

CHAPTER 26

Cumulative impacts

NARRABRI TO NORTH STAR—PHASE 2 ENVIRONMENTAL IMPACT STATEMENT

ARTC

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26 Combined cumulative impacts

This chapter provides an overview and assessment of cumulative impacts of the Narrabri to North Star Phase 2—Moree to Camurra North project (the proposal), together with other projects within the area, and identifies the impacts on the key issues for the proposal. It also identifies mitigation measures to address these impacts.

The Secretary's Environmental Assessment Requirements (SEARs) relevant to cumulative impacts and where they are addressed are provided in Table 26-1. A full copy of the SEARs is provided in Appendix A: Secretary's Environmental Assessment Requirements.

TABLE 26-1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS FOR CUMULATIVE IMPACTS

Desired performance outcome	Requirement	Where addressed
2. Environmental impact statement	1. The EIS must include...the following: (p) an assessment of the relevant cumulative impacts of the project taking into account other projects that have been approved but where construction has not commenced, projects that have commenced construction, and projects that have recently been completed;	Chapter 26

26.1 Summary of impacts

Other existing projects within the study area are considered a part of the existing environment and have therefore been included within the impact assessment of the proposal. Accordingly, the combined cumulative impact chapter of the EIS deals only with:

- ▶ projects that have been approved but where construction has not yet commenced
- ▶ projects that have commenced construction but have not been completed,
- ▶ projects only recently completed but not yet operational
- ▶ projects that are currently being assessed as State Significant Infrastructure (SSI) within the proposal's local government areas (LGAs).

The following projects qualify to be further assessed in terms of determining the significance of cumulative impacts:

- ▶ Narrabri to North Star Phase 1 (ARTC) (SSI-7474)
- ▶ Narramine to Narrabri—Inland Rail (ARTC) (SSI-9487)
- ▶ Newell Highway upgrade north of Moree
- ▶ Queensland–Hunter Gas Pipeline (SSI, project number: MP06_0286)
- ▶ Narrabri Gas Project.

The likely impacts from the development of each of these projects was considered with respect to the proposal, to establish if any potential overlap of impacts could materialise.

The potential for cumulative impacts was afforded a cumulative risk rating of low, medium or high. Overall, the potential for cumulative impacts resulting from the interaction of the proposal with other projects, either existing or proposed, in the surrounding area is considered medium to low. Biodiversity, traffic and transport, social and economic impacts may result in a cumulative impact with a significance rating of medium.

Hydrology and flooding would likely result in a cumulative impact with a significance rating of high. This is predominantly due to:

- ▶ potential of the cumulative impacts of the proposed Newell Highway Upgrade project and the proposal to cause flood impacts to landowners in the southern portion of the proposal
- ▶ additional surface flows originating from Narrabri to North Star Phase 2 overtopping a portion of the new rail in Narrabri to North Star Phase 1.

A significance score of high may require the consideration of alternative options, implementation of specific mitigation measures, implementation of a comprehensive monitoring program, and specific approval conditions to be set.

Mitigation measures specific to the chapters that scored a medium or high risk are provided in section 26.7 and Chapter 27: Environmental Management. Targeted hydrology and flooding mitigation measures, including cumulative impact mitigation measures, are provided in Chapter 12: Hydrology and flooding.

26.2 Overview

Cumulative impacts refer to the successive and combined impacts of numerous activities that share a spatial or temporal overlap, on the environment, economy and society. When considered in isolation, the impacts of a particular project may be negligible or easily mitigated; however, when combined with the effects of other relevant developments, the cumulative impacts may be greater in extent or duration, requiring alternative mitigations.

The projects included in this cumulative impact assessment were chosen due to their spatial or temporal influence on the proposal, as determined for each of the environmental, social and economic issues identified. Specifically, projects were included in this assessment due to:

- ▶ location—projects in proximity to the proposal where the potential for impacts to geographically overlap was identified. This includes shared use of roads and town centres and impacts to resources such as greenfield sites or floodplains.
- ▶ timeframe—projects with a current planning approval or development application under assessment, that have commenced construction or have a real likelihood of commencing construction
- ▶ size—projects considered in this assessment are limited to large-scale developments such as State significant infrastructure (SSI) and other strategic projects in the public domain that would involve one or more of the following:
 - ▶ substantial changes to current traffic conditions, including additional traffic generation/congestion, changes to traffic flows, large truck movements and disruptions to key access routes or road closures
 - ▶ substantial changes to the existing noise levels
 - ▶ impacts on heritage items
 - ▶ impacts on ecology and hydrology of the area
 - ▶ substantial additional pressure on local town centres due to social or economic influences.

Existing projects within the study area are considered a part of the existing environment and have therefore been included within the impact assessment of the proposal. Accordingly, the cumulative impact chapter deals only with projects that have been approved but construction has not yet commenced; projects that have commenced construction but have not been completed, projects only recently completed; and projects that are currently being assessed as SSI within the proposal's local government areas (LGAs). For projects currently under construction, consideration has been given to whether relevant impacts have already been accounted for in baseline scenarios in the impact assessments within this EIS.

The assessment is predominantly qualitative and draws on the findings of Chapters 9 to 25 of this EIS as well as the publicly available impact assessments of projects deemed likely to contribute to a cumulative impact.

26.3 Assessment approach and methodology

The methodology used to assess the proposals cumulative impacts included:

- ▶ a review of the impacts of this proposal, as outlined in Chapters 9 to 25 of this EIS
- ▶ identifying projects to be considered for the cumulative impact assessment via desktop data base searches, including:
 - ▶ Department of Planning and Environment (DPE) online major projects database
 - ▶ proponent websites
 - ▶ local council websites/Development Approval tracking databases
 - ▶ the public register under the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act)
 - ▶ local knowledge
- ▶ identifying spatial and temporal boundaries to define specific projects to be included in the assessment
- ▶ for each key issue considered, assess the relevance and significance of potential cumulative impacts of projects within the identified temporal and spatial boundaries
- ▶ identify suitable mitigation measures where medium or cumulative impacts are identified.

Once the projects included for further assessment have been identified, likely environmental, social and economic impacts from the development of these projects is considered to establish if any potential overlap of impacts could materialise. Each impact was afforded a cumulative risk rating of low, medium or high in accordance with the following general categorisation: for each potential cumulative impact (e.g. land use and property, traffic and transport, biodiversity), a relevance rating of 1 (low), 2 (medium) or 3 (high) was assigned to the following four criteria:

- ▶ likelihood of impact
- ▶ duration of impact
- ▶ magnitude of impact
- ▶ sensitivity of existing environment.

Table 26-2 demonstrates how each criterion may be afforded an impact level rating.

TABLE 26-2 ASSESSMENT MATRIX

Factor	Relevance factor		
Likelihood of cumulative impact	1	2	3
Duration of cumulative impact	1	2	3
Magnitude of cumulative impact	1	2	3
Sensitivity of existing environment	1	2	3

An overall cumulative significance rating of low, medium or high was then assigned to each environmental aspect considered. This cumulative risk rating was determined based on the sum of the four relevance ratings assigned to each aspect.

Table 26-3 outlines the factors associated with each cumulative risk rating.

TABLE 26-3 CUMULATIVE RISK RATING FACTORS

Sum of relevance rating	Cumulative significance rating	Outcomes
1–6	Low	▶ Standard environmental management practices are sufficient to manage negative impacts. General monitoring program to be implemented. ▶ Special approval conditions unlikely.
7–9	Medium	▶ Specific management practices would be required, with mitigation measures to be implemented ▶ Monitoring program may be required ▶ Special approval conditions likely.
10–12	High	▶ Alternative options should be considered ▶ Mitigation measures to be implemented ▶ Comprehensive monitoring program likely to be required ▶ Specific approval conditions required.

For example, if a potential environmental aspect, such as noise and vibration, had a low likelihood of impact (1); a low duration of impact (1); a medium magnitude of impact (2); and a high impact on the sensitivity of the existing environment (3), the sum of the relevance ratings would be 7, resulting in a cumulative risk rating of medium for this particular potential cumulative impact. A summary of the outcomes of this cumulative impact assessment for each environmental aspect is in section 26.5.

26.3.1 Cumulative assessment

Projects specifically included in the cumulative impact assessment are:

- ▶ Inland Rail projects immediately adjacent to the proposal:
 - ▶ North Star to Border and Narromine to Narrabri
- ▶ projects outside the Inland Rail project scope of works but deemed relevant based on their proximity to the Narrabri to North Star (N2NS) project, timing, and potential impacts as outlined above.

Projects excluded from the cumulative assessment include:

- ▶ projects that have commenced operation. These projects are considered a part of the existing environment, and their impacts have, accordingly, been accounted for in the impact assessment of the proposal (see Chapters 9 to 25)

- ▶ proposed projects that have been determined as not likely to contribute to a cumulative impact, due to their lack of proximity to the proposal, lack of temporal cross over between projects, i.e. construction of the project would be at a different time or anticipated impacts
- ▶ proposed projects that have not been developed to the extent that their environmental assessment documentation has been made publicly available.

The assessment of potential cumulative impacts has been undertaken in accordance with the SEARs and identifies potential impacts of the proposal with respect to other projects in the study area. The assessment draws on the findings outlined in Chapters 9 to 25. The issues identified include: impacts on land use and property; biodiversity; traffic and transport; hydrology and flooding; water quality; groundwater; heritage; noise and vibration; social impacts; economic impacts; landscape and visual impact; soils and contamination; waste and resource management; climate change risk adaption; sustainability; air quality; and health and safety. Additional issues were also considered where they arose as a result of adjacent projects.

Projects that have been identified for cumulative assessment consideration are shown in Table 26-4. Of all the projects considered, only five met the overlapping temporal and spatial requirements to qualify for further assessment. The location of projects considered for inclusion in the cumulative assessment is also shown in Figure 26-1.

