Parkes to Narromine Project
Environmental Impact Statement
Main Report

ARTC

InlandRail

The Australian Government's priority freight rail project

Australian Rail Track Corporation

Inland Rail – Parkes to Narromine

Environmental Impact Statement

Volume 1

Main report – Part A

Volume 1 – Main Report

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Certification

Submission of environmental impact statement

Prepared under Part 5.1 of the Environmental Planning and Assessment Act 1979 (NSW).

Environmental impact statement prepared by:

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Address	GHD Pty Ltd 133 Castlereagh Street, Sydney NSW 2000	
Responsible person name and address **(proponent)**	Simon Thomas Programme Director Inland Rail Australian Rail Track Corporation Level 12, 40 Creek Street Brisbane QLD 4000	
The address of the land to which the statement relates	Land within the Parkes and Narromine local government areas as described within this environmental impact statement.	
Description of the infrastructure to which this statement relates	Construction and operation of a section of Inland Rail, located between Parkes and Narromine in NSW.	
Environmental impact statement	An environmental impact statement is attached addressing all matters in accordance with Part 5.1 of the Environmental Planning and Assessment Act 1979 (NSW) and Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (NSW).	
Declaration	I certify that I have prepared this environmental impact statement in accordance with the Secretary's Environmental Assessment Requirements dated 8 November 2016. The environmental impact statement contains all available information that is relevant to the environmental assessment of the infrastructure to which the statement relates. To the best of my knowledge, the information contained in the environmental impact statement is neither false nor misleading.	
Signatures	A Raleigh	A Pyliotis
Name	Amanda Raleigh	Aryel Pyliotis
Date	22.06.2017	22.06.2017

Abbreviations

Abbreviation	Definition
ABS	Australian Bureau of Statistics
ACM	asbestos containing material
AEP	annual exceedance probability
AGO	Australian Greenhouse Office
AHD	Australian height datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
ANZS	Standards Australia and New Zealand
ARI	average recurrence interval
AS	Australian Standard
BoM	Bureau of Meteorology
CEEC	critically endangered ecological community
CEMP	construction environmental management plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DPI	Department of Primary Industries
EEC	endangered ecological community
EIS	environmental impact statement
EPA	Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
EPL	environment protection licence
ESD	ecologically sustainable development
FM Act	Fisheries Management Act 1994
GHD	GHD Pty Ltd
Infrastructure SEPP	State Environmental Planning Policy (Infrastructure) 2007

Abbreviation	Definition
IS	infrastructure sustainability
ISCA	Infrastructure Sustainability Council Australia
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation
km	kilometres
km^2	square kilometres
km/h	kilometres per hour
LGA	local government area
LALC	Local Aboriginal Land Council
m	metres
mAHD	metres above Australian height datum
NCA	noise catchment area
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NPW Act	National Parks and Wildlife Act 1974
OEH	Office of Environment and Heritage
OEMP	operation environmental management plan
PMF	probable maximum flood
POEO Act	Protection of the Environment Operations Act 1974
RBL	rating background level
the Regulation	Environmental Planning and Assessment Regulation 2000
RING	Rail Infrastructure Noise Guideline (EPA, 2013)
SEARs	Secretary's Environmental Assessment Requirements (for the EIS)
SEPP	state environmental planning policy
TEC	threatened ecological community
TSC Act	Threatened Species Conservation Act 1995
TSS	total suspended solids
WARR Act	Waste and Resource Recovery Act 2001

Definitions

Term	Definition
Aboriginal object	Defined by the *National Parks and Wildlife Act 1974* as: 'any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains'.
Aboriginal site	A place where physical remains or modification of the natural environment indicate past and 'traditional' activities by Aboriginal people. Site types include artefact scatters, isolated artefacts, burials, shell middens, scarred trees, quarries and contact sites. Includes sites listed on the. Also known as Aboriginal objects.
Aboriginal place	Declared by the Minister for the Environment, in accordance with Section 84 of the National Parks and Wildlife Act 1974 and by an order published in the Gazette, as a place that, in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture.
Aboriginal places of heritage significance	Defined in the Standard Instrument - Principal Local Environmental Plan as an area of land, the general location of which is identified in an Aboriginal heritage study adopted by the Council, and that may be shown on the Heritage Map. The term may include (but is not limited to) places that are declared as Aboriginal places under section 84 of the National Parks and Wildlife Act 1974.
Absorptive capability	Absorptive capability relates to the ability of the landscape character zones to absorb the proposal within the existing landscape setting
Active control (level crossings)	Where the movement of vehicular or pedestrian traffic across a railway crossing is controlled using devices such as flashing signals, gates or barriers (or a combination of these), with the device/s activated prior to, and during, the passage of a train through the crossing
Annual exceedance probability (AEP)	The chance of a flood if a nominated size occurring in a particular year. The chance of the flood occurring is expressed as a percentage and, for large floods, is the reciprocal of the ARI. For example, the 1 per cent AEP flood event is equivalent to the 100 year ARI flood event
Approved methods	*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005)*
Average recurrence interval (ARI)	The long term average number of years between the occurrence of a flood of a nominated size
Ballast	Crushed rock, stone etc used to provide a foundation for a railway track. Ballast usually provides the bed on which railway sleepers are laid, transmits the load from train movements, and restrains the track from movement
Biobanking agreement	Landowners enter into a biobanking agreement with the Minister for the Environment to establish a biobank site. A biobanking agreement is a conservation covenant that is attached to the land title. A biobanking agreement specifies the management actions that are required to be undertaken on biobank sites to improve biodiversity values and allow biodiversity credits to be created.
Biobank site	A site to which a biobanking agreement applies

Term	Definition
Biodiversity credits	In accordance with the *Framework for Biodiversity Assessment* (OEH, 2014b) the biodiversity credits, which consist of ecosystem credits and species credits, represent the impacts on threatened species as a result of a proposal. A decision support tool, produced by OEH, is used to determine the number of biodiversity credits required to offset the impacts of the development.
Biodiversity offsets	Biodiversity offsets are measures that benefit biodiversity by compensating for the adverse impacts elsewhere of an action, such as clearing for development. Biodiversity offsets work by protecting and managing biodiversity values in one area in exchange for impacts on biodiversity values in another.
Biophysical environment	The physical environment (water, soil etc) as well as the biological activity within it (plants, animals etc)
Bulk freight	Bulk freight generally involves large quantities of homogenous product, typically liquid or loose crushed solid material (such as cement, grains and ores), transported on mass without packaging
Classified road	A road that meets the definition of a classified road and is listed as such under the Roads Act 1993 – includes main roads, highways, freeways etc
Climate	The average weather experienced at a site or region over a period of many years, ranging from months to many thousands of years. The relevant measured quantities are most often surface variables such as temperature, rainfall and wind.
Climate scenario	A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models
Construction compound	An area used as the base for construction activities, usually for the storage of plant, equipment and materials and/or construction site offices and worker facilities
Crossing loop	A section of track off to the side of the main track/s that allows a train to move to the side so that another train can pass
Culvert	A structure that allows water to flow under a road, railway, track, or similar obstruction
Dangerous goods	Dangerous goods are substances or articles that pose a risk to people, property or the environment, due to their chemical or physical properties. They are usually classified with reference to their immediate risk.
Ecologically sustainable development	Development that uses, conserves and enhances the resources of the community so that ecological processes on which life depends are maintained, and the total quality of life, now and in the future, can be increased
Ecosystem credit	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a plant community type. Ecosystem credits measure the loss in biodiversity values as a result of a proposal, and the gain in biodiversity values at an offset site.
Emission	A substance discharged into the air

Term	Definition
Existing rail corridor	The corridor within which existing rail infrastructure, subject to works as part of Inland Rail, are located. The existing rail corridor is defined by ARTC to mean everywhere within 15 metres of the outermost rails; or within the boundary fence where boundary fences are provided and are closer than 15 metres; or if the property boundary is less than 15 metres, the property boundary; or a permanent structure such as a fence, wall or level crossing separating the operating rail corridor from other land.
Formation	The earthworks/material on which the ballast, sleepers and tracks are laid
Freight	Goods transported by truck, train, ship, or aircraft
Freight task	The amount of freight transport, usually measured in tonnes or tonne-kilometres
Heritage listed	An item, building or place included on statutory heritage lists maintained by local, State and/or the Australian Government
Infrastructure sustainability	Infrastructure that is designed, constructed and operated to optimise environmental, social and economic outcomes of the long term
Inland Rail programme (Inland Rail)	The Inland Rail programme encompasses the design and construction of a new inland rail connection between Melbourne and Brisbane, via Wagga, Parkes, Moree, and Toowoomba. The route for Inland Rail is about 1,700 km in length. Inland Rail will involve a combination of upgrades of existing rail track and the provision of new track.
Intermodal	The movement of freight using multiple modes of transport (rail, ship, truck) without handling of the freight itself when changing modes. For a railway this usually refers to the transport of freight in containers which may be double stacked on the wagons carrying them.
$L_{A90(period)}$	The sound pressure level exceeded for 90 per cent of the measurement period
$L_{Aeq(time)}$	Typically used to described ambient (background) noise levels
$L_{Aeq(1\ hour)}$	The busiest 1-hour ‘equivalent continuous noise level’ – it represents the typical LAeq noise level from all the proposal noise events during the busiest 1-hour of the assessment period
$L_{Aeq(9\ hour)}$	The night-time ‘equivalent continuous noise level’ - it represents the cumulative effects of all the proposal noise events occurring in the night-time period from 10pm to 7am
$L_{Aeq(15\ hour)}$	The daytime ‘equivalent continuous noise level’ - it represents the cumulative effects of all the proposal noise events occurring in the daytime period from 7am to 10pm
$L_{Aeq(24\ hour)}$	The ‘equivalent continuous noise level’, sometimes also described as the ‘energy-averaged noise level’ – it represents the cumulative effects of all the proposal noise events occurring in one day
L_{Amax}	The maximum sound level recorded during the measurement period.
Landscape	All aspects of a tract of land, including landform, vegetation, buildings, villages, towns, cities and infrastructure
Landscape character	The combined quality of built, natural and cultural aspects that make up an area and provide its unique sense of place
Landscape character zone	An area of landscape with similar properties or strongly defined spatial qualities, distinct from areas immediately adjacent

Term	Definition
Landscape feature	A component, part or feature of the landscape that is prominent or eye-catching, e.g. hills, buildings, vegetation
Landscape quality	Largely subjective judgement based on particular characteristics that influence the way in which the environment is experienced, including special interests such as cultural associations or heritage interests, the presence and/or type of elements and condition.
Level crossing	A place where rail lines and a road cross at the same elevation
Level crossing protection	The level of control provided at level crossings, which is determined on a case by case basis, and depends on the particular characteristics of a crossing. It generally falls into two categories: passive protection (uses warning signage only) or active protection (uses either signage and flashing lights only, or signage/flashing lights with boom gates)
Level of service	Defined by Austroads as a measure for ranking operating road and intersection conditions, based on factors such as speed, travel time, freedom to manoeuvre, interruptions, comfort and convenience
Local road	Road used primarily to access properties located along the road
Non-bulk freight	Non-bulk freight is generally characterised as any containerised, packaged or other unitised freight, such as: pallets; motor vehicles and trailers; laden transported vehicles and live animals. It is generally placed or lifted onto or into transport vehicles or holds. It often involves heterogeneous goods being moved between dispersed locations. Non-bulk freight varies in density, perishability and fragility.
Passive control (level crossings)	Where the movement of vehicular or pedestrian traffic across a railway crossing is controlled using signs or devices that are not activated by the approach or passage of a train, relying on the road user to detect the approach or presence of a train by direct observation
PM_{10}	Particulate matter 10 micrometres or less in diameter. Particles in this size range make up a large proportion of dust that can be drawn deep into the lungs. This is a classification of particles by size rather than chemical properties.
Possession	A period of time during which a rail line is blocked to trains to permit work to be carried out on or near the line
Proposal	The construction and operation of the Parkes to Narromine section of Inland Rail
Proposal site	The area that would be directly affected by construction works (also known as the construction footprint). It includes the location of proposal infrastructure, the area that would be directly disturbed by the movement of construction plant and machinery, and the location of the storage areas/compounds sites etc, that would be used to construct that infrastructure.
Pioneer line	Rail lines constructed to a lesser standard than main rail lines, providing access to mainly agricultural areas
Rail alignment	The exact positioning of the track, accurately defined both horizontally and vertically, along which the rail vehicles operate
Rail corridor	The corridor within which the rail tracks and associated infrastructure are located

Term	Definition
Rail level	The theoretical level of the running surface of the rails
Rating background level	The underlying level of noise present in an area once transient and short-term noise events are filtered out
Relic	A relic is defined by the NSW *Heritage Act 1977* as 'any artefact, object or material evidence which relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and which is of State or local heritage significance.'
Sensitivity	The sensitivity of a landscape character area or view and its capacity to absorb change. In the case of visual impact this also relates to the type of viewer and number of viewers
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the threatened species profile database.
Spoil	Material generated by construction
Strahler stream order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it
Section 170 register	Under section 170 of the *Heritage Act 1977*, all state government agencies must keep and administer a database of heritage assets called a Section 170 Heritage and Conservation Register
Sensitive receivers	Land uses which are sensitive to potential noise, air and visual impacts, such as residential dwellings, schools and hospitals
Study area	The study area is defined as the wider area including and surrounding the proposal site, with the potential to be directly or indirectly affected by the proposal (for example, by noise and vibration, visual or traffic impacts). The actual size and extent of the study area varies according the nature and requirements of each impact assessment technical report.
Super T girder	A concrete bridge girder that is fully pretensioned, prestressed, and precast, and which incorporates the structural function of a box girder with permanent formwork in the deck
Track	The structure consisting of the rails, fasteners, sleepers and ballast, which sits on the formation
Track formation	Refer to the definition of formation
Travelling stock routes	Travelling stock routes and reserves are parcels of Crown land reserved under the Crowns Lands Act 1989 for use by travelling stock
Turnout	A junction point where a rail vehicle can leave a given track for a branching or parallel track
Visual amenity	The value of a particular area or view in terms of what is seen
Visual impact	The impacts on the views from residences, workplaces and public places. This can be positive (i.e. benefit or an improvement) or negative (i.e. adverse or a detraction)
Visual catchment	Extent of potential visibility to or from a specific area, feature or proposal
View	The visual experience from the viewer's perspective

Term	Definition
Waste	Waste is defined by the EPA as any matter (whether liquid, solid, gaseous or radioactive) that is discharged, emitted or deposited in the environment in such volume, constituency, or manner as to cause an alteration to the environment
Waste management hierarchy	The waste management hierarchy is a set of priorities for the efficient use of resources, which underpins the objectives of the Waste Avoidance and Resource Recovery Act 2001. The waste management hierarchy progresses from avoidance (most preferred), to re-use/recycling, to disposal (least preferred).

Executive summary

Overview

The Australian Government has committed to building a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane, via central-west New South Wales (NSW) and Toowoomba in Queensland. Inland Rail is a major national project that will enhance Australia's existing national rail network and serve the interstate freight market.

The Inland Rail route, which is about 1,700 kilometres long, involves:

- using the existing interstate rail line through Victoria and southern NSW
- upgrading about 400 kilometres of existing track, mainly in western NSW
- providing about 600 kilometres of new track in northern NSW and south-east Queensland.

Inland Rail has been divided into 13 projects, seven of which are located in NSW.

This environmental impact statement (EIS) considers the potential impacts of the proposal to construct and operate the Parkes to Narromine section of Inland Rail ('the proposal'). It has been prepared to support Australian Rail Track Corporation's (ARTC) application for approval of the proposal in accordance with the requirements of Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The proposal is State significant infrastructure, and is subject to approval by the NSW Minister for Planning. The EIS addresses the environmental assessment requirements of the Secretary of the Department of Planning and Environment ('the SEARs'), dated 8 November 2016. The proposal is also a controlled action under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) (referral reference 2016/7731), and requires approval from the Australian Government Minister for the Environment and Energy.The EIS focuses on the key assessment requirements specified by the SEARs. It is supported by specialist technical assessment reports.

ARTC is seeking the proposal to be declared by the Minister for Planning as critical State significant infrastructure under section 115V of the EP&A Act.

The proposal

Key features

The proposal consists of 106 kilometres of upgraded track and associated facilities, and is generally located in the existing rail corridor between the towns of Parkes and Narromine, via Peak Hill. A new connection to the Broken Hill line is also proposed outside the existing rail corridor at the southern end of the proposal near Parkes.

The key features of the proposal involve:

- upgrading the track, track formation, and culverts within the existing rail corridor for a distance of 106 kilometres between Parkes and Narromine
- realigning the track where required within the existing rail corridor to minimise the radius of tight curves
- providing three new crossing loops within the existing rail corridor, at Goonumbla, Peak Hill, and Timjelly
- providing a 5.3 kilometre long rail connection between Inland Rail and the Broken Hill line to the west of Parkes ('the Parkes north west connection'), including a road bridge over the new section of rail at Brolgan Road ('the Brolgan Road overbridge').

Ancillary works would include works to level crossings, signalling and communications, signage, fencing, and services and utilities within the proposal site.

Timing

Subject to approval of the proposal, construction is planned to commence in early to mid 2018, and is expected to take about 18 months. Inland Rail as a whole is expected to be operational in 2025.

Operation

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators. Prior to the opening of Inland Rail as a whole, the rail line would be used by existing rail traffic, which includes trains carrying grain and ore at an average rate of about four trains per day.

It is estimated that the operation of Inland Rail would involve an annual average of about 8.5 trains per day in 2025, increasing to 15 trains per day in 2040. In the proposal site, this would be additional to the existing rail traffic using the rail line.

The trains would be a mix of grain, bulk freight, and other general transport trains. Total annual freight tonnages would be about 11.8 million tonnes in 2025, increasing to about 19 million tonnes in 2040 (from the existing two million tonnes of grain per year).

Train speeds would vary according to axle loads, and range from 80 to 115 kilometres per hour (for 21 tonne trains). Trains would operate 24 hours per day. They would be up to 1,800 metres long; carry double stacked containers; and have a height of 6.5 metres.

Need for the proposal

The proposal is a critical component of Inland Rail, and Inland Rail cannot proceed if the proposal does not proceed. The proposal has been designed to maximise use of the existing rail corridor, while still contributing to the overall efficiency of Inland Rail. Through the Parkes north west connection, the proposal would provide a more direct rail link between south-east Queensland, Adelaide, and Perth (via Parkes). This connection would deliver immediate interoperability with the high performance east-west trans-continental rail line to Perth.

Objectives of the proposal

The objectives of the proposal are to:

- provide upgraded rail infrastructure that meets the Inland Rail specifications, to enable trains using the Inland Rail corridor to travel between Parkes and Narromine, connecting with other sections of Inland Rail to the north and south
- provide new rail infrastructure to connect Inland Rail to the Broken Hill line at Parkes, to enable trains using Inland Rail to connect with destinations in South Australia and Western Australia via the east-west trans-continental rail line
- minimise the potential for environmental and community impacts, by maximising use of the existing rail corridor.

Inland Rail

Objectives

The objectives of Inland Rail are to:

- provide a rail link between Melbourne and Brisbane that is interoperable with train operations between Perth and Adelaide, to serve future rail freight demand, and stimulate growth for inter-capital and regional/bulk rail freight
- provide an increase in productivity that will benefit consumers through lower freight transport costs
- provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor and deliver a freight rail service that is competitive with road

- improve road safety, ease congestion, and reduce environmental impacts by moving freight from road to rail
- bypass bottlenecks within the existing metropolitan rail networks, and free up train paths for other services along the coastal route
- act as an enabler for regional economic development along the Inland Rail corridor.

Need for Inland Rail

There is no direct continuous inland rail link between Melbourne and Brisbane. Interstate rail freight currently travels between Melbourne and Sydney via Albury, and then between Sydney and Brisbane, generally along the coast. About 70 per cent of the freight between Melbourne and Brisbane is carried by road, principally the Newell Highway in NSW, and connecting highways in Victoria and Queensland.

Growth in freight demand

The Melbourne to Brisbane corridor is one of the most important general freight routes in Australia, supporting key population and employment precincts along the east coast and inland NSW. It is estimated that 21 million tonnes of non-bulk and complementary freight moves along this corridor each year. This is expected to grow to over 40 million tonnes per year by 2050.

With the population of the eastern states forecast to increase by 60 per cent over the next 40 years, the need for efficient and effective freight transport will continue to increase. Strong forecast population growth, accompanied by comparable growth in employment, is likely to place significant pressure on existing infrastructure and services.

Existing freight capacity and infrastructure issues

Without the increased use of rail, the growth in freight demand is likely to result in increasing pressure on the road network and associated safety and environmental issues, increased freight costs, and a loss of economic opportunity. The current national infrastructure network cannot support this projected growth, with increasing pressure on already congested roads through Sydney, and increasing use of heavy trucks such as B-doubles and, potentially, B-triples along the Hume-Pacific and Newell Highway corridors.

Rail is generally the most productive and efficient mode for freight travelling from regional areas to export ports and urban destinations. Freight trains travelling along the Melbourne to Brisbane corridor currently travel through the Sydney metropolitan rail network, often experiencing significant delays. Travel time reliability is poor, because of the priority given to passenger services, freight transit curfews in the Sydney metropolitan area, and substandard rail alignments elsewhere. Limited capacity during morning and afternoon passenger peaks restricts freight movements at these times.

Summary of the need for Inland Rail

Inland Rail is needed to improve the efficiency of freight moving between Melbourne and Brisbane. Inland Rail will bypass the Sydney metropolitan area, substantially cut the overall journey time to less than 24 hours, and increase the reliability of services between Melbourne and Brisbane. This is expected to increase the competitiveness of rail transport relative to road transport. The Parkes north west connection also allows train movements between Brisbane and Adelaide/Perth.

In addition, Inland Rail will encourage growth and investment in regional areas along the route through improved freight connections.

As noted by the *Australian Infrastructure Audit Report* (Infrastructure Australia, 2015), ‘Rail offers an alternative to road transport and societal benefits in terms of lower emissions, reduced road congestion and increased safety per tonne kilometre, particularly over longer distances or when carrying heavy goods.’

In summary, Inland Rail is needed to respond to the growth in demand for freight transport, and address existing freight capacity and infrastructure issues. The analysis of demands undertaken by ARTC indicated that there would be sufficient demand for Inland Rail.

Summary of the key findings of the EIS

Traffic, transport and access

The proposal would not result in any significant adverse impacts with respect to traffic, transport and access issues such as traffic operations, road capacity on the surrounding network, site access and road safety. During construction, traffic and transport would be managed by a construction traffic management plan prepared prior to the commencement of construction.

The proposal may result in changes to some level crossings. Consultation with potentially affected landowners would be undertaken, and changes would only occur following agreement with the property owner and relevant agencies.

The Brolgan Road overbridge has been included as part of the scope of the proposed Parkes north west connection to ensure that road access is maintained in this area. Construction of the north west connection would require potential changes to two local roads – Millers Lookout Road and Coopers Road. Any road realignment as a result of the Parkes north west connection would be determined during the detailed design phase where further investigations and consultation with stakeholders will be undertaken.

The road network has sufficient spare capacity to cater for the estimated construction and operation traffic, and no significant network impacts are predicted. The main operational traffic impacts relate to changes in delays at level crossings. Traffic activity at most level crossings in the study area is low, and the volume of traffic likely to be delayed by train activity is not substantial. There is capacity at each level crossing for delayed traffic to queue clear of adjacent intersections.

The transfer of freight to rail when the Inland Rail becomes operational would reduce truck movements particularly on the Hume Highway. This would have safety benefits and would reduce emissions.

Biodiversity

The majority of the study area has been heavily modified by past and ongoing disturbances associated with the existing rail corridor and surrounding agricultural activities. Clearance and maintenance of the existing rail corridor has resulted in fragmentation, a high level of disturbance, and degradation of vegetation communities. However, although the majority of the proposal site consists of non-native vegetation or cleared land, patches of native vegetation remain.

Biodiversity impact assessments of the proposal were undertaken, including a terrestrial biodiversity assessment prepared in accordance with the Framework for Biodiversity Assessment (OEH, 2014a), an aquatic biodiversity assessment, and an assessment of the potential impacts on matters listed under the EPBC Act.

The main potential impact of the proposal on biodiversity would occur during construction as a result of the clearing of native vegetation within the proposal site, including vegetation within the existing rail corridor, and in areas of the proposal site located outside the existing rail corridor. At this stage of the design, it is estimated that the proposal would require the permanent removal of 75.8 hectares of native vegetation. This vegetation includes threatened ecological communities listed under both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or the EPBC Act. The assessment concluded that the proposal would not significantly impact any of the listed ecological communities as a result of the very small percentage decrease in the area of each community, and because the impacts would exist as small areas of scattered clearance over a long linear proposal site, rather than one localised area of impact. The assessment also concluded that the proposal would not significantly impact any threatened flora or fauna listed by the TSC Act.

ARTC is committed to minimising the environmental impacts of the proposal. The area of direct impact would be further refined during detailed design, with the aim of reducing the amount of vegetation clearing required as far as practicable. To mitigate the potential impacts to biodiversity, a Biodiversity Offset Strategy is being prepared in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014b). This includes consideration of potential offset sites and/or opportunities to purchase biodiversity credits to offset the impacts of the proposal. Impacts to EPBC listed threatened ecological communities, flora and fauna would be offset under the Framework for Biodiversity Assessment (OEH, 2014a).

The main impacts on aquatic ecological systems would be as a result of the removal and construction of new culverts along the proposal site, and access over watercourses for movement of construction equipment and personnel. These potential impacts would be minimised by implementing the construction mitigation and management measures provided by the EIS. No impacts to aquatic threatened species or communities are predicted.

