Cecil Plains Road	A high-tech medicinal cannabis cultivation, research and manufacturing facility. The project, situated on a 75-ha site, involves construction of a 40-ha glasshouse to produce a projected capacity of 537,500 kg/annum is better 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.	**https://asterioncannabis.com/investors/news/index.php?content_id=68**	Under construction, expected to finish in 2021	The timeframes of this project are unlikely to result in conflicts for resources or workforce availability as construction is expected to conclude before H2C construction starts.

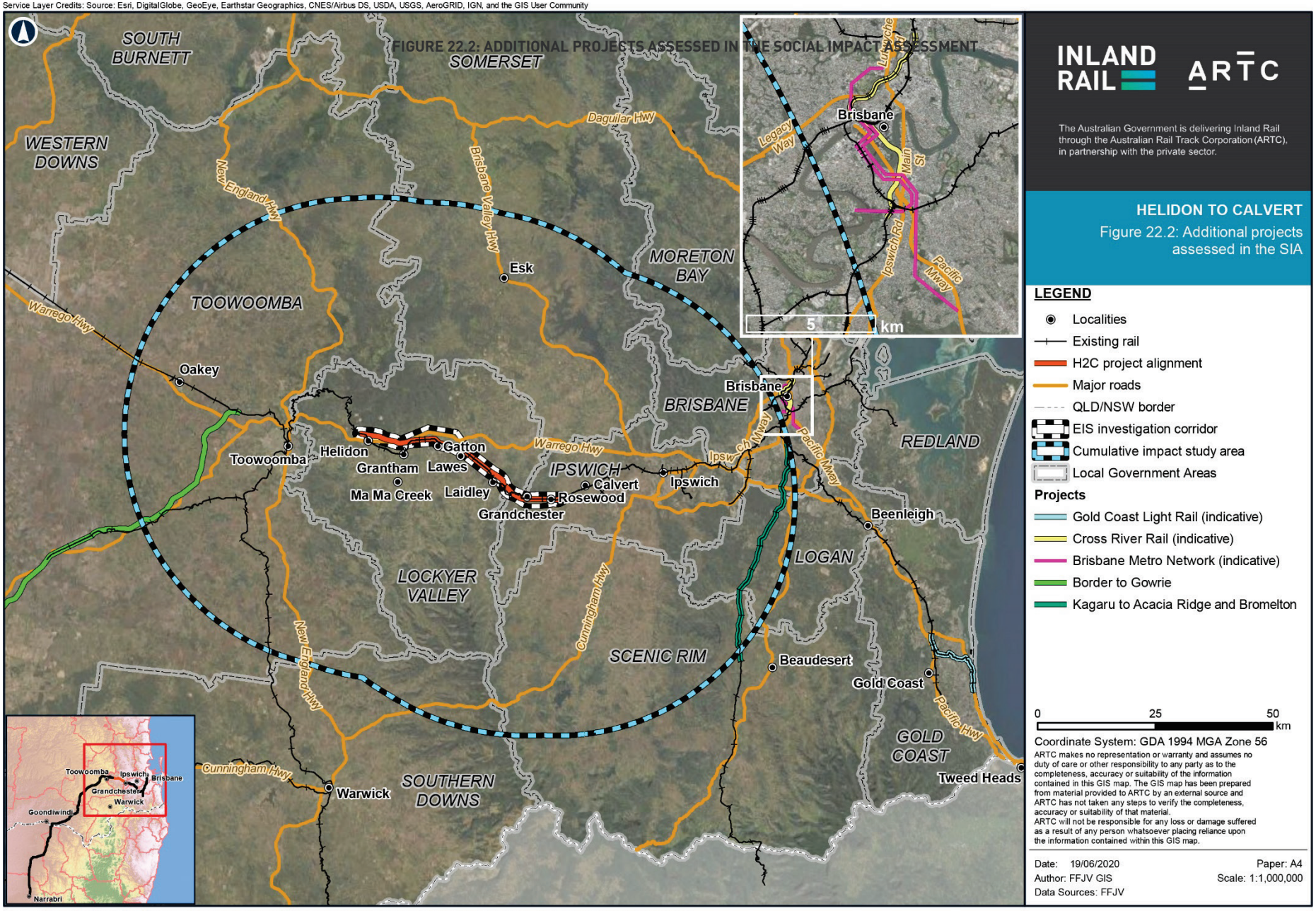
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map by: DMcP/MF/LCT/IW Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201811071156_Cumulative\330-EAP-201811071156_ARTC_Fig22.1_Cumulative_v4.mxd Date: 24/06/2020 08:54

TABLE 22.6: ADDITIONAL RAIL PROJECTS CONSIDERED AS PART OF SOCIAL IMPACT ASSESSMENT

Project (and proponent)	Location	Description	Project status	Construction dates and jobs	Operation years and jobs	Selection criteria	Relationship to the proposal
B2G (ARTC)	Rail alignment from Border to Gowrie	146 km single-track, dual-gauge freight railway as part of Inland Rail	Draft EIS being prepared by ARTC	2021–2026 Jobs: approx. 950	>50 years Jobs: 10–15	c)	Overlap of construction with H2C and other Inland Rail projects resulting in conflict in demand for construction resources and additional traffic on arterial roads.
K2ARB (ARTC)	Rail alignment from Kagaru to Acacia Ridge and Bromelton	49 km single-track, dual-gauge freight railway as part of the Inland Rail Program	Draft EIS being prepared by ARTC	2023–2025 Jobs: approx. 500	>50 years Jobs: 10–15	c)	Overlap of construction with H2C and other Inland Rail projects, resulting in conflict in demand for construction resources and additional traffic on arterial roads.
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	First stage has commenced	2019–2022 Jobs: approx. 500 personnel	Ongoing	c) and d)	Due to its separation distance from H2C it is unlikely to result in material cumulative environmental impacts; however, depending on timing there may be competition for construction workers.
Cross River Rail (Queensland Government)	Brisbane City	A 10.2 km rail line from Dutton Park to Bowen Hills, which includes 5.9 km of tunnel under the Brisbane River and central business district	Commenced	2019–2024 Jobs: approx. 1,547 (average)	Ongoing	c) and d)	Due to its separation distance from H2C it is unlikely to result in material cumulative environmental impacts; however, depending on timing, there may be competition for construction workers particularly specialist tunnelling crews.
Gold Coast Light Rail Stage 3A (Department of Transport and Main Roads)	Gold Coast	Stage 3A will expand the tram network to 27 km from Helensvale to Burleigh Heads	Construction due to commence 2021	2021–2023, Jobs: approx. 500 personnel	Ongoing	c) and d)	Due to its separation distance from H2C it is unlikely to result in material cumulative environmental impacts; however, depending on timing there may be competition for construction workers.