TABLE 26-4 PROJECTS CONSIDERED FOR THE CUMULATIVE ASSESSMENT

Project and proponent	Location	Description	Statutory approval status	Construction dates¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
Narrabri to North Star Phase 1 (ARTC) (SSI-7474)	Narromine NSW to North Star NSW	The proposal consists of 188 km of upgraded track and associated facilities, generally within the existing rail corridor between Narrabri and North Star, via Moree.	Approved, construction to commence end of 2020, or start of 2021.	2020–2023	500	50	Dividing N2NS Inland Rail projects into Phase 1 and Phase 2 allows Phase 1 to commence construction while Phase 2 remains in the planning and environmental approvals stage. Construction of Phase 1 is scheduled to finish in mid–late 2023, with construction to commence on Phase 2 in 2024. As such, it is unlikely that construction on both projects would occur cumulatively. Construction-related cumulative impacts associated with these projects are therefore considered minimal; however, some physical and social cumulative impacts may occur.	Yes
North Star to NSW/Qld border—Inland Rail (ARTC) (SSI-9371)	North Star in NSW to the NSW/Qld border	The construction of approximately 25 km of new track within the existing rail corridor, and approximately 5 km of new track within a greenfield corridor.	Proponent reviewing public EIS submissions. The exhibition of the EIS ended on 6 October 2020. Project registered as critical state significant infrastructure (CSSI) Project #9371.	2021–2025	350	50	Potential overlap on construction commencement for North Star to Border and Narrabri to North Star Inland Rail projects; however, this project would likely be serviced out of Goondiwindi and is unlikely to spatially overlap.	No

Project and proponent	Location	Description	Statutory approval status	Construction dates ¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
Narromine to Narrabri—Inland Rail (ARTC) (SSI-9487)	Narromine to Narrabri in NSW	The construction of approximately 300 km of new single-track rail line, through private and public property in a greenfield environment between Narromine and Narrabri.	EIS approved Registered as CSSI Project #9487.	2021–2024	TBA	TBA	While the northern section of this rail line is situated some 150 km south of Moree, it is possible that the town of Narrabri may not have the capacity to service the project. The potential exists for some spill over to occur into the town of Moree. Construction timing is likely to coincide.	Yes
Moree Solar Farm	10 km south of Moree, off the Newell Highway in northern NSW	Construction of a 56 MWac/70.1 MWdc single-axis, tracking solar PV facility. Construction works currently involve installation of a framing system, which consists of BladePiles and NexTracker tracking systems, JA Solar Photovoltaic modules, DC and AC wiring of electrical equipment, 22/66 kV onsite substation and a 66 kV transmission line.	Approved by NSW Minister for Planning on 17 July 2011.	Completed 2016	100	5–10	While the Moree Solar Farm and the N2NS projects overlap in terms of spatial context, the solar farm construction was completed in 2016 and is already operational. The solar farm requires only a small number of permanent employees, meaning the potential for cumulative traffic or social impacts is negligible.	No
Newell Highway Moree Town Centre Bypass	Moree, NSW	Construction of a 4.4 km two-lane bypass of the Moree town centre.	Approved by the NSW Minister for Planning on 20 July 2004. Latest modification approved 7 July 2010.	Completed 2011	125	–	The Newell Highway Moree Town Centre Bypass project and the N2NS project spatially overlap; however, the bypass was completed in 2011 and does not itself generate any additional impact on traffic or society.	No

Project and proponent	Location	Description	Statutory approval status	Construction dates ¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
Newell Highway upgrade north of Moree	Moree, NSW	Project involves heavy-duty pavement upgrades along eight sections of the Newell Highway, five between Narrabri and Moree and three north of Moree.	Statutory approval not required—review of environmental factors undertaken.	2021–2024	TBA	–	An upgrade of approximately 5 km of the Newell Highway north of Moree is proposed adjacent to the proposal from chainage 668.4 km to 673.4 km. It is likely that the timing of construction of the two projects would coincide. If construction is undertaken at the same time as the rail corridor project, significant traffic impacts are expected on the Newell Highway due to the Newell Highway serving as a portion of the haul route. There is also the potential for construction worker accommodation pressure in Moree and surrounds. Noise and air quality impacts to local residents are also expected. Significant hydrology impacts to properties between the N2NS rail corridor and the Newell Highway are likely.	Yes

Project and proponent	Location	Description	Statutory approval status	Construction dates ¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
Queensland–Hunter Gas Pipeline	Wallumbilla to Newcastle, NSW	825 km high-pressure gas pipeline, connecting the existing gas transmission hub at Wallumbilla in south-eastern Queensland to the industrial area to the north of Newcastle.	Project classified as Critical State significant infrastructure and, in 2009, Minister for Planning approved the NSW component of the project.	Department has recommended that Hunter Gas be given until 15 October 2024 to physically commence the project development, after which the approval will lapse. In 2021, project status is listed as 'ongoing landholder engagement and refinement of route alignment'.	350	150	If construction occurs at the same time, there is potential for increase in traffic using similar routes and demand for construction resources and personnel. There is also the potential for construction worker accommodation pressure in Moree and surrounds.	Yes
White Rock Solar Farm	20 km south-west of Glen Innes, 40 km east of Inverell, NSW	Establishment of a 20 MW solar farm and associated infrastructure.	Approved by NSW Minister for Planning 14 June 2016.	Construction completed 2018	50	TBA	The White Rock Solar Farm and the N2NS projects are approximately 120 km apart and, for the purposes of this assessment, do not spatially overlap. Further, the solar farm construction was completed in 2018 and is already operational. The solar farm requires only a small number of permanent employees, meaning the potential for cumulative traffic or social impacts is negligible.	No

Project and proponent	Location	Description	Statutory approval status	Construction dates ¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
White Rock Wind Farm	20 km south-west of Glen Innes, 40 km east of Inverell, NSW	Stage 2 of White Rock Wind Farm upgrades consist of up to 48 turbines, producing up to 202 megawatts (MW) of renewable energy.	Approved by the NSW Minister for Planning on 10 July 2012.	Late 2018	100	20	The White Rock Solar Farm and the N2NS projects are approximately 120 km apart, and for the purposes of this assessment do not spatially overlap. Further, the solar farm construction was completed in 2018 and is already operational. The solar farm requires only a small number of permanent employees, meaning the potential for cumulative traffic or social impacts is negligible.	No
Sundown Solar Farm	South of Gwydir Highway, 30 km east of Inverell, NSW	The project consists of a large-scale solar photovoltaic generation facility, including battery storage and associated infrastructure, with an estimated maximum capacity of up to 600 MW.	SEARs issued by NSW Department of Planning and Environment in 2017.	2021–2023	TBA	TBA	If construction occurs at the same time, there is potential for increase in traffic on the Gwydir Highway and the Newell Highway. It is likely that the town of Inverell would support the demand for construction resources and personnel.	No
Bonshaw Solar Farm	Bruxner Highway, 16 km south of Bonshaw and 66 km north of Inverell (NSW)	The development of a 200 MW solar farm, energy storage facility and associated infrastructure.	The project is currently with the Independent Planning Commission (IPC) for assessment, after a recommendation was made by DPE to approve the project, in November 2020.	12 months. Start date TBA.	180	10	It is unlikely that construction would occur concurrently, due to this project currently still being in the approval phase; however, if construction occurs at the same time, there is potential for increase in traffic on the Gwydir Highway and the Newell Highway. It is likely that the towns of Inverell and Glen Innes would support the demand for construction resources and personnel. The project is not considered spatially relevant for this assessment.	No

Project and proponent	Location	Description	Statutory approval status	Construction dates ¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
Sapphire Solar Farm	Project in the Kings Plains, Wellingrove and Sapphire areas, approximately 28 km east of Inverell and 18 km west of Glen Innes	A 200 MW Hybrid solar and battery power facility.	Approved by the NSW Minister for Planning on 16 August 2018.	2019–2020	200	150	If construction occurs at the same time, there is potential for increase in traffic on the Gwydir Highway and the Newell Highway. It is likely that the towns of Inverell and Glen Innes will support the demand for construction resources and personnel. The project is not considered spatially relevant for this assessment.	No
Sapphire Wind Farm	Project in the Kings Plains, Wellingrove and Sapphire areas, approximately 28 km east of Inverell and 18 km west of Glen Innes	Construction of a 238 MW to 425 MW capacity wind farm (between 125 and 159 turbines).	Approved by the NSW Minister for Planning on 26 June 2013.	2017–2018	150		Construction of the wind farm is complete and it is currently operational. The local centres of Glen Innes and Inverell are the primary service providers for this project and it is therefore disregarded from further consideration.	No
Moree Special Activation Precinct (SAP)	Moree	Dedication of Moree as a Special Activation Precinct—an area in a regional location identified by the NSW Government to become a business hub. Involves fast-tracked planning, infrastructure investment, government-led studies, government-led development and business concierge. Uses Moree's logistical advantage, being in close proximity to the Inland Rail project and the Newell Highway, as well as the region's agribusiness and food processing industries.	Master planning process has commenced—Master plan is on exhibition.	TBA	TBA	4000 (by 2060)	A strong relationship exists between the SAP and the proposal in terms of geographic location; however, as the Moree SAP is still in the master planning phase and is considered a long-term strategy (40 years) for the Moree area, it does not meet the temporal criteria to be included within the cumulative impact assessment.	No