Noise and vibration

There is the potential for construction noise to exceed the relevant criteria at various receivers along the proposal site. The potential significance of the impacts would be minimised by the mobile nature of the majority of the construction works. Construction noise would be temporary and localised in nature, and the potential impacts would be managed through the implementation of noise control measures provided in the EIS, particularly for those sections of the project within close proximity of sensitive receivers (less than 50 metres).

Construction vibration was assessed, and management and mitigation measures have been provided to minimise the potential for significant human comfort and structural vibration impacts at the nearest receivers.

For operation, the noise modelling predicted that the noise levels at 28 residential receivers had the potential to exceed the redeveloped rail line criteria for operational rail noise by the year 2040. It is anticipated that Inland Rail would be complete in 2025, and this is when train movements would increase above existing numbers. However, the route is not expected to reach design capacity until 2040.

Mitigation options have been identified, and would be refined during detailed design and in consultation with affected receivers. Post construction noise monitoring would be undertaken at representative locations to verify the effectiveness of the applied mitigation measures with respect to the appropriate guidelines.

Air quality

The main potential impact on air quality during construction would occur as a result of the generation of dust from construction works and the movement of equipment and machinery. If dust is not adequately controlled, it could impact on surrounding sensitive receivers and agricultural land uses. These issues would be managed by implementing air quality management controls guided by the construction environmental management plan (CEMP).

During operation, the increase in diesel operated freight trains using the corridor has the potential to increase levels of pollutants such as nitrogen oxides and particulate matter. The air quality impact assessment considered the potential increases and concluded that the emissions are expected to be below the relevant impact assessment criteria. Air pollution from transport corridors decrease significantly with distance, and are not expected to be an issue for this proposal given the distance from the majority of potentially sensitive receivers.

Soils

Potential areas of contamination include agricultural land uses, mining operations and services stations.

Construction of the proposed has the potential to result in erosion and sedimentation and contamination of soils and surface waters. A number of management activities would be implemented to minimise these risks, including the implementation of a soil and water management sub-plan, and implementation of protocols for construction in areas of potentially contaminated soils.

Implementation of proposed environmental controls and management measures provided within the CEMP would reduce the risk of activities impacting on workers, surrounding residents, and the environment. The risk of contamination associated with the operation of the proposal is expected to be low. Sediment and erosion control plans for exposed soils would be adopted and implemented, which would reduce the risk of environmental impact.

Hydrology and flooding

The proposal involves raising the level of the rail formation along the majority of the proposal site, to achieve ARTC's design standards for flood immunity. This would include installing structures such as culverts on ephemeral watercourse crossings. The proposal would not directly impact on any perennial watercourses. Potential impacts during construction would be limited to inundation during flood events. These impacts would be short term and managed by implementing construction management measures as detailed in the CEMP.

The proposal would be constructed using pre-cast structures where practicable. This would reduce the size of the construction footprint, the extent of earthworks, and the timeframe to construct each structure. Minimising the duration of disturbance at each work site reduces the risk of a significant rainfall event flooding the work area.

The proposal incorporates design measures to avoid or minimise potential impacts on flooding and hydrology during operation. These focus on providing structures at all existing watercourse crossings to minimise the potential for changes in surface water flow paths.

Raising the height of the rail formation would impact surface water flows across the floodplain. This would change the upstream flooding regime, and result in more concentrated flows through culverts that discharge to downstream waterways.

Currently about 7,175 metres of the existing rail corridor in the proposal site is overtopped during a one per cent annual exceedance probability (AEP) flood event. Flood modelling for the local catchments predicts that the proposal would reduce the length of overtopping during this type of flood event to 406 metres.

The proposal is predicted to reduce the area of upstream flooding for flood events up to the two per cent AEP flood event. The reduction in the area subject to flooding for smaller flood events occurs because structures for the proposal have been designed to ensure that the one per cent AEP flood event does not exceed the top of the formation. The extent of flooding in a one per cent AEP flood event is anticipated to increase by about 10 per cent.

Water quality

The potential impacts of construction relate mainly to erosion and the generation of sediment, particularly during watercourse crossings and the construction of new culverts. To mitigate these impacts, erosion and sediment control measures would be implemented during construction in accordance with the CEMP. A surface water monitoring framework would be prepared to guide the monitoring of water quality.

During operation, surface water runoff would be managed through a drainage system that connects to cross drainage infrastructure at existing drainage lines and watercourses. The drainage system would include measures such as scour protection at culvert outlets to minimise the potential for scouring and erosion. Where appropriate, culvert outlets would be lined to minimise scouring.

Aboriginal heritage

Within the existing rail corridor, the construction and maintenance of the existing rail line is likely to have resulted in the removal/relocation of archaeological evidence that may have been present. No areas of moderate or high archaeological potential were identified within the proposal site.

Artefacts associated with two listed Aboriginal sites were identified within the proposal site. Two listed sites (consisting of a scarred tree and an artefact scatter) were identified adjacent to the proposal site. These sites were assessed as having low archaeological significance. The potential for impacts to these items would be avoided where practicable. Where impacts are unavoidable, the significance of impacts would be minimised by the implementation of the mitigation measures provided.

Historic heritage

No heritage listed items are located within or near the proposal site, and therefore no direct or indirect impacts to any listed heritage impacts are predicted. The proposal would impact the existing rail line, which is a potential heritage item considered to be generally of local significance. It also has the potential to indirectly impact a potential heritage item considered to be of local significance – an old cottage, referred to as Wyanga cottage, located on Peak Hill Railway Road. The significance of impacts would be minimised by the implementation of the mitigation measures provided.

Landscape and visual amenity

The proposal would generate visual impacts during construction. Construction impacts would be temporary and limited to the construction period.

Operation impacts of the proposal would occur as a result of the introduction of new structures in the landscape, mainly associated with the Parkes north west connection. The proposal has been designed to minimise the potential for landscape and visual impacts, through careful siting of proposal elements, and by minimising clearing as far as practicable. Mitigation measures are provided to further reduce the visual impacts of the proposal. These would be implemented during the detailed design and construction phases.

Land use and property

The main potential impacts on land use would occur during the construction phase. Impacts include temporary disruption to land use along the construction corridor for construction areas, compounds and haulage routes. These impacts, such as soil compaction, disruption of services or utilities, changes in access and interrupted land management, would be short term and minimised with the implementation of mitigation measures.

Land use impacts during operation would mainly relate to acquisition. Acquisition of privately owned land would be required for construction of the Parkes north west connection. Based on the current design, no properties require complete acquisition, however the option for complete acquisition would be discussed with landowners where a property is materially affected.

While the extent of flooding in a one per cent AEP flood event is anticipated to increase by about 10 per cent, the duration of flooding would be generally less than a few hours, with increases in inundation mainly impacting (in terms of total area) cropping and grazing land uses. No buildings, either residential or business related, would experience increases in flooding frequency or depth as a result of the proposal.

Socio-economic impacts

Both socio-economic benefits and impacts would result from the construction and operation of the proposal. Beneficial impacts during construction include employment (an estimated average workforce of 150 people would be required to construct the proposal), training opportunities, and flow on local and regional economic benefits. Impacts during construction would include potential impacts on the amenity of the local community, and impacts associated with the inflow of the workforce into the local area.

Beneficial impacts as a result of the operation of the proposal include the following opportunities, which would be refined as Inland Rail progresses:

- better access to and from regional markets (including via the Parkes intermodal facility)
- enabler for regional economic development along the Inland Rail corridor
- safety and amenity benefits as a result of the reduction of freight transport on major road corridors.

The potential for environmental and social disturbance as a result of construction has to be balanced against the long term benefits of Inland Rail overall.

Other issues

The main wastes that would be generated during construction of the proposal include excess spoil, vegetation, construction materials, and general waste. All of the spoil generated would be reused on site through the creation of spoil mounds within the existing rail corridor, except where the presence of contamination is noted.

The potential for cumulative impacts resulting from the interaction of this proposal with other projects, either existing or proposed, in the surrounding area is considered low. Depending on construction timing of the proposal and other projects, there may be an increase in traffic, housing demand, and workforce demand. There are no anticipated cumulative impacts during operation.

Environmental mitigation and management

Potential impacts resulting from the proposal are considered manageable through the implementation of the proposed mitigation and management measures.

The detailed design for the proposal is being carefully developed with the objective of minimising potential impacts on the local and regional environment and the local community. The design and construction methodology would continue to be developed with this overriding objective in mind, taking into account the input of stakeholders.

To manage the potential impacts identified by the EIS, and in some cases remove them completely, the assessment chapters outline a range of mitigation and management measures that would be implemented during construction and operation. Chapter 27 summarises the environmental mitigation and management measures that would be implemented. The environmental performance of the proposal would be managed by the implementation of the CEMP and an operation environmental management plan. These plans would also ensure compliance with relevant legislation and any conditions of approval.

PART A: Introduction

1. Introduction

1.1 Inland Rail

The Australian Government has committed to delivering a significant piece of national transport infrastructure by constructing a high performance and direct interstate freight rail corridor between Melbourne and Brisbane, via central-west New South Wales (NSW) and Toowoomba in Queensland. Inland Rail is a major national project that will enhance Australia's existing national rail network and serve the interstate freight market.

The Inland Rail route, which is about 1,700 kilometres long, involves:

- using the existing interstate rail line through Victoria and southern NSW
- upgrading about 400 kilometres of existing track, mainly in western NSW
- providing about 600 kilometres of new track in northern NSW and south-east Queensland.

Inland Rail has been divided into 13 sections, seven of which are located in NSW.

Australian Rail Track Corporation Ltd (ARTC) ('the proponent') has developed a ten-year programme to deliver Inland Rail. ARTC was created after the Australian and state governments agreed in 1997 to the formation of a 'one stop shop' for all operators seeking access to the national interstate rail network. Across its network, ARTC is responsible for:

- selling access to train operators
- developing new business
- capital investment in the corridors
- managing the network
- infrastructure maintenance.

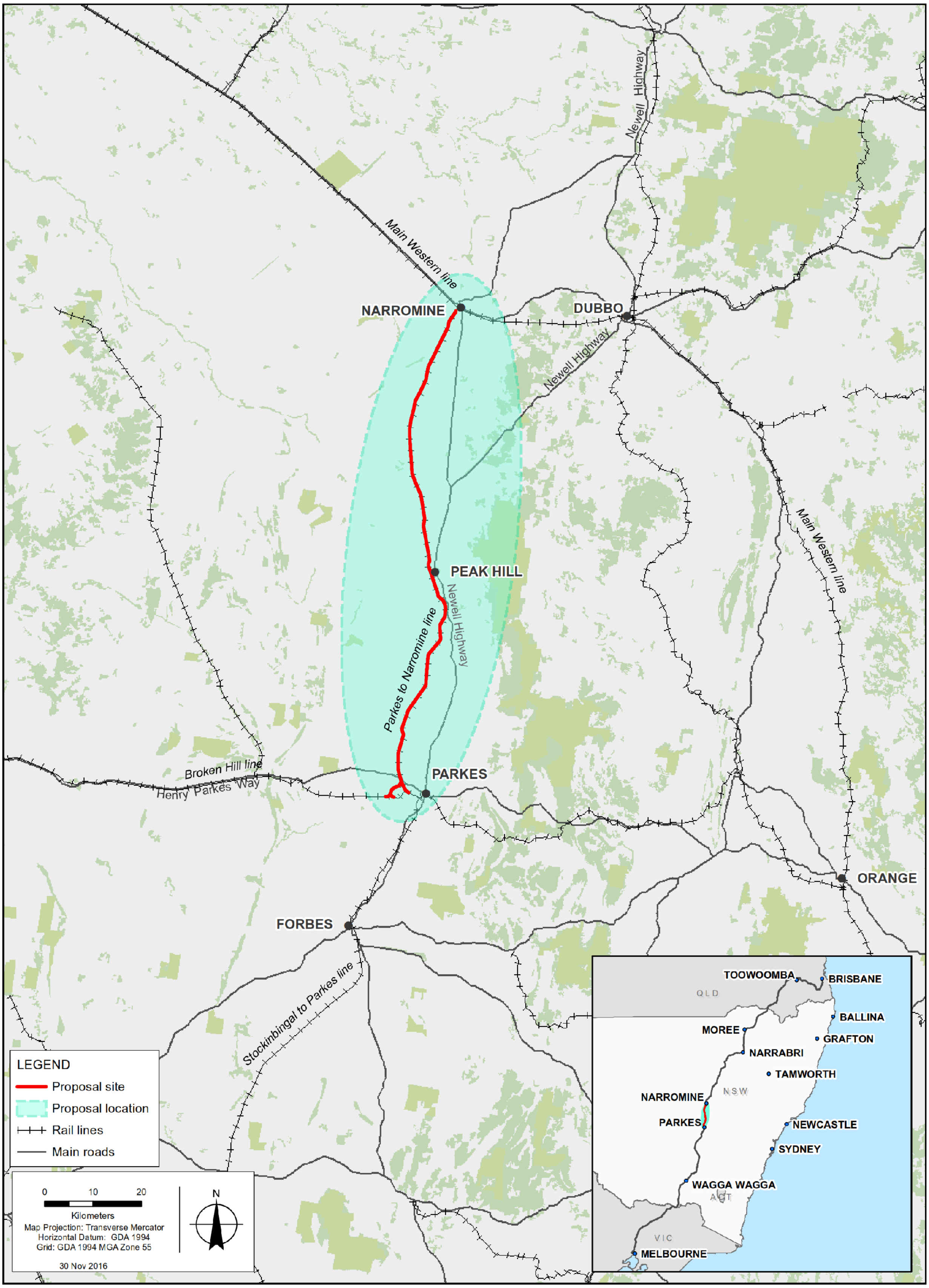
Further information on ARTC and Inland Rail can be found at www.artc.com.au and www.inlandrail.artc.com.au.

1.2 The proposal

The proponent is seeking approval to construct and operate the **Parkes to Narromine section of Inland Rail** ('the proposal'), which consists of 106 kilometres of upgraded rail track and associated facilities. The proposal forms a key component of Inland Rail.

1.2.1 Location

The proposal is generally located in the existing rail corridor between the towns of Parkes and Narromine, via Peak Hill. In addition, a new connection to the Broken Hill rail line ('the Parkes north west connection') is proposed outside the existing rail corridor at the southern end of the proposal site near Parkes. The location of the proposal is shown in Figure 1.1. Further information on the location of the proposal and a description of the proposal site for the purposes of the EIS is provided in chapter 2.



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 1.1
Location of the proposal

1.2.2 Key features

The key features of the proposal involve:

- upgrading the track, track formation, and culverts within the existing rail corridor for a distance of 106 kilometres between Parkes and Narromine
- realigning the track where required within the existing rail corridor to minimise tight curves
- providing three new crossing loops within the existing rail corridor, at Goonumbla, Peak Hill, and Timjelly
- providing a new 5.3 kilometre long rail connection to the Broken Hill line to the west of Parkes, ('the Parkes north west connection'), including a road bridge over the new section of rail at Brolgan Road ('the Brolgan Road overbridge').

The key features of the proposal are shown in Figure 1.2.

Ancillary work would include works to level crossings, signalling and communications, signage and fencing, and services and utilities within the proposal site.

The land requirement for the proposal will comprise the existing corridor with an average width of 30 metres, with some variation to accommodate particular infrastructure and to cater for local topography. The corridor will be of sufficient width to accommodate the infrastructure currently proposed for construction, as well as future expansion, including possible future requirement for 3,600 metre trains.

Proposal construction will be a single-track standard gauge railway, with crossing loops to accommodate double stacked freight trains up to 1,800 metres long. Components of the construction will include infrastructure to accommodate possible future augmentation and upgrades of the track, including a possible future requirement for 3,600 metre trains. Clearing of the corridor will occur to allow for construction and to maintain the safe operation of the railway.

The operational phase at year 2040 will be of a single track with crossing loops to accommodate double stacked freight trains up to 1,800 metres long. Impact assessment will be undertaken for the proposed development described in the *Inland Rail 2015 – Melbourne to Brisbane Inland Rail, Attachment A: ARTC 2015 Inland Rail Programme Business Case* (ARTC, 2015) for rail traffic and associated activities projected at the year 2040.

1.2.3 Timing and operation

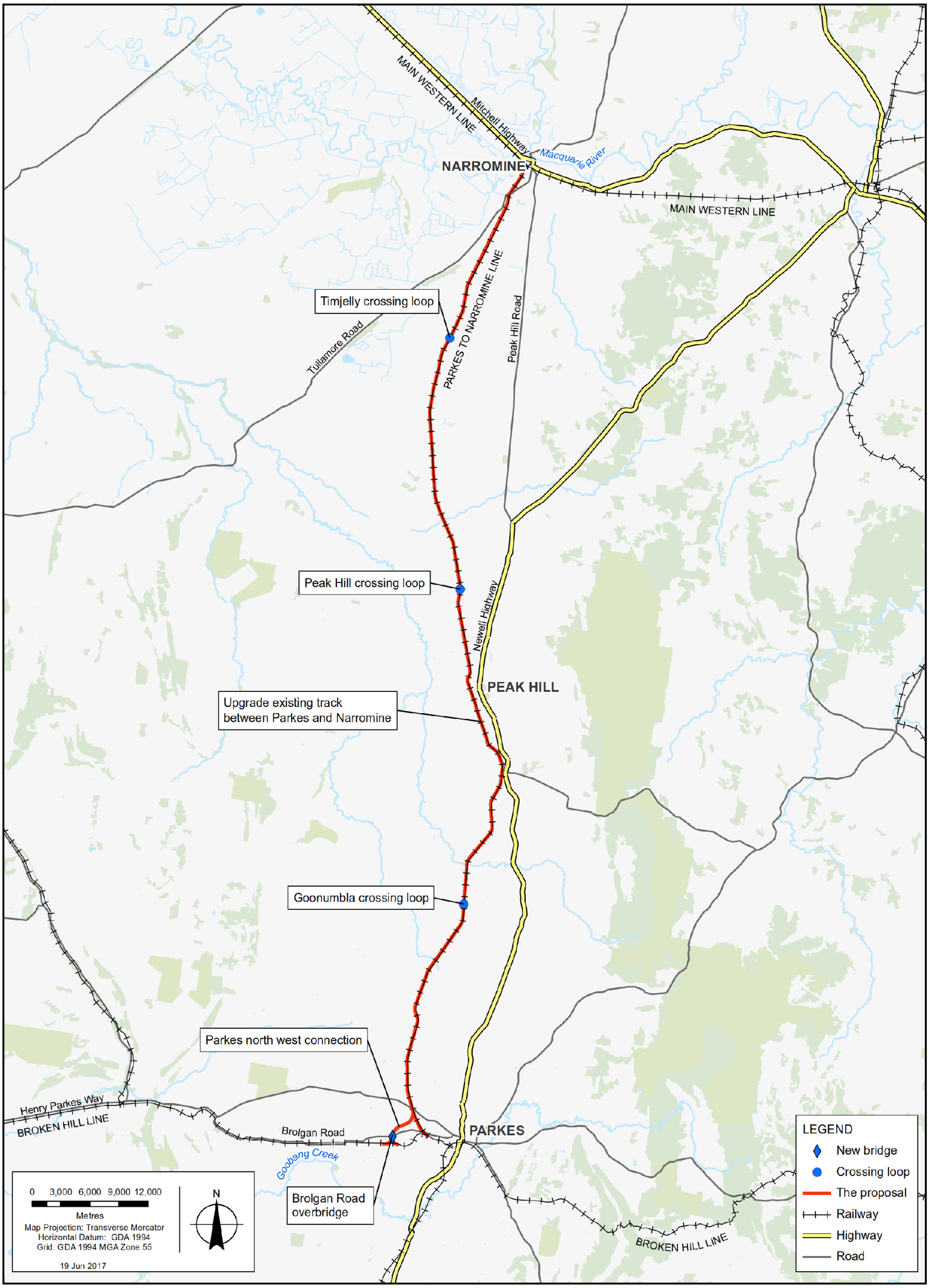
Subject to approval of the proposal, construction of the proposal is planned to start in early to mid 2018, and is expected to take about 18 months. Construction is expected to be completed in late 2019.

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators. Prior to the opening of Inland Rail as a whole, the rail line would be used by existing rail traffic, which includes trains carrying grain and ore at an average rate of about four trains per day.

Existing train operations along the Parkes to Narromine line would continue prior to, during, and following construction. Train numbers are not anticipated to significantly increase until all 13 sections of Inland Rail are complete, which is estimated to be in 2025.

It is estimated that the operation of Inland Rail would involve an annual average of about 8.5 trains per day in 2025, increasing to 15 trains per day in 2040. The trains would be a mix of grain, intermodal (freight), and other general transport trains. The EIS assesses the operational impacts of the use of the proposal as part of Inland Rail.

Further information on the proposal is provided in chapters 7 and 8.



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 1.2
Key features of the proposal

1.3 Objectives of the proposal and Inland Rail

The objectives of the proposal are to:

- provide upgraded rail infrastructure that meets the Inland Rail specifications, to enable trains using the Inland Rail corridor to travel between Parkes and Narromine, connecting with other sections of Inland Rail to the north and south
- provide new rail infrastructure to connect Inland Rail to the Broken Hill line at Parkes, to enable trains using Inland Rail to connect with destinations in South Australia and Western Australia via the east-west trans-continental rail line
- minimise the potential for environmental and community impacts, by maximising use of the existing rail corridor.

The objectives of Inland Rail as a whole are to:

- provide a rail link between Melbourne and Brisbane that is interoperable with train operations to Perth, Adelaide, and other locations on the standard gauge rail network, to serve future rail freight demand, and stimulate growth for inter-capital and regional/bulk rail freight
- provide an increase in productivity that will benefit consumers through lower freight transport costs
- provide a step-change improvement in rail service quality in the Melbourne to Brisbane corridor and deliver a freight rail service that is competitive with road
- improve road safety, ease congestion, and reduce environmental impacts by moving freight from road to rail
- bypass bottlenecks within the existing metropolitan rail networks, and free up train paths for other services along the coastal route
- act as an enabler for regional economic development along the Inland Rail corridor.

1.4 EIS purpose and structure

This environmental impact statement (EIS) supports an application for approval of the proposal under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). It addresses the environmental assessment requirements of the Secretary of the Department of Planning and Environment (the SEARs) dated 8 November 2016 (refer to Appendix A). The proposal is also a controlled action under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), and requires approval from the Australian Minister for the Environment and Energy. The EPBC Act assessment requirements are specified by the SEARs.

The EIS (volume 1) is structured in four parts as follows:

- **Part A Introduction** - including:
  - an introduction to the environmental assessment (**chapter 1**)
  - a description of the general biophysical and socio-economic environment within which the proposal would be located, including the regional setting and a description of the proposal site (**chapter 2**)
  - an overview of the statutory context for the proposal and the approval requirements (**chapter 3**)
  - a summary of the consultation that occurred during the proposal development and environmental assessment process, and the consultation proposed during public exhibition, detailed design, and delivery (**chapter 4**).
- **Part B The proposal** - including:
  - an overview of the strategic context and need for the proposal (**chapter 5**)
  - a summary of the alternatives to the proposal as a whole, and the options considered during development of the concept design for the proposal (**chapter 6**)

  - a description of the proposal features and operation (**chapter 7**), including the approach to avoiding or minimising impacts, design features and infrastructure proposed, operation, maintenance, and other related information
  - an indicative description of the likely construction process and activities (**chapter 8**).
- **Part C Environmental assessment** – including:
  - the results of the assessment of key environmental issues identified by the SEARs, including information on the existing environment, potential construction and operation impacts, and the proposed approach to mitigation and management (**chapters 9 to 26**).
- **Part D EIS synthesis** - including:
  - a consolidated summary of the key potential impacts, a description of the proposed approach to environmental management, and a compilation of the mitigation measures (**chapter 27**)
  - conclusion and justification for the proposal (**chapter 28**).

An assessment of environmental risks is provided in Appendix B of volume 1. The assessment was undertaken to provide a preliminary identification of the potential risks to be considered in more detail by the EIS. Other appendices in volume 1 provide supporting information and data.

The specialist technical reports prepared as an input to the EIS are provided in volumes 2 to 6.

2. General biophysical and cultural environment

This chapter provides a description of the proposal site, including a summary of its general biophysical and cultural (including community, land use and socio-economic) environment.

2.1 Regional setting

The proposal site is located in central west NSW. The central west region of NSW covers an area of over 63,000 square kilometres, which starts at the temperate, elevated central tablelands on the western side of the Blue Mountains, and extends almost 500 kilometres to the semi-arid central west plains.

The proposal site traverses two local government areas (LGAs), with the southern section of the proposal located in the Parkes LGA, and the northern section in the Narromine LGA (shown in Figure 2.1). The two LGAs are predominantly rural, with the main local industries based around agriculture (mainly wheat and wool) and mining.

Parkes is located at the southern end of the proposal site on the Newell Highway. The location of Parkes is close to the geographical centre of NSW, and is located about 785 kilometres south-west of Brisbane, 290 kilometres west of Sydney and 595 kilometres north-east of Melbourne. The main towns in the surrounding area are Forbes (located about 30 kilometres to the south-west of Parkes) and Orange (located about 87 kilometres to the east of Parkes).

Peak Hill is a small village within the Parkes LGA, located about half way along the proposal site. Narromine is located in the Narromine LGA about 100 kilometres north of Parkes, on the Macquarie River and the Mitchell Highway. Narromine is located about 35 kilometres west of Dubbo, which is an important regional service centre.

The regional context for the proposal site is shown in Figure 2.1.

2.2 Description of the proposal site

2.2.1 Definition

The proposal site is the area that would be directly impacted by construction of the proposal and includes the location of operational infrastructure. The majority of works associated with the proposal would be undertaken within the existing rail corridor for the Parkes to Narromine rail line (shown in Figure 2.2). The proposal site also includes the Parkes north west connection.