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
FIGURE 22.2: ADDITIONAL PROJECTS ASSESSED IN THE SOCIAL IMPACT ASSESSMENT
SOUTH BURNETT
SOMERSET
WESTERN DOWNS
MORETON BAY
TOOWOOMBA
BRISBANE
REDLAND
IPSWICH
LOGAN
LOCKYER VALLEY
SCENIC RIM
SOUTHERN DOWNS
GOLD COAST
Dagular Hwy
New England Hwy
Brisbane Valley Hwy
Warrego Hwy
Cunningham Hwy
Pacific Hwy
Ipswich Mway
Legacy Way
Main St
Ipswich Rd
Esk
Oakey
Toowoomba
Helidon
Gatton
Grantham
Lawes
Ma Ma Creek
Laidley
Calvert
Rosewood
Grandchester
Ipswich
Brisbane
Beenleigh
Beaudesert
Gold Coast
Tweed Heads
Warwick
Goondiwindi
Narrabri
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25
50
km
INLAND RAIL
ARTC
The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.
HELIDON TO CALVERT
Figure 22.2: Additional projects assessed in the SIA
LEGEND
Localities
Existing rail
H2C project alignment
Major roads
QLD/NSW border
EIS investigation corridor
Cumulative impact study area
Local Government Areas
Projects
Gold Coast Light Rail (indicative)
Cross River Rail (indicative)
Brisbane Metro Network (indicative)
Border to Gowrie
Kagaru to Acacia Ridge and Bromelton
Coordinate System: GDA 1994 MGA Zone 56
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Data Sources: FFJV
Map by: KG/GN Z:\GIS\GIS_3300_H2C\Tasks\330-EAP-201811071156_Cumulative\330-EAP-201811071156_ARTC_Fig22.2_Additional_Projects_Ass_in_SIA_v2.mxd Date: 19/06/2020 14:26

Table 22.7 presents the anticipated construction timing of each of the assessable projects in relation to the Project.

TABLE 22.7: CUMULATIVE PROJECT TIMING

Project	Estimated construction timeframe	Overlap in construction periods by project year							
		2021	2022	2023	2024	2025	2026	2027	2028+
The Project (Helidon to Calvert)	2021–2026								
C2K	2021–2026								
G2H	2021–2026								
Bromelton SDA	2016–2031								
Ipswich Motorway Upgrade Rocklea to Darra (Stage 1 and remaining sections)	20016/17–2020/21								
RAAF Base Amberley future works	2016–2022								
Gatton West Industrial Zone (GWIZ)	2019–2024								
InterLinkSQ	2017–2037								
Potential cumulative social matters									
B2G	2021–2026								
K2ARB	2023–2025								
Brisbane Metro Network	2019–2022								
Cross River Rail	2020–2025								
Gold Coast Light Rail	2021–2023								

22.6 Potential impacts

A project's cumulative impacts are likely to occur at the construction, operation and decommissioning phases. These impacts could be temporal in nature (e.g. traffic or workforce) or spatial (e.g. habitat loss or soil disposal locations). The initial phase (construction) is typically more likely to have the most material impact 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 the project is established (operational) there are no longer any footprint impacts and the operational impacts associated with environmental aspects such as visual, surface water etc. are stabilised and below that at the peak of construction.

It is for this reason that the CIA has focused on the construction phase of the Project and its potential cumulative impacts as detailed below. An exception to this is operational noise and air that are considered separately within this chapter and aspects such as economics and social that have also included post-construction impacts in their assessment.

22.6.1 Land use and tenure

It is recognised that the Project may contribute to cumulative impacts on land use, as the removal of agricultural land for the purpose of a rail corridor cannot be fully mitigated. The Project has potential to impact Class A land within an IAA. However, as the Project is predominantly located within the West Moreton System rail corridor and Gowrie to Grandchester future State transport corridor, land use impacts have been minimised.

The AOI for cumulative land use and tenure impacts was defined by placing a 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 localised to the area within which a project is occurring. Based on this criterion, the subset of projects included in the assessment of cumulative impacts on land use and tenure is:

- G2H
- C2K
- Bromelton State Development Area
- Ipswich Motorway Upgrade Rocklea to Darra
- RAAF Base Amberley future works
- Gatton West Industrial Zone
- InterlinkSQ.

Although projects across the region may have different land use and tenure impacts to the Project, it was considered that the key potential impacts that are likely to be common to all are:

- Loss of Class A and Class B agricultural land and within an IAA
- Disruption to agricultural operations
- Potential sterilisation of mineral and petroleum resources
- Impacts on accessibility within the wider road network and to private properties
- Temporary disruption to services and utilities.

Using the methodology described in Section 22.4, the cumulative land use and tenure impacts of the Project are expected to be of **low significance** (refer Table 22.8).

The following factors contributed to this assessment:

- There is limited potential for cumulative impacts given the relatively limited land use and tenure impacts associated with the Project
- The permanent operational disturbance footprint is predominantly located within the West Moreton System rail corridor and Gowrie to Grandchester future State transport corridor, consistent with existing and future State land use planning for the area.
- The G2H and C2K 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 impact on land use and tenure) are considered to be localised to the Project.
- The implementation of mitigation measures for all projects will further minimise land use and tenure impacts.

TABLE 22.8: CUMULATIVE IMPACT ASSESSMENT FOR LAND USE AND TENURE

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Loss of agricultural land, loss of land within an IAA, and 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		
Sterilisation of mineral and petroleum resources	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 within the road network and to private properties, and temporary disruption to services and utilities	Probability of the impact	2	6	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		

22.6.2 Land resources

The cumulative impacts of the identified assessable projects in the vicinity of the Project may contribute to impacts on land resources if not managed appropriately. Based on the assessment of land resources in the land resources study area (refer Chapter 9: Land Resources), the risk of the Project impacting on land resources is low. However, 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.

Seven of the projects presented in Table 22.4 have been identified as having the potential to contribute to cumulative impacts on land resources and were considered as within the AOI. These include:

- G2H
- C2K
- Bromelton State Development Area
- Ipswich Motorway Upgrade Rocklea to Darra
- RAAF Base Amberley future works
- Gatton West Industrial Zone
- InterLinkSQ.

The assessable projects mostly comprise rail and road upgrades and high-density industrial infrastructure development. Due to their location in distant sub-catchments as well as their limited extent of earthworks, these projects are considered unlikely to cumulatively impact on land resources within the land resources study area.

Although projects across the region may have different land resource impacts to the Project, the following impacts are likely to be common to each project, if not managed appropriately:

- Soil conditions not appropriately characterised
- Disturbance of existing contaminated land
- Leaks or spills leading to migration of contaminants
- Disturbance of acid sulphate soils (ASS)
- Changes to landform and topography
- Salinity and sodicity development
- Erosion potential – leading to increased total dissolved solids in run off
- Increase in weed migration.

The overall significance of cumulative impacts during the construction, operation and decommissioning phases of the Project is expected to be of low significance, with the exception of loss of soil resources, change to landform and topography, and weed management, which may be of **medium significance** (refer Table 22.9). Provided all of the assessable projects apply appropriate mitigation measures, it is unlikely that long-term cumulative impacts would occur. The key factors that contributed to this assessment are the distributed nature of the assessable projects, and the likely stability of project landforms during the operation phase.