Project and proponent	Location	Description	Statutory approval status	Construction dates ¹	Construction jobs	Operation jobs	Relationship to the proposal	Included in Assessment
Narrabri Gas Project	The Narrabri Gas Project will be located over 95,000 ha of state land in the Pilliga, set aside by the NSW State Government for extractive industries. The site is approximately 150 km south west of Moree, and 300 km west of Armidale.	The Narrabri Gas project involves the development of a coal seam gas field, comprising up to 850 gas wells on 425 well pads over 20 years. The facility will include infrastructure for gas processing and water treatment.	The IPC issued their consent for the Narrabri Gas project on 30 September 2020.	12–18 months of appraisal drilling, to inform final plans for phased development of the project	1300	350	While the Narrabri gas fields are situated approximately 150 km from Moree, Narrabri town has limited capacity to service a project of this magnitude. As such it is expected that some spill over into Moree will result, particularly with respect to socio economic influences, and it is included in the cumulative assessment.	Yes
Moree Town Levee Bank Project	Between the Mehi River and Moree— various locations.	A proposed levee bank has been proposed for enhanced flood protection around the town of Moree. This initiative has been unresolved is has been the subject of contention for many years within the LGA.	The project is a consideration of the local council.	TBA	TBA	TBA	The Levee project will be situated along the banks of the Mehi river to protect Moree from flood inundation. The proposal is under consideration; however, no evidence is currently available to suggest that the project is close to implementation and is therefore disregarded.	No

1. Based on information publicly available at the time of writing.

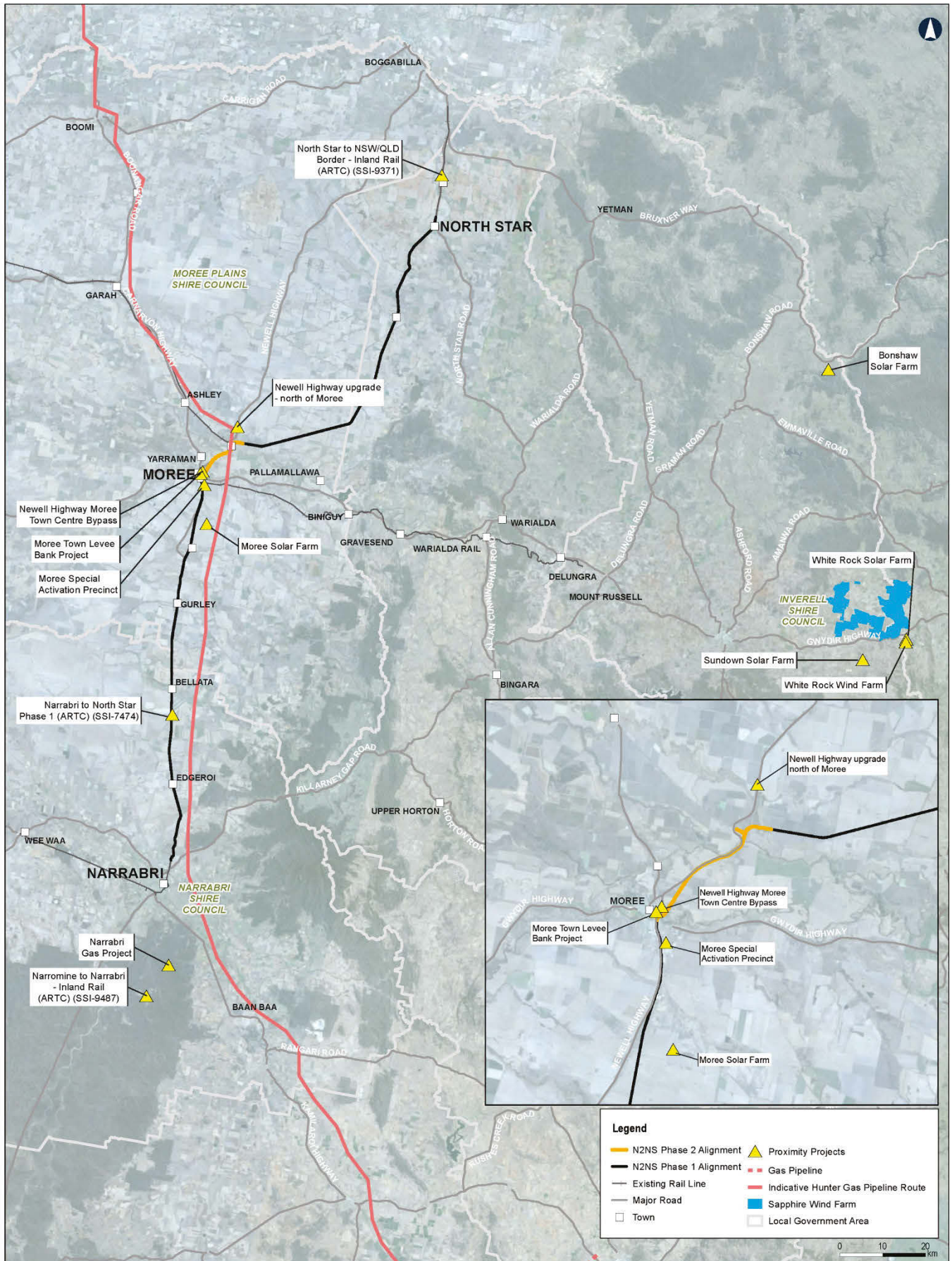


Figure 26-1 Projects assessed for cumulative assessment with the proposal

Data Sources: ARTC, IRDJV, LPI

N2NS_SP2_EIS_F26_01_AlternativeProjects_1102.mxd

Considering the assessment of projects in Table 26-4, the following projects qualify to be further assessed in terms of determining the significance of cumulative impacts:

- ▶ Narrabri to North Star Phase 1 (ARTC) (SSI-7474)
- ▶ Narramine to Narrabri—Inland Rail (ARTC) (SSI-9487)
- ▶ Newell Highway upgrade north of Moree
- ▶ Queensland–Hunter Gas Pipeline (SSI, project number: MP06_0286)
- ▶ Narrabri Gas Project.

26.4 Cumulative impacts

Environmental, social and economic impacts associated with each project were considered to determine if any cumulative impacts exist. Assessment of potential cumulative impacts was undertaken by comparing the extent and duration of the impacts from other projects, and their potential to occur at the same time and place as the proposal. The significance of the cumulative impacts was determined through considering the extent, magnitude and duration of the combined (cumulative) impact and the sensitivity of the affected environment. The subsequent sections explore the environmental aspects outlined in previous chapters of the EIS, with respect to other projects deemed relevant based on their spatial and temporal proximity to the proposal.

26.4.1 Land use and property

Chapter 9: Land use and property discusses the existing environment of the proposal site, with regard to land tenure and land use. It also assesses the potential impacts of construction and operation of the proposal. Most of the proposal site is located within the existing rail corridor, which is owned by the NSW Government and leased to ARTC for railway use and supporting infrastructure.

Outside of the existing rail corridor, the majority of land in the study area consists of agricultural and rural properties, between the residential township of Moree and rural suburb of Camurra. Properties include open grazing land, land used for cropping, scattered vegetation, residences and other farm buildings. The majority of land within the study area is held in freehold title, held by both private owners and various state government departments. The study area also comprises areas identified as Crown land, including travelling stock reserves (TSRs), public roads and waterways.

It is recognised that the proposal would have a minor impact on agricultural land, by way of temporary and permanent acquisition, and severance of properties. The proposal is expected to impact on TSRs and may disrupt farm operations and agricultural vehicle and stock movements on the local road network. Access to the local road network and internal property roads may also be affected. Additional impacts include biosecurity risks during earthworks and construction vehicle movement, and the loss of Crown land from state landholdings.

The proposal does, however, minimise the potential for direct impacts to land use and properties, as the majority of works would be undertaken within the existing rail corridor. For works outside the corridor (particularly the Camurra bypass), land use and property information has been considered in the proposal design process to inform the proposal location and construction methodology to minimise potential impacts. Implementing the land use and property mitigation measures provided in Chapter 9 would minimise the potential for some land use and property impacts.

The potential for impacts from other projects in the area to accumulate with those of the proposal is primarily based on the proximity of the other projects to the proposal, and the similarity of development types. That is, only other projects requiring severance of land and/or a change in land use (loss of agricultural land) would be considered to contribute cumulative impacts. The significance of potential cumulative land use and property impacts is low, due to the limited land use types and property impacts associated with the proposal, as well as the proposal's distance from any other qualifying projects. N2NS Phases 1 and 2 and the Narramine to Narrabri rail projects generally follow the existing rail line, with the majority of works occurring within the rail corridor. No additional severance of land is required, and the loss of agricultural land is limited to a marginal increase in the rail corridor width. Similarly, the Newell Highway upgrade works are to occur primarily within the existing road corridor. The Hunter Gas Pipeline will be constructed generally below ground, via various means, such as trenching, boring or horizontal directional drilling, limiting its impact on existing land uses. The Narrabri Gas Project environmental impact assessment (EIA) stipulates that impacts on land use would be characterised by small and discrete areas of change, that could co-exist with existing land uses. Pipelines would be located underground and above-ground infrastructure facilities are unlikely to require substantial land acquisition, loss of agricultural land or severance of land. Interaction with other projects causing a cumulative impact on land use is unlikely. A comparison of the potential impacts on land use and property, and the potential for impacts to be cumulative in nature, is shown in Table 26-5, while Table 26-6 provides a summary of the determination of significance of the impacts.

The cumulative land use and property impact significance is determined to be low.

TABLE 26-5 LAND USE AND PROPERTY

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Severance of land	No	No	No	No	No	No
Loss of agricultural land	No	No	No	No	No	No

TABLE 26-6 LAND USE IMPACT SIGNIFICANCE

Land use and property impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	2
Magnitude of cumulative impact	1
Sensitivity of existing environment	1
Sum	5
Impact significance	LOW

26.4.2 Biodiversity

Chapter 10: Biodiversity provides a summary of the biodiversity impact assessments (both terrestrial and aquatic) for the proposal. It describes the existing environment, assesses the impacts of construction and operation of the proposal, and provides recommended mitigation and management measures.