For the purposes of the EIS, the proposal site is generally considered to have a width of 30 metres, providing for a 15 metre buffer on each side of the alignment centreline. The proposal site is assumed to include all the required track infrastructure, cess drains, haul roads, culverts, level crossings, spoil mounds, and the Brolgan Road overbridge. The proposal site also includes the location of construction compounds (described in chapter 8).

The land requirement for the proposal will comprise the existing corridor with an average width of 30 metres, with some variation to accommodate particular infrastructure and to cater for local topography. The corridor will be of sufficient width to accommodate the infrastructure currently proposed for construction, as well as future expansion, including possible future requirement for 3,600 metre trains.

Proposal construction will be a single-track standard gauge railway, with crossing loops to accommodate double stacked freight trains up to 1,800 metres long. Components of the construction will include infrastructure to accommodate possible future augmentation and upgrades of the track, including a possible future requirement for 3,600 metre trains. Clearing of the corridor will occur to allow for construction and to maintain the safe operation of the railway.

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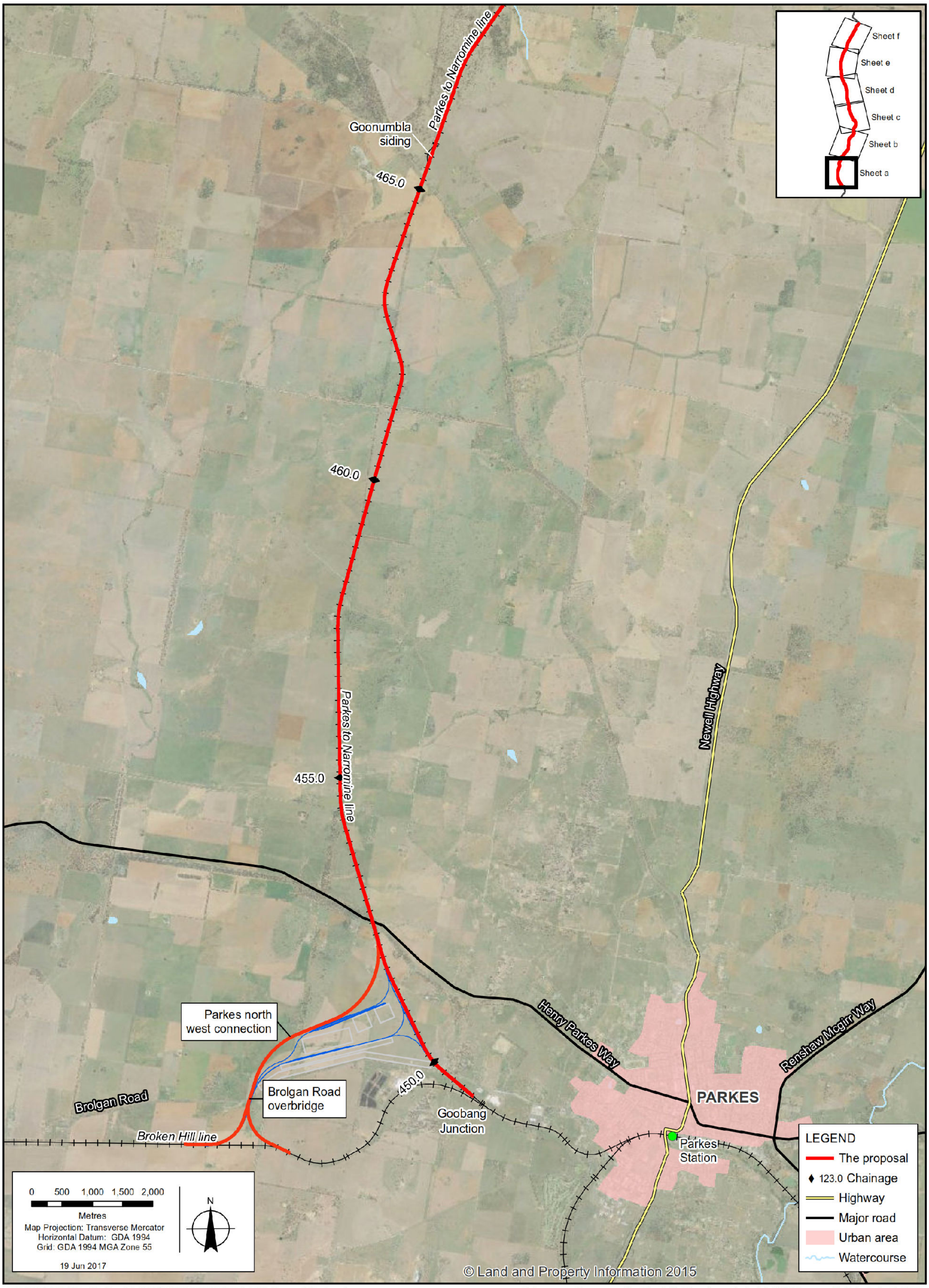
Data source: Commonwealth of Australia (Geoscience Australia). 250K Topographic Data Series 3, 2006. LPI, DTDB, 2012.

Figure 2.1

Regional context



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 2.2a
Proposal site

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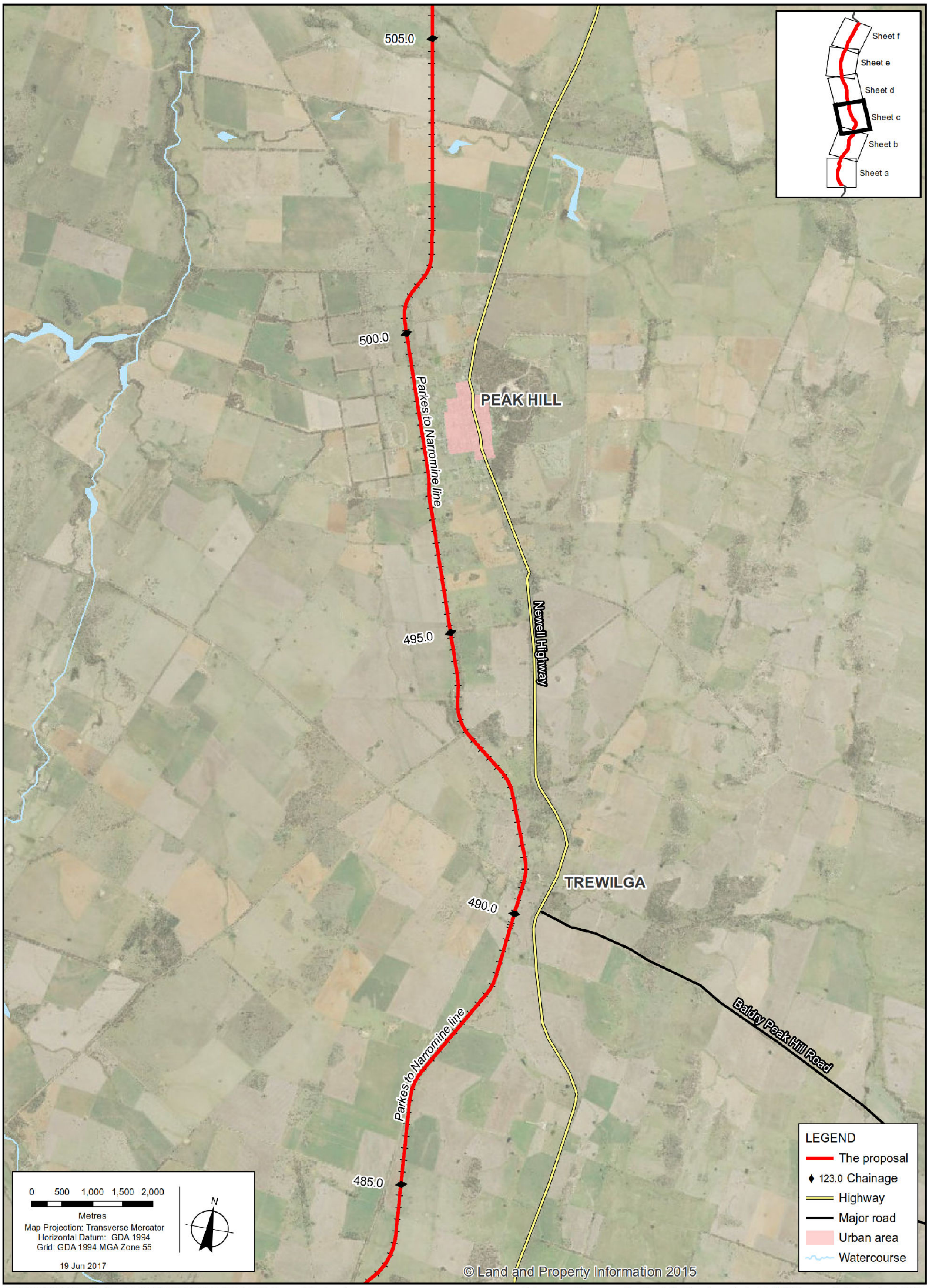
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 2.2b
Proposal site



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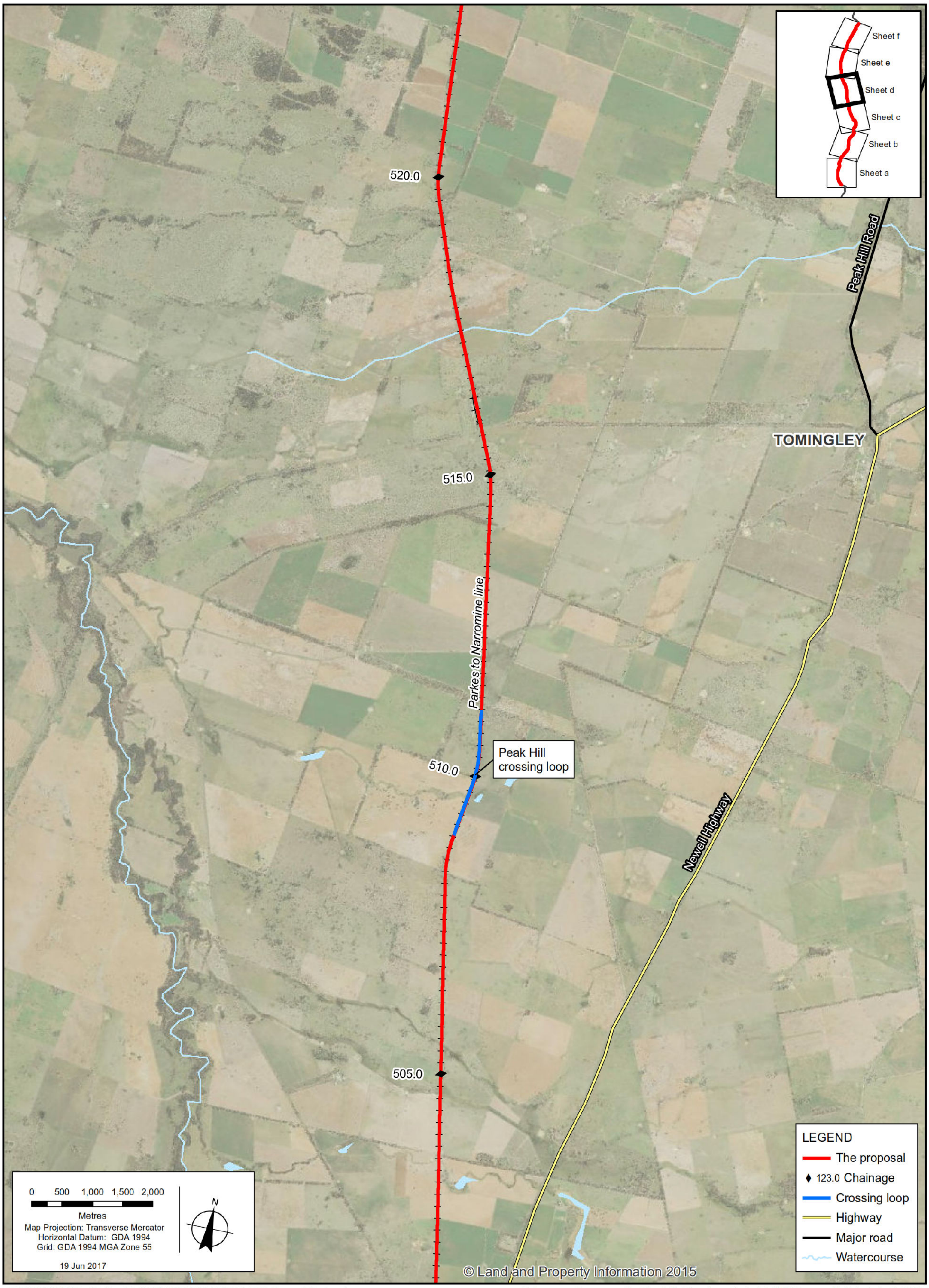
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 2.2c
Proposal site



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 2.2d
Proposal site

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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 2.2e
Proposal site

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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 2.2f
Proposal site

The operational phase at year 2040 will be of a single track with crossing loops to accommodate double stacked freight trains up to 1,800 metres long. Impact assessment will be undertaken for the proposed development described in the *Inland Rail 2015 – Melbourne to Brisbane Inland Rail, Attachment A: ARTC 2015 Inland Rail Programme Business Case* (ARTC, 2015) for rail traffic and associated activities projected at the year 2040.

The following additional assessment areas outside the proposal site have also been considered for the biodiversity and heritage assessments – an approximate 60 metre buffer around culverts; an approximate 120 metre buffer around level crossings, and some additional areas to provide flexibility for future planning and design work.

The need for works in these additional assessment areas would be determined during detailed design for the proposal. The design of works in these areas would take into account the findings of the biodiversity and heritage assessments.

2.2.2 Description

The southern end of the works within the existing rail corridor is located just to the west of Parkes near where Brolgan Road crosses the railway, about 3.5 kilometres from Parkes Station at Goobang Junction. Further information on the existing rail lines in the study area is provided in section 2.5.

The new section of rail line connecting Inland Rail with the existing Broken Hill Line via the existing Parkes to Narromine Line (the Parkes north west connection) is proposed at this location, to the west of the Parkes urban area. The proposal site for the Parkes north west connection commences to the south of Henry Parkes Way. It leaves the existing rail corridor for the Parkes to Narromine line to the west, and travels in a south-westerly direction.

The proposal site for the Parkes north west connection then travels to the north of the Parkes intermodal facility, and crosses Millers Lookout Road. It then travels to the south across Brolgan Road, where the Brolgan Road overbridge is proposed. The proposal site then splits into two to the south of Brolgan Road, with two turnouts proposed connecting to the Broken Hill line about seven kilometres west of Parkes station. The proposal site for the eastern turnout crosses Coopers Road.

From the northern end of the Parkes north west connection, the proposal site extends through rural lands along the existing rail corridor. It travels in a roughly north–south direction for a distance of 51 kilometres through the localities of Nanardine, Goonumbla and Trewilga (near the Newell Highway) to Peak Hill. The rail line passes through the western outskirts of Peak Hill to the west of the main residential area. It is located 980 metres west of the Newell Highway (which passes through the eastern side of the town).

From Peak Hill, the proposal site extends through rural lands along the existing rail corridor. It travels in a roughly north–south direction for a distance of 58 kilometres through the localities of Tomingley West and Wyanga to Narromine.

The existing rail corridor is located adjacent to (just to the east of) the road corridor for the Peak Hill Railway Road from Tomingley West for a distance of 28 kilometres. At about 12 kilometres south of Narromine, the existing rail corridor diverges from the road corridor. The existing rail corridor for the Parkes to Narromine line passes to the west of the main residential area of Narromine. It meets the corridor for the Main West Line just to the west of Narromine Station.

The northern end of the proposal site is located south of Narromine, just south of where Old Blackwater Road crosses the railway 500 metres west of the town, and 1.1 kilometres south-west of Narromine Station.

2.3 General biophysical environment of the proposal site

A summary of the biophysical characteristics of the proposal site is provided below.

2.3.1 Biodiversity

The majority of the study area has been heavily modified by past and ongoing disturbances associated with the active rail corridor and agricultural activities. Clearance and maintenance of the existing rail corridor has resulted in fragmentation, a high level of disturbance, and degradation of vegetation. No conservation areas, reserves, or large areas of native remnant vegetation are located within or close to the proposal site.

The majority of the proposal site consists of non-native vegetation or cleared land, with patches of native vegetation scattered within and around the proposal site. These patches generally comprise a woodland community, with the dominant canopy species including inland grey box, fuzzy box, yellow box, and weeping myall. Of the native vegetation present, a total of nine native plant community types were identified, with the most common community being Western Grey Box tall grassy woodland.

Four threatened ecological communities listed under the *Threatened Species Conservation Act 1995* (TSC Act), and three listed under the EPBC Act were identified, including the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland commun*ity, which is listed as critically endangered under the EPBC Act.

None of the threatened flora species listed under the TSC Act and/or the EPBC Act that are known to occur in the study area were recorded during field surveys, and the likelihood of threatened flora species occurring in or around the proposal site is low. Two threatened species was recorded during field surveys – the superb parrot (listed under both the TSC Act and the EPBC Act) and the grey-crowned babbler (listed under the TSC Act).

Further information on biodiversity is provided in chapter 10.

2.3.2 Soils

The proposal site is located within the Central Lachlan Fold Belt. Near surface materials include Tertiary to Quaternary aged red silty alluvium over folded and faulted Silurian and Ordovician aged sedimentary and minor metamorphic sequences, which outcrop intermittently along the proposal site (GHD, 2014).

Thick reactive brown and grey clay soils are predominantly associated with the near level terrain north of Peak Hill, while moderately thick red and brown sandy and silty clay soils are typically associated with the undulating terrain south of Peak Hill.

Further information on soils and contamination is provided in chapter 14.

2.3.3 Water

The majority of the proposal site is located within the Macquarie-Bogan River basin. A small portion of the southern end of the proposal site is located within the Lachlan River basin. At its closest point, the Macquarie River is about 900 metres north of the proposal site near Narromine.

The proposal site crosses a number of watercourses, all of which are ephemeral in nature. Most of the watercourses are in moderate to poor condition as a result of historical disturbances associated with agricultural practices. There is no existing water quality data for the watercourses crossing the proposal site. The *National Water Quality Assessment 2011* (SKM, 2011) classified the water quality of the Lachlan and Macquarie-Bogan river catchments as being relatively poor.

In general, the study area is characterised by relatively flat land. The existing rail corridor is subject to flooding, which in some locations overtops the rail track.

Further information on hydrology, flooding, and water quality is provided in chapters 15 and 16.

2.4 General cultural environment of the proposal site

A summary of the main cultural characteristics (including land use, heritage, and socio-economic) of the proposal site is provided below.

2.4.1 Land use and property

The majority of the proposal site is located within the existing rail corridor, land within which is used for transport (rail) purposes. Land surrounding the proposal site is used mainly for agriculture and grazing purposes, with large rural properties surrounding the majority of the proposal site. A number of grain storage and handling facilities are located in various locations adjacent to the proposal site. Other land uses include roads, residential (including houses on rural properties, and those in Peak Hill and the smaller villages), and the Parkes intermodal facility (also known as the Parkes National Logistics Hub).

The existing rail corridor is owned by the NSW Government (Transport for NSW) and leased to ARTC. Existing rail facilities and operations are described in section 2.5.

Further information on land use and property is provided in chapter 20.

2.4.2 Heritage

Aboriginal heritage

The proposal site extends over the country of the Wiradjuri people and the Wongaibon people. The earliest historical records relating to Aboriginal people in the study area date from 1817.

Within the existing rail corridor, the construction and maintenance of the existing rail line is likely to have resulted in the removal/relocation of archaeological evidence that may once have been present. No areas of moderate or high archaeological potential were identified within the proposal site.

Artefacts associated with two listed Aboriginal sites were identified within the proposal site during field surveys. Two listed sites (consisting of a scarred tree and an artefact scatter) were identified adjacent to the proposal site.

Further information on Aboriginal heritage is provided in chapter 17.

Non-Aboriginal heritage

The region in which the study area is located was first explored between 1815 and 1817. The first squatter in the Parkes area established a station on Goobang Creek in 1835. The Parkes to Narromine Line opened in 1910 as a ‘pioneer line’ (rail lines constructed to a lesser standard than main rail lines, providing access to mainly agricultural areas).

No heritage listed items are located within the proposal site. The nearest listed item to the proposal site is the Peak Hill Police Station and Official Residence (NSW Police Force’s section 170 register) located about 750 metres to east of the proposal site in Peak Hill.

The heritage assessment noted a number of potential heritage items within the study area. An assessment of significance was undertaken of the potential heritage items along the proposal site. The assessment concluded, for items not currently subject to a heritage listing, that the existing rail line is considered to be generally of local significance, and Wyandra cottage (located between the rail line and Peak Hill Railway Road) is considered to be of local significance.

Further information on non-Aboriginal heritage is provided in chapter 18.

2.4.3 Socio-economic

The community surrounding the proposal site is concentrated in the three main towns described below, with scattered residences in the smaller localities and on rural properties.

Parkes

At the 2011 census, Parkes had a population of 10,026 people. Parkes has a number of freight industries and service providers as a result of its central NSW location, and its position on a major highway and the existing rail corridor. The Newell Highway, a major arterial road linking Melbourne and Brisbane, runs through Parkes at about the highway’s midway point.

The major industries in the Parkes area include mining, agriculture, transport, and warehousing. The Parkes intermodal facility is a 517 hectare site located on the western fringe of the town, about five kilometres from the town centre. The facility is intended to operate as a multi-modal transport facility, 24 hours a day, seven days per week, taking advantage of its location on the Newell Highway and the existing rail corridor. Transport companies with significant landholdings and operations on this site include SCT Logistics, Asciano, and Linfox. FCL Interstate Transport Services Pty Ltd runs a significant intermodal operation at Goobang Junction on Parkes' western outskirts.

The Parkes Observatory, run by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) as part of the Australia Telescope National Facility network of radio telescopes, is located about 20 kilometres north of the town. The Northparkes gold and copper mine is located about 27 kilometres north-west of the town.

Peak Hill

Peak Hill is a small town located along the proposal site. At the 2011 census, Peak Hill had a population of 755 people. Peak Hill offers a number of tourist attractions, including the former Peak Hill Open Cut Gold Mine situated about 1.5 kilometres east of the proposal site. Peak Hill is located in a major sheep producing area.

Narromine

Located at the northern end of the proposal site, Narromine is a medium sized rural service town, with a population of 3,789 people at the 2011 census. Narromine’s major industries include citrus farming and agriculture, along with grain crops, livestock, wool and cotton. A major rural industrial facility is located about three kilometres south-west of the town centre, adjacent to the proposal site. This includes a grain handling and distribution centre (operated by Agrigrain) and the Pioneer Hi-Bred Australia seed production facility.

Further information is provided in chapter 21.

2.5 Existing rail facilities and operations

2.5.1 Rail infrastructure

The first steam railway between Sydney and Parramatta opened in 1855. However, providing a rail connection between Sydney and western NSW was delayed by the engineering challenges associated with crossing the Blue Mountains. Rail connections to Bathurst and Orange were opened in the 1870s. The extension of the Main Western line to Molong served as the railhead for Parkes and the western districts until the 1890s.

From 1910 to 1930, a large number of branch railway lines were constructed through western and north-western NSW to provide access to the wheat and wool growing areas. The development of the railway through these regions enabled the bulk transportation of agricultural products, and was a major factor in encouraging agricultural expansion as it reduced or eliminated the long and costly haul by slow horse transport to distant rail heads.

Peak Hill was linked to Narromine in 1910, and a southern connection to Goobang Junction near Parkes was provided in 1914.

Main lines

Parkes Station was opened in 1893. Parkes is located on the Broken Hill line, which forms part of the transcontinental railway from Sydney to Perth. The Broken Hill line extends from the Main Western line at Orange, and travels to Broken Hill via Parkes. At Broken Hill, the line continues into South Australia towards Adelaide as the Crystal Brook to Broken Hill line. The Broken Hill line provides an important link for east–west rail operations in Australia. It carries trans-continental freight and is used by the Indian Pacific passenger train, and a weekly passenger train.

The Main Western line passes through Narromine to the north of the study area. The Main Western line travels between Sydney Central and Bourke via the Blue Mountains, Bathurst, Orange and Dubbo. Narromine Station, which opened in 1882, is now closed to passenger services.

Branch lines

Peak Hill is located on the Parkes to Narromine line. The Parkes to Narromine line, which connects to the Broken Hill line at Goobang Junction (about 3.5 kilometres west of Parkes Station), was closed to passenger services in the early 1970s.

The Stockinbingal to Parkes line (also known as the Forbes line) opened between Parkes and Forbes in 1893, and Forbes and Stockinbingal in 1918. Rail services, consisting of a mail train and a rail-motor service, operated between Parkes and Forbes until 1983. No regular passenger services use the line, although passenger services on the Main Western line occasionally divert onto the Stockinbingal to Parkes line when track work closes the main line.

Stockinbingal to Parkes and the Parkes to Narromine lines form a cross country route between Cootamundra on the Main South line, and Werris Creek on the Main North line.

Figure 2.3 provides a schematic drawing of the rail network in the study area.