TABLE 22.9: CUMULATIVE IMPACT ASSESSMENT FOR LAND RESOURCES

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Soil conditions in the proposed area are not appropriately characterised to inform what the railway corridor will impact, 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	6	Low
	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
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Loss of soil resources	Probability of the impact	2	6	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		
Acid sulfate soils, including the potential to disturb ASS	Probability of the impact	1	6	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Change to landform and topography	Probability of the impact	2	6	Medium
	Duration of the impact	3		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Salinity hazard (in-situ, soil)	Probability of the impact	2	5	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Erosion	Probability of the impact	2	4	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		
Weed Management	Probability of the impact	2	7	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		
Feral Animal Management	Probability of the impact	1	4	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		

Table notes:

* Relevance factors between 1 and 3 were determined using professional judgement to select the most appropriate factor for each aspect and summing.

** Sum of relevant factors definition:

- **Low** (1–6): Negative impacts need to be managed by standard environmental management practices. Special conditions are unlikely to be necessary. 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. Specific conditions are likely. Targeted monitoring program required, where appropriate.
- **High** (10–12): Alternative actions will be considered and/or mitigation measures applied to demonstrate improvement. Specific conditions expected to be required. Targeted monitoring program necessary, where appropriate.

22.6.3 Landscape and visual

Cumulative impacts to the landscape and visual amenity of the Project will be largely the product of:

- Temporary construction impacts—presence of construction traffic, workforce and machinery operating on adjoining projects at the same time
- Spatial operational impacts—the residual impact of the visibility of infrastructure of identified projects to sensitive receptors, including as a result of the introduction of additional visual receptors (including residential receptors) into an area and with potential to view the Project.

Due to the potential for sequential impacts, for example when driving through the landscape, a wider AOI than the LVIA study area was considered, extending 50 km (approximately 30 mins drive or more). Beyond this distance, it is considered that there would be no reasonable expectation of cumulative impact being registered by a viewer.

In terms of temporal (construction) impact, it is considered likely that the following projects may have some overlap in construction periods:

- G2H
- C2K
- Bromelton State Development Area
- Ipswich Motorway Upgrade Darra to Rocklea
- RAAF Base Amberley future works
- GWIZ
- InterLinkSQ.

The overlapping construction periods of 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 within the AOI.

The section of the road network likely to be most affected by this cumulative activity is the Warrego Highway within the LVIA study area and the areas at the easternmost and westernmost section of the alignment. The western area will be affected simultaneously by the construction of the Project and the G2H Project. The eastern area will potentially (depending on specific project phasing) be affected simultaneously by the C2K project, RAAF Base Amberley upgrade and, further afield, the Bromelton SDA. As large vehicles on the highway would not be unexpected from a visual perspective and the construction impacts are temporary, the consequence of this cumulative impact during construction in the LVIA study area is considered to be of **low significance**.

In terms of spatial (operational) impacts of other linear transport infrastructure projects, the G2H and C2K projects immediately adjoin the Project. Some receptors will experience views of both G2H/H2C or H2C/C2K, but the Project will, in practice, be viewed as part of the same integrated project (Inland Rail). The Ipswich Motorway upgrade is over 40 km from the H2C alignment, so no cumulative impacts are anticipated.

With regards to the other land development projects, InterLinkSQ is closest to the G2H project, being located around 25 km west of H2C from which it is separated by landform associated with Toowoomba and the Great Dividing Range. Consequently, there would be no combined or successive impacts and the potential for sequential impacts is highly limited. Similarly, RAAF Base Amberley is over 15 km from the H2C alignment so there would be no combined or successive impacts and the potential for meaningful sequential impacts is limited.

The Bromelton SDA is a large-scale major land development project that will affect many hectares of land with associated landscape and visual impacts. This Project will also potentially introduce additional visual receptors (residents and workers) into the wider landscape of the LVIA study area. It directly adjoins the eastern end of the C2K alignment. This development will result in a noticeable intensification of built development and extension into the rural and natural landscape character west of Greater Brisbane, particularly in terms of sequential impacts gained while travelling around the region. However, combined or successive impacts of H2C are unlikely.

The GWIZ is considered to have the greatest potential for cumulative impacts when considered with the H2C alignment. The area north of Placid Hills, North Gatton, is currently highly natural and rural in character and the clearance of vegetation and intensification of built and transportation infrastructure development throughout this zone would result in a considerable change to the landscape character and visual amenity that is likely to be perceived by users of the Warrego Highway as well as some residents living in the acreage properties of Placid Hills.

In the context of these projects, the cumulative landscape and visual impact of the Project alignment, which occupies a narrow, linear corridor, is considered to be generally very modest. The significance of the contribution of the Project to cumulative impact is considered to be **low significance** for both landscape and visual values for most of the projects identified, with the exception of the GWIZ that would have up to **medium significance** cumulative impacts. Mitigation to address this impact will generally be as described for the standalone H2C Project (and G2H/C2K). However, specific mitigation is likely to be required associated with the Project alignment through Placid Hills to minimise potential cumulative impacts of the GWIZ and the Project on views from acreage properties.

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.

Overall, the cumulative LVIA in the region is likely to be of **low significance**. Refer Table 22.10.

TABLE 22.10: CUMULATIVE IMPACT ASSESSMENT FOR LANDSCAPE AND VISUAL AMENITY

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Construction impacts associated with views of increases in: ▸ Construction traffic ▸ Construction areas	Probability of the impact	2	6	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		
Operation impacts associated with combined, successive and sequential views of adjoining projects	Probability of the impact	2	8	*(up to)* Medium
	Duration of the impact	2		
	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 flora and fauna impacts of multiple projects occurring in the vicinity of the Project will likely include the continued loss of biodiversity in the South East Queensland (SEQ) bioregion. The major potential impacts identified as a result of the Project are common to all of the projects throughout the region and are therefore, by their nature, cumulative. It is for this reason that they were all considered within the AOI for the flora and fauna CIA. The impacts range from short term to long term and will occur in each of the projects considered in this assessment 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 of the developments, but the nature of the impacts mean they will also be experienced when the projects are operational.

The assessment of cumulative impacts on flora and fauna has been considered separately for environmental aspects that are protected by different pieces of Commonwealth and State legislation, including:

- *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act)
- *Vegetation Management Act 1999* (Qld) (VM Act)
- *Nature Conservation Act 1992* (Qld) (NC Act).

Potential cumulative impacts include:

- 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 results of the significance assessment of the CIA on flora and fauna are presented in Table 22.11. Further detailed CIA can be found in Chapter 11: Flora and fauna.