The cumulative impacts of multiple projects requiring vegetation clearing occurring in close proximity to the proposal would likely result in the increased loss of biodiversity in the Narrabri and northern NSW region.

The following lists the key biodiversity impacts associated with relevant projects:

- ▶ N2NS Phase 1—EIS (GHD, 2017a) states that the assessed risk level for the majority of potential risks to biodiversity was between low and medium. The key action assessed as likely to impact biodiversity, both terrestrial and aquatic, was the clearing of native vegetation. It was estimated that the proposal would result in the permanent removal or modification of 411 hectares (ha) of native vegetation, and the temporary disturbance of about 72 ha of native vegetation. The ecological communities, flora and fauna to be impacted, currently occur as, or within, fragmented and disturbed patches of vegetation and, therefore, the increase in fragmentation is considered to be negligible. Biodiversity offsets for native vegetation loss would work to help mitigate impacts associated with habitat loss.
- ▶ Narromine to Narrabri—the EIS (Jacobs GHD, 2020) states that up to around 1,732 ha of native vegetation would need to be removed, constituting a notable increase in cleared land in the locality, particularly within the Pilliga forests. The removal of native vegetation would be permanent and irreversible. The clearing of native vegetation would involve removing a large number of individuals, and a moderately diverse range of non-threatened native plants; however, the reduction in native vegetation is less significant at a regional scale and is unlikely to threaten the persistence of any populations of native plants, vegetation communities or threatened ecological communities (TEC). The proposal is located in a fragmented rural landscape for much of the alignment; however, the proposal would exacerbate fragmentation and cause additional fragmentation of the Pilliga East State Forest. The proposal is likely to significantly impact terrestrial fauna species.
- ▶ Newell Highway upgrade—the Review of Environmental Factors (REF) (RMS, 2018) states that the project would require the removal of about 49.19 ha of native vegetation, including 3.2 ha of state-listed TEC, and 9.45 ha of nationally listed TECs. The REF found that the proposal would not have a significant impact on any species, population or TEC listed under state legislation. The proposal is, however, likely to have a significant impact on two threatened species and a TEC listed under the EPBC Act due to the clearing of 6.25 ha of a critically endangered TEC. Biodiversity offsets would be required for residual impacts to threatened biodiversity.
- ▶ Queensland–Hunter Gas Pipeline (QHGP)—the Environmental Assessment (EA) (Manidis Roberts, 2008) states that the QHGP would be buried for its entire length, with ancillary aboveground facilities being the only features on the surface. The EA states that the project has specifically avoided areas of conservation significance and has used areas of cleared or degraded lands wherever possible; however, the proposal is anticipated to result in a decrease in the extent and quality of a number of endangered ecological communities due to vegetation clearing. Similarly, potential habitat for threatened fauna within the study area is characterised by fragments of vegetation and habitat features within a landscape that has been subject to historical disturbance. Construction may impact already limited movement corridors, increase mortality and reduce available habitat for threatened species.

- ▶ Narrabri Gas Project—the EIS (GHD, 2017b) concluded that it was unlikely to have a significant impact on threatened flora, fauna or ecological communities. The construction and operation of the project would result in the removal of up to 988.8 ha of native vegetation, with indirect impacts of the project being equivalent to the removal of an additional 181.1 ha of native vegetation. This 1,169.9 ha of vegetation, however, equates to approximately 1.5 per cent of native vegetation dispersed throughout the area. Half of this vegetation is expected to be rehabilitated following construction.

The following direct impacts are likely to occur at the construction and operational phases of the N2NS proposal:

- ▶ habitat clearing for permanent and temporary construction facilities (e.g. new rail line, replacement bridges, upgraded crossings, ancillary facilities), causing direct loss of native flora and fauna habitat. The total area subject to clearing is approximately 143.05, consisting of 99.74 ha of native vegetation, and 43.31 of non-native vegetation)
- ▶ displacement of resident fauna, causing a potential decline in local fauna populations
- ▶ injury or death of fauna, causing a decline in local fauna populations
- ▶ removal of habitat features, e.g. hollow bearing trees, causing a direct loss of native fauna habitat
- ▶ disruption to connectivity, causing a direct loss of native fauna habitat
- ▶ work in waterways, causing a direct loss of riparian habitat and disturbance of aquatic habitat.

The following indirect impacts may also occur at the construction and operational phases of the proposal:

- ▶ reduced viability of adjacent habitat due to edge effects
- ▶ transport of weeds or pathogens from the site to adjacent vegetation
- ▶ cumulative loss of breeding habitat and competition for remaining resources
- ▶ increase in predatory species populations
- ▶ increase in pest animal populations.

The major potential impacts to biodiversity identified as a result of the proposal are also likely outcomes of other projects assessed in the region, and the impacts are therefore considered cumulative. The cumulative impacts are considered to be of medium to high significance. A comparison of the potential impacts, and the potential for impacts to be cumulative in nature, is shown in Table 26-7. The determination of impact significance is provided in Table 26-8.

TABLE 26-7 BIODIVERSITY

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Loss of biodiversity through native vegetation clearing and habitat loss	Yes – 143.05 ha	Yes – 411 ha	Yes – 1,732 ha	Yes – 29.19 ha	Yes—area to be cleared to be confirmed	Yes – 988 ha
Loss of fauna connectivity due to linear nature of project	No (culverts)	Yes	Yes	Yes	Yes	Yes
Potential increased risk of threatening processes (pests and weeds)	Yes	Yes	Yes	Yes	Yes	Yes
Displacement, injury or death of fauna causing a decline in local fauna populations	Yes (likely)	Yes (likely)	Yes (likely)	Yes (limited extent as within existing road reserve)	Yes	Yes
Work in waterways, causing loss of riparian habitat and disturbance of aquatic habitat	Yes	Yes	Yes	No	Possibly (route refinement ongoing)	Possibly (route refinement ongoing)

TABLE 26-8 BIODIVERSITY IMPACT SIGNIFICANCE

Biodiversity cumulative impact	Relevance factor
Likelihood of cumulative impact	2
Duration of cumulative impact	2
Magnitude of cumulative impact	2
Sensitivity of existing environment	2
Sum	8
Impact significance	MEDIUM

In summary, the existing rail corridor and surrounding lands have been subject to a range of historic disturbances from land clearing, agriculture, and rail and power infrastructure. This cumulative loss of habitat has placed increasing pressure on local flora and fauna species, and ecological communities. While the proposal is unlikely to significantly change the overall connectivity of habitats in the region due to the majority of works occurring in the existing rail corridor, the works would contribute to an increase in vegetation fragmentation when considered alongside other projects in the area. Native vegetation clearing is likely to result in habitat loss and subsequent decline in native flora and fauna populations, as well as the direct and indirect impacts listed above. Fragmentation and connectivity have been considered as part of the biodiversity assessment and the biodiversity offsets calculations. N2NS Phase 2 would be constructed predominantly within the existing rail corridor and contributes less than 1 per cent of the length of the overall Inland Rail program and less than 10 per cent of the N2NS Phase 1 project. Mitigation measures would be required to manage impacts, in relation to proposed techniques, timing, frequency, responsibility for implementing each measure, risk of failure, and an analysis of consequences of any residential impacts.

The cumulative biodiversity impact significance is determined to be medium.

26.4.3 Traffic and transport

Chapter 11: Traffic and transport provides a summary of the traffic, transport and access impact assessment of the proposal. It describes the existing traffic, transport and access environment, assesses the impacts of construction and operation, and provides recommended mitigation and management measures. The traffic generation from other developments in the region was also considered for the cumulative impact assessment.

This cumulative impact assessment concluded that there would be potential for cumulative traffic and transport impacts in the Narrabri to North Star and Moree (being the closest town centre) regions. The following projects in particular, were identified as likely to contribute cumulative traffic and transport impacts based on a temporal and spatial overlap with the proposal:

- ▶ N2NS Phase 1—The Narrabri to North Star Phase 1 project consists of 188 km of upgraded track and associated facilities, generally within the existing rail corridor between Narrabri and North Star, via Moree (GHD, 2017a). The project is approved, with construction expected to occur from 2021–2023. There is unlikely to be overlap on construction commencement for Phase 1 and Phase 2 projects, as Phase 2 is expected to commence construction in 2024. Therefore, cumulative traffic impacts on the Newell Highway due to construction staff, transportation of materials and machinery, and use of facilities (e.g. quarries, waste facilities, towns) are unlikely.
- ▶ Narromine to Narrabri—this project involves the construction of approximately 300 km of new single-track rail line between Narromine and Narrabri, adjacent to the proposal (Jacobs GHD, 2020). Construction is expected to occur between 2022–2024, resulting in a potential overlap with the N2NS Inland Rail projects. Traffic associated with construction staff, transportation of materials and machinery, and the use of local facilities is likely to increase on local roads and the Newell Highway. Traffic in Moree is also expected to be affected due to dependence on services such as accommodation out of Moree.
- ▶ Newell Highway upgrade north of Moree—the upgrade of the Newell Highway, north of Moree, involves heavy-duty pavement upgrades from the Moree town centre to approximately 50 kilometres north (RMS, 2018). Construction is expected to commence mid-2021 and be completed in 2024, meaning that it is likely that construction of this project and the proposal will coincide. Traffic impacts are expected on the Newell Highway as it serves as a portion of the haul route for both the proposal and the Newell Highway upgrade. Increased traffic will likely be due to construction staff, transportation of materials and machinery, and the use of local facilities.
- ▶ Narrabri Gas Project—the Narrabri Gas Project site is approximately 150 km south-west of Moree, and 300 kilometres west of Armidale (GHD, 2017b). The Independent Planning Commission issued their consent for the Narrabri Gas Project on 30 September 2020, and 12–18 months of appraisal drilling is expected to commence to inform final plans for phased development of the project. With 1,300 construction jobs anticipated, there is potential for an increase in traffic on the Newell Highway during construction as a result of construction staff, and transport of materials and machinery.