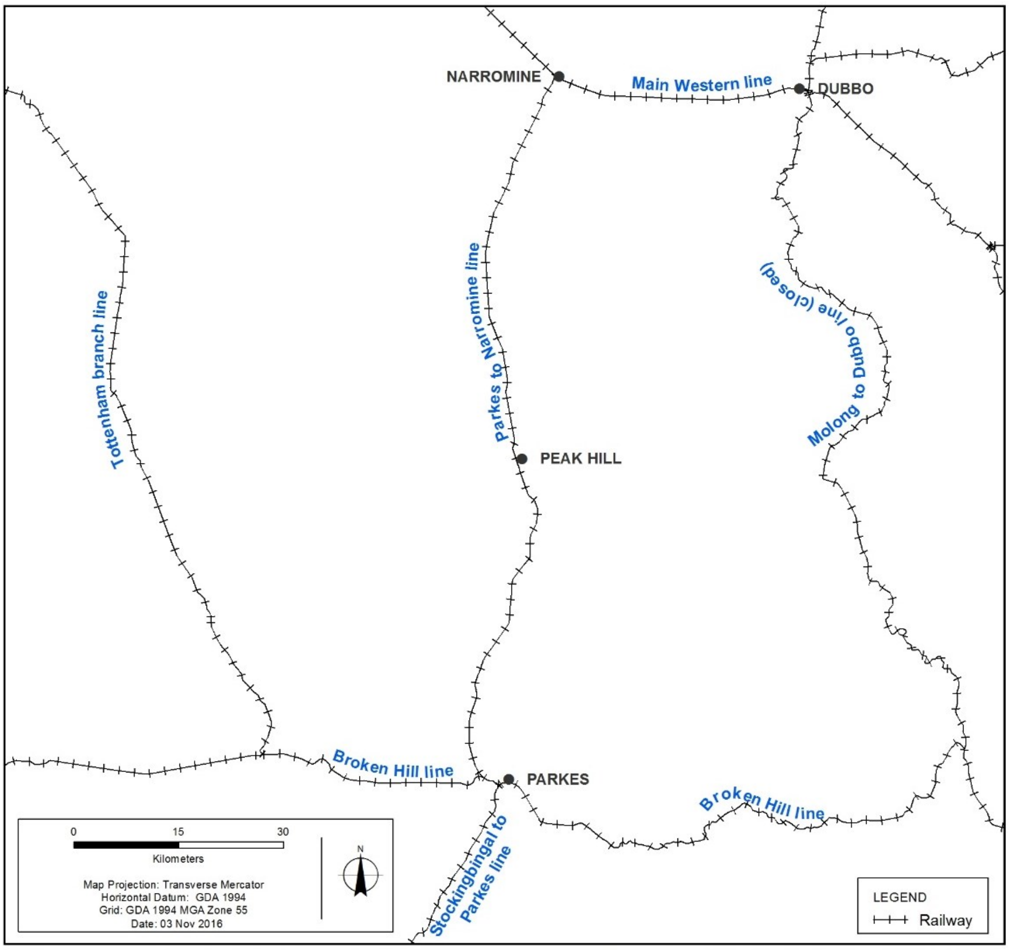

Figure 2.3 Existing rail lines in the study area

Track characteristics

The existing track is a mixture of track weights (47 and 53 kilograms per metre). Originally, the track was constructed for light traffic on the existing sub-grade materials. Over time, the track has been re-ballasted and maintained, however no significant improvements have been made to the track formation.

Sections of track pass through low lying flood prone areas, and wash-aways have occurred in the past after heavy rain events. The maintenance access track along the existing rail corridor is not continuous and can be impassable by two-wheel drive vehicles after wet weather.

The track was built with minimal preparatory earthworks, with a number of 1:100 grades in short sections between Peak Hill and Parkes. In some locations, the original timber sleepers have been replaced with steel, new ballast has been laid, and damaged culverts replaced.

About 16 sidings are located between Parkes and Narromine to provide access to and from the main line for private operations. These include the Goonumbla siding, where ore from the Northparkes mine is transferred from truck to train and transported by rail to Port Kembla; and the Narwonah grain siding near Narromine, next to the Grain Flow facility.

2.5.2 Rail operations

Passenger services

The Indian Pacific, run by Great Southern Rail, travels between Sydney and Perth via Adelaide. Trains stop at Parkes four times a week – bound for Sydney on Tuesdays and Fridays, and bound for Perth on Saturdays and Wednesdays.

The Broken Hill Outback Xplorer, run by NSW Train Link, travels between Sydney and Broken Hill via Orange and Parkes. Trains stop at Parkes twice a week – bound for Broken Hill on Mondays, and Sydney on Tuesdays.

Freight services

The Parkes to Narromine line is used by grain trains at an average rate of three to four trains per day (both directions), with up to 10 trains on a peak day. Annually, these trains carry about two million tonnes of grain per year. Trains carrying ore produced by the Northparkes mine also travel along the line from the Goonumbla rail siding bound for Port Kembla at an average rate of one train per day.

Trains using the line have a maximum length of 1,800 metres.

Train speeds are limited to a maximum of 90 to 100 kilometres per hour, with local speed restrictions due to limitations associated with the existing track.

Maintenance

Maintenance works and other minor works along the Parkes to Narromine line are undertaken by ARTC in accordance with existing ARTC procedures and processes, and relevant State legislative requirements.

3. Statutory context

This chapter provides a review of the legislation and environmental planning instruments that are relevant to the environmental assessment and approval of the proposal. The permissibility and approval pathway is summarised, and other planning instruments and legislation that are relevant to the assessment and approval of the proposal are considered.

3.1 Overview of the approval pathway

The proposal would be permitted without consent in accordance with *State Environmental Planning Policy (Infrastructure) 2007* (the Infrastructure SEPP), and is subject to assessment under Part 5 of the EP&A Act. The capital investment value of the proposal is estimated to be over $50 million, and as a result, the proposal is State significant infrastructure under *State Environmental Planning Policy (State and Regional Development)* 2011. The proposal is therefore subject to approval under Part 5.1 of the EP&A Act. Approval requirements under the EP&A Act are described in section 3.2.

Other approvals and permits are also required, including approval as a controlled action under the EPBC Act. The requirements under other legislation are described in sections 3.4 and 3.5.

3.2 Environmental Planning and Assessment Act 1979

The EP&A Act and the Regulation provide the framework for development assessment in NSW. The EP&A Act and the Regulation include provisions to ensure that the potential environmental impacts of a development are considered in the decision making process prior to proceeding to construction.

The key requirements of the EP&A Act in relation to the assessment and approval of the proposal are considered below.

3.2.1 Application of Part 5 of the EP&A Act

Part 5 of the EP&A Act defines the assessment process for proposals that do not require development consent. In accordance with section 110(1), ARTC would be the proponent and a determining authority for the proposal.

Section 111 imposes a duty on a determining authority to *'examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity'*.

Section 112(1) provides that 'a determining authority shall not carry out an activity, or grant an approval in relation to an activity …. *that is likely to significantly affect the environment (including critical habitat) or threatened species, populations or ecological communities, or their habitats, unless (a) the determining authority has obtained or been furnished with and has examined and considered an environmental impact statement in respect of the activity'.*

In accordance with the requirements of section 112, ARTC considers that the proposal has the potential to significantly affect the environment. As a result, an EIS is required.

3.2.2 State significant infrastructure and the application of Part 5.1 of the EP&A Act

State significant infrastructure is development that is so declared under section 115U of the EP&A Act. Under section 115U(2), development may be declared to be State significant infrastructure by a State environmental planning policy. Section 115U(3) specifies that:

> *'Development that may be so declared to be State significant infrastructure is development of the following kind that a State environmental planning policy permits to be carried out without development consent under Part 4:*
>
> *(a) infrastructure,*
>
> *(b) other development that (but for this Part and within the meaning of Part 5) would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent, require an environmental impact statement to be obtained under Part 5.'*

The proposal is for infrastructure, and is for an activity for which the proponent is the determining authority and, in their opinion, requires an EIS (refer to section 3.2.1).

Clause 14 and Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011* (the State and Regional Development SEPP) operate to make the proposal State significant infrastructure (refer to section 3.3.2). The proposal is therefore subject to Part 5.1 of the EP&A Act. Under section 115W of the EP&A Act, the approval of the Minister for Planning is required for State significant infrastructure. In accordance with section 115X (Application for approval of State significant infrastructure):

> *'(1) The proponent may apply for the approval of the Minister under this Part to carry out State significant infrastructure.*
>
> *(2) The application is to:*
>
> > *(a) Describe the infrastructure, and*
> >
> > *(b) contain any other matter required by the Director-General.*
>
> *(3) The application is to be lodged with the Director-General.'*

This document provides the information required to support the proponent's application for approval of the proposal. In accordance with the requirements of section 115X, it addresses the SEARs (refer to section 3.7.1).

Critical State significant infrastructure

Section 115V of the EP&A Act provides for the declaration of critical State significant infrastructure.

Critical State significant infrastructure projects are high priority infrastructure projects that are essential to the State. Section 115V of the EP&A Act provides that any State significant infrastructure may also be declared to be critical State significant infrastructure, if it is '…of a category that, in the opinion of the Minister, is essential for the State for economic, environmental or social reasons.'

As critical State significant infrastructure the proposal would be permissible without consent under clause 16(a) of the State and Regional Development SEPP. The proposal remains subject to assessment under Part 5.1 of the Environmental Planning and Assessment Act 1979 and requires the approval of the Minister for Planning.

3.2.3 Land owner's consent/notification requirements

Clause 193 of the Regulation provides owner's consent and notification requirements for State significant infrastructure projects. Clause 193(1) specifies that:

> *'The consent of the owner of the land on which State significant infrastructure is to be carried out is required for an infrastructure application or modification request unless the application or request relates to any of the following:*
>
> *(a) State significant infrastructure proposed to be carried out by a proponent that is a public authority,*
>
> *(b) critical State significant infrastructure.*
>
> *(c) State significant infrastructure comprising any one or more of the following:*
>
> > *(i) Linear transport infrastructure,*
> >
> > *(ii) Utility infrastructure,*
> >
> > *(iii) Infrastructure on land with multiple owners designated by the Secretary for the purposes of this clause by notice in writing to the person making the application or request.'*

As the application for the proposal is being made by a public authority and is for linear transport infrastructure, the consent of individual land owners will not be required to make the application. However, the proponent needs to give notice of the application in accordance with the requirements of clause 193(4).

This clause requires:

> *'(4) Notification if consent not required*
>
> *If the consent of the owner of the land is not required for an infrastructure application or modification request under this clause, the proponent is required to give notice of the application or request:*
>
> *(a) by written notice to the owner of the land before, or no later than 14 days after, the application or request is made, or*
>
> *(b) by advertisement published in a newspaper circulating in the area in which the infrastructure is to be carried out:*
>
> > *(i) in the case of an infrastructure application—at least 14 days before the environmental impact statement that relates to the infrastructure is placed on public exhibition, or*
> >
> > *(ii) in the case of a modification request—no later than 14 days after the request is made.*

3.2.4 Environmental Planning and Assessment Regulation 2000

Clauses 6 and 7 of Schedule 2 of the Regulation set out requirements for the form and content of an EIS. These requirements are included in Appendix C.

In addition, clause 193A specifies that:

> *'For the purposes of section 115ZM (e) of the Act, a proponent must, when preparing an environmental impact statement for State significant infrastructure on land less than 200 kilometres from the Siding Spring Observatory, take into consideration the Dark Sky Planning Guideline.'*

At the northern end, the proposal site is located within 200 kilometres of the Siding Spring Observatory. Consideration has been given to the *Dark Sky Planning Guideline* (Department of Planning and Environment, 2016). Further information is provided in chapter 19.

3.3 NSW environmental planning instruments

The environmental planning instruments relevant to the assessment and approval of the proposal are described below.

3.3.1 State Environmental Planning Policy (Infrastructure) 2007

The Infrastructure SEPP clarifies the consent arrangements for infrastructure projects. According to clause 8(1) *'if there is an inconsistency between this Policy and any other environmental planning instrument, whether made before or after the commencement of this policy, this policy prevails to the extent of the inconsistency'*.

The proposal meets the definition of rail infrastructure facilities, which are defined by clause 78 of the Infrastructure SEPP as *'railway tracks, associated track structures, rail freight terminals, sidings and freight intermodal facilities'*.

Clause 79(1) provides that development for the purpose of a railway, or for rail infrastructure facilities, may be carried out by or on behalf of a public authority without consent on any land. This clause also specifies the conditions whereby such development can be carried out without consent on land reserved under the *National Parks and Wildlife Act 1974*. As the proposal site is not reserved under the *National Parks and Wildlife Act 1974*, these conditions do not apply, and the proposal is permissible without consent.

3.3.2 State Environmental Planning Policy (State and Regional Development) 2011

Sections 89C(2) and 115U(2) of the EP&A Act provide that a SEPP may declare any development, or any class or description of development, to be State significant infrastructure or State significant development. The State and Regional Development SEPP provides definitions of State significant infrastructure and State significant development. The proposal does not meet the definitions of State significant development.

Clause 14 of the State and Regional Development SEPP provides that development is State significant infrastructure if it is wholly or partly permissible without development consent under Part 4 of the Act, by virtue of the operation of a SEPP, and it meets the definitions provided in Schedule 3 to the State and Regional Development SEPP.

As noted above, the Infrastructure SEPP provides that the proposal is permissible without consent. Schedule 3 (item 3) of the State and Regional Development SEPP includes the following definition of 'rail infrastructure' - '*Development for the purpose of rail infrastructure by or on behalf of the Australian Rail Track Corporation that has a capital investment value of more than $50 million*.' The capital investment value of the proposal is over $50 million. As the proposal meets the requirements of clause 14 it is defined as State significant infrastructure.

3.3.3 Other environmental planning instruments

Section 115ZF(2) of the EP&A Act provides that environmental planning instruments do not apply to or in respect of State significant infrastructure, except where they apply to the declaration of infrastructure as State significant infrastructure.

3.4 Other NSW legislative requirements

3.4.1 Approvals not required

The following approvals are not required for approved State significant infrastructure (in accordance with section 115ZG of the EP&A Act):

- a permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*
- an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*
- an Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*
- an authorisation referred to in section 12 of the *Native Vegetation Act 2003* (or under any Act repealed by that Act) to clear native vegetation or State protected land
- a water use approval under section 89, a water management work approval under section 90, or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000*
- Division 8 of Part 6 of the *Heritage Act 1977* (relating to making heritage orders) does not apply to prevent or interfere with the carrying out of approved State significant infrastructure.

3.4.2 Approvals to be applied consistently

The following approvals cannot be refused if necessary for the carrying out of approved State significant infrastructure (in accordance with section 115ZH of the EP&A Act):

- an environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997*
- consent under section 138 of the *Roads Act 1993*.

The approval requirements of these Acts as they relate to the proposal are summarised below.

3.4.3 Consideration of requirements under other NSW Acts

Other NSW environmental planning legislation that are directly relevant to the approval and assessment of the proposal are considered below.

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) establishes, amongst other things, the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. Environment protection licences are generally required for scheduled activities or scheduled development work.

The definitions of scheduled activities provided in Schedule 1 include:

> *'33 Railway systems activities*
>
> *1. This clause applies to railway systems activities, meaning:*
>
> *a) The installation, on site repair, on-site maintenance or on site upgrading of track. Including the construction or significant alteration of any ancillary works.*
>
> *b) The operation of rolling stock on track.'*

The proposal meets this definition and would therefore require an environment protection licence (EPL).

An EPL would be obtained for construction of the proposal. In relation to operation, ARTC currently holds a licence to carry out railway systems activities on certain parts of the NSW rail network (licence number EPL3142). It may be appropriate to either amend this licence to include the operation of the proposal or to obtain a new licence. This would be considered in consultation with the Environment Protection Authority (EPA).

Roads Act 1993

Under Section 138 of the *Roads Act 1993*, approval from the relevant roads authority is required to impact, or carry out work on or over, a public road. Clause 5(1) of Schedule 2 to the Roads Act exempts public authorities from this requirement, except in relation to works on or over classified and Crown roads. No works to these types of roads would be required as part of the proposal. As a result, approval under section 138 of the Roads Act is not required.

Water Management Act 2000 and Water Act 1912

The *Water Management Act 2000 and Water Act 1912* control the extraction of water, the use of water, the construction of works such as dams and weirs and the carrying out of activities in or near water sources in NSW. The provisions of the Water Management Act are being progressively implemented to replace the Water Act. Since 1 July 2004 the new licensing and approvals system has generally been in effect in those areas of NSW covered by operational water sharing plans.

Temporary dewatering and construction activities that interfere with aquifers are generally identified as aquifer interference activities in accordance with the Water Management Act and the *NSW Aquifer Interference Policy* (DPI, 2012). However, the aquifer interference approval provisions of the Water Management Act have not commenced, and licensing of these activities is carried out under Part 5 of the Water Act. A licence under Part 5 is required for any dewatering activity that would require the extraction of more than three mega litres of groundwater per year. Excavation would be undertaken as part of the proposal. Although groundwater may be intercepted, it is unlikely that any dewatering would exceed three mega litres of groundwater per year.

Extraction of groundwater is proposed as part of the requirements for water during construction (described in chapter 8). A licence would be sought under Part 5 of the Water Act if extraction of more than three mega litres of groundwater per year is required to construct the proposal.

Crown Lands Act 1989

The *Crown Lands Act 1989* sets out how Crown land is to be managed. In particular, in relation to actions affecting Crown land:

- All actions are to be consistent with the 'principles of Crown land management'.
- An assessment must be carried out prior to any dealings in Crown land (such as a lease).
- Specific use of Crown land generally needs to be authorised by a lease, licence or other permit.

In summary, the principles of Crown land management are that, as appropriate:

- environmental protection principles be observed
- natural resources be conserved wherever possible
- public use and enjoyment, and multiple use be encouraged
- the land and its resources be sustained in perpetuity
- it be occupied, sold, or otherwise dealt with consistent with these principles.

An authorisation under the Crown Lands Act to allow occupation of Crown land must be obtained. The potential impacts of the proposal on land use, including Crown land, are considered in chapter 20.

Transport Administration Act 1988

The *Transport Administration Act 1998* provides for the administration and management of transport infrastructure and transport agencies in NSW. Under section 99B of the Transport Administration Act, a rail infrastructure owner may close any level crossing provided that, prior to closing the crossing, it notifies Roads and Maritime and the local council, and receives Ministerial approval.

Transport for NSW reviews all applications for level crossing closures before they are submitted to the Minister for Transport, to ensure that the relevant issues have been considered, and adequate consultation has been undertaken.

As described in chapter 7, the proposal includes changes to a number of level crossings. ARTC is undertaking, and will continue to undertake, necessary consultation to confirm the changes required. Approval for closures, if required, would be obtained in accordance with the requirements of the Transport Administration Act.

3.5 Commonwealth requirements

3.5.1 Environment Protection and Biodiversity Conservation Act 1999

Under the EPBC Act, proposed ‘actions’ that have the potential to significantly impact on matters of national environmental significance, the environment of Commonwealth land, or that are being carried out by an Australian Government agency, must be referred to the Australian Minister for the Environment and Energy for assessment. If the Minister determines that a referred project is a ‘controlled action’ under the EPBC Act, the approval of the Minister would be required.

An EPBC Act protected matters search was undertaken on 7 September 2015 for an area within a 10 kilometre radius of the proposal site. The results of the search indicated that the proposal has the potential to impact on two protected matters:

- threatened ecological communities – three EPBC Act listed threatened ecological communities have the potential to be impacted
- threatened species – four EPBC Act listed fauna species and one flora species have the potential to be impacted.

As a result of the potential for impacts on protected matters, the proposal was referred to the (then) Australian Minister for the Environment on 22 June 2016. On 11 October 2016, the Australian Government Department of the Environment and Energy notified that the proposal is a controlled action, with the controlling provision being ‘listed threatened species and communities’ (under section 18 of the EPBC Act) (referral reference 2016/7731).

As part of the overall approval process for the proposal, the proposal will be assessed by the NSW Department of Planning and Environment in accordance with the *Bilateral agreement made (between New South Wales and the Commonwealth) under section 45 of the EPBC Act relating to environmental assessment*. The assessment requirements are defined by the SEARs (provided in Appendix A). Following this assessment, the Australian Minister for the Environment and Energy will make a separate decision whether or not to approve the proposal under the EPBC Act.

Further information on potential biodiversity impacts, including the assessment of the potential impacts on EPBC Act listed threatened species and communities, is provided in chapter 10.

3.6 Summary of approval and notification requirements

In summary:

- The proposal is permissible without consent under the Infrastructure SEPP. The proposal is State significant infrastructure, and it requires approval from the Minister for Planning under Part 5.1 of the EP&A Act.
- An EPL under the POEO Act is required for the construction and operation of the proposal.
- Landowners need to be notified in accordance with clause 193(4) of the Regulation.
- Approval to close level crossings may be required under s99B of Transport Administration Act.
- A licence would be sought under Part 5 of the Water Act if extraction of more than three mega litres of groundwater per year is required to construct the proposal.
- The proposal is a controlled action under the EPBC Act and requires approval under the EPBC Act from the Australian Minister for the Environment and Energy.

3.7 Summary of the assessment process

3.7.1 Environmental assessment requirements

Under section 115Y(1) of EP&A Act, *'When an application is made for the Minister's approval for State significant infrastructure, the Secretary is to prepare environmental assessment requirements in respect of the infrastructure'*. These identify the general requirements for the EIS, and the key issues to be assessed. The SEARs for the proposal were originally issued on 17 February 2016. Amended SEARs, which included the original SEARs with slight amendments, and additional assessment requirements for matters of national environmental significance under the EPBC Act, were issued on 8 November 2016.

The requirements outlined in the SEARs, together with where they are addressed by this EIS, are provided in Appendix A.

3.7.2 Public exhibition and submissions

If the EIS is considered to meet the SEARs, the Department of Planning and Environment would place the EIS on public exhibition for at least 30 days and invite submissions. The Department would provide ARTC with a copy of the submissions and ask ARTC to respond to the issues raised. ARTC may modify the proposal to minimise impacts on the environment if required and practicable. If the proposal is modified in response to the issues raised, a preferred infrastructure report would be prepared to describe the scope of the revised project. Otherwise, a submissions report would be prepared. The Department would then make the report public.

Further information on the proposed approach to consultation during the exhibition period is provided in chapter 4.

3.7.3 Assessment and approval

Following the exhibition period, the Department will, on behalf of the Minister for Planning, review the EIS and the submissions/preferred infrastructure report. The Department will prepare an assessment report, which is submitted to the Minister for Planning for determination. The Minister may refuse the project, or approve it with any conditions considered appropriate. The Minister's approval and the assessment report would be published on the Department of Planning and Environment's Major Projects website following determination. Approval under the EPBC Act from the Australian Minister for the Environment and Energy will be advised separately.

4. Consultation

This chapter summarises the community and stakeholder consultation undertaken prior to and during preparation of the EIS, and the consultation proposed to be undertaken during the design and delivery of the proposal. The key issues relevant to the EIS are summarised. Further information is provided in the consultation report, included in Appendix D.

4.1 Consultation approach, objectives and strategy

4.1.1 Overall approach and objectives

ARTC's values commit the organisation to active engagement with stakeholders and the community. For Inland Rail, effective communication and stakeholder engagement are fundamental to reducing risk, optimising the route alignment, and minimising social and environmental impacts. ARTC believes that identifying, engaging, and effectively communicating with stakeholders is critical to the successful delivery of Inland Rail.

ARTC's approach to consultation for Inland Rail aims to:

- build awareness, understanding, and support for Inland Rail among customers, stakeholders and the community
- harness a sense of ownership through advocates of Inland Rail
- create an active dialogue with customers, communities and other stakeholders
- identify and manage issues and opportunities
- achieve a design that minimises the potential for environmental and community impacts
- actively seek opportunities to create beneficial outcomes for stakeholders, while not compromising the scope and budget of Inland Rail (for example, improving local rail and road interfaces where it benefits Inland Rail and improves community safety and amenity).

4.1.2 Consultation plan

Stakeholder and community engagement for Inland Rail is an evolving process that commenced in 2010. In early 2015, ARTC developed the *Inland Rail Strategic Stakeholder and Engagement Plan*. The aim of the plan was to inform early engagement with local councils, including those within which the proposal site is located, ahead of the commencement of formal consultation and fieldwork.

ARTC's approach to stakeholder engagement during this early stage was to:

- provide an update to key stakeholders
- revisit issues raised by councils and other local stakeholders during early consultation
- discuss any issues identified during technical studies
- seek input regarding key local stakeholder groups to be engaged through future consultation
- identify new opportunities and issues associated with delivery of Inland Rail at a local level.

This approach was welcomed by the local councils, who were actively seeking information and urging early engagement.

Later in 2015, ARTC developed the *Communication and Engagement Plan – Parkes to Narromine* to guide engagement with the local community. As defined by the plan, consultation has been, and will continue to be undertaken, over five phases:

- development of the business case
- planning, design, and approvals (including preparation of the EIS)
- construction

- commissioning and handover
- operation.

The communication and engagement activities are tailored in the plan for each phase, and generally include:

- meetings and briefings
- workshops
- community information sessions
- phone, email and written correspondence
- project website
- distribution of information, including mail outs.

Consultation will continue on a regular basis as guided by this plan. A full list of the activities undertaken and proposed is provided in Appendix D.

4.1.3 Stakeholder Identification

A stakeholder is defined as a person, group, or organisation who has an interest in a project and/or is directly or indirectly impacted by the project. The key stakeholders for consultation in relation to the proposal include:

- elected members of the parliaments of NSW and Australia
- local councils
- government agencies
- landowners and residents with the potential to be directly or indirectly impacted by the proposal
- community and environment groups
- traditional owners
- representatives of neighbouring and related projects.

A full list of stakeholders is provided in Appendix D.

4.2 Consultation process and activities

4.2.1 Consultation during the EIS process

A summary of the activities and tools employed to provide information on the proposal is provided in Table 4.1.