TABLE 22.11: CUMULATIVE IMPACTS ON ECOLOGICAL RECEPTORS

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
EBPC Act				
Commonwealth significant ecological constraint (community)	Probability of the impact	1	4	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Commonwealth significant ecological constraint (species)	Probability of the impact	2	9	Medium
	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	2	9	Medium
	Duration of the impact	3		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	3		
Commonwealth significant ecological constraint (internationally significant wetlands)	Probability of the impact	Nil	Nil	Nil
	Duration of the impact	Nil		
	Magnitude/intensity of the impact	Nil		
	Sensitivity of the receiving environment	Nil		
VM Act				
State Significant Ecological Constraint—Remnant vegetation (REs) (Category B)	Probability of the impact	1	7	Medium
	Duration of the impact	2		
	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*	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		

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
State Significant Ecological Constraint—Regulated vegetation (Category B and C) intersecting watercourses and wetlands	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—State Significant High Ecological Value (HEV) Wetlands	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	9	Medium
	Duration of the impact	3		
	Magnitude/intensity of the impact	1		
	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 Constraint—Priority Back on Track	Probability of the impact	2	7	Medium
	Duration of the impact	3		
	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
	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	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 (BPA): State habitat values	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 (BPA): Regional habitat values	Probability of the impact	2	8	Medium
	Duration of the impact	3		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	2		

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
State Significant Ecological Constraint (BPA): Local habitat values	Probability of the impact	2	7	Medium
	Duration of the impact	3		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
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		

Table note:
* Flora and fauna species that are both MNES and MSES listed species are included as a MSES.

As part of the Project impact assessment for ecological aspects, a number of mitigation measures have been proposed (refer Chapter 11: Flora and fauna). To further mitigate the potential cumulative impacts on the receptors listed above, particularly those identified as having **medium significance**, the other assessable projects will also have to successfully apply similar mitigation measures.

22.6.5 Air quality

As discussed in Chapter 12: Air quality, dispersion modelling undertaken for the assessment of operational phase air quality impacts has included emissions from the adjoining sections of the Inland Rail Program adjacent to the Project, namely the G2H and C2K sections. No other projects (in addition to G2H and C2K) were identified that required inclusion in the assessment of cumulative operational phase impacts. As cumulative impacts for the operation phase have already been considered in detail, this cumulative impact assessment is limited to the construction phase of the Project only.

The following projects were considered for cumulative air quality impacts for the construction phase:

- G2H
- C2K
- RAAF Base Amberley future works
- GWIZ
- InterLinkSQ.

The relevance factor for the sensitivity of the receiving environment has been assigned for each selected project (refer Table 22.12). This factor has been assigned considering the number of sensitive receptors that may be affected by cumulative impacts with the assessed project, the sensitivity to the emissions that will cause the impact (e.g. dust), and the mostly isolated nature of construction phase emissions from the Project.

TABLE 22.12: CUMULATIVE IMPACT ASSESSMENT FOR AIR QUALITY

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
G2H (ARTC)	Probability of the impact	2	6	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
C2K (ARTC)	Probability of the impact	2	6	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
RAAF Base Amberley future works (Department of Defence)	Probability of the impact	1	4	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Gatton west Industrial Zone (GWIZ) (Lockyer Valley Regional Council)	Probability of the impact	1	4	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
InterLinkSQ	Probability of the impact	1	4	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		

Based on the assigned relevance factors, the cumulative air quality impacts are expected to be of **low significance** for all assessed projects.

Mitigation measures for the construction phase of the Project are recommended in Chapter 12: Air quality. The recommended mitigation measures for the Project will reduce the potential for cumulative impacts at sensitive receptors and it is expected that implementation of the recommended mitigation measures in combination with the implementation of a CEMP is expected to be sufficient to minimise the risk of significant cumulative impacts.

22.6.6 Surface water quality and hydrology

Due to the broad nature of surface water catchments, all of the Projects identified in Table 22.4 could potentially contribute to cumulative surface water quality and hydrology impacts and have been considered in this CIA.

Key potential impacts may include:

- Riparian vegetation loss from vegetation clearing/removal
- Potential impacts to aquatic fauna species both through impacts to water quality and waterway 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.

The cumulative impacts of multiple projects occurring in the vicinity of the Project may contribute to impacts to water quality if not managed appropriately. However, the risk of significant cumulative impacts both in the short term or long term is considered of **low significance** based on:

- The highly ephemeral nature of the majority of waterways in the AOI
- The dispersed nature of these projects
- The likely stable landforms for the operation of these projects.

The only exception to this is the risk of riparian vegetation loss from vegetation clearing/removal during construction, which is considered of **medium significance.** This is due to the potential overlapping loss of riparian vegetation communities with works involving watercourses and associated crossings. Impacts may be compounded with interface between the current Project and other listed projects in regard to decreased resilience to biotic and abiotic factors.

The assessment of the significance of cumulative impacts relating to surface water quality is presented in Table 22.13. Provided that all assessable projects apply appropriate mitigation measures during construction, including CEMPs and salinity management plans, limited cumulative impacts are expected during the construction, operation or decommissioning phases of the Project.

TABLE 22.13: CUMULATIVE IMPACT ASSESSMENT FOR SURFACE WATER QUALITY

		Relevance factor of aspects				Sum of relevance factors	Impact significance
Cumulative impact	**Phase**	**Probability**	**Magnitude**	**Duration**	**Sensitivity**		
Riparian vegetation loss from vegetation clearing/removal	Construction	2	1	2	2	7	Medium
	Operations	1	1	1		5	Low
	Decommissioning	1	1	1		5	Low
Potential impacts to aquatic fauna species both through impacts to water quality and barrier works	Construction	1	1	2	2	6	Low
	Operations	1	1	2		6	Low
	Decommissioning	1	1	2		6	Low
Displacement of flora and fauna species from invasion of weed and pest species	Construction	1	1	2	2	6	Low
	Operations	1	1	2		6	Low
	Decommissioning	1	1	2		6	Low
Reduction in the connectivity of waterways	Construction	1	1	2	2	6	Low
	Operations	1	1	2		6	Low
	Decommissioning	1	1	2		6	Low
Increase in erosion and sedimentation in the waterways	Construction	1	1	2	2	6	Low
	Operations	1	1	2		6	Low
	Decommissioning	1	1	2		6	Low
Increase in litter (waste)	Construction	1	1	1	2	5	Low
	Operations	1	1	1		5	Low
	Decommissioning	1	1	1		5	Low
Saline discharge into proximal watercourses	Construction	1	1	2	2	6	Low
	Operations	1	2	1		6	Low
	Decommissioning	1	2	1		6	Low
Increase in surface salinity around alluvial watercourses	Construction	1	1	2	2	6	Low
	Operations	1	1	2		6	Low
	Decommissioning	1	1	2		6	Low

Table notes:

1. Impact significance ratings are as follows:
   - **Low** (sum of relevance factors = 1 to 5): 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.
   - **Medium** (sum of relevance factors = 6 to 9): Mitigation measure likely to be necessary and specific management practices to be applied. Specific conditions are likely. Targeted monitoring program required.
   - **High** (sum of relevance factors = 10 to 12): Alternative actions will be considered and/or mitigation measures applied to demonstrate improvement. Specific conditions expected to be required. Targeted monitoring program necessary.

The hydrologic and hydraulic investigation (refer Appendix M: Hydrology and Flooding Technical Report) 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 is followed for all infrastructure projects that have the potential to impact on this investigation with projects required to mitigated and minimise impacts to acceptable levels. Therefore, cumulative impacts have been addressed in the Project's assessment of hydrology impacts.