- ▶ **Queensland–Hunter Gas Pipeline**—the NSW Government has recommended that Hunter Gas be given until 15 October 2024 to physically commence project development, after which the approval will lapse. As such, some overlap of construction activities is considered likely. The project expects to generate 350 construction jobs, meaning that there is potential for increase in traffic on shared routes due to construction staff, and the transport of materials and machinery.

The construction of these five projects is expected to overlap with the construction of the proposal. As such, the significance of cumulative impacts is considered medium and mitigation measures, as outlined in Chapters 11 and 27, would be required to manage these impacts. A traffic management plan would also be implemented as part of the construction environmental management plan (CEMP). Table 26-9 provides a summary of the potential cumulative traffic impacts for projects outlined above. The determination of impact significance is provided in Table 26-10.

TABLE 26-9 TRAFFIC AND TRANSPORT

Impact / project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Impact to local road users due to increased construction traffic	Yes	No	Yes	Yes	Yes	Yes
Increase in heavy vehicles on Newell and/or Gwydir Highway	Yes	No	Yes	Yes	Yes	Yes

TABLE 26-10 TRAFFIC AND TRANSPORT IMPACT SIGNIFICANCE

Traffic and transport IMPACT	Relevance factor
Likelihood of cumulative impact	2
Duration of cumulative impact	2
Magnitude of cumulative impact	1
Sensitivity of existing environment	2
Sum	7
Impact significance	MEDIUM

The cumulative traffic and transport impact significance is determined to be medium.

26.4.4 Hydrology and flooding

Chapter 12: Hydrology and flooding provides a summary of the hydrology and flooding impact assessment for the proposal. The impact assessment focuses on impacts on drainage and flooding processes within the catchments adjacent to the proposal and concludes that the proposal is located within a highly sensitive floodplain, and the construction phase has the potential to significantly impact flooding of sensitive assets and property if not appropriately managed.

A key design objective of the proposal is to deliver a more reliable rail corridor with improved flood immunity and increased resilience to the effects of flooding. The proposal has been designed to improve the top of formation (TOF) flood immunity to at least the 5% AEP event and to ensure no overtopping of the rail occurs up to the 1% AEP event. This requires raising the level of the rail approximately 500 mm above the existing rail levels, with a reconstructed rail formation.

Raising the rail level has the potential to considerably worsen flooding on the upstream (eastern) side of the rail corridor due to obstruction of the floodwater that previously overtopped the rail. To avoid this impact, significant numbers of additional cross-drainage structures have been provided in the design to allow equivalent volumes of floodwater to pass under the rail in a more controlled manner. These new cross-drainage structures replace the overtopping mechanism and have been carefully sized and located to ensure that they do not pass flow too efficiently through the rail corridor and adversely impact flooding on the downstream (western) side of the rail corridor during frequent flood events.

Of particular relevance to the potential cumulative hydrology and flooding impacts associated with the proposal is the N2NS Phase 1 project and the planned upgrades of the Newell Highway north of Moree.

As outlined in Technical Paper 4: Hydrology and flooding impact assessment, N2NS Phase 1 and Phase 2 have combined effects on flooding processes on the southern Mehi River floodplain around Moree near the southern interface of both projects. Specifically, these combined effects occur south of the Alice Street level crossing around Moree Railway Station. N2NS Phase 1 and the proposed Newell Highway upgrade do not produce combined effects on flooding due to the distance between the projects, with the Newell Highway upgrade located approximately 2.3 km to the north of N2NS Phase 1. The cumulative effects of N2NS Phase 2 with N2NS Phase 1 and the Newell Highway upgrade are described separately in the following sections.

26.4.4.1 Cumulative impacts of N2NS Phase 1 and Phase 2

Flood impact maps for the cumulative impact assessment that considers the combined effects of N2NS Phase 1 and Phase 2 are provided in Appendix B of Technical Paper 4. The impacts can be summarised as follows:

- ▶ Up to the 2% AEP event, there are no adverse impacts on flooding as a result of the combined effects of both projects. The 2% AEP afflux map shows that flood levels around the southern Mehi floodplain in Moree are reduced by between 10 mm and 100 mm.
- ▶ However, the 1% AEP afflux map shows that the combined effects of both projects produce adverse flood impacts in Moree, west of Moree Railway Station, with afflux values of between 10 mm and 40 mm occurring at 86 residential properties. The cause of this impact is an increase in the 1% AEP flood level east of Moree Railway Station of up to 10 mm, which is sufficient to divert significant quantities of additional floodwater around the station and into the centre of Moree. Further investigation would be conducted during detailed design to establish the accuracy of these predicted impacts, noting the potential for results to be a consequence of the flood model resolution.
- ▶ The 1% AEP impact in Moree is mainly an increase in flood level. There are no widespread or significant changes in velocity and duration for the 1% AEP event.

26.4.4.2 Cumulative impacts of N2NS Phase 2 and Newell Highway upgrade

Flood impact maps for the cumulative impact assessment that considers the combined effects of the proposal and the planned Newell Highway upgrade are provided in Appendix C of Technical Paper 4: Hydrology and flooding impact assessment. The impacts can be summarised as follows:

Regarding impacts to the highway:

- ▶ The upgraded section of the highway has greater than 20% AEP flood immunity and impacts of the proposal on this section of the highway are significantly reduced for all events up to the 1% AEP event.
- ▶ The number of points no longer flooded increases, particularly for the low to medium events, due to the raised pavement levels of the highway (which improves its flood immunity).
- ▶ There are increased hazard impacts on the highway in the upgrade case. This is due to localised increases in water level and velocity (i.e. water flowing across the highway) generated by the raised highway embankment for events that overtop the upgraded section of the highway (i.e. the 5%, 2% and 1% AEP events).

Regarding impacts occurring around the highway and rail corridor:

- ▶ For the 1% and 2% AEP events, mapping provided in Technical Paper 4: Hydrology and flooding impact assessment demonstrates that the cumulative impact results are in generally consistent with the design scenario results, with some minor increases in afflux around the rail corridor.
- ▶ Afflux maps demonstrate a change in afflux due to the cumulative impact of the projects. In both events, the properties located in the area between the road and rail corridor are subject to new impacts from increased flood levels. Key conclusions regarding cumulative afflux include:
 - ▶ The increase in flood level is generally less than 100 mm with some localised increases up to 200 mm. There are also impacts noted immediately downstream of new cross drainage structures under the highway.
 - ▶ No exceedances of the afflux QDLs for buildings located in this area occur in the cumulative case (i.e. with both projects in place).
 - ▶ The unprotected areas surrounding these buildings including property accesses (i.e. driveways) are affected by the additional afflux. It should be noted that this additional afflux is most pronounced in the 10% and 5% AEP events.
 - ▶ It is considered that the contribution of the proposal to the cumulative afflux impacts does not generally alter the materiality of the impacts due to the relatively lower contribution of the proposal to the total cumulative afflux in this area.
 - ▶ The Newell Highway Upgrade Review of Environmental Factors sets flood impact criteria for the highway upgrade and, where these criteria are exceeded, TfNSW has undertaken consultation with affected

landowners. In areas where the cumulative impacts of both projects occur, ARTC will undertake further consultation with TfNSW and affected landowners to determine the potential for design modifications or other mitigation measures to address the cumulative impacts attributable to the rail project scope.

- ▶ Velocity impacts remain similar to the 1% AEP event impact.
- ▶ An increase to the duration of flooding with exceedances of the duration criteria (duration increase greater than 10 per cent) across all events both upstream and downstream of the proposed highway changes.
- ▶ Hazard impacts are similar to the non-cumulative design case impacts, with some increased hazard impact upstream of the rail corridor in the cumulative case.

Flood impact maps for the cumulative impact assessment that considers the combined effects of N2NS Phase 2 and the Newell Highway upgrade are in Appendix B of Technical Paper 4.

While the flooding impacts associated with the proposal alone would be considered relatively minor, the cumulative flooding impacts associated with the proposal and adjacent Newell Highway project are considered more significant. As per Technical Paper 4: Hydrology and flooding impact assessment, the combined impacts from the construction of both the proposal and Newell Highway project would likely result in increases in afflux around the rail corridor and on properties located in the area between the road and rail corridor. An increase in the duration of flood events is also anticipated. Table 26-11 provides a summary of the potential cumulative hydrology and flooding impacts for projects. The determination of impact significance is provided in Table 26-12. The cumulative hydrology and flooding impact significance is determined to be high.

TABLE 26-11 HYDROLOGY AND FLOODING

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Increase in flood levels	Yes	Yes	No	Yes	No	No
Increase in the duration of flood events	No	No	No	Yes	No	No

TABLE 26-12 HYDROLOGY AND FLOODING IMPACT SIGNIFICANCE

Hydrology and flooding impact	Relevance factor
Likelihood of cumulative impact	3
Duration of cumulative impact	2
Magnitude of cumulative impact	2
Sensitivity of existing environment	3
Sum	10
Impact significance	HIGH

26.4.5 Water quality

Chapter 13: Surface water quality impact assessment provides a summary of the surface water impact assessment for the proposal. A cumulative impact assessment was undertaken where potential surface water impacts of the proposal were assessed, with consideration given to other planned or existing activities in the region.