Table 4.1 Consultation tools

Consultation and communication tool	Purpose	Timing
Community contact mechanisms: - toll free community information line (1800 732 761) - project email (inlandrailnsw@artc. com.au) - Inland Rail website (https://inlandrail.artc.com.au/)	- Obtain feedback and measure awareness of the proposal - Provide information and promote channels through which stakeholders can communicate their views, issues, and concerns	Commenced in 2014 and ongoing

Consultation and communication tool	Purpose	Timing
Printed information – distributed to people on the mailing list and at communication sessions: - fact sheets - project information packs - mail outs	- Raise awareness and understanding of the proposal - Provided to stakeholders to increase understanding of the proposal - Provide information on land access guidelines and procedures	Commenced in 2014 and ongoing
Community information sessions	- Provide information on the proposal to the local community - Seek local input to inform the design process and EIS	Held in Parkes and Narromine in May and November 2016
Workshops	- Discuss the proposal and address specific questions and concerns in person - Provide an opportunity for stakeholder input to inform the design process and EIS.	Commenced in April 2015 and held on a regular basis
Landowner face to face meetings	- Raise awareness of the proposal and the potential impacts on landowners - Provide an opportunity for landowners to ask questions and have input into the design and EIS	Commenced in March 2016 and ongoing
Stakeholder meetings and briefings	- Opportunity to address specific questions and issues in person - Provide an opportunity for stakeholder input to inform the design process and development of the EIS.	Commenced in 2014 and ongoing
Submissions	- Submissions from local councils and businesses have been invited to provide an opportunity for local knowledge and views to be shared with the proposal team	Early 2015

Consultation and communication tool	Purpose	Timing
Local media: - advertisements - media releases	- Raise awareness and understanding - Provide information and promote channels through which stakeholders can communicate their views, issues and concerns - Celebrate project milestones publically	Ongoing
Project database	- Record all correspondence relating to the proposal, including feedback, concerns, and comments	Established in 2014, ongoing

4.3 Results of consultation relevant to the EIS

A summary of the key issues raised during consultation relevant to the EIS, including the potential impacts to be considered and the information to be provided by the EIS, is provided in Table 4.2. More detailed information on the issues raised by individual stakeholders is provided in Appendix D.

Table 4.2 Summary of issues raised relating to the EIS

Issue category	Issues raised in relation to potential impacts to consider	Where addressed in the EIS
Traffic/access	- Impacts on private and public level crossings	Chapters 7 and 9
	- Impacts on heavy vehicle movements particularly during peak harvest times	Chapter 9
	- Safety impacts associated with proposal and motorists and heavy vehicle movements over the rail alignment	Chapters 9 and 25
Biodiversity	- Impact of weeds and management strategies to prevent spread to neighbouring agricultural properties	Chapter 10
Noise	- Impact of noise and vibration during operation	Chapters 11 and 12
Flooding	- Impact of flooding on construction and operation	Chapter 15
Heritage	- Impacts on culturally important locations to be assessed	Chapter 18
Socio-economic	- Potential benefits of the Inland Rail project including increased opportunities for education, employment and vocational training; increased modal competition between road and rail; improved road safety and community amenity - Amenity impacts to residential receivers near the proposal	Chapter 21

Issue category	Issues raised in relation to potential impacts to consider	Where addressed in the EIS
Visual amenity	- Visual impacts during operation, and the need to consider mitigation strategies such as tree screening	Chapter 19
Land use/properties	- Process of property acquisition	Chapters 20 and 21
Bushfire	- Corridor maintenance to avoid bushfire and other damage	Chapter 25

4.3.1 Consultation undertaken as an input to the SEARs

A summary of issues raised by government agencies consulted by the Department of Planning and Environment during preparation of the SEARs is provided in Table A.3 in Appendix A, together with a reference to where they are addressed in the EIS.

4.4 Consultation during exhibition of the EIS

The EIS will be placed on public exhibition for a minimum of 30 days. During that time, the consultation tools implemented during preparation of the EIS will continue to be used, where relevant. Consultation tools used during this period will include:

- advertisements in the local media giving information regarding the proposal and display of the EIS
- issuing of newsletters to the community (Council newsletters, e-newsletter, other).

The EIS will be available for viewing at the following locations:

- Department of Industry, Skills and Regional Development, Level 48, MLC Centre, 19 Martin Place, Sydney
- EPA, Level 13, 10 Valentine Avenue, Parramatta
- Department of Planning and Environment Information Centre, 320 Pitt Street, Sydney
- Department of Planning and Environment, Western Region Office, Information Centre - Area 1, Level 1, 188 Macquarie Street, Dubbo
- Parkes Shire Council Administration Centre, 2 Cecile Street, Parkes
- Narromine Shire Council Administration Centre, 124 Dandaloo Street, Narromine
- Peak Hill Library, 98 Caswell Street, Peak Hill
- Nature Conservation Council of NSW, Level 14, 338 Pitt Street, Sydney.

The document can be viewed at the Department's website (www.majorprojects.planning.nsw.gov.au) and at a NSW Service Centre near you.

The EIS will also be made available for viewing on the Department of Planning and Environment and Inland Rail websites. The public will be able to review the EIS and send submissions to the Department of Planning and Environment for consideration.

Community information sessions and briefings will be held during the display to enable community members and representatives to ask questions and to provide feedback to ARTC project team members.

At the completion of the display period the Department of Planning and Environment will provide ARTC with a copy of all public and government submissions and a summary of issues raised. ARTC will deal with any submissions received in accordance with the Regulation. A submisssions report will be prepared responding to the issues raised, and will be made available for viewing on the Department of Planning and Environment website. ARTC will continue to liaise directly with key stakeholders regarding the proposal's progress. If changes to the proposal need to be made, a preferred project report would be prepared.

While all submissions received will be posted on the Department of Planning and Environment website, if requested, the privacy of submitters will be protected by removing names from submissions.

4.5 Consultation during design and delivery of the proposal

4.5.1 Consultation and community feedback

Consultation with the community and key stakeholders would be ongoing in the lead up to, and during construction. The consultation activities would ensure that:

- the community and stakeholders have a high level of awareness of all processes and activities associated with the proposal
- accurate and accessible information is made available
- a timely response is given to issues and concerns raised by the community
- feedback from the community is encouraged
- opportunities for input are provided.

The 1800 phone number and proposal email address would continue to be available during construction, along with a 24-hour construction response line. Targeted consultation methods, such as letters, notifications, signage and face-to-face communications, would continue to occur. The Inland Rail website and social media platforms would also include updates on the progress of the proposal.

The following communication tools and activities used during the construction phase would include:

- development of a communication plan detailing a complaints handling process
- proposal email address
- 1800 phone number
- updates to the Inland Rail website
- targeted consultation and notifications such as letters, notifications, and face to face communication
- construction signage.

4.5.2 Complaints management

The construction contractor engaged to construct the proposal would be required to implement a complaints management procedure during construction of the proposal. This procedure would be defined within the Construction Environmental Management Plan (CEMP), which the contractor would be required to prepare and have approved by ARTC prior to construction commencing.

The complaints management procedure would include the following at a minimum:

- contact details for a 24-hour project response line and email address, for ongoing stakeholder contact throughout the proposal
- provision of accurate public information signs while work is in progress

- staging of works, developed in consultation with relevant stakeholder groups, to minimise disruption and impacts to community activities and functions
- management of complaints in accordance with ARTC's emergency management procedure, specifically:
  - details of all complaints received will be recorded
  - verbal and written responses will be provided within time limits.

PART B: Proposal

5. Strategic context and need for the proposal

This chapter describes the strategic planning context, and the key issues and demands, that have influenced the need for, and development of, Inland Rail together with the proposal as part of the overall Inland Rail project. A summary of the need for Inland Rail and the proposal is also provided.

5.1 Strategic planning context

5.1.1 The existing situation

There is no direct continuous inland rail link between Melbourne and Brisbane, with interstate rail freight travelling between Melbourne and Sydney via Albury, and then between Sydney and Brisbane, generally along the coast. About 70 per cent of the freight between Melbourne and Brisbane is carried by road, principally the Newell Highway in NSW, and connecting highways in Victoria and Queensland (Transport for NSW, 2015).

The idea for extending the Australian rail network to provide an inland railway between Melbourne and Brisbane has been around for at least one hundred years (Inland Rail Implementation Group, 2015). In the last decade, the concept of an inland railway between Melbourne and Brisbane has been subject to significant analysis for the following reasons (ARTC, 2010):

- the existing north–south coastal railway will reach capacity in the medium term, and additional capacity will be required to service future demands for interstate and regional rail freight
- the efficiency and service quality associated with the existing coastal route is currently impacting on freight productivity and transport costs
- road freight transport has a competitive advantage over rail, making it difficult for rail to increase its market share
- road freight is associated with the potential for safety, congestion and environmental costs as a result of the movement of heavy vehicles on roads
- rail paths on the coastal route through Sydney are shared between passenger and freight trains, impacting on the reliability of rail freight, and constraining opportunities for the expansion of passenger services.

Two major studies have been undertaken in relation to the development of an inland rail route between Melbourne and Brisbane. The first study, the *North–South Rail Corridor Study* (Department of Transport and Regional Services, 2006) considered potential corridors for the rail line. This study is described in section 6.1.3. As an outcome of the study the 'far-western sub-corridor', via Parkes, Moree and Toowoomba, was identified as the preferred corridor for a Melbourne-Brisbane inland railway.

In 2008, the then Minister for Infrastructure, Transport, Regional Development and Local Government announced a study to determine the optimum alignment, as well as the economic benefits and likely commercial success, of a new standard gauge inland railway between Melbourne and Brisbane. This study, the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) developed the current Inland Rail alignment (as shown in Figure 5.1).

Figure 5.1 Proposed alignment for Inland Rail

The conclusions of the *Melbourne–Brisbane Inland Rail Alignment Study* include:

- there is demand for an inland railway
- the route for an inland railway would be more than 100 kilometres shorter than the existing coastal route
- the preferred alignment could achieve an average Melbourne to Brisbane transit time (terminal to terminal) of less than 24 hours, compared to a transit time on the existing coastal route of about 27 hours and 30 minutes
- the inland railway would free up rail and road capacity through Sydney
- the inland railway would achieve a positive economic net present value between 2030 and 2035, and if demand volumes grow more strongly than forecast, viability could be reached sooner.

In November 2013, the Minister for Infrastructure and Regional Development announced that the Australian Government had committed $300 million to enable the development of Inland Rail to commence, starting with pre-construction activities such as detailed corridor planning, environmental assessments, and community consultation. The Minister also announced that a high-level Implementation Group would be formed to drive the project. The alignment identified by the *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) was endorsed by the Implementation Group as the base case for further work (Inland Rail Implementation Group, 2015).

In 2014, the Implementation Group appointed ARTC to develop a business case and a 10-year delivery plan for Inland Rail. Planning and design work for the two projects in NSW is underway:

- Parkes to Narromine (the proposal)
- Narrabri to North Star (subject to a separate application).

Further information on the options and alternatives considered is provided in chapter 6.

5.1.2 Consistency with Australian, State and regional strategic planning

The strategic context of Inland Rail (including the proposal) is influenced by the outcomes of a number of strategic plans for transport, development, and freight that have been prepared at the national, state, and regional levels. Key national and state strategies, policies, and plans have also informed and influenced the vision, objectives, and development of Inland Rail and the proposal.

The proposal, as part of Inland Rail, is consistent with the following relevant strategies:

National

- *Australian Infrastructure Plan* (Infrastructure Australia, 2016)
- *State of Australia's Cities 2014-2015* (Department of Infrastructure and Regional Development, 2015)
- *Urban Transport Strategy* (Infrastructure Australia, 2013)
- *National Land Freight Strategy* (Standing Council on Transport and Infrastructure, 2013)
- *National Ports Strategy* (Infrastructure Australia, 2011)

NSW

- *State Priorities: NSW Making it Happen* (NSW Government, 2015)
- *Newell Highway Corridor Strategy* (NSW Government, 2015)
- *Rebuilding NSW – State Infrastructure Strategy* (NSW Government, 2014a)
- *NSW Freight and Ports Strategy* (NSW Government, 2013)
- *NSW Road Safety Strategy 2012-2021* (Transport for NSW, 2012)
- *NSW Long Term Transport Master Plan* (Transport for NSW, 2012)

Regional/local

- *Draft Central West and Orana Regional Plan* (NSW Government, 2016)
- *Economic Development Strategy for Regional NSW* (DTIRIS, 2015)
- *A Plan for Growing Sydney* (NSW Government, 2014b)
- *Central West Regional Transport Plan and the New England North West Transport Plan* (Transport for NSW, 2013)
- *Central West Freight Study* (Regional Development Australia Central West, 2013).

Further information on these strategies and their relationship to Inland Rail and the proposal in provided in Appendix E.

5.2 Summary of key issues and demands

A summary of the key issues and demands relevant to the development of, and need for, Inland Rail (including the current proposal) is provided below. A detailed analysis of the issues and project drivers is provided in the *Programme Business Case* (ARTC, 2015) and in the *Inland Rail Implementation Group Report* (Inland Rail Implementation Group, 2015).

5.2.1 Growth in freight demand

In 2011, the domestic rail freight task totalled 261.4 billion tonne kilometres, accounting for approximately 46 per cent of total domestic freight. This represents an increase of 91 per cent since 2000–01 (Infrastructure Australia, 2015).

The *Infrastructure Audit* (Infrastructure Australia, 2015) notes that:

- the national land freight task is expected to grow by 80 per cent between 2011 and 2031
- demand for freight rail infrastructure is projected to grow, in particular for resource bulk commodity haulage in WA, Queensland and NSW
- freight rail will need to play a growing role in the movement of goods between ports and inland freight terminals, and in the movement of containerised and general freight over longer distances.

The Melbourne to Brisbane corridor is one of the most important general freight routes in Australia, supporting key population and employment precincts along the east coast and inland NSW. The non-bulk and complementary volumes moving within the corridor are currently estimated at 21 million tonnes per annum. This is expected to grow to over 40 million tonnes per annum by 2050 (Infrastructure Australia, 2016).

The eastern states of Australia comprise 18 million residents (79 per cent of Australia's population), nine million jobs (78 per cent of Australia's national employment) and contributes $1.1 trillion in gross state product (75 per cent of gross domestic product). Interstate freight transport is projected to increase by 70 per cent between 2015 and 2030, to 140 billion tonne kilometres. The Melbourne to Brisbane corridor already supports 17 per cent of these interstate movements (ARTC, 2015).

With the population of the eastern states forecast to increase by 60 per cent over the next 40 years, the need for efficient and effective freight transport will continue to increase. Strong forecast population growth, accompanied by comparable growth in employment, is likely to place significant pressure on existing infrastructure and services (ARTC, 2015).

Without the increased use of rail, the growth in freight demand is likely to result in increasing pressure on the road network and associated issues, increased freight costs, and a loss of economic opportunity.

5.2.2 Existing freight capacity and infrastructure issues

As the demand for regional and interstate freight transport grows, rail and road infrastructure in the north–south corridor will face progressive challenges in meeting future demand. There will be increasing pressure on freight capacity between capital cities and from the regions to export ports and urban freight destinations.

Freight trains travelling along the Melbourne to Brisbane corridor currently travel through the Sydney metropolitan rail network, often experiencing significant delays. Travel time reliability is poor, as a result of the priority given to passenger services, freight transit curfews in the Sydney metropolitan area, and substandard rail alignments elsewhere. Limited capacity during morning and afternoon passenger peaks restricts freight movements at these times (NSW Government, 2013).

The *Australian Infrastructure Plan* (Infrastructure Australia, 2016) notes that the existing north–south rail corridor between Melbourne and Brisbane does not provide a service offering that is competitive with road transport. This is largely the result of 19th century alignments leading to low travel speeds and reliability, and major bottlenecks, most notably in the Sydney metropolitan area.

Infrastructure Australia (2016b) notes that the demand for urban transport infrastructure is projected to increase significantly. Without action, the cost to the wider community of congestion on urban roads could rise to more than $50 billion each year by 2031. Demand for many key urban road and rail corridors is projected to significantly exceed current capacity by 2031.

The *National Land Freight Strategy* identifies a number of existing challenges facing road and rail freight in general, including:

- congestion from increasing numbers of passenger vehicles, and the priority given to passenger vehicles over freight vehicles in urban transport, can adversely impact on the efficiency of freight vehicle movement
- the encroachment of urban development on freight routes and precincts as cities grow in size and density leads to an increased potential for amenity, environmental and interface issues.

The *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010) indicated that:

- there are likely to be capacity constraints on the existing coastal railway unless significant capital works are undertaken
- the coastal railway between Sydney and Brisbane would reach capacity around 2052.

The issues associated with the existing regional rail systems also include the fact that much of the infrastructure is old and has maintenance and renewal issues. Poor maintenance of rail lines leads to more freight being transported by road, imposing additional maintenance burdens on the affected councils (Infrastructure Australia, 2015).

5.2.3 Assessment of demands for Inland Rail

Continued growth in freight volumes is giving rise to a range of increasingly complex challenges for government, industry and the community. Over the last four decades, the Australian freight task (that is, the amount of freight transport, usually measured in tonnes or tonne-kilometres) has quadrupled, with major increases evident in road and rail transport. Forecasts indicate that the total freight task will continue to grow, and is estimated to nearly double by 2030 based on 2010 levels (Infrastructure Australia, 2012).

The Programm*e Business Case* (ARTC, 2015) provides a detailed description of the potential demand for Inland Rail. The demand projections have been used to:

- estimate the potential revenue of Inland Rail
- assess the economic benefits arising from mode shift from road and the coastal route to Inland Rail
- determine the appropriate capacity of Inland Rail
- determine appropriate service frequency and the impact of this on capacity utilisation, railway and train operating costs.

The main categories of freight that are expected to comprise the market for Inland Rail are non-bulk manufactured products, including bulk steel, paper, coal and grain. The demand analysis indicates that (ARTC, 2015):

- Inland Rail is expected to increase rail's share of the Melbourne to Brisbane freight market from the current 26 per cent to 62 per cent by 2049-50. Similarly, it is estimated that Inland Rail would increase rail freight's share of the Adelaide to Brisbane market by 28 per cent and Brisbane to Perth's share by seven per cent
- better connections to the Port of Brisbane would result in an estimated two million tonnes of freight shifting from road to rail by 2049–50, particularly grain and cotton from New England, as well as grain on both rail and road from the Darling Downs to the Port of Brisbane. In NSW, a significant tonnage of grain (approximately 7.5 million tonnes, spread) would also use Inland Rail on its way to NSW ports
- Inland Rail would attract induced freight such as coal in the Surat and Clarence-Moreton Basins, which would increase from the current eight million tonnes to 19.5 million tonnes.

5.3 Need for the proposal

5.3.1 Need for Inland Rail

As noted in the *National Land Freight Strategy* (Standing Council on Transport and Infrastructure, 2013) 'The efficient movement of land freight is crucial for Australia's productivity and competitiveness, and affects the lives of every Australian'. The existing rail mode share of freight between Melbourne and Brisbane (averaging the two directions) varies between approximately 22 to 27 per cent for non-bulk freight, to 60 to 90 per cent for commodities transported in bulk (ARTC, 2010).

The National Land Freight Strategy notes that the infrastructure supporting the movement of land freight, such as road, rail and ports, must be sufficient for the significant projected growth in demand for freight transport (noted in section 5.2.1).

Rail is generally the most productive and efficient mode for freight travelling from regional areas to export ports and urban destinations. Rail has traditionally dominated the freight market for mining and agricultural commodities, particularly iron ore, coal, grains, rice, cotton, and sugar for processing or export (ARTC, 2015). As noted by the Minister for Infrastructure and Regional Development (2013), 'an efficient rail freight network is the key to effective supply chains, national productivity and competitiveness'.

Inland Rail is needed to improve the efficiency of freight moving between Melbourne and Brisbane. Inland Rail would bypass the Sydney metropolitan area, it would substantially cut the overall journey time to less than 24 hours, and increase the reliability of services between Melbourne and Brisbane (Infrastructure Australia, 2016). This is expected to increase the competitiveness of rail transport relative to road transport (ARTC, 2014).

As noted by the *Australian Infrastructure Audit Report* (Infrastructure Australia, 2015) 'Rail offers an alternative to road transport and societal benefits in terms of lower emissions, reduced road congestion and increased safety per tonne kilometre, particularly over longer distances or when carrying heavy goods.'

In summary, Inland Rail is needed to respond to the growth in demand for freight transport (as described in section 5.2.1), and address existing freight capacity and infrastructure issues (described in section 5.2.2). The analysis of demands undertaken by ARTC indicated that there would be sufficient demands for Inland Rail (described in section 5.2.3).

With respect to the need for the proposal, the Inland Rail Implementation Group (2015) found that:

- without Inland Rail, the amount of freight travelling by road between Melbourne and Brisbane in 2050 will be approximately 7.1 million tonnes, 2.3 million tonnes more than what would be on the road with Inland Rail
- key transport links are experiencing increasing capacity constraints and congestion as a result of inadequate infrastructure
- current investment in road and rail is insufficient to address Australia's future freight task
- further population and freight growth along the north-south corridor will increase the demand for transport services at a local, state and national level, placing freight corridors under severe pressure and compounding the inefficiencies that already exist
- if capacity constraints and congestion resulting from inadequate infrastructure are not overcome, national productivity and economic growth will be constrained with environment and safety outcomes also becoming increasingly sub-optimal.

5.3.2 Need for the proposal

Inland Rail consists of 13 geographically based projects, involving:

- building sections of new or 'greenfield' route
- upgrading sections of existing secondary lines to meet Inland Rail's performance specification
- enhancing sections of existing main lines, mainly to improve vertical and horizontal clearances between infrastructure above the rail corridor and the tracks themselves, to enable trains with double stacked containers to pass safely beneath.

The proposal involves upgrading an existing secondary rail line to meet Inland Rail's performance specification. Development of both the proposal and the Narrabri to North Star project is required to enable implementation of Inland Rail to align with funding availability.

6. Alternatives and proposal options

This chapter provides a summary of the alternatives that have been considered as part of the development of Inland Rail. These included the strategic alternatives to Inland Rail as a whole (including road upgrades, upgrading the east coast railway, and greater use of maritime and air freight), and alternative route locations. The chapter also includes a summary of the main options that were considered during the concept design process for the proposal. Information on how the options were developed and assessed is provided.

6.1 Inland Rail alternatives

6.1.1 Strategic alternatives - alternative freight transport solutions

Alternative freight transport solutions with the potential to address Australia's current and future freight challenges were considered as part of a strategic options assessment set out in the *Programme Business Case* (ARTC, 2015), and examined in the *Inland Rail Implementation Group Report* (2015).

Strategic options assessment

Three options were assessed by the *Programme Business Case* (ARTC, 2015):

- progressive road upgrades
- upgrading the existing east coast railway
- an inland railway.

These options were subjected to a rigorous assessment consistent with Infrastructure Australia's Reform and Investment Framework Guidelines. The options were assessed against seven equally weighted criteria:

- capacity to serve east coast future inter-capital regional/bulk freight market needs
- foster economic growth through improved freight productivity and service quality (including improved reliability and resilience)
- optimise environmental outcomes
- alleviate urban constraints
- enable regional development
- ease of implementation
- cost-effectiveness.

Overall, constructing an inland railway ranked highest, with an average high likelihood of improving outcomes across all criteria. Progressive road upgrades and upgrading the existing east coast railway both had an average medium overall ranking across all criteria. In relation to individual criteria, progressive road upgrades outranked an inland railway only in relation to ease of implementation, and ranked equally with an inland railway in relation to enabling regional development outcomes. An inland railway was found to be the best option across all other criteria.

Review of alternatives

The following alternatives were reviewed by the Inland Rail Implementation Group:

- maritime freight
- air freight
- road freight
- rail solutions.

The results of the review of alternatives undertaken by the Inland Rail Implementation Group are summarised below:

Maritime shipping

Maritime freight was examined as a potential alternative to Inland Rail based on two types of services:

- a dedicated service between the Melbourne and Brisbane (coastal shipping)
- using spare capacity on vessels calling at Melbourne and Brisbane as part of an international voyage.

The Inland Rail Implementation Group report (Inland Rail Implementation Group, 2015) concluded that:

- shipping is unlikely to be a strong alternative to Inland Rail, as it does not provide the level of service (transit time and service availability) required by the majority of the Melbourne to Brisbane interstate market
- shipping still has a role to play, especially due to its strengths in transporting high volume and long distance cargo around the coast. Shipping must be used in conjunction with other modes such as inland rail to meet Australia's future transport needs.

Air freight

Domestic air freight accounts for less than 0.01 per cent of total domestic freight movements in Australia by weight. The majority of these movements are comprised of newspapers and parcels between major cities, on either dedicated freight flights or on existing passenger flights. Air freight is highly specialised due to the inherent constraints on aircraft size and the nature of the goods that can be carried. The report (Inland Rail Implementation Group, 2015) concluded that:

- air freight has a limited role in the transport of bulky or heavy goods on the Melbourne to Brisbane corridor, but will continue to play a crucial role for small, high-value and time-dependant goods
- air freight is not a viable alternative for addressing Australia's freight requirements on the Melbourne to Brisbane corridor into the future.

Road freight

The role of road transport was considered as a potential alternative to Inland Rail. While rail carries a larger volume of freight overall, road transport is the main mode of transport for the majority of commodities produced or consumed in Australia. Along the north–south corridor, the main routes for road freight are on the Hume Highway (between Sydney and Melbourne), the Pacific Highway (for coastal transport between Sydney and Brisbane), and the Newell Highway (between Melbourne and Brisbane).