The exception is the C2K and G2H project alignments, which are being concurrently developed. The C2K and G2H projects have been included in the Developed Case for the Project to enable cumulative impacts to be considered and addressed.

22.6.7 Groundwater

Cumulative impacts to groundwater would most likely occur where multiple projects intersect and/or extract groundwater from the same shallow aquifer units. The key cumulative impacts that were considered as part of the groundwater CIA were:

- Dewatering of shallow groundwater (very localised)
- Potential impacts on groundwater quality through contamination (spills and leaks from machinery).

Due to the localised nature of potential groundwater impacts associated with this Project, only the adjacent Inland Rail projects (G2H and C2K) were included in the groundwater CIA and are considered within the AOI.

There is likely to be overlap of construction activities at the northern and southern extents of the Project with G2H and C2K projects. With the implementation of the following mitigation measures, it is considered that localised impacts on shallow groundwater levels due to excavations and spills of contaminants are considered unlikely to be compounded by interactions between these projects:

- Adherence to dewatering and water supply mitigation measures discussed in Chapter 14: Groundwater
- Adherence to the CEMP to respond effectively to groundwater level drawdown triggers
- Implementation of the groundwater monitoring program to identify and respond to triggers being breached
- Adherence to the CEMP to prevent and respond effectively to spills and leaks.

Any extraction of groundwater for construction purposes would be in line with existing water licences that have already had impact assessments undertaken. Construction water has therefore not been considered as part of the cumulative assessment.

As potential cumulative impacts on groundwater are highly localised in nature, the potential for cumulative impacts associated with the Project is considered to be of **low significance** (refer Table 22.14).

TABLE 22.14: CUMULATIVE IMPACT ASSESSMENT FOR GROUNDWATER

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Changes in groundwater levels	Probability of the impact	1	6	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	2		
Groundwater quality and contamination	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

Noise from construction activities being undertaken simultaneously on the adjoining G2H and C2K projects has the potential to increase noise levels at nearby sensitive receptors for the Project.

Other projects in the region are considered too far from the Project alignment compared to the localised nature of construction noise and vibration impacts and, as such, have not been included within this CIA.

The modelling techniques used for the Project assessed the worst-case construction scenarios and L_{Aeq} 15-min levels (refer Chapter 15: Noise and Vibration). Therefore, the expected noise impacts due to cumulative construction activities is not expected to significantly increase the predicted noise levels.

The cumulative impact of noise will be managed by ARTC through approved CEMPs. In addition, any overlap of construction works is likely to be for a limited time period. Therefore, the predicted cumulative noise and vibration impacts during construction of the Project is considered of **low significance** (refer Table 22.15).

TABLE 22.15: CUMULATIVE IMPACT ASSESSMENT FOR CONSTRUCTION NOISE

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Increased noise levels at sensitive receptors	Probability of the impact	2	6	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		

22.6.8.2 Operation

Projects included in the CIA for operational noise are to the two adjacent Inland Rail projects, G2H and C2K. During the operation phase of the Project, the primary source of noise for sensitive receptors within the EIS investigation corridor will be from freight trains traveling on the G2H, H2C and C2K alignments.

Noise from freight trains entering and leaving the H2C Project area from the G2H alignment are not expected to result in a cumulative increase in noise levels at sensitive receptors within the H2C EIS investigation corridor. As the majority of rail freight traffic is anticipated to use the Inland Rail corridor, a cumulative increase in daily railway noise from the H2C Project alignment and the QR West Moreton System is not expected.

At the time of writing, the infrastructure design and future railway operations of the K2ARB Project, which include operation of the existing Interstate Line, are being developed by ARTC. An assessment of potential cumulative impacts from operation the G2H, C2K and H2C projects will be in the operational noise assessment prepared as part of the EIS for the K2ARB project.

Overall, cumulative noise impacts during operation of the Project are considered to be of **low significance** (refer Table 22.16).

TABLE 22.16 CUMULATIVE IMPACT ASSESSMENT FOR OPERATIONAL NOISE

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Increased noise levels at sensitive receptors	Probability of the impact	2	6	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		

22.6.9 Social

As the Project is part of the larger Inland Rail Program, cumulative social impacts were considered at local, regional and State and national levels. Both positive and negative cumulative social impacts are possible.

22.6.9.1 Local impacts

The local area of influence for assessment of cumulative social impacts has been defined as including the EIS investigation corridor and a buffer of approximately 5 km from the Project, on the basis that this is the area were the physical interface of multiple projects, and the potential for noise and connectivity issues, is most likely to have a material impact.

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

- Connectivity between properties and amenity in the Project areas in relation to G2H and C2K
- Employment opportunity and regional development, in relation to the Bromelton SDA
- Access to skilled labour, in relation to the combined impacts of all projects on construction labour availability during years 1–2, and potentially in year 5 in relation to the other Inland Rail projects.

Projects that have a large workforce drawn from outside the region, but are staying locally, may combine to impact on health services, social infrastructure, housing stocks, perceptions of community safety and other community qualities. The Project is unlikely to make a large contribution to this, as the majority of the construction workforce is expected to be drawn from the existing labour force within the region, returning home each night. There is, however, potential for cumulative labour demands in the SIA study area to require non-local workers to service the Project's construction, which could lead to demands for short-term or rental accommodation.

The Gatton West Industrial Zone would have only been expected to have 13–14 construction personnel and in the order of 36–37 operations personnel, so the potential cumulative impacts of this project are not significant.

The Remondis Waste to Energy Facility is planned for construction in 2021-2023 on a site located approximately 40 km north-east of the Project. Information on this Project's construction traffic routes is not available to provide any indications of potential cumulative impacts on connectivity.

There is also potential for the coincidence of major works affecting roads (e.g. for C2K, G2H, the Cunningham Highway–Yamanto Interchange and Ipswich Motorway Upgrade) to affect travel times and cause driver frustration in the EIS investigation corridor and wider region. This is also unquantifiable but, if it eventuates, it will need to be considered in relation to driver safety and emergency services access.

22.6.9.2 Regional impacts

The Project and a number of other projects would draw construction labour from SEQ. If the three Queensland Inland Rail projects were to be constructed simultaneously, they may require a total labour force of some 1,500 to 2,000 people. 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. However, if multiple projects are constructed in the same timeframe as the Project, there may be a significant draw on trades and construction labour in the SIA study area.

If the coincidence of several major projects' construction phases strains the capacity of the construction labour force in the region, this may lead to a requirement for large numbers of non-local personnel to stay locally, with consequent cumulative impacts on housing and social infrastructure (particularly health and emergency services). The populations of both LGAs are expected to experience population growth over the next 5 to 10 years, so demand for additional labour may be partially or wholly met by this growth.