The proposal is located within the Gwydir catchment, which is a sub catchment of the Murray–Darling Basin. Many of the projects considered in the assessment were determined as not likely to contribute to cumulative impacts on water quality due to the nature and extent of the construction activities and being located in different sub-catchments. Provided industry standard erosion and sediment control measures are implemented, construction of the proposal and surrounding projects is not anticipated to cause significant changes to water quality in receiving systems. Similarly, water quality would be maintained in the operational phase of projects through design considerations (e.g. scour protection) and appropriate management practices.

Table 26-13 provides a summary of the potential cumulative water quality impacts for projects. The determination of impact significance is provided in Table 26-14.

TABLE 26-13 WATER QUALITY

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Decrease in water quality	No	No	No	No	No	No

Table 26-14 Water quality impact significance

Water quality impact	Relevance factor
Likelihood of cumulative impact	2
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	2
Sum	6
Impact significance	LOW

The cumulative water quality impact significance is determined to be low.

26.4.6 Groundwater

Chapter 14 provides a summary of the groundwater assessment undertaken for the proposal. It describes the existing environment, assesses the impacts from construction and operation of the proposal, and provides mitigation recommendations. Based on this assessment, the potential impacts to groundwater from adjacent projects are localised and unlikely to contribute to cumulative impacts. The study area for the purpose of this assessment is a 2-km buffer encapsulating the linear proposal site. This area incorporates important environmental receptors such as registered groundwater bores, and aquatic and terrestrial groundwater dependant ecosystems (GDEs).

Key risks to groundwater typically relate to groundwater levels/availability and groundwater quality. The Lower Gwydir Alluvium underlies the entire study area and is the principal unit of groundwater servicing the town of Moree with potable water requiring only minor treatment. Numerous household and irrigation bores are also within the study area. Impacts to groundwater quality and availability have been assessed at both the construction and operational phases of the proposal and surrounding projects such as adjacent Inland Rail projects, the Newell Highway upgrade, and the Queensland–Hunter Gas Pipeline. Key potential cumulative impacts identified include: construction dewatering; construction water over-supply; flow-path disruption; compression or settlement due to soil moisture changes; contamination; and changes to groundwater recharge through altering surface infiltration.

The proposal is at-grade and does not include deep excavations or cuttings that have the potential to intersect groundwater or divert groundwater flow paths. Similarly, ARTC has developed a Construction Water Plan for the Inland Rail projects outlining the preferred hierarchy for obtaining construction water supply, and the implementation of mitigation measures outlined in both the proposal and surrounding projects EIAs is considered sufficient to manage groundwater levels and quality. Substantial decrease in soil permeability, preventing groundwater recharge is not anticipated due to the Inland Rail projects remaining largely within the existing rail corridor; therefore, provided recommended mitigation measures and CEMPs addressing groundwater level drawdown triggers and measures to prevent and respond to spills and leaks are complied with, the risk of potential cumulative impacts to groundwater during construction is considered low.

Table 26-15 provides a summary of the potential cumulative groundwater impacts for projects. The determination of impact significance is provided in Table 26-16.

TABLE 26-15 GROUNDWATER IMPACT SIGNIFICANCE

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Decrease in groundwater quality	No	No	No	No	No	Possible
Decrease in ground water quantity	No	No	No	No	No	Possible

Table 26-16 Groundwater impact significance

Groundwater impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	2
Sum	5
Impact significance	LOW

The cumulative water quality impact significance is determined to be low.

26.4.7 Cultural heritage

26.4.7.1 Aboriginal heritage

Chapter 15: Cultural heritage summarises the Aboriginal and non-Aboriginal heritage assessment completed for the proposal. Given the lack of general Aboriginal heritage surveys conducted for the wider region, as well as a lack of standardisation in site recording in NSW for the registration of Aboriginal heritage, this cumulative assessment should not be regarded as a complete account of potential impacts to Aboriginal heritage in the area. The Aboriginal cultural heritage assessment focused on identified sites; however, Aboriginal heritage values can also occur at the landscape scale, which would have greater potential for interaction between projects and therefore greater cumulative impacts.

The results of the Aboriginal Heritage Information Management System (AHIMS) search identified 27 listed Aboriginal sites within the search parameters of the proposal, one of which was within the proposal works area. Further, archaeological survey of the proposed site identified five isolated artefacts, and consultation with registered Aboriginal parties (RAPs) identified five cultural heritage values across the site. The N2NS Phase 1 project EIS (GHD, 2017a) states that two registered cultural heritage sites are located within the proposal site, and an additional 12 new sites were identified during field surveys. Five areas of archaeological potential were also identified. No cultural heritage assessment has yet been conducted as part of the EIA for the Narrabrie to Narrabri Inland Rail project, and other projects are not considered to be within a spatial proximity to contribute to cumulative impacts to cultural heritage.

Section 2A(2) of the *National Parks and Wildlife Act 1974* (NSW) stipulates that protection of the environment and Aboriginal heritage is to be achieved by applying the principles of ecologically sustainable development. Ecologically sustainable development can be implemented through integrating economic and environmental considerations (including cultural heritage) in decision-making processes. Due to the potential cumulative impact on Aboriginal cultural heritage as a result of this proposal and the N2NS Phase 1 project, detailed design should aim to minimise potential impacts to any and all cultural heritage sites and areas as far as possible. Where impacts are unavoidable, the significance of impacts would be minimised by implementing the mitigation measures outlined in Chapter 15: Cultural heritage.

26.4.7.2 Historical heritage

Chapter 15: Cultural heritage summarises the Aboriginal and non-Aboriginal heritage assessment completed for the proposal. Four listed heritage items were identified within both the proposal site and within a 3,000-m visual assessment area for the proposal. These items include the Mehi River Bridge (SHI no. 4281692); the Camurra–Gwydir River underbridge (SHI no. 4281693); the Moree Railway Station; and the Victoria Hotel. Moree Railway Station is considered by the Moree Plains Local Environmental Plan to be of state significance, and the Mehi River Bridge and the Camurra–Gwydir River Underbridge are considered to be of local significance.

Due to design constraints, it has been determined that the retention of the Mehi River Bridge (SHI no. 4281692) and the Camurra–Gwydir River Underbridge (SHI no. 4281693) is not feasible for the N2NS Phase 2 project; therefore, to mitigate the impacts resulting from the removal of the bridges, design elements of the Mehi River Bridge and the Camurra–Gwydir River underbridge would be incorporated into the new bridge designs. The project would not adopt the standard ARTC bridge design for the replacements of the extant bridges; instead, a more sympathetic design that incorporates or references the original design of the steel Pratt truss bridges would be considered to reflect the heritage values of the Mehi River Bridge (SHI no. 4281692) and the Camurra–Gwydir River underbridge (SHI no. 4281693). The new bridges would be designed in consultation with suitably qualified heritage consultants and heritage architects.

Options for the reuse of original elements of the existing bridges for non-structural elements or in interpretation near to the bridges would also be considered for the new bridges during the detailed design stage, in consultation with the local community and council. Landscape design and the rehabilitation of the landscape would incorporate interpretation and native plants.

The N2NS Phase 1 project EIS also lists the Mehi River Bridge, the Moree Railway Station and the Camurra–Gwydir River underbridge as heritage-listed items within the project site that are likely to be directly impacted. No heritage assessment has yet been conducted as part of the EIA for the Narromine to Narrabri Inland Rail project, and other projects are not considered to be within a spatial proximity to contribute to cumulative impacts to historical heritage.

Impact mitigation recommendations made in Chapter 15, such as the incorporation of design elements of the existing bridges for non-structural elements or in interpretation next to the bridges, should be considered for the new bridges; however, no cumulative impacts to heritage listed items are expected to occur.

Table 26-17 provides a summary of the potential cumulative heritage impacts for projects. The determination of impact significance is provided in Table 26-18.

TABLE 26-17 CULTURAL HERITAGE

Impact / project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Cumulative impact on Aboriginal heritage	No	No	No	No	No	No
Cumulative impact on historical heritage	No	No	No	No	No	No

TABLE 26-18 HERITAGE IMPACT SIGNIFICANCE

Heritage impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	1
Sum	4
Impact significance	LOW

The cumulative heritage impact significance is determined to be low.

26.4.8 Noise and vibration

Chapter 16: Noise and vibration summarises the noise and vibration assessments undertaken for the proposal. To assess cumulative construction noise within the proposal area, other projects planned to be under construction simultaneously with this proposal were identified.

The existing noise environment surrounding the proposal is characteristic of a rural landscape, dominated by natural sounds and distant road traffic noise. Generally, the area experiences only low background noise levels. The Newell Highway is the main noise source within the proposal study area.

During construction, predictions indicate that construction noise levels generated by the proposal would likely impact receivers in the study area. Potential impacts include noise impacts on local residents and sensitive receivers (particularly during work outside standard working hours), temporary exceedance of noise management levels (NMLs) for highly noise-affected receivers, increase in construction traffic noise, damage to structures from vibration caused by construction activities and, in some cases, sleep disturbance. Simultaneous noise from construction works of the Narromine to Narrabri Inland Rail project are likely to have a noticeable impact on sensitive receptors located in inner and north Moree, as identified in Chapter 16: Noise and vibration.

Works are expected to progress along the proposal site, however, so these predicted noise levels would not be expected to occur continuously over the duration of the construction of the proposal.

Table 26-19 provides a summary of the potential cumulative noise and vibration impacts for projects. The determination of impact significance is provided in Table 26-20.

TABLE 26-19 NOISE AND VIBRATION

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Increase in noise and vibration impacts to receptors	Yes	No	Yes	Yes	No	No

TABLE 26-20 NOISE AND VIBRATION IMPACT SIGNIFICANCE

Noise and vibration impact	Relevance factor
Likelihood of cumulative impact	2
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	2
Sum	6
Impact significance	LOW

The cumulative noise and vibration impact significance is determined to be low.