The identified issues and considerations relevant to road freight on these corridors include:

- the north–south road corridor will face significant local and regional capacity constraints for road freight in the medium to longer term
- the mix of local traffic, private vehicles, and freight vehicles on road transport corridors reduces reliability as a result of the different average travel speeds between cars and heavy vehicles, and increases accident rates
- conflicts between local traffic, private vehicles and freight vehicles on these corridors will increase in line with significant forecast growth in population, employment, and demands for freight transport
- compared with rail, road freight results in additional environmental costs, including from air pollution, greenhouse gas emissions, and water pollution

- the cost to freight operators of congestion in urban areas as a result of reduced travel speeds and reliability for freight transport is estimated to be around $60 million per year for Melbourne to Brisbane inter-capital freight alone
- Australian and State governments are investing in road infrastructure along the north – south corridor. However, this investment will be insufficient to remove all the existing and predicted future issues along the full length of the corridor, leaving trucking productivity exposed to the cumulative effects of the remaining deficiencies.

The report concluded that:

- while road transport will continue to contribute to Australia's freight task, unless substantial additional investment is made, it will be unlikely to meet the longer term needs for Australia's freight task alone
- should the Australian Government decide not to proceed with a rail solution, further investigation of road transport is required to determine its capacity to manage the future north–south freight task.

Rail solutions

The two main rail solutions considered were enhancing the existing east coast railway, and constructing a new inland railway.

The report noted that there are a number of capacity, reliability, and performance issues associated with the existing east coast railway, mainly relating to constraints associated with moving freight trains through the Sydney metropolitan rail network.

As a sub-option of enhancing the existing east coast railway, the report noted that the proposed new Outer Sydney Orbital corridor would provide opportunities for a rail route that could ease freight congestion on Sydney freight networks. However, the main role of this corridor is to address freight capacity constraints on other routes, such as those for intrastate and export freight. In addition, this option would not provide significant transit time savings for Melbourne to Brisbane freight, as the missing link between northwest NSW and southern QLD would still be required, or the existing coastal line would need to be upgraded. The report concluded that use of the Outer Sydney Orbital corridor would complement, but not replace, Inland Rail.

The report concluded that:

- for Melbourne to Brisbane freight, the existing east coast railway would not be competitive with road in terms of cost or time, even with significant further investment, and it is not a viable alternative to Inland Rail
- Inland Rail would meet Australia's future freight challenge, and bring significant and positive national benefits by boosting national productivity and economic growth, while promoting better safety and environmental outcomes.

Summary of findings

Overall, in relation to the various alternatives to Inland Rail, the Implementation Group concluded that (Inland Rail Implementation Group, 2015):

- while shipping and air will continue to play a role in the interstate freight market, they are not viable alternatives to rail
- without Inland Rail, road is the only mode capable of addressing the majority of the future freight task, with associated direct and indirect costs.

6.1.2 The 'do nothing' alternative

Not developing Inland Rail would result in continued growth in the use of road for freight transport between Melbourne and Brisbane, particularly along the Newell Highway. The issues associated with using road transport alone to address Australia's freight needs into the future are considered in section 6.1.1. In addition, road transport will be unlikely to meet the longer term needs for Australia's freight task alone unless substantial additional investment is made (Inland Rail Implementation Group, 2015).

6.1.3 Alternative locations/route options for Inland Rail

Alternative routes for Inland Rail have been considered by the following two studies.

- *North–South Rail Corridor Study* (Department of Transport and Regional Services, 2006)
- *Melbourne–Brisbane Inland Rail Alignment Study* (ARTC, 2010).

The results of the studies are summarised below.

North–South Rail Corridor Study

The *North–South Rail Corridor Study* considered potential corridors for the rail line to determine which route would deliver the best economic and financial outcome.

Options identified

Potential options were identified within a ‘north–south rail corridor’, which comprises an elliptically-shaped area defined by the standard gauge rail line along the NSW coast, and a broad arc west of Shepparton, Jerilderie, Coonamble, Burren Junction, Goondiwindi and Toowoomba. This area covers all sections of the existing rail network in Victoria, NSW, and Queensland that currently form, or could potentially form, part of a freight route between Melbourne and Brisbane.

Within this corridor, four sub-corridors were identified for comparative analysis, each of which could be combined with alternative routes between Melbourne and Junee, via Shepparton or via Albury. The four sub-corridors comprised:

- Far-western sub-corridor – linking Junee to Brisbane via Parkes, Dubbo and/or Narromine, Coonamble, Burren Junction, Narrabri and/or Moree, North Star, Goondiwindi, Warwick and/or Toowoomba.
- Central inland sub-corridor – linking Junee to Brisbane via any inland route that includes the Werris Creek to Armidale to Tenterfield rail links.
- Coastal sub-corridor – following the existing coastal route between Junee and Brisbane (via Goulburn), through Sydney.
- Hybrid sub-corridor – combining elements of an inland and coastal route, linking Junee to Brisbane via Muswellbrook and Maitland.

Within each of these sub-corridors, the feasibility of 136 possible route options was investigated. These options involved different amounts of new track and/or upgrading existing sections of track.

Analysis of options

The route options were compared using an optimisation model specifically developed for the study, based on the following criteria:

- operating efficiency
- infrastructure requirements
- market demand
- environmental constraints
- financial and economic viability.

The study identified potential demand, financial issues, environmental issues, and infrastructure costs relevant to the four sub-corridors. The analysis undertaken for the study concluded that the far-western sub-corridor was markedly superior to the other alternatives.

Melbourne–Brisbane Inland Rail Alignment Study

The purpose of the *Melbourne–Brisbane Inland Rail Alignment Study* was to determine the optimum alignment as well as the economic benefits and likely commercial success of a new standard gauge inland railway between Melbourne and Brisbane. The terms of reference for the study required it to develop a detailed route alignment, generally following the far western sub-corridor identified by the *North-South Rail Corridor Study*.

Options identified

The *Melbourne–Brisbane Inland Rail Alignment Study* short-listed and analysed a number of route options. The stages of route analysis involved:

- identification of the route – evaluation of the route options and preliminary analysis for the three main areas: Melbourne to Parkes; Parkes to Moree; and Moree to Brisbane
- analysis of the route – the route was analysed in terms of capital cost, environmental impacts and journey time, as well as its preliminary economic and financial viability
- development of the preferred alignment – the alignment was developed considering environmental and engineering factors.

The study noted that, with the combination of numerous route options and sections, there were over 50,000 possible options for the route between Melbourne and Brisbane. As it was not feasible to analyse each option, two key criteria (capital cost and journey time) were used to establish a shortlist of route options in each of the three main areas. The shortlist included:

- Melbourne to Parkes – two main options:
  - via Albury, using existing track from Melbourne to Parkes (with a possible new direct line from Junee or Illabo to Stockinbingal by-passing Cootamundra)
  - via Shepparton, using the existing broad gauge Mangalore–Tocumwal line via Shepparton, the disused standard gauge line to Narrandera, and a new direct connection through to near Caragabal, before re-joining the existing line to Parkes.
- Parkes to Moree – four main options:
  - Parkes to Moree via Werris Creek, using existing track (with a new section of track at Binnaway and Werris Creek to avoid reversals)
  - Parkes to Moree via Binnaway and Narrabri, using existing track to Binnaway, and then a new section connecting to the existing track near Emerald Hill or Baan Baa
  - Parkes to Moree via Curban, Gwabegar and Narrabri, using existing track to Narromine, predominately new track between Narromine and Narrabri, and existing track from Narrabri to Moree
  - Parkes to Moree via Burren Junction, using existing track to Narromine, and predominately new track via Coonamble and Burren Junction to Moree.
- Moree to Brisbane – two main options:
  - the Warwick route, a new ‘greenfield’ route via Warwick to the existing standard gauge Sydney–Brisbane lined
  - the Toowoomba route, a new corridor direct from Inglewood to Millmerran and Oakey, near Toowoomba, and then a new alignment down the Toowoomba range, and use of the proposed Southern Freight Rail Corridor from Rosewood to Kagaru.

Analysis of options

The shortlist of route options was subjected to more detailed technical, financial and economic assessment. The option involving use of existing track towards Werris Creek had the lowest capital expenditure whilst still meeting the performance specification. This option had a length of about 1,880 kilometres. The option involving the more direct route between Narromine and Narrabri had the fastest transit time for a reasonable capital expenditure. This option, which had a length of about 1,731 kilometres, became the focus for more detailed route, demand, economic and financial analysis.

Refining the proposed alignment involved an iterative process, with evaluation of the following:

- environmental and land issues
- railway operations considerations
- engineering assessments
- capital cost estimates.

The final preferred alignment, between South Dynon in Melbourne and Acacia Ridge in Brisbane, incorporated:

- Melbourne to Parkes – 670 kilometres of existing track and 37 kilometres of new track on a greenfield alignment from Illabo to Stockinbingal, bypassing Cootamundra and the Bethungra spiral
- Parkes to North Star – 307 kilometres of upgraded track, and 291 kilometres of new track on a greenfield alignment from Narromine to Narrabri
- North Star to Acacia Ridge – 271 kilometres of new track on a greenfield alignment, 119 kilometres of existing track upgraded from narrow gauge to dual gauge, and 36 kilometres of the existing coastal route.

6.2 Proposal option development

6.2.1 Approach to the option development and design process

Option development has been an integral part of the overall design process for the proposal. An iterative process of option selection, design development, and evaluation has been undertaken to define the proposal to date. Further to the strategic and initial planning studies for Inland Rail, as described in section 5.1, the design process for the proposal involves the following general phases:

- phase 1 – concept design
- phase 2 – feasibility design
- phase 3 – detailed design.

The proposal as described in this EIS is based on the outcomes of the feasibility design. The detailed design would take into account the outcomes of the feasibility design phase; the findings of this EIS, including the mitigation measures detailed in chapters 9 to 26 (and summarised in chapter 27); and any conditions of approval (if the proposal is approved).

The design has, and will continue to, evolve over these phases as a result of engineering, traffic, financial, economic and environmental considerations. The option selection and design process has also taken into account the issues raised during consultation with relevant stakeholders (refer to chapter 4), and the findings of preliminary environmental investigations.

6.2.2 Option assessment process

Options assessments have been undertaken for the following features of the proposal:

- track upgrading
- crossing loops
- level crossings

- Parkes north west connection
- Brolgan Road overbridge.

A summary of the outcomes of the options assessments for these features is provided in section 6.3. In general, the assessments involved the following tasks:

- confirm requirements
- identify options to be assessed
- review potential impacts, constraints, risks and opportunities associated with each option
- agree on evaluation criteria
- assess the options against the criteria using a multi-criteria analysis
- identify the preferred option
- reporting.

6.3 Options considered for proposal features

6.3.1 Track upgrading

Within the existing rail corridor, the existing track and formation needs to be upgraded/replaced to meet the operational requirements for Inland Rail, in particular, for the types and speeds of trains that would use Inland Rail.

Options considered

The track consists of the rails, fasteners, sleepers and ballast. The formation consists of the foundation material beneath the ballast and above the sub-grade. It is comprised of structural fill but may also include a capping layer. Three options for upgrading the track and/or formation were considered:

- track reconstruction – replacing the existing track and formation
- skim reconditioning – using the existing track ballast and sub-ballast as structural capping on the existing consolidated subgrade
- skim plus reconditioning – a combination of skim reconditioning and track reconstruction.

Assessment

Geotechnical investigations were undertaken along the existing rail corridor to provide a preliminary quantification of the extent of each potential treatment option. The results of this investigation were tested against the key parameters for each option.

Preferred option

All three options would be implemented as required, depending on the existing track and formation conditions. The track would be reconstructed in areas where the subgrade strength is inadequate, the existing formation has failed, and/or there is insufficient quality material in the existing track to be retained. Skim reconditioning would be used in areas where the existing ballast and sub-ballast is suitable for reuse. Skim plus reconditioning would be used in areas where there is not enough existing ballast.

6.3.2 Crossing loops

Initial options

A crossing loop is a section of track off to the side of the main track/s that allows a train to move to the side so that another train can pass along the main track. Trains move to the crossing loop via turnouts.

Crossing loops are positioned along a rail line using a network modelling methodology. This identifies locations to provide the maximum number of possible 'train paths' on the network. The number of potential train paths on a network represents the capacity of that network. For Inland Rail, a crossing loop is required around every 25 kilometres.

Assessment

A multi criteria analysis was undertaken to determine the location of crossing loops as part of the proposal, based on network capacity requirements and taking into account local constraints. Considerations included:

- future train lengths
- minimising impacts on level crossings
- existing structures currently recommended to be retained
- distance to a receiver (noise)
- earthwork cut and fill volumes
- access
- geometry.

Preferred option

Based on this assessment, three new crossing loop locations were selected to allow trains to pass safely – at Goonumbla, near Peak Hill, and at Timjelly.

6.3.3 Level crossings

A total of 71 level crossings are located along the proposal site. Of these, 33 are located on public roads (a number of which are Crown roads providing access to a single property), and 38 crossings are located on private roads or maintenance access tracks.

The majority of level crossings along the proposal site have passive forms of control, consisting of stop signs only (66 crossings). Other crossings have active controls (either signage with flashing lights, or signage with flashing lights and boom gates).

Initial options and assessment

ARTC has prepared a level crossing strategy for the proposal. The level crossing strategy involves reviewing all crossings along the proposal site to determine the works required to meet relevant crossing standards, guidelines, and Inland Rail operational criteria. The level crossing strategy consists of two stages:

- Stage 1 – identify options for level crossings and the preferred approach
- Stage 2 – consult with relevant stakeholders (including landowners and road owners) to confirm the preferred approach, and finalise the strategy.

Stage 1 of the level crossing strategy involved:

- identifying all level crossings across the proposal site
- field assessments of crossings
- review existing crossings with regard to Australian and ARTC level crossing design standards
- consulting with stakeholders about the use of crossings
- identifying preferred works and consolidation options for further stakeholder consultation as part of stage 2.

The following options were considered for each level crossing:

- retain existing crossing controls
- upgrade the level of control at the crossing
- construct a gated crossing with administrative controls, such as a requirement to phone train control prior to use
- consider crossing consolidation based on the outcomes of further investigation and stakeholder agreement.

Preferred option

The preferred option for level crossings across the proposal site is listed in Table 6.1.

Table 6.1 Summary of preferred option for level crossings

Action	Number of crossings affected		
	Public	Private	Total
Retain existing crossing controls	20	19	39
Consider crossing consolidation	2	17	19
Upgrade crossing from passive to active (boom barriers)	6	0	6
Upgrade form of active control (from flashing lights to boom barriers)	5	0	5
Provide a gated crossing	0	2	2
Total	**33**	**38**	**71**

The next stage

The next stage in the level crossing strategy involves:

- consulting with stakeholders regarding the preferred option
- reviewing the proposed works for each crossing in detail, taking into account input from stakeholders
- reviewing consolidation options in accordance with the requirements of the *Transport Administration Act 1998*
- preparing detailed designs for works
- stakeholder consultation
- finalise the detailed designs for each crossing, taking into account the results of consultation.

As noted in section 3.4, any closure of level crossings needs to be undertaken in accordance with the requirements of the *Transport Administration Act 1998*. Private level crossings cannot be closed unless there is an alternative means of legal access to the property. Further information on the requirements of the *Transport Administration Act 1998* in relation to level crossings is provided in section 3.4.

6.3.4 Parkes north west connection

Initial options

As described in chapter 2, the southern end of the proposal site commences to the west of Parkes on the existing Parkes to Narromine line. At this location, the existing Broken Hill line extends in an east–west direction. A new connection between the Broken Hill line and Inland Rail is proposed at this location. The connection would enable trains travelling to and from the west on the Broken Hill line to travel north via Inland Rail (currently the Parkes to Narromine line), and for trains travelling south on Inland Rail (currently the Parkes to Narromine line) to travel west via the Broken Hill Line.

Location and configuration options for the new connection were identified with consideration given to the following:

- operational speed
- environmental impacts
- impacts on the existing use of Goobang Junction
- length of new track required
- volume of excavations required
- road changes
- number of properties impacted
- services relocations required.

The following options were identified for further assessment (options are described using the terminology from the assessment report):

- Option 1 – involves 5.3 kilometres of new track that consists of a major departure from the existing corridor (two kilometres long at its furthest point). This option has at grade connections to the main alignment at both the northern and southern ends. A road overbridge would also be required, to enable Brolgan Road to pass over the rail corridor.
- Option 4 – involves three kilometres of new track that consists of a departure from the existing corridor. This option has at grade connections to the main alignment at both the northern and southern ends. A road overbridge would also be required at Brolgan Road.
- Option 5 – involves 0.7 kilometres of new track and realigning the existing track for a distance of 1.7 kilometres. This option has at grade connections to the main alignment at both the northern and southern ends. This option also involves closing the existing road crossing at Brolgan Road, and constructing two new road overbridges.
- Option 6 – involves 0.6 kilometres of new track and realigning the existing track for a distance of 2.3 kilometres. This option has an at grade connection to the main alignment on the eastern end, and it runs next to the existing alignment on a grade separation for 200 metres at the western end.

The location of the options is shown in Figure 6.1.

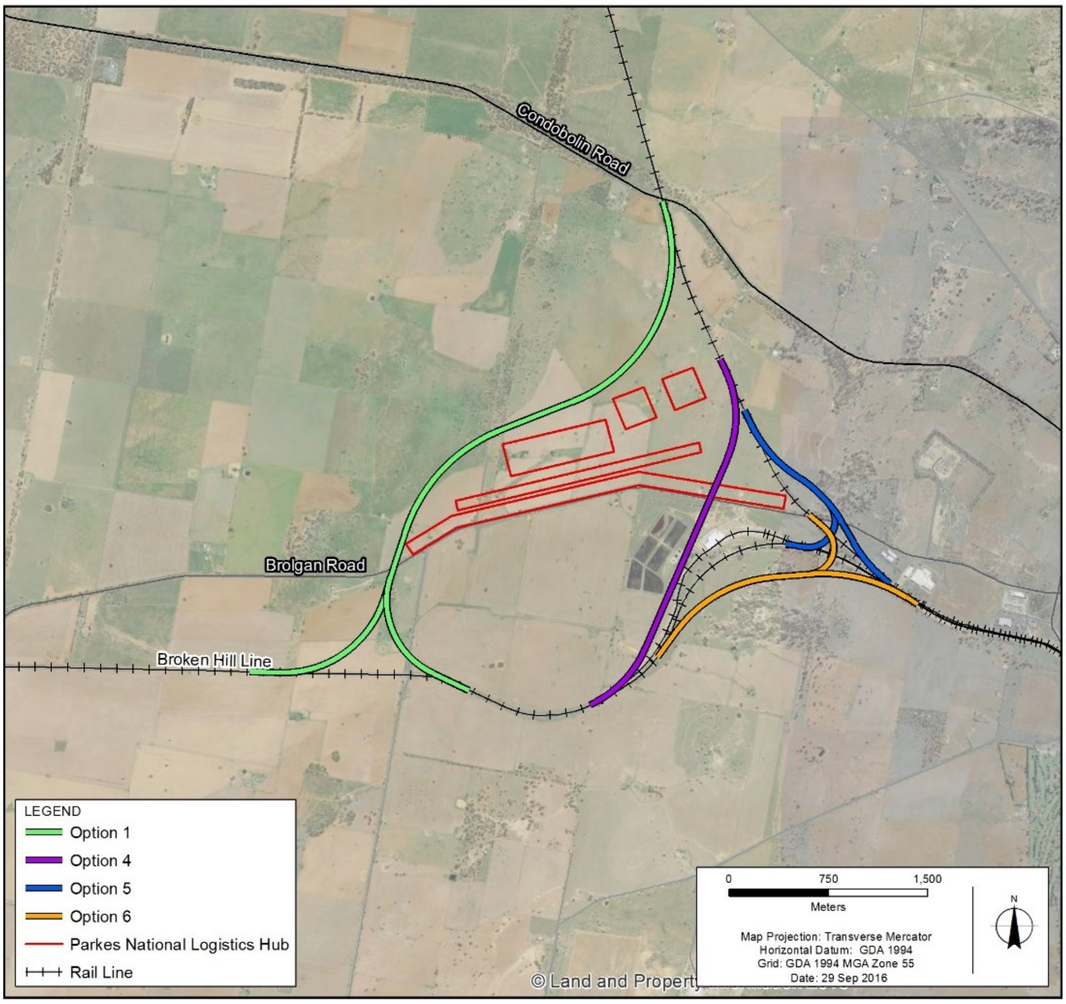

Figure 6.1 Parkes north west connection options

Assessment

A multi-criteria analysis of the options was undertaken. The following criteria were used:

- operational benefits
- safety
- maintenance
- road impacts
- utility impacts
- environmental impacts
- property impacts
- land use
- track
- civil and geotechnical
- structures
- capital cost (based on quantities).

Option 5 scored the highest in the multi-criteria analysis. Further assessment was then undertaken based on additional contributions from stakeholders. This assessment considered the following in more detail:

- turnout arrangements
- interaction with Goobang Junction
- impacts on future intermodal facilities and existing logistics compounds
- weightings of criteria were modified to put more focus on operational benefits, maintenance, and land use.

Another multi-criteria analysis was undertaken.

Preferred option

As an outcome of the additional assessment, option 1 scored the highest and was identified to be the preferred option. This option forms part of the proposal, and further information is provided in chapter 7.

6.3.5 Brolgan Road overbridge

Initial options

As described in section 6.3.4, option 1 for the Parkes north west connection would involve the provision of a road overbridge to enable Brolgan Road to pass over the rail corridor. Following confirmation of option 1 as the preferred option, an options assessment was undertaken to determine the preferred option for the overbridge.

The objectives of the overbridge are to:

- provide a road connection across the Parkes north west connection at Brolgan Road
- provide an overbridge of sufficient height to cater for the height of trains that would use Inland Rail
- minimise environmental impacts
- minimise property impacts
- minimise disruption to road users via closures during construction
- minimise disruption to road users once the Parkes north west connection is operational
- provide the opportunity to construct an extra rail line in the future (if required)
- avoid building new level crossings wherever possible.

The following options were identified and assessed (options are described using the terminology from the assessment report):

- Base case – level crossing: this option would involve provision of a level crossing with active protection.
- Option 1 – online: the overbridge would be constructed at the location of the existing road.
- Option 2 – offline north: the overbridge would be constructed to the north of the existing road.
- Option 3 – offline south: the overbridge would be constructed to the south of the existing road.

The location of the Brolgan Road overbridge options is shown in Figure 6.2.

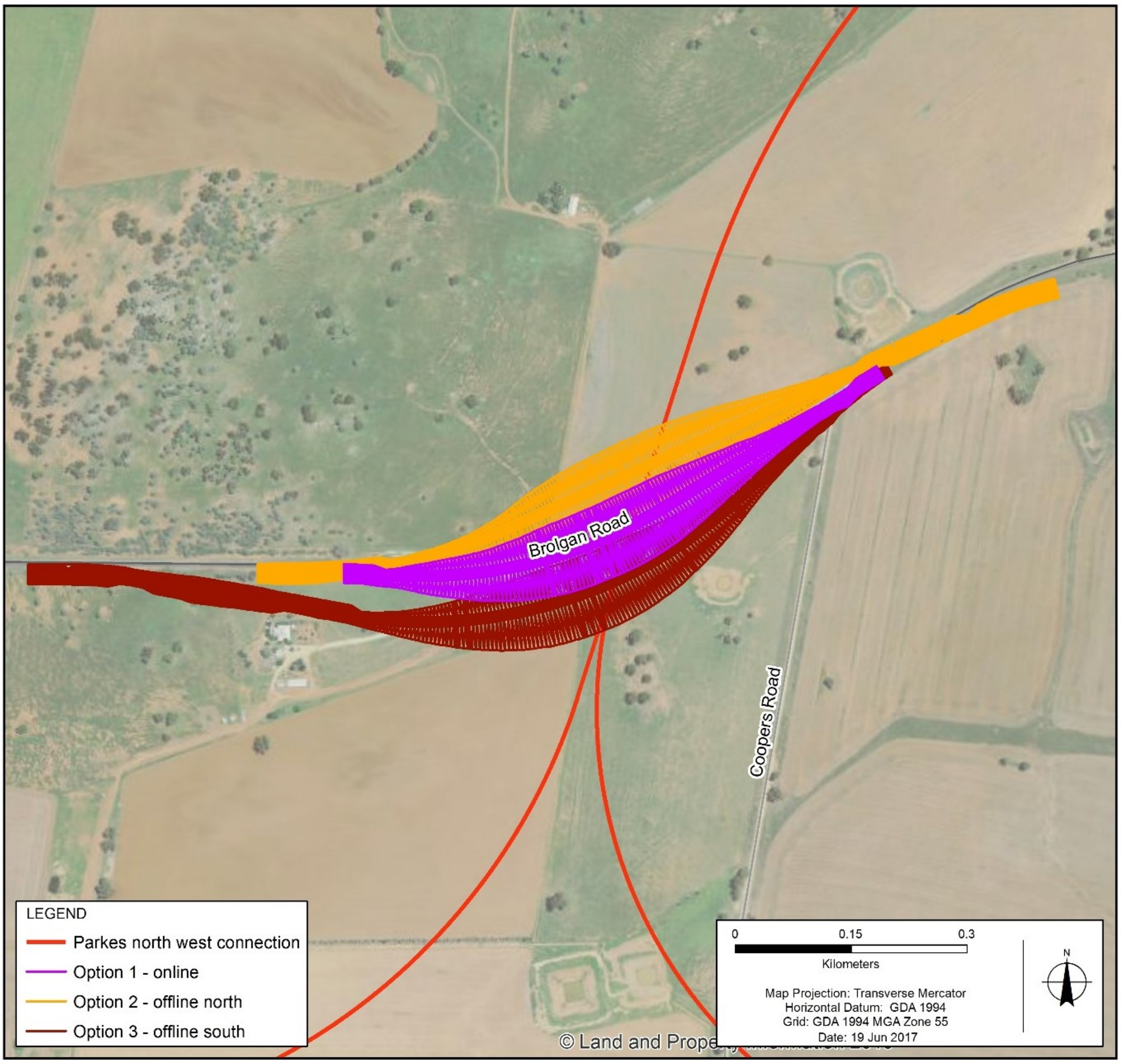

Figure 6.2 Brolgan Road overbridge options

Assessment

A multi-criteria analysis of the options was undertaken. The following criteria were used:

- technical viability
- safety
- operational approach
- constructability and schedule
- approvals and stakeholder risk
- environmental and heritage impacts
- community and property impacts.