The Project also has potential to catalyse the positive impacts of industrial development by attracting rail-dependent industry to locations such as Ebenezer and at Wellcamp and facilitating development of intermodal freight facilities such as the InterLinkSQ hub. Also, by providing a strategic link between Inland Rail and the interstate railway line, the Project has the potential to contribute to attracting rail-dependent industries to the region. There is therefore potential for significant positive cumulative employment opportunities in the SIA study area.

22.6.9.3 State and national impacts

The Project is part of Inland Rail's 13 Projects. The Inland Rail Business Case (ARTC, 2015a) anticipates that an anticipated additional 16,000 jobs will be required program-wide at the peak of construction, with an average of 800 jobs per annum over the 10–year construction period. An average of 700 additional jobs per annum, program-wide, is anticipated over 100 years of operation. The 10–year delivery schedule would support economic activity in the regions and create regional jobs in Queensland, NSW, and Victoria during both construction and operations.

The expansion in the construction sector would support additional flow-on demand through the construction industry supply chain, and additional spending on consumer-orientated products by the construction workforce in the local area.

The associated supply of construction materials, the development of associated external infrastructure and complementary services, will require additional workforce beyond those directly associated with Inland Rail, stimulating jobs and growth in the region (ARTC, 2017b).

There is also potential for the cumulative impacts of projects, including Cross River Rail, Brisbane Metro, 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. There are multiple uncertainties in relation to timing of these projects, so a quantitative assessment has not been attempted. However, there is potential for the labour force to be drawn from other industries, including agriculture, police and emergency services, and the range of businesses dependent on construction-related skills and labour.

22.6.9.4 Significance rating

Potential social cumulative impacts are evaluated in Table 22.17.

TABLE 22.17: CUMULATIVE IMPACT ASSESSMENT FOR SOCIAL IMPACTS

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Potential for construction of G2H and the Project to result in temporary disruptions to access to the Helidon to Ravensbourne Trail	Probability of the impact	2	6	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Works to Cattos Road (for G2H) and Airforce Road (for H2C) may result in traffic delays in this area	Probability of the impact	2	6	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	2		
Combined impacts of rail construction on amenity of surrounding rural landowners and the towns of Calvert and Helidon respectively	Probability of the impact	2	8	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		
Increased traffic volumes during construction and requirement for integrated management of road safety	Probability of the impact	2	8	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Potential labour draw in the Project region affecting access by businesses, industries and households	Probability of the impact	2	6	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	2		
Project region businesses would benefit from Project and personnel expenditure of the combined Inland Rail projects	Probability of the impact	3	10	**High (positive)**
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	3		
Increase in demands for policing and emergency services may affect service capacity (at local and regional levels)	Probability of the impact	2	7	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	2		
Potential to provide significant employment and business opportunities for local residents, including via facilitation of development and support for additional flow-on demand through the construction industry supply chain	Probability of the impact	3	11	**High (positive)**
	Duration of the impact	2		
	Magnitude/intensity of the impact	3		
	Sensitivity of the receiving environment	3		
Transport of spoil may increase traffic volumes on key routes with potential to affect Levels of Service or traffic safety	Probability of the impact	Unknown	4+	Unknown
	Duration of the impact	2		
	Magnitude/intensity of the impact	Unknown		
	Sensitivity of the receiving environment	2		

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Potential for cumulative increases in construction traffic leading to safety concerns and local drivers' fatigue or frustration with road works and traffic congestion	Probability of the impact	2	8	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		
Labour draw leading to requirement for non-local personnel to stay locally, with consequent cumulative impacts on housing and social infrastructure (particularly health and emergency services)	Probability of the impact	2	7	Medium
	Duration of the impact	1		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		
Potential for cumulative demands on housing and/or short-term accommodation, but with minimal Project contributions to impacts expected	Probability of the impact	1	8	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	3		
Community concern relating to increased numbers of non-local workers, including 'stranger danger' and traffic safety	Probability of the impact	1	6	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	2		
Potential for stresses associated with construction projects to increase local demands for support services	Probability of the impact	1	7	Medium
	Duration of the impact	1		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	3		

22.6.10 Economics

The following impacts have been considered in the cumulative economic impact assessment: labour market impacts, impacts on local businesses, and supply chain impacts. As with cumulative social impacts, cumulative economic impacts have been considered at local, regional, State and national levels. There is some cross-over between the social and economic impacts particularly at the local and regional level and as a result have been presented in both social and economic sections.

22.6.10.1 Labour market impacts

The concurrent construction of interfacing Inland Rail projects (i.e. G2H, H2C and C2K) has the potential to increase the demand for labour in the local and regional economy, particularly for workers with trade and construction skills. The demand for construction workers within a similar timeframe will lead to cumulative demands on construction labour, not only within the local and regional economy, but also across Queensland and potentially nationally.

The subsequent labour-market impact of this cumulative demand to the local and regional economy will be dependent on the workforce profile and construction schedule of the interfacing Inland Rail projects and the state of the labour market at the time of construction. Given the timing and size of the workforce required to construct and operate the interfacing Inland Rail projects, as well as the current shortage of suitably skilled construction workers at a national level due to significant rail-related infrastructure expenditure in QLD, NSW and Vic., this impact has been assessed as **medium significance** (refer Table 22.18). ARTC proposes to mitigate its potential contribution to cumulative impacts on skilled construction labour availability through contributions to workforce training and development (refer Chapter 16: Social).

Where the local labour market pool is insufficient to meet increasing demand, labour may be imported from other regions of QLD and nationally. Under these conditions, the cost of labour may increase the total construction cost of the Project, adversely impacting on the economic return of the Project and impacting local housing availability but bringing additional income to local businesses.

22.6.10.2 Impacts on local businesses

The expansion in construction activity and employment within the region (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 retail businesses by increasing their trading levels.

22.6.10.3 Supply chain impacts

Cumulative supply-chain impacts are likely to be realised where construction timeframes occur concurrently, and comparable material is required (e.g. on the adjacent Inland Rail projects of G2H and C2K). Opportunities to supply these projects may include 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. However, should the demand for material surpass the available supply, resulting in a shortage of available material, input costs to the Project may increase due to increased prices of materials. This could drive up the total cost of construction of the Project, and negatively impact on the economic return of the Project.

22.6.10.5 Significance rating

Cumulative economic impacts are evaluated in Table 22.18. Overall, cumulative economic impacts have been assessed as **medium significance**.

TABLE 22.18: CUMULATIVE IMPACT ASSESSMENT FOR ECONOMIC IMPACTS

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Increased demand for local/regional skilled construction labour due to an expansion in construction activity	Probability of the impact	2	8	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		
Increased demand for local/regional infrastructure and services due to an expansion in construction activity	Probability of the impact	2	8	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		
Increased demand for local/regional construction materials (e.g. fuels, equipment, borrow and quarried material)	Probability of the impact	1	5	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		

22.6.11 Cultural heritage

22.6.11.1 Non-Indigenous heritage

The potential for 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 (ICOMOS, 2011).

The Projects most relevant to the cumulative impact assessment are considered to be two adjoining ARTC proposed rail developments: Calvert to Kagaru (C2K) and Gowrie to Helidon (G2H).