26.4.9 Social impact

Chapter 17: Social impact assessment provides an assessment of the potential social impacts of the proposal, both positive and negative, and identifies mitigation measures to address these impacts. The study area comprised a local study area (areas within 1 km of the proposal corridor), a community level study area (townships of Moree and the villages of Ashley and Pallamallawa) and a regional study area (Moree Plains Shire). Specific aspects that are likely to be affected as a result of cumulative impacts of this proposal and other relevant projects relate to amenity and lifestyle, and demand/pressure for personnel and resources.

An analysis of community values outlined in Chapter 17 identified key themes relating to protecting and enhancing the local amenity, future-proofing the community, and protecting and supporting the natural environment. Residents of Moree and surrounds value the lifestyle that comes with living in the Moree Plains Shire, and have concerns surrounding noise, visual impacts, and maintaining a clean and healthy environment.

If construction of the five assessed projects overlaps with construction of the N2NS Phase 2 project, there is potential for cumulative noise, vibration, dust and visual impacts to occur, subsequently affecting the amenity and lifestyle values of residents within the Moree Plains Shire.

Project construction would likely increase demand for labour and accommodation services in Moree and surrounds. Both the Narramine to Narrabri Inland Rail project and the Narrabri Gas project are located approximately 150 km south of the town of Moree; however, the town of Narrabri may not have the capacity to service the projects—some spill over into Moree may occur. Similarly, the Newell Highway upgrade and the Queensland–Hunter Gas pipeline would likely increase demand for construction worker accommodation in Moree. A subsequent effect may be an increase in accommodation pricing that could negatively impact existing residents of Moree.

The *Inland Rail Program Business Case* (ARTC, 2015) identifies that an anticipated additional 16,000 jobs would 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 is anticipated over 100 years of operation. The 10-year delivery schedule would support economic activity across regions and create regional jobs in Queensland, NSW and Victoria during both construction and operation.

Inland Rail, once completed, would have positive social impacts by way of efficient freight transport, supporting existing and new businesses, and increased road safety due to reduced congestion. A reduction in pollution from road freight is also a possible positive impact.

Table 26-21 provides a summary of the potential cumulative social impacts for projects. The determination of impact significance is provided in Table 26-22.

TABLE 26-21 SOCIAL IMPACT

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narramine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Impact to amenity and lifestyle	Yes	Yes	Yes	Yes	No	No
Increased demand for labour and accommodation	Yes	Yes	Yes	Yes	No	No

TABLE 26-22 SOCIAL IMPACT SIGNIFICANCE

Social impact	Relevance factor
Likelihood of cumulative impact	3

Social impact	Relevance factor
Duration of cumulative impact	1
Magnitude of cumulative impact	2
Sensitivity of existing environment	2
Sum	8
Impact significance	MEDIUM

The cumulative social impact significance is determined to be medium.

26.4.10 Economics

Chapter 18: Economics outlines the potential economic benefits and impacts of the proposal on regional, state and national economies. The chapter identifies that the concurrent construction of interacting projects has the potential to increase the demand for labour in the local and regional economy, particularly for workers with trade and construction skills/knowledge. The demand for workers for projects with overlapping construction timeframes may lead to cumulative demands on construction labour, not only within the local and regional economy, but also across NSW, southern Queensland and, potentially, nationally.

The N2NS Phase 1 project is scheduled to conclude approximately three months prior to the commencement of construction on N2NS Phase 2. As such, it is unlikely that pressure for worker accommodation in Moree and surrounds would arise; however, construction of the Narromine to Narrabri Inland Rail project is likely to coincide with N2NS Phase 2. While situated some 150 km south of Moree, it is possible that the town of Narrabri may not have the capacity to service the project, resulting in spill over to occur into Moree for workforce recruitment and accommodation. The Newell Highway upgrade, Queensland–Hunter Gas Pipeline and Narrabri Gas Project may also place increased pressure on local workforce recruitment and accommodation in Moree and surrounds as they would likely coincide with N2NS Phase 2 construction. Increased pressure on workforce accommodation in regional towns, such as Moree, has the potential to reduce the availability and affordability of housing and accommodation in the area by creating an artificial spike in rental prices, which may prevent local residents from obtaining affordable housing.

There may also be economic benefits for Moree and surrounds as a result of additional infrastructure projects in the adjacent and surrounding areas around the same time as the proposal. These benefits include increased consumer spending by the construction workforce, which may benefit local businesses, as well as direct net economic benefits driven by improvements in freight productivity, reliability and availability, and the procurement of local materials and services required by projects, which could benefit businesses in the region.

Table 26-23 provides a summary of the potential cumulative economic impacts for projects. The determination of impact significance is provided in Table 26-24.

TABLE 26-23 ECONOMIC IMPACT

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Adverse economic impacts to local residents with regard to affordability and availability of accommodation	Possible	No	No	Possible	Possible	Possible

TABLE 26-24 ECONOMIC IMPACT SIGNIFICANCE

Economic impact	Relevance factor
Likelihood of cumulative impact	2
Duration of cumulative impact	1
Magnitude of cumulative impact	2
Sensitivity of existing environment	3
Sum	8
Impact significance	MEDIUM

The cumulative economic impact significance is determined to be medium.

26.4.11 Landscape and visual impact

Chapter 19: Landscape and visual provides a summary of the landscape and visual impact assessment for the proposal. The existing landscape of the proposal site is characterised as rural, with land uses including cropping and grazing. The landscape is substantially cleared agricultural land, with scattered isolated patches of native vegetation and an undulating topography. The town of Moree at the southern end of the proposal site represents the only area with an urbanised character. As a result, the number of private receptors that have visual access to the proposal is limited. The largest concentration of private residences that would register a visual impact during construction are located on the northern side of Moree, nearest to the reconstruction of the Mehi River Bridge.

The low profile and horizontal, linear nature of the proposal, as well as projects nearby such as N2NS Phase 1, Narromine to Narrabri Inland Rail project, and the Newell Highway upgrade, means that the potential cumulative visual impacts are limited to a distance that is relatively close to the area subject to change. The significance of the impacts for the proposal are considered low due to the low-lying nature of the proposal and adjacent projects, and the lack of sensitive receivers.

Table 26-25 provides a summary of the potential cumulative landscape and visual impacts for projects. The determination of impact significance is provided in Table 26-26.

TABLE 26-25 LANDSCAPE AND VISUAL

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Reduced visual amenity	No	No	No	No	No	No

TABLE 26-26 LANDSCAPE AND VISUAL IMPACT SIGNIFICANCE

Landscape and visual impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	1
Severity of cumulative impact	1
Sensitivity of existing environment	1
Sum	4
Impact significance	LOW

The cumulative landscape and visual impact significance is determined to be low.

26.4.12 Soils and contamination

Chapter 20: Soils and contamination assesses the existing soil environment, as well as potential sources of contamination for the N2NS Phase 2 study area. Acid sulfate soils (ASS) and areas of high land-based salinity were deemed as unlikely to occur within the project site. Similarly, the NSW EPA POEA Act public register database yielded no records to suggest the presence of contamination within the study area (NSW EPA, 2020). Numerous sites listed on the ARTC contaminated sites register, however, exist within 250 m of the proposal site.

The key potential risk to soil resources during construction include erosion and sedimentation in waterways due to vegetation removal, earthworks and excavation. Implementing erosion and sedimentation control measures, as well as a construction environmental management plan for the proposal, is expected to be able to mitigate soil erosion and sediment impacts. There is also the potential that the removal of vegetation and topsoil could cause the water table to rise due to an increase in the amount of water infiltration, which may bring salt to the soil surface. Additionally, runoff from disturbed soils or stockpiled spoil may disperse ASS or saline soils into receiving waterways; however, there is extremely minimal risk of mobilisation of saline or ASS due to the low potential of occurrence in the local landscape. Similarly, impact to soils (outside the corridor or in greenfield areas) as a result of construction activities associated with the proposal are considered to be minimal, as excavation and exposure of soils would be temporary and short in duration.

Construction activities associated with adjacent projects, including the Narromine to Narrabri project, have the potential to cause cumulative impacts in terms of erosion, sedimentation and salinity increase; however, it has been assessed that the implementation of mitigation and management measures in both the proposal and adjacent projects should minimise potential for cumulative impacts of erosion, sedimentation, and salinity increase. Table 26-27 provides a summary of the potential cumulative soils and contamination impacts for projects. The determination of impact significance is provided in Table 26-28.

TABLE 26-27 SOILS AND CONTAMINATION

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Cumulative erosion and sediment impacts	No	No	No	No	No	No
Cumulative contamination impacts	No	No	No	No	No	No

TABLE 26-28 SOIL AND CONTAMINATION IMPACT SIGNIFICANCE

Soil and contamination impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	1
Severity of cumulative impact	1
Sensitivity of existing environment	1
Sum	4
Impact significance	LOW

The cumulative soil and contamination impact significance is determined to be low.

26.4.13 Waste

Chapter 21: Waste provides an assessment of waste and resources management for the N2NS Phase 2 project. Phase 2 is a small portion of the overall Inland Rail alignment and includes about 13.4 km of existing rail track and green field construction of about 1.6 km of realigned rail track. It has been assessed as low risk with regard to the production and generation of waste due to the ability to reuse some of the materials within the existing corridor. The construction of the proposal would likely overlap with the adjacent Narromine to Narrabri and Newell Highway upgrade projects. Cumulative waste and resource use impacts arising from construction activities across these Inland Rail projects could occur.