Preferred option

The assessment concluded that option 2 (the offline north option) is the preferred option, as it scored highest as an outcome of the multi-criteria assessment. This option has the following benefits:

- improved bridge and road environment (shoulder, line marking etc)
- direct access to cutting material, meaning limited interaction with live traffic apart from tie-in works (minimal staging works)
- no high voltage impacts (clearances to be confirmed)
- no turnout at the bridge location
- limited bridge skew and no horizontal curve through the bridge
- minimal impact to nearby residents.

This option forms part of the proposal (as part of the works required to undertake the Parkes north west connection), and further information is provided in chapter 7.

7. Proposal features and operation

This chapter provides a description of the proposal's features and operation for the purposes of the EIS. It includes a description of the approach to avoiding/minimising impacts during the design of the proposal, the infrastructure proposed, land acquisition likely to be required, and how the proposal would operate. The proposed approach to construction of the proposal is described in chapter 8.

7.1 Overview

7.1.1 The proposal

The key features of the proposal, which are shown in Figure 1.2, are as follows:

- upgrading the track, track formation, and culverts within the existing rail corridor for a distance of 106 kilometres between Parkes and Narromine
- realigning the track where required within the existing rail corridor to minimise tight curves
- providing three new crossing loops within the existing rail corridor, at Goonumbla, Peak Hill, and Timjelly
- providing a new 5.3 kilometre long rail connection to the Broken Hill line to the west of Parkes, ('the Parkes north west connection'), including a road bridge over the new section of rail at Brolgan Road ('the Brolgan Road overbridge').

The key features of the proposal are described in sections 7.2 and 7.3.

Ancillary work would include works to level crossings, signalling and communications, signage, fencing, and services and utilities. Ancillary works are described in section 7.4.

The Parkes to Narromine line is an existing operational rail line, which would continue to operate prior to, during, and following construction of the proposal. Accordingly, the existing operation of the Parkes to Narromine line, described in section 2.5, does not form part of the proposal. Any associated maintenance works and other minor works, undertaken by ARTC in accordance with existing ARTC procedures and processes and under relevant State legislative requirements on this existing line, does not form part of the proposal.

7.1.2 Approach to avoiding or minimising potential impacts during the design process

The approach to design development (shown in Figure 7.1) has included a focus on avoiding and/or minimising the potential for impacts during all key phases of the process.

As described in chapter 6, the multi-criteria assessments undertaken during the option selection and design process included consideration of environmental and social impacts. Various options assessments have been undertaken, and the preferred option chosen based on the outcome of the assessments. The options assessment process also included assessment of opportunities and risks.

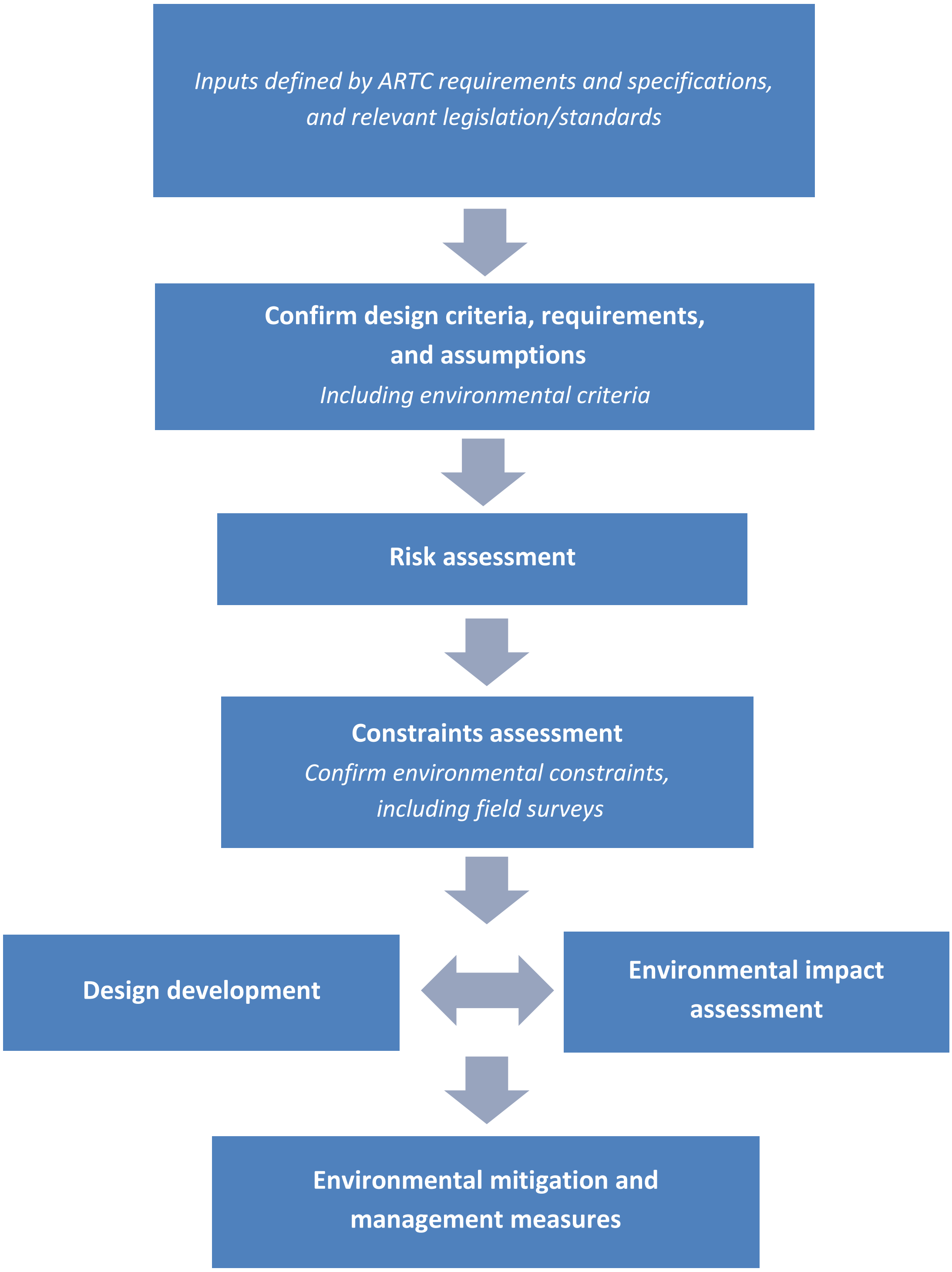

Figure 7.1 Approach to avoiding and minimising impacts during the design process

Reuse of material

Track upgrade works make up a large part of the overall proposal. A standard rail formation design involves removing all existing material and replacing it with 'structural' and 'capping' materials. These materials are specification controlled, and are therefore generally required to be imported onto a site from a quarry or other suitable location. Importing material and exporting spoil requires truck movements.

For the proposal, the track works have been designed to reuse as much existing material as possible. Geotechnical investigations have been undertaken to identify what materials are contained within the proposal site. This has enabled the proposal to include reuse of as much existing material as possible via a site-specific formation design.

By undertaking this approach, import quantities have been reduced, and excess spoil quantities have been further reduced.

7.2 Description of key proposal features within the existing rail corridor

This section describes those features of the proposal that would be located within the existing rail corridor.

7.2.1 Track upgrading

The existing track would be upgraded within the existing rail corridor for a distance of 106 kilometres. All of the existing track would be upgraded in some way. As noted in section 6.3.1, this would involve a combination of:

- track reconstruction
- skim reconditioning
- skim plus reconditioning.

Track reconstruction would involve replacing the existing track and formation. An indicative design for this form of treatment is provided in Figure 7.2.

Skim reconditioning would involve using the existing track ballast and sub-ballast as structural capping on the existing consolidated subgrade. An indicative design for this form of treatment is shown in Figure 7.3.

Skim plus reconditioning would involve a combination of skim reconditioning and track reconstruction. This form of treatment seeks to reuse as much existing material as possible. An indicative design for this form of treatment is shown in Figure 7.4.

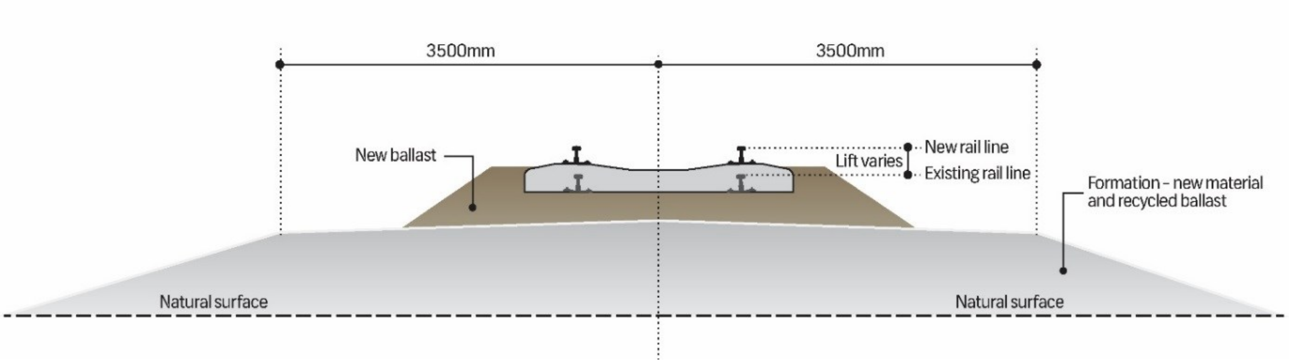

Figure 7.2 Track reconstruction

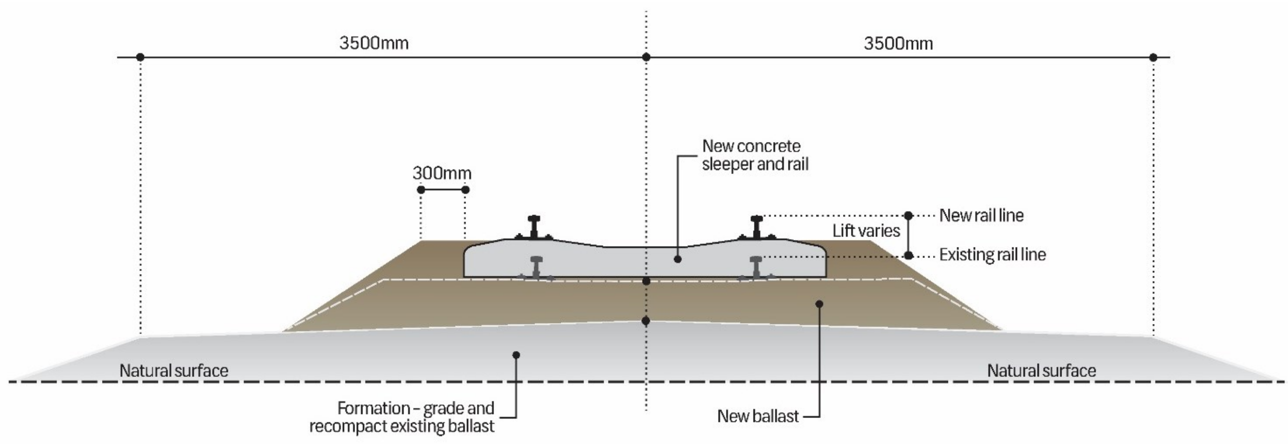

Figure 7.3 Skim reconditioning

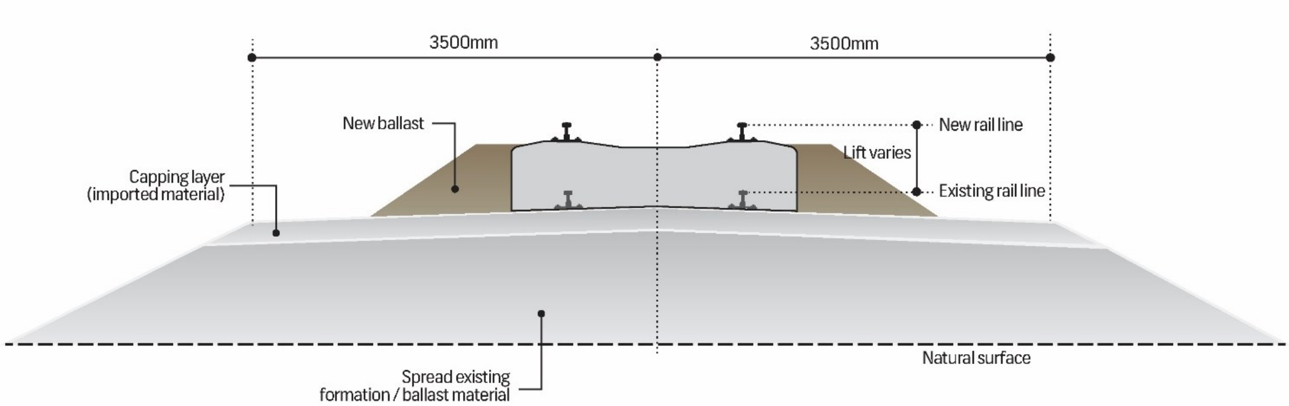

Figure 7.4 Skim plus reconditioning

7.2.2 Culvert upgrading

There are 165 culverts located along the proposal site. The majority of these need to be replaced as part of the proposal to meet Inland Rail operational requirements. The design of replacement culverts has been informed by a hydrologic and hydraulic assessment of the proposal site, and an assessment of existing structures. An assessment of flooding events has been undertaken for each culvert. The target design condition for the new culverts is the 100-year average recurrence interval (ARI) runoff event (one per cent annual exceedance probability (AEP) event), where reasonably practicable. Geotechnical investigations were also completed along the alignment to provide additional information for the culvert design.

Replacement culverts have been designed with the intent to:

- take into account local constraints and flooding/hydrological conditions (described in chapter 15)
- permit an appropriate flow and minimise the potential for adverse flooding impacts, by:
  - locating culverts at low points along the proposal site to prevent upstream water ponding
  - ensuring that the inside base of the culverts match the bed of the watercourse
  - retaining (at a minimum) the existing flow
  - minimising the potential for increases in the area of flood inundation
  - ensuring that sizes and capacities are as close to the existing situation as practicable, to minimise impacts on adjacent land and infrastructure

- meet ARTC design standards
- ensure that the flooding situation is no worse than the existing situation.

The culverts would be constructed of concrete, and would consist of three types:

- low level culvert consisting of twin cells, with approximate dimensions for each cell of 300 millimetres high by 755 millimetres wide
- mid level culvert consisting of a single cell with approximate dimensions of 700 millimetres high by 2.6 metres wide
- high level culvert consisting of a single cell with approximate dimensions of 1.5 metres high by 2.5 metres wide.

7.2.3 Crossing loops

Three new crossing loops are proposed at Goonumbla, Peak Hill and Timjelly. The loops would be constructed as new sections of track roughly parallel to the existing track. They would each be 2.2 kilometres long, to fit the design length of the train (1.8 kilometres). The existing rail corridor is of sufficient width to accommodate the new crossing loops.

An indicative crossing loop design is shown in Figure 7.5. The loops are shown in Figure 7.6 to Figure 7.8.

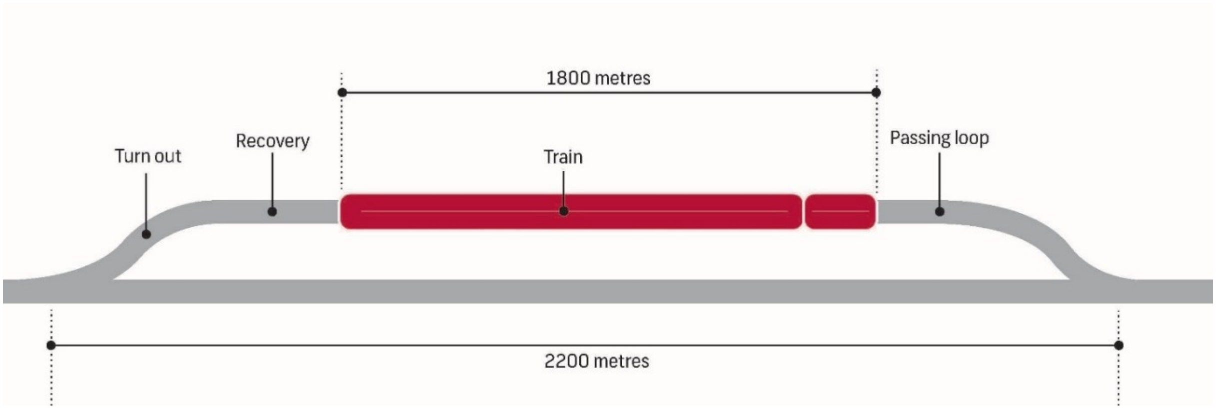

Figure 7.5 Indicative crossing loop

7.2.4 Turnouts

Turnouts enable trains to be guided from one track to another. The proposal involves replacing some existing turnouts, and providing new turnouts, as described below.

New turnouts

Turnouts would be constructed at the beginning and end of each of the crossing loops (six in total).

An additional three turnouts are proposed as part of the construction of the Parkes north west connection. Refer to section 7.3.1 for further information.

Replacement turnouts

Six turnouts would be replaced at existing sidings. All siding turnouts are maintained by ARTC under agreement with the siding owner.

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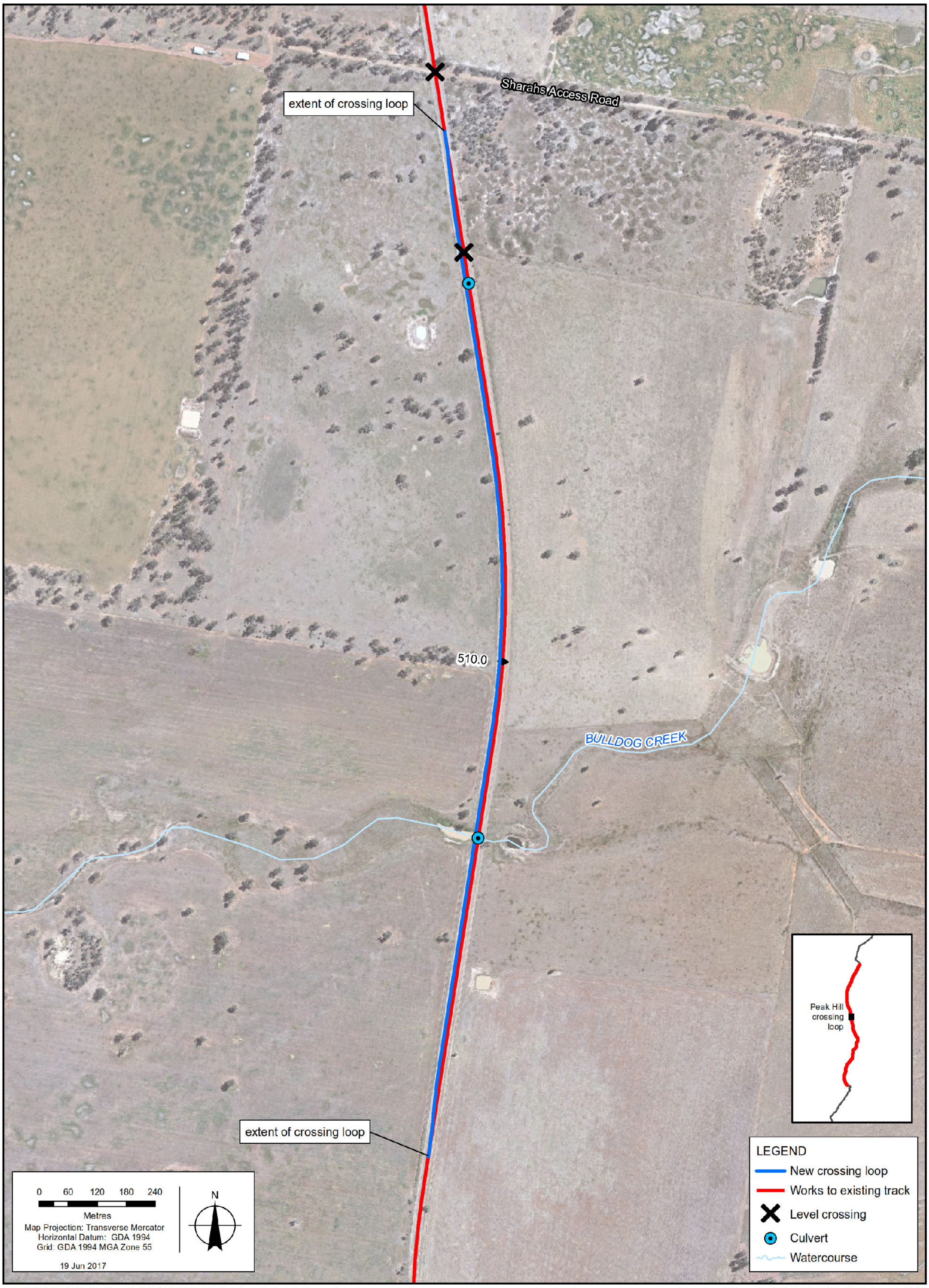
Data source: LPI, DCDB, 2015. ARTC, Imagery, 2015

Figure 7.6
Goonumbla crossing loop



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Data source: LPI, DCDB, 2015. ARTC, Imagery, 2015

Figure 7.7
Peak Hill crossing loop

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Data source: LPI, DCDB, 2015. ARTC, Imagery, 2015

Figure 7.8
Timjelly crossing loop

7.3 Description of key proposal features outside the existing rail corridor

This section describes those features of the proposal that would be located outside the existing rail corridor.

7.3.1 Parkes north west connection

The Parkes north west connection (shown in Figure 7.9) would involve:

- 5.3 kilometres of new track and formation, including three turnouts and four culverts
- an access track within the new rail corridor next to the track
- a road overbridge at Brolgan Road
- crossing of Millers Lookout Road and Coopers Road.

Further information on the features of the Parkes north west connection is provided below.

New track

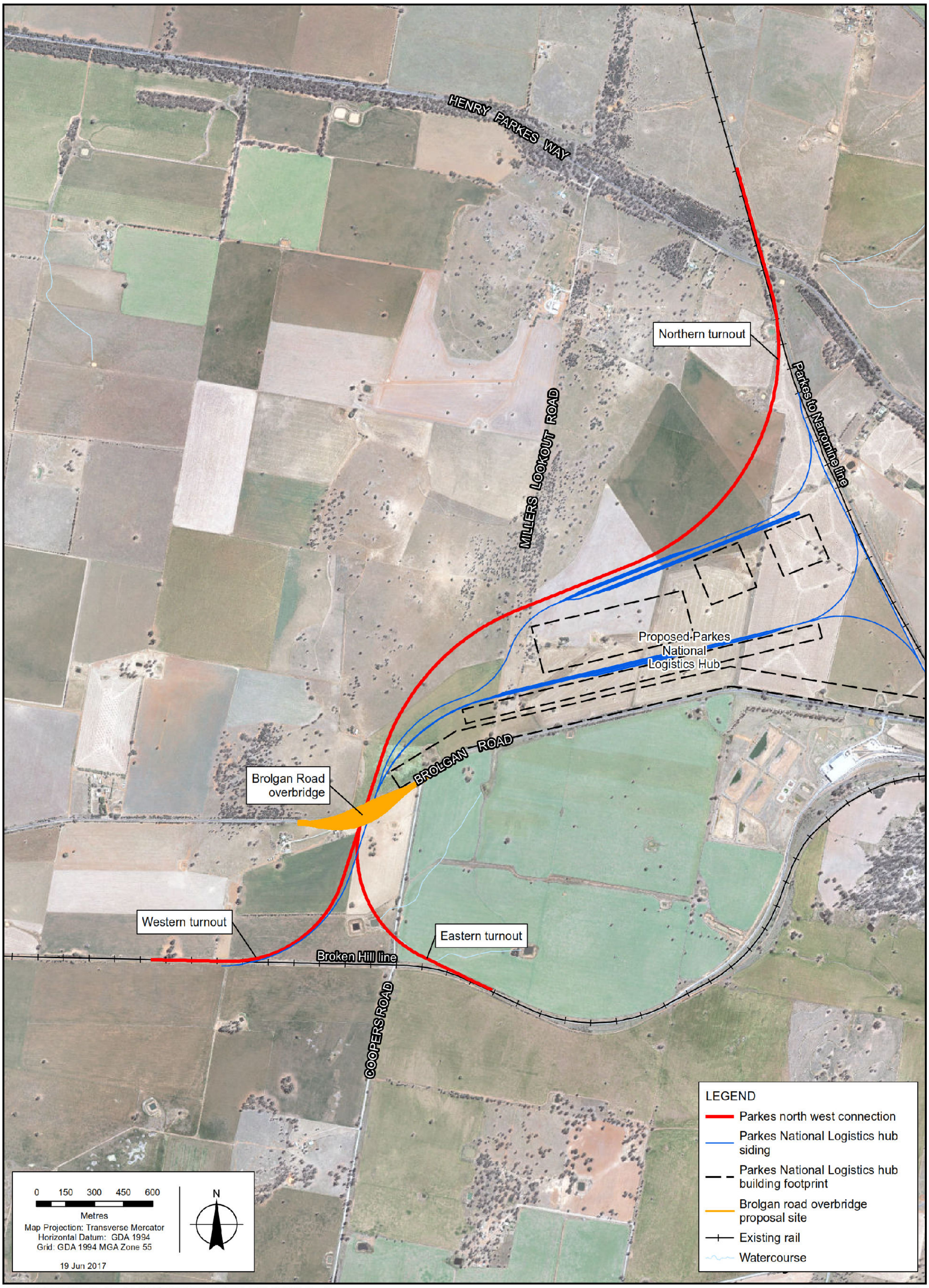
As described in section 2.2, the proposal site for the new section of track would cross rural land between the existing Broken Hill line and the Parkes to Narromine line, travelling to the north of the Parkes Hub. The proposal site traverses flat to undulating terrain resulting in a variety of embankment types, including a cutting of six metres to the north of Brolgan Road.