Assessment of the potential impacts of the adjacent C2K project and G2H project was undertaken and an analysis of the number of heritage sites impacted has been undertaken. There are 79 non-Indigenous heritage sites identified within the cultural heritage study area for the Project (refer Chapter 18: Cultural heritage) with 31% being impacted. A total of 17 non-Indigenous heritage sites were identified on the C2K project, with 30% being impacted; and 42 non-Indigenous heritage sites for the G2H project, with 29% being impacted.

All three Inland Rail projects have a similar extent of impact. Depending on the type of mitigation measures implemented, cumulative impacts may result in a change of the 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.

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 in Table 22.4 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.

Based on implementation of the above mitigation measures, the resulting non-Indigenous cumulative impact of the Project is considered of **medium significance** (refer Table 22.19).

TABLE 22.19: CUMULATIVE IMPACT ASSESSMENT FOR CULTURAL HERITAGE

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Loss of cultural heritage sites	Probability of the impact	3	9	Medium
	Duration of the impact	3		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	1		

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

22.6.12 Traffic, transport and access

The potential for traffic generation from other developments in the region at planning, design or construction stages were considered as part of the traffic and transport CIA.

All of the projects listed in Table 22.4 were considered for potential cumulative impacts in combination with the Project due to overlapping construction schedules, with impacts dependent on the timing and location of the works of multiple projects at that time. Impacts include increased traffic volumes and congestion and potentially lead to delays during the construction period.

The G2H, H2C and G2H projects' overlapping construction schedules and proposed primary construction routes might create for increases in construction traffic volumes. Mitigation measures and specific management practices will be applied to mitigate these impacts.

In relation to the Bromelton SDA, work is in progress on this project; however, construction traffic will be marginal as the duration of development for this project spans up to 15 years, and therefore not concentrated when the Project is to be constructed. Traffic impacts from this project are not likely to be exacerbated by or significantly impact the Project.

Upgrade works are in progress at the RAAF Base Amberley, which can create an overlap of construction schedules and proposed construction routes, resulting in increase in construction traffic volumes. The exact construction routes for this project are unknown, therefore mitigation measures may be necessary and specific management practices to be applied.

The GWIZ Project may have small impacts due to the proximity to construction traffic routes being used during the Project construction period. And no impact is expected as a result of InterlinkSQ as the construction area does not overlap with construction traffic routes or Project alignment.

As each of these projects may have an overlap in construction schedules and potentially proposed construction routes, the cumulative traffic and transport impacts on the wider transport network are considered to be of **medium significance** (refer Table 22.20).

TABLE 22.20: CUMULATIVE IMPACT ASSESSMENT FOR TRAFFIC AND TRANSPORT

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Increase in construction traffic volumes and number of vehicles using the same construction traffic routes	Probability of the impact	3	9	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	2		
	Sensitivity of the receiving environment	2		

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 the adjoining G2H and C2K Inland Rail projects.

Given the similar nature of the G2H and C2K 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 of explosives for tunnel construction.

For the purpose of assessing cumulative impacts from other identified hazards and risks, those attributed to the following potential impacts have been assessed in the CIA in the following technical areas:

- Landslide, sudden subsidence, movement of soil or rocks—Land resources
- Wildlife and biosecurity—Flora and fauna
- Traffic—Traffic, transport and access.

22.6.13.1 Loss of containment of dangerous goods

During construction, the expected quantities of hazardous chemicals are not considered to be sufficient to introduce significant offsite impacts or the potential to contribute to cumulative impacts at the adjacent, regional and national level. 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. Natural hazards in the surrounding area such as bushfires may increase the risk at site and can negatively impact hazardous chemical storage; however, hazardous chemical storage locations have been located outside bushfire impact areas, where possible. The Cunningham Highway upgrades may also overlap with the Project resulting in an increase of workforce and transportation of construction materials within the Project. However, the duration of these activities is only temporal and the potential of hazardous chemicals transportation collision, developing into a societal and environmental impact is considered to be low.

The potential for cumulative impacts during operations are associated with dangerous goods freight. Freight of dangerous goods through Little Liverpool Range tunnel, across river bridges and within the vicinity of newly developed areas and future development areas such as the Gatton West Industrial Zone, Principal Rural Activity Centre and Urban Footprint land use designation around Helidon, Gatton, Forest Hill and Laidley have the potential for a cumulative increase in risk as a result of the land use activities and increased likelihood for incidents (e.g. increased road traffic, other hazardous industry land uses). Particularly for industrial land uses, overlapping risk contributions from adjoining facilities/activities can increase the overall level of risk for a specific location. The adjoining land use and infrastructure increase the interactions between live trains and the local community and environment, which have the potential to increase the societal risks.

Certain conditions can increase the potential for harm, for instance, hot work activities within the bushfire zone, the presence of highly reactive chemicals or compressed gas and strong wind conditions. High fire risk activities such as hot work will be restricted as per the ARTC *Total Fire Ban* (ARTC, 2018d) procedure. A permit will be required from the Queensland Fire and Emergency Services if hot work or other high fire risk activities need to be carried out during fire danger season.

Overall, the significance of cumulative impact assessment of loss of containment of dangerous goods associated with the Project is likely to be low.

22.6.13.2 Blasting and explosion

The potential uses of explosives for the tunnel construction have potential cumulative impacts to the environment. Explosives incidents have the potential for significant impact distances and could potentially cause secondary incidents at surrounding land uses (e.g. impacts on industrial facilities, initiation of landslide). 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 impact.

A number of non-ARTC projects could potentially coincide during the construction phase of the Project; however, the uncertainty with the construction dates and the distance of non-ARTC projects to the Project; therefore, it can be expected that the Project have a low cumulative impact.

Overall, the outcome of cumulative impact assessment of loss of containment of dangerous goods and blasting and explosives associated with the Project is considered to be of **low significance** and is shown in Table 22.21.

TABLE 22.21: CUMULATIVE IMPACT ASSESSMENT FOR HAZARD AND RISK

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Loss of containment of dangerous goods	Probability of the impact	1	5	Low
	Duration of the impact	2		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Blasting failures or improperly conducted blasting works creating unstable land and causing damage to surrounding structures, including road and rail assets	Probability of the impact	1	5	Low
	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 within appropriately licensed facilities.

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

- Gowrie to Helidon (ARTC)
- Calvert to Kagaru (ARTC)
- Bromelton State Development Area
- InterLinkSQ.

Gowrie to Helidon and Calvert to Kagaru projects are both ARTC projects and, despite the potential for cumulative impacts on receiving waste management facilities, ARTC will be able to liaise with the relevant contractors and operators to negotiate appropriate waste disposal arrangements across the three Inland Rail projects.