Overall, the risk of potential impacts during construction is considered low, as waste would be managed in accordance with ARTC standard mitigation measures, which would be implemented into the CEMPs for the ARTC projects. Mitigation measures would be implemented during both construction and operation stages of the projects, and follow the waste management hierarchy of avoid, reduce/treat, re-use, recycle, recover and, finally, dispose. A waste management plan would likely also be implemented for the Newell Highway upgrade, thereby minimising the potential for cumulative impacts to arise from waste. Table 26-29 provides a summary of the potential cumulative waste impacts for projects. The determination of impact significance is provided in Table 26-30.

TABLE 26-29 WASTE MANAGEMENT

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Cumulative spoil production	No	No	No	No	No	No
Cumulative waste production	No	No	No	No	No	No

TABLE 26-30 WASTE MANAGEMENT IMPACT SIGNIFICANCE

Waste management impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	1
Sum	4
Impact significance	LOW

The cumulative waste impact significance is determined to be low.

26.4.14 Climate change risk adaption and sustainability

The climate change risk assessment in Chapter 22 addresses the SEARs as well as the requirements outlined in the Infrastructure Sustainability Council of Australia Rating Scheme (ISCA) (Version 1.2) (ISCA, 2018), by assessing the impacts of climate change on the proposal.

The sustainability assessment required by the SEARs and presented in Chapter 23, is an assessment of the sustainability of the proposal, using the Infrastructure Sustainability Rating Tool, and current guidelines and targets. This rating tool will be applied across all Inland Rail projects to pursue an 'excellent' rating; however, insufficient information is available to assess the sustainability of other qualifying projects.

26.4.15 Air quality and greenhouse gases

Chapter 24: Air quality and greenhouse gas details the air quality and greenhouse gas (GHG) impact assessment undertaken for the proposal. As construction and operation of N2NS Phase 2 has the potential to increase emissions of air pollutants in the study area, it is important to establish the expected risks of these potential air quality impacts with respect to adjacent projects also.

The N2NS Phase 1 project has been explicitly included in the cumulative air quality assessment because it would involve the same trains as the proposal and is within proximity to the proposal. Similarly, the Newell Highway upgrade has been included due to its proximity to the proposal and the likely overlap in construction timing. The potential cumulative impacts for these projects include:

- ▶ during construction, nuisance dust impacts are expected to be most significant. Although exhaust emissions would be produced by construction vehicles and plant, these emissions are expected to be less significant due to their nature (discontinuous, transient, and mobile)
- ▶ during operation, the highest risk impacts are likely to occur from rail exhaust emissions as a result of the increase in train movements, with the main emissions for consideration being oxides of nitrogen (NO_x) and particulate matter.

In assessing potential air quality impacts, it is important to acknowledge the transient, short-term nature of construction-phase emission sources, as a result of construction works progressing along the alignment. Furthermore, it is important to acknowledge the nature of the area in which the works are occurring. Agriculture is the primary industry in Moree and surrounds and, as such, the region is subject to emissions from farm machinery, and dust generated from crop farming, particularly during harvest seasons. The number of sensitive receivers within proximity to the project is also limited to the town of Moree, as the alignment traverses predominantly agricultural land beyond the town.

As such, the cumulative air quality impacts associated with the proposal and adjacent projects are considered low. Dust impacts are likely to be localised to construction site locations, and ARTC project impacts would be managed by approved mitigation measures outlined in CEMPs. The Newell Highway upgrade is not anticipated to significantly increase pollutant emissions; rather, dust during construction is likely to be the primary potential air quality concern. It is likely that the Newell Highway upgrade would also implement mitigation measures to control pollutant and dust emissions under a CEMP. The Narrabri Gas Project is not considered likely to contribute to construction dust due to its distance from the proposal, which is over 100 km. As such, the cumulative air quality impacts as a result of the proposal and the surrounding projects are not considered significant.

Table 26-31 provides a summary of the potential cumulative air quality impacts for projects. The determination of impact significance is provided in Table 26-32.

TABLE 26-31 AIR QUALITY

Impact \ project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Increase in exhaust emissions	Yes	Yes	No	Yes	No	No
Increase in dust	Yes	No	No	Yes	No	No

TABLE 26-32 AIR QUALITY IMPACT SIGNIFICANCE

Air quality impact	Relevance factor
Likelihood of cumulative impact	2
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	1
Sum	5
Impact significance	LOW

The cumulative air quality impact significance is determined to be low.

26.4.16 Health and safety

As outlined in Chapter 25: Health and safety (including hazardous materials), during construction, the N2NS Phase 2 project may result in reduced safety for road users and pedestrians, the potential interference with underground utilities, and increased emissions from construction vehicles or plant, which has the potential to trigger health impacts associated with air pollution. There is also an increased risk of bushfire, due to the storage of fuel and various construction works; however, the cumulative health and safety risks associated with this proposal and other approved and proposed projects are not anticipated to materially increase the risk to public safety.

Table 26-33 provides a summary of the potential cumulative health and safety impacts for projects. The determination of impact significance is provided in Table 26-34.

TABLE 26-33 HEALTH AND SAFETY

Impact / project	N2NS Phase 2	N2NS Phase 1	Narromine to Narrabri	Newell highway upgrade	Queensland–Hunter Gas pipeline	Narrabri Gas Project
Increased risk to health and safety for workers and residents	Yes	No	No	No	No	No

TABLE 26-34 HEALTH AND SAFETY IMPACT SIGNIFICANCE

Health and safety Impact	Relevance factor
Likelihood of cumulative impact	1
Duration of cumulative impact	1
Magnitude of cumulative impact	1
Sensitivity of existing environment	1
Sum	4
Impact significance	LOW

The cumulative health and safety impact significance is determined to be low.

26.5 Summary of results

Table 26-35 provides a summary of the cumulative impact significance for each of the assessed potential impacts.

TABLE 26-35 SUMMARY OF RESULTS

Impact	Cumulative impact significance
Land use and property	Low
Biodiversity	Medium
Traffic and transport	Medium
Hydrology and flooding	High
Water quality	Low
Groundwater	Low
Cultural heritage	Low

Impact	Cumulative impact significance
Noise and vibration	Low
Social impact	Medium
Economic impact	Medium
Landscape and visual impact	Low
Soils and contamination	Low
Waste	Low
Climate change and sustainability	Low
Air quality and greenhouse gases	Low
Health and safety	Low

26.6 Residual impacts

26.6.1 Medium impact significance

The cumulative impact assessment identified that biodiversity, traffic and transport, social and economic impacts may result in a cumulative impact with a significance rating of medium. This is largely due to:

- ▶ Biodiversity:
 - ▶ habitat clearing for permanent and temporary construction facilities causing direct loss of native flora and fauna habitat
 - ▶ displacement, injury or death of resident fauna, causing a decline in local fauna populations
 - ▶ removal of habitat features, e.g. HBTs, causing a direct loss of native fauna habitat
 - ▶ disruption to connectivity, causing a direct loss of native fauna habitat
 - ▶ work in waterways, causing a direct loss of riparian habitat and disturbance of aquatic habitat.
- ▶ Traffic and transport:
 - ▶ increased traffic on the Newell Highway, which is a major thoroughfare and haul route for the five assessed projects (traffic associated with construction staff, transport of materials and machinery, and use of local quarries)
 - ▶ increased traffic on local roads due to dependence on services such as accommodation out of Moree.
- ▶ Social and economic impacts:
 - ▶ increased demand for skilled construction workers from Moree and surrounds
 - ▶ increased demand for worker accommodation in Moree, subsequently increases accommodation prices
 - ▶ increase in economic returns for local businesses due to workforce population residing in/near Moree, as well a more efficient and secure freight transport system.

A significance score of medium may result in:

- ▶ specific management practices being required, with mitigation measures to be implemented
- ▶ the potential requirement for monitoring
- ▶ special approval conditions likely.

26.6.2 High impact significance

The cumulative impact assessment identified that hydrology and flooding would likely result in a cumulative impact with a significance rating of high. This is largely due to:

- ▶ the potential of the proposed Newell Highway upgrade to cause flood impacts to landowners in the southern portion of the proposal
- ▶ additional surface flows originating from N2NS Phase 2 overtopping a portion of the new rail in N2NS Phase 1.

A significance score of high may require:

- ▶ consideration of alternative options

- ▶ implementation of specific mitigation measures
- ▶ comprehensive monitoring program likely
- ▶ specific approval conditions to be set.

26.7 Mitigation and management

This chapter has identified the potential cumulative impacts of the proposal and surrounding major projects during construction and operation. The following mitigation and management measures would be applied to the proposal to mitigate these impacts:

- ▶ Biodiversity: biodiversity offsets in accordance with the BAM-C would be implemented in order to offset permanent removal of native vegetation. Clearing limits would be clearly set out, including minimising the construction footprint during detailed design, avoiding impacts to native vegetation as far as practicable, conducting pre-clearing surveys, and implementing the approved flora and fauna management subplan under the CEMP.
- ▶ Traffic and transport: impacts would be managed through the traffic and transport management plan as a sub-plan of the CEMP, to mitigate increased traffic volumes on the Newell Highway and local roads.
- ▶ Social and economic impacts: social and economic impacts relate primarily to the risk of accommodation shortages. To mitigate this risk, construction accommodation facilities would be provided for workers in and around Moree. Artificial spikes in rental prices through workers housed in standard residential accommodation within the town of Moree would be avoided by providing alternative accommodation where possible. Ongoing consultation with the affected communities would be maintained throughout the detailed design, construction and operation of the proposal.
- ▶ Hydrology and flooding: hydrology and flooding is the most significant cumulative impact identified in this assessment. Technical Paper 4: Hydrology and flooding impact assessment and Chapter 12: Hydrology and flooding have identified suitable mitigations, including the use of culverts, to manage these impacts. Mitigations for each of these issues where they apply to this proposal have been included in the relevant chapter in this EIS.