The assessment has identified that the Project and neighbouring projects will generate large volumes of spoil as a result of required earthworks and tunnelling activities. It is acknowledged that, in the future, detailed design and execution phases of the Project and adjacent inland Rail projects there will be opportunities to optimise the use and placement of spoil material outside of the extent of each individual project. As part of this assessment, however, it has been conservatively assumed that each project will manage spoil in isolation, and the spoil that is generated for the H2C Project alone and the adjoining Inland Rail projects have been assessed independently. The strategy for the disposal of the spoil is consistent with the waste management hierarchy and seeks to reuse the material for beneficial purposes in close proximity to the Project, where possible, including for mine/quarry rehabilitation or other suitable use. Disposal to landfill will be avoided, as much as possible. In the event that landfill is identified as the most appropriate location for the spoil, the material will be used as an interim cover in addition to final closure capping and rehabilitation.

As for Bromelton State Development Project and InterLinkSQ, their construction periods may potentially extend to 2037. This reduces the potential construction phase overlap with Project construction. Where feasible, options for beneficial reuse of spoil material and C&D waste (such as concrete) will be considered during Project detailed design.

The risk of cumulative impacts from the interaction of these projects with the Project is considered to be of **low impact** with mitigation and management measures in place (refer Table 22.22). However, this can be specifically determined before the commencement of construction when exact quantities, construction methods and Project-specific disposal locations have been determined. The magnitude of the cumulative impacts of these projects will be refined as the detailed design for each project progresses, post-EIS. When construction facility locations and intensity of use is better understood, the potential waste production may be assessed against proposed receival and disposal locations. The assessment will therefore investigate the waste and resource management infrastructure that is least susceptible to being capacity constrained.

TABLE 22.22: CUMULATIVE IMPACT ASSESSMENT FOR WASTE MANAGEMENT

Impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance
Increased waste generation and airspace consumption of local waste management infrastructure, thereby reducing the local community's access to such services	Probability of the impact	2	5	Low
	Duration of the impact	1		
	Magnitude/intensity of the impact	1		
	Sensitivity of the receiving environment	1		
Spoil disposal if required outside of the project footprint	Probability of the impact	3	9	Medium
	Duration of the impact	2		
	Magnitude/intensity of the impact	3		
	Sensitivity of the receiving environment	1		

22.7 Summary of residual cumulative impacts

The CIA of the Project considered seven projects within a wide geographic extent that have the potential to contribute to cumulative impacts (with an additional five considered as part of the social impact assessment). Spatial areas of influence as well as temporal overlaps of project activities were considered for the environmental aspects assessed in Chapter 8 to Chapter 21.

The assessment concludes that the impacts from the Project combined with other considered existing and proposed projects, have potential cumulative impacts that are considered of **low to medium significance** for the various environmental aspects that were assessed (refer Table 22.23).

TABLE 22.23: CUMULATIVE IMPACT SUMMARY

Projects included in the cumulative impact assessment for each environmental aspect	Land use and tenure	Landscape and visual amenity	Land resources	Flora and fauna	Air quality	Surface water and hydrology	Groundwater	Construction noise and vibration	Operational noise and vibration	Social	Economics	Cultural heritage	Traffic transport and access	Hazard and risk	Waste and resource
G2H	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
C2K	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bromelton SDA	✓	✓	✓	✓		✓	–	–	–	✓	✓	–	✓	–	✓
Ipswich Motorway Upgrade—Rocklea to Darra	✓	✓	✓	✓		✓	–	–	–	✓	✓	–	✓	–	–
RAAF Base Amberley future works	✓	✓	✓	✓	✓	✓	–	–	–	✓	✓	–	✓	–	–
Gatton West Industrial Zone	✓	✓	✓	✓	✓	✓	–	–	–	✓	✓	–	✓	–	✓
InterlinkSQ	–	✓	–	–	✓	✓	–	–	–	✓	✓	–	✓	–	–
Overall cumulative impact significance	Low	Med	Med	Med	Low	Low	Low	Low	Low	Med	Med	Med	Med	Low	Med

22.8 Conclusions

The assessment of cumulative impacts has considered all relevant existing and proposed projects for which data was available. Spatial areas of influence as well as temporal overlaps of project activities were considered for key environmental, social and economic aspects.

Potential cumulative impacts on environmental aspects were considered of low significance, with the exception of potential cumulative impacts on the following environmental aspects:

- Land resources due to the potential cumulative impacts on soil resources (losses), changes to landform and topography, erosion, and weed management.
- Landscape and visual amenity due to the operational impacts associated with views of combined, successive, and sequential adjoining projects.
- Flora and fauna due to the impacts of habitat loss from vegetation clearing/removal and potential cumulative issues from edge/barrier effects, habitat fragmentation and the associated reduction in connectivity to existing biodiversity corridors.
- Surface water and hydrology due to the potential clearing and removal of existing riparian vegetation during construction. Individual water supply plans will be prepared for each Inland Rail project in consultation with regulatory agencies, local government authorities and other stakeholders. These individual plans will identify specific water supply options applicable to each project, including relevant approval requirements. ARTC will continue consultation with relevant stakeholders to: share the overall water demand for the Inland Rail Projects; highlight the relevant options that are being considered once they have been determined; and, discuss how any stakeholder concerns can be mitigated.
- Social and economic impacts due to the combined effects of adjoining projects on social values, including the construction labour demands, traffic volumes, traffic safety, and amenity for landowners. To address labour force issues, local training and recruitment strategies will be implemented combined with business capacity development measures.Economics due to potential increased demand on both the labour market and physical inputs (materials, goods and services). Implementation of the Workforce Management Action Plan and the Local Business and Industry Participation Action Plan within the Social Impact Management Plan (SIMP) will address key issues associated with labour market and demand.
- Cultural heritage due to the loss of cultural heritage sites.
- 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.
- Waste and resource management due to spoil disposal if required outside of the project footprint. The spoil generated from the Project alone and the adjacent Inland Rail projects has been assessed independently. Matters relating to the management of the spoil is provided in the Spoil Management Strategy (refer Appendix T: Spoil Management Strategy) and is consistent with the waste management hierarchy, which seeks to reuse the material for beneficial purposes in close proximity to the Project. Disposal to landfill will be avoided in the event that landfill is identified as the most appropriate location for the spoil, the material will be preferentially used as an interim cover in addition to final closure capping and rehabilitation.

The majority of all potential cumulative impacts are expected to be associated with, and occur during, the Project construction works.

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. The key mitigation measures to reducing the potential cumulative impacts of the Project are presented within the mitigation measures sections of Chapter 8 to Chapter 21 and within Chapter 23: Draft Outline Environmental Management Plan.

Recommended mitigation and management measures have been based on the potential level of impact and how affected receivers (including communities) are expected to be potentially impacted. Due to the nature and scale of the projects considered in this CIA, it is anticipated that each project that has been considered (being: major projects under construction, and proposed significant development progressing through the statutory assessment processes, for which information is publicly available) will be required to mitigate and minimise their respective potential incremental and cumulative impacts to acceptable levels.

The proposed combined delivery approach for the G2H, H2C and C2K Projects provides opportunities to coordinate the management of cumulative impacts generated as a result of construction traffic movements, workforce requirements, spoil management and reuse, and identification and protection of environmental offsets. These aspects will be considered collectively across these three projects in future delivery stages.