The features of the new section of track would be similar to the upgraded track (described in section 7.2) and would include:

- track formation
- ballast, sleepers, and rails
- culverts
- turnouts
- drainage
- signalling and communications.

Typical sections are shown in Figure 7.10 and Figure 7.11.

Three turnouts are proposed to provide connections to the Parkes to Narromine line (one connection – the northern turnout) and the Broken Hill line (two connections – the eastern and western turnouts). Four culverts are required to cross ephemeral watercourses located across the proposal site.



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Data source: LPI, DCDB, 2015.

Figure 7.9
Parkes north west connection

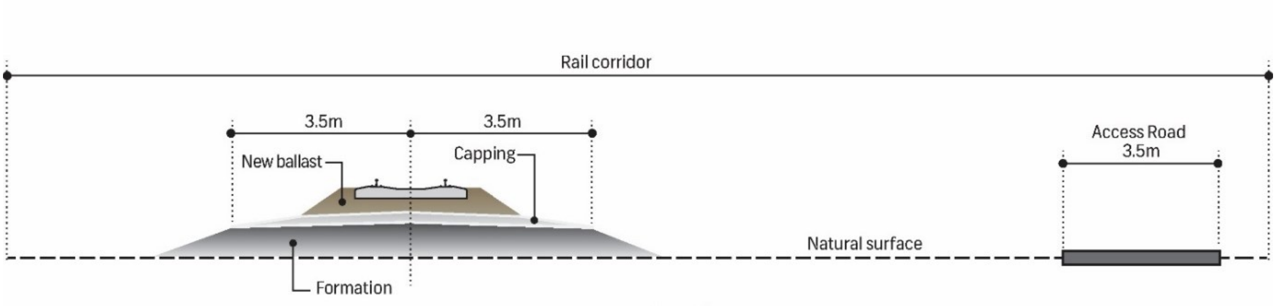


Figure 7.10 Parkes north west connection – typical section

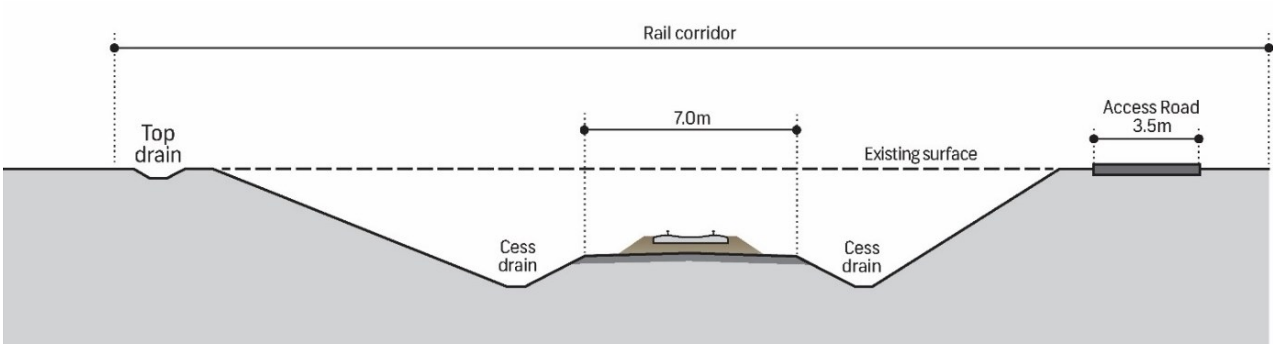


Figure 7.11 Parkes north west connection – section in cut

Road crossings

The Parkes north west connection would cross Millers Lookout Road about 675 metres to the north of Brolgan Road, and 2.3 kilometres to the south of its intersection with Henry Parkes Way. The eastern turnout of the Parkes north west connection would cross Coopers Road about 110 metres to the north of the existing level crossing on the Broken Hill line, 845 metres to the south of the intersection of Coopers Road and Brolgan Road, and 2.8 kilometres to the north of the intersection of Coopers Road and London Road.

The need for any road changes would be determined during the detailed design phase following further investigations and consultation with relevant stakeholders (including Parkes Shire Council).

7.3.2 Brolgan Road overbridge

An overbridge is proposed to enable Brolgan Road to cross the Parkes north west connection with sufficient clearance for double stacked Inland Rail trains to pass beneath. To enable access along Brolgan Road to be maintained during construction, the overbridge would be constructed 'offline' and to the north of Brolgan Road. The overbridge would consist of 1,040 metres of new two-lane road with a design speed of 80 kilometres per hour, and would include a bridge structure and two tie-ins.

Key features of the overbridge are described on the following page and are shown in Figure 7.12.

Bridge structure

The bridge structure would consist of:

- single 22 metre long span super T girders, supported on cast insitu reinforced concrete piers/abutments, and founded using reinforced concrete bored piles
- road pavement 23 metres long and 11 metres wide, consisting of two lanes with a width of 3.5 metres each, and two shoulders with a width of two metres each
- the maximum bridge height would be nine metres, which would provide a minimum clearance above Inland Rail trains of 6.5 metres

- reinforced soil wall abutments with a maximum height of 10 metres
- maximum grade of four percent over 110 metres
- throw screens on both sides of the bridge.

Tie-ins

New sections of road (known as 'tie-ins') would be constructed at the eastern and western ends of the overbridge to connect the bridge to the existing section of Brolgan Road. The tie-ins would be about 500 metres long (each) and 11 metres wide, and would consist of two lanes with a width of 3.5 metres each, and two shoulders with a width of two metres each.

The western tie-in would commence about 730 metres west of the existing intersection between Brolgan Road and Coopers Road. The eastern tie-in would commence about 335 metres east of this intersection.

Retain existing section of Brolgan Road

Construction of the overbridge would leave a short section of Brolgan Road about 1.1 kilometres long to the south of the overbridge. This section of road would be retained for local access purposes (to be confirmed in consultation with Parkes Shire Council).

7.4 Ancillary works and infrastructure

7.4.1 Track drainage

Drainage in the form of a cess drain would be installed within the rail corridor adjacent to the track. Cess drains are surface drains located to the side of the tracks, used to remove water that percolates through the ballast and flows along the capping layer towards the outside of the track formation. Cess drains are used to protect the track formation by keeping it dry.

As the proposal site is relatively flat, cess drains are proposed where the upstream catchment has an area of 5,000 square metres or greater, and is within 25 metres of the rail line.

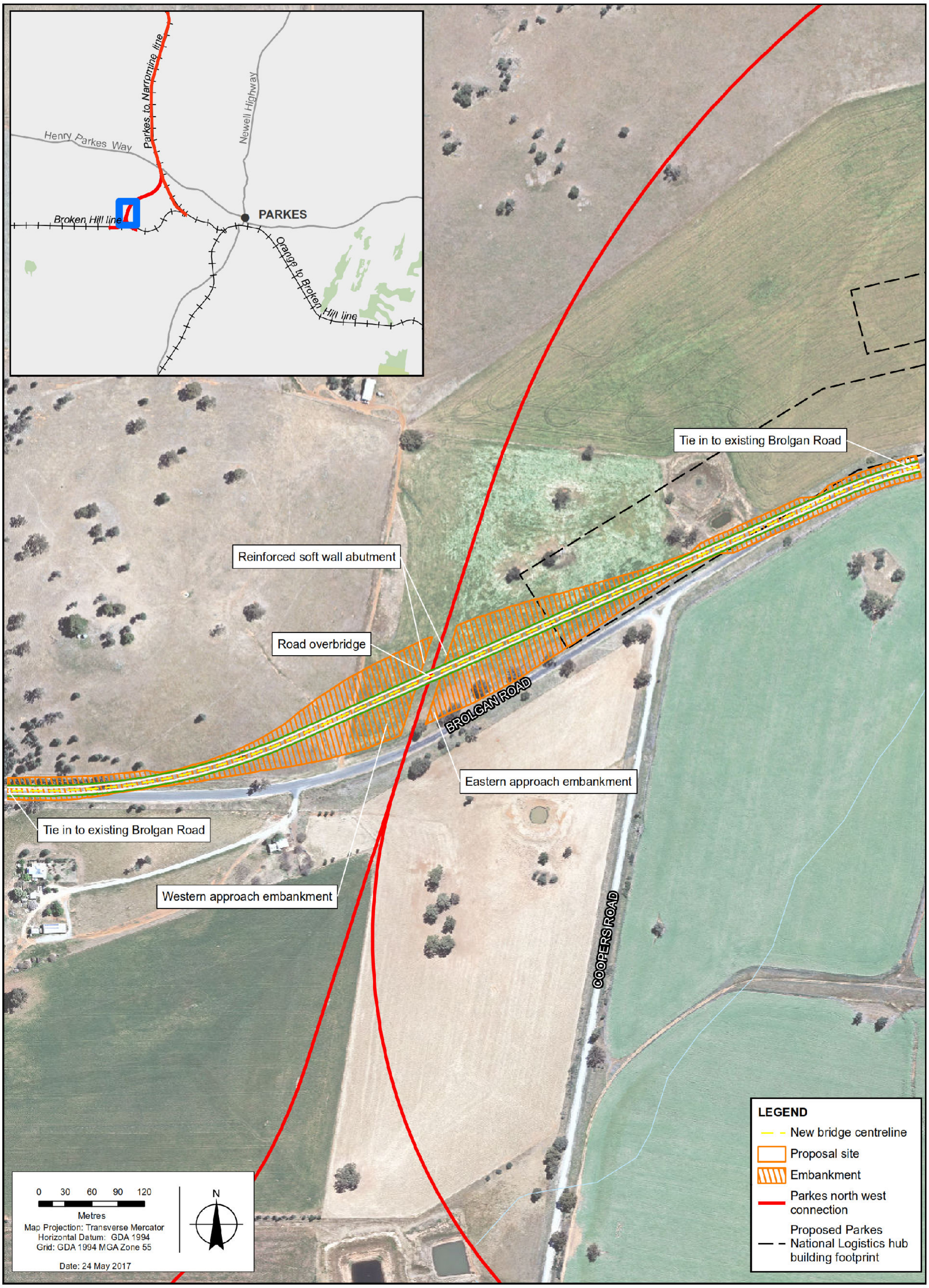
The cess drains would be positioned towards the outer limit of the rail corridor, with the surrounding earthworks shaped to shed water towards its location.

7.4.2 Spoil mounds

Excess material resulting mainly from the excavation of track formation and cess drains would be stockpiled along the rail corridor. The stockpiles would be located as close as possible to the source of the excavated material and would be formed into permanent spoil mounds, spread out to minimise height. Spoil mounds would be designed to have a maximum height of two metres (about one metre above the height of the rails), and in some cases, may need to be located on both sides of the rail track. The mounds would be stabilised as required.

Gaps in the spoil mounds would be provided to allow water to drain away from the formation. The location, sizing and design of the mounds would be determined during the detailed design phase, with consideration given to the results of hydraulic modelling and sight distances. Mounds would not be located in areas where they would impact on flooding or drainage.

An indicative cross section of the proposal with spoil mounds on both sides of the corridor is shown in Figure 7.13.



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Data source: LPI, DCDB, 2015. ARTC, Imagery, 2015.

Figure 7.12
Brolgan Road overbridge

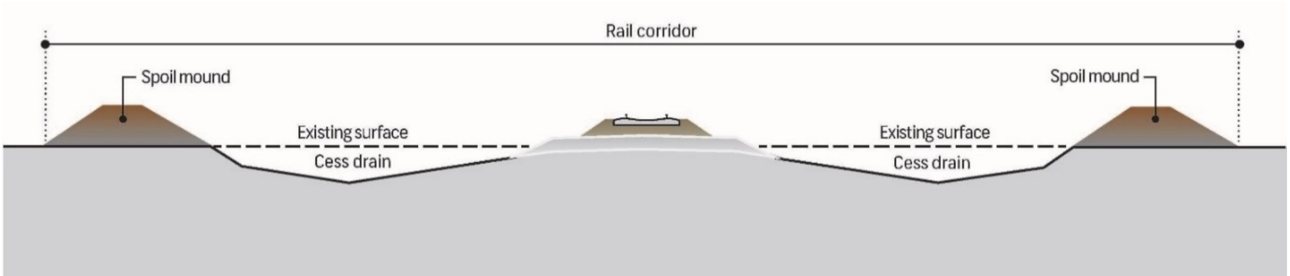


Figure 7.13 Indicative spoil mound cross-section

7.4.3 Level crossings

Works at the majority of the 71 level crossings along the proposal site are required to ensure crossings meet relevant Australian and ARTC level crossing design standards. The preferred option for level crossings, developed as an outcome of stage 1 of the level crossing strategy, involves a mix of retaining/refurbishing existing crossings, considering the consolidation of some crossings, upgrading the level of control, or installing a gated crossing.

ARTC is currently undertaking stage 2 of the level crossing strategy, which involves consulting with relevant stakeholders (including landowners and road owners) to confirm the preferred approach, and finalising the designs for the works at each crossing.

Where an existing access to or within a property is proposed to be removed, altered, or severed, additional works to reinstate access to the property would be undertaken. This may require works outside the rail corridor.

Further information on the level crossing strategy is provided in section 6.3.3.

Upgrading signalling and communications

Signalling and communications would be upgraded as part of the level crossing works, to enable any level crossings with active controls to tie into the rail network.

ARTC's Advanced Train Management System (ATMS) would be implemented to manage signalling and communications for the wider rail network. ATMS is a communication based train management system, which communicates via both voice and data between Network Control Centres and locomotives operating on ARTC's rail network.

New fencing

Existing fencing along the rail corridor would be replaced as required. Where the corridor abuts a public road, fencing would be installed on the track side only. The fencing would consist of a standard stock fence (1.2 metres high).

Signage

Signage would be provided/replaced where required.

7.5 Land acquisition

The existing rail corridor is owned by the NSW Government (Transport for NSW) and leased by ARTC. The majority of the proposal would be undertaken within the existing rail corridor or on land for which ARTC has existing access agreements.

A limited amount of property acquisition would be required, as summarised in Appendix G. The extent of property impacts would be refined and confirmed during detailed design in consultation with property owners. For partial acquisitions, property adjustment plans would be developed in consultation with the property owner.

Leasing requirements are unknown at this stage. Consultation regarding agreements would be undertaken with landowners prior to works commencing.

All acquisitions would be undertaken in accordance with the requirements of the *Land Acquisition (Just Terms) Compensation Act 1991*.

7.6 Operation of the proposal

7.6.1 Train operations

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators. The existing operation of the Parkes to Narromine line (described in section 2.5.2) will continue prior to, during, and following construction of the proposal. Inland Rail as a whole would be operational once all 13 sections are complete, which is estimated to be in 2025.

Inland Rail would involve operation of a single rail track with crossing loops, to accommodate double stacked freight trains up to 1.8 kilometres long and 6.5 metres high. Train speeds would vary according to axle loads, and range from 80 to 115 kilometres per hour.

It is estimated that Inland Rail would be trafficked by an average of 8.5 trains per day in 2025, increasing to the estimated maximum of 15 trains per day in 2040. This rail traffic would be in addition to the existing rail traffic using the Parkes to Narromine line. If business and market demands require increased capacity, consultation with relevant agencies would be undertaken, and approvals sought as required.

Figure 7.14 shows the projected growth in the number of Inland Rail trains that would travel between Melbourne and Brisbane between the commencement of operation of Inland Rail (2025) and 2040. These numbers do not include existing train volumes.

The trains would be a mix of grain, bulk freight, and other general transport trains. Total annual freight tonnages would be about 11.8 million tonnes in 2025, increasing to about 19 million tonnes in 2040 (from the existing two million tonnes of grain per year). Train stop locations would be confirmed during detailed design.

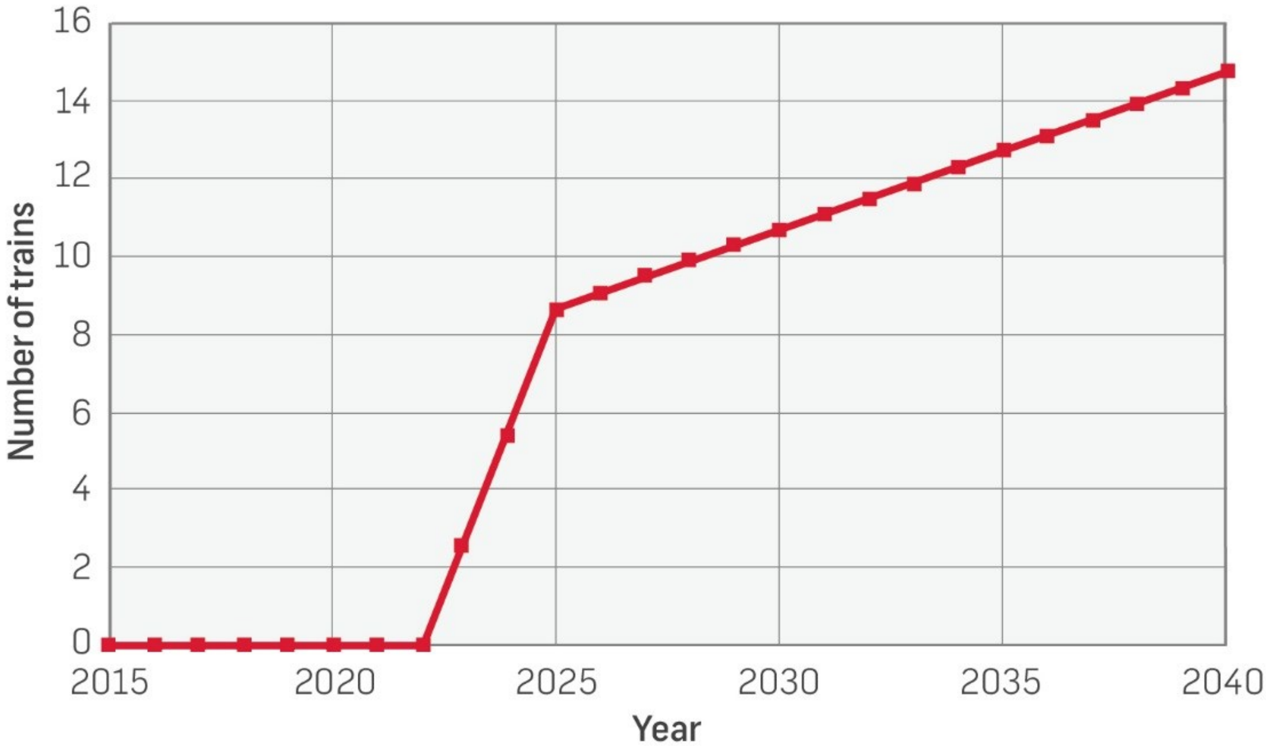


Figure 7.14 Projected growth in train numbers for Inland Rail

7.6.2 Maintenance activities

Standard ARTC maintenance activities would be undertaken during operations. Typically, these activities include minor maintenance works, such as bridge and culvert inspections, rail grinding and track tamping, through to major maintenance, such as reconditioning of track and topping up of ballast as required.

8. Construction of the proposal

This chapter provides an outline of the indicative construction activities likely to be used to construct the proposal. It includes a summary of the proposed timing, an indicative construction methodology, likely resources, and proposed access arrangements. This information is preliminary only, and is based on the current stage of the design. The construction methodology would be refined as the design of the proposal progresses, and once the construction contractor is engaged.

8.1 Overview of construction scope and approach

Construction of the proposal would commence once all necessary approvals are obtained, and the detailed design is complete. It is anticipated that construction would take about 18 months, commencing in mid 2018, and concluding in late 2019.

The construction methodology, sequencing and durations would be confirmed once a possession strategy has been agreed with affected train operators, track stakeholders, and relevant government departments. The possession strategy would define the times that rail traffic would not be permitted to operate along the existing rail corridor. An indicative possession strategy is provided in Table 8.1

Construction along the existing rail corridor would depend on the possession strategy however, it is anticipated that progress would be from south to north, and involve three main stages:

- stage 1 – Parkes to Goonumbla
- stage 2 – Goonumbla to Narwonah
- stage 3 – Narwonah to Narromine.

Construction of the Parkes north west connection and the Brolgan Road overbridge would be undertaken in parallel with the above stages.

8.1.1 Approach to avoiding or minimising impacts during construction

Mitigation and management measures applicable to the design, pre-construction and construction stages would be implemented to avoid or minimise the construction impacts described in chapters 9 to 26. Mitigation measures are provided in each chapter in Part C, and are summarised in chapter 27. The measures include preparing and implementing a construction environmental management plan (CEMP) including detailed sub-plans.

The CEMP would be prepared for the construction phase of the proposal by the responsible construction contractor. The CEMP would provide a centralised strategy through which all potential environmental impacts would be managed during construction, and would include detailed management measures to avoid or minimise potential impacts. The requirements for the CEMP are described in chapter 27. An outline of the CEMP, including the required sub-plans, is provided in Appendix K.

8.2 Indicative construction methodology

For each stage, construction would typically involve:

- site establishment (described in section 8.2.1)
- main construction works (described in sections 8.2.2 to 8.2.6)
- testing and commissioning (described in section 8.2.7)
- finishing works (described in section 8.2.8).

The construction methodology would be further developed and confirmed during detailed design.

8.2.1 Site establishment

Site establishment would generally involve:

- consult landowners/occupants where required
- install site environment management and traffic controls in accordance with the CEMP
- establish site compounds and facilities
- clear vegetation
- erect temporary fencing
- establish site access roads where required
- utility relocations as required
- deliver and stockpile materials including rail, sleepers, ballast, culverts and structural fill.

8.2.2 Track works

Track upgrading

A general methodology for the main proposed forms of track upgrading is provided below:

- Skim reconditioning:
  - remove fastenings, rail and sleepers and stockpile to one side of the rail corridor
  - trim and level the existing ballast bed and compact
  - place concrete sleepers and rail track on prepared ballast bed and weld up rails
  - place new ballast on top of the sleepers
  - tamp and profile the ballast around the sleepers and line to a smooth alignment.
- Track reconstruction:
  - remove fastenings, rail and sleepers and stockpile to one side of the rail corridor
  - excavate the existing ballast and earth formation
  - place new earth and recycled ballast into the excavated area and compact
  - place new ballast on top of the earth formation and compact
  - place concrete sleepers and rail tracks on prepared ballast bed and weld up rails
  - place new ballast on top of the sleepers
  - tamp and profile the ballast around the sleepers and line to a smooth alignment.

Culverts

Where required, culverts would be removed and replaced as described below. Culvert replacement would be undertaken online (the structure would be replaced in the same location). Culverts would be pre-cast off-site, and installed along the proposal site as the track upgrading works progress.

Culvert removal

- remove existing culvert structure (either concrete or steel pipes)
- excavate to the required depth
- place and compact bedding material.

Culvert replacement

- place pre-fabricated culvert structures on the new formation area and fasten together
- place ballast, sleepers and rail on top of the culverts and tamp and profile the ballast under and around the sleepers and weld up tracks.

Crossing loops

The general methodology for constructing crossing loops is as follows:

- excavate beside the existing track for the length of the crossing loop
- place and compact formation material
- place ballast, sleepers and rail tracks on top of the new formation
- install signal equipment and associated equipment
- testing and commissioning.

Turnouts

The general methodology for constructing turnouts is as follows:

- cut existing track, remove and dispose of existing turnout (at existing sidings only)
- undertake formation improvement works as required
- install ballast and rails
- install control mechanisms (points motor, power supply etc)
- testing and commissioning.

Drainage

The general methodology for drainage construction is as follows:

- prepare survey control points for planned excavation of cess drains
- excavate earth material from the side of the existing track formation, and trim and compact base and sides of the drain
- form spoil mounds.

8.2.3 Level crossings

The general methodology for level crossings is as follows:

- Upgrading controls:
  - remove existing controls, excavate to a suitable depth as required, place new formation material and ballast, replace track and surface panel as required
  - install new controls
  - provide standard road signs and road markings.
- Consolidating level crossings:
  - complete road works and appropriate road signage to redirect traffic
  - remove level crossing signs and road markings
  - upgrade tracks as described in section 8.2.2.

8.2.4 Parkes north west connection

Construction of the Parkes north west connection would generally involve the following:

- undertake cut and fill earthworks
- place imported formation material
- place bottom ballast
- place track consisting of fastenings, rail and sleepers on bottom ballast
- place ballast on top of the track
- tamp and profile the ballast around the sleepers and tracks
- construct cess drainage
- provide signalling and communications.

8.2.5 Brolgan Road rail overbridge

Construction of the overbridge would generally involve the following:

Bridge works

- construct cast-in-place piles at abutments and piers
- construct reinforced soil wall abutment on the northern and southern side of the bridge
- construct column extensions and pier headstocks
- install super T girders and construct reinforced concrete deck including end diaphragms
- install throw screens
- install expansion joints and steel traffic barrier railing
- install waterproof membrane and asphalt.

Embankment and pavement works

- place bulk general fill to construct approach embankments
- construct new pavement, including placing and compacting select fill, sub base and asphalt wearing surface
- tie into existing Brolgan Road.

Finishing works

- rehabilitate disturbed areas in accordance with the rehabilitation plan
- line marking and sign posting
- final site clean-up.

8.2.6 Earthworks

Earthworks would be required:

- where upgrades to the formation are required
- to widen existing embankments and cuttings to meet design requirements
- to construct the Parkes north west connection and Brolgan Road overbridge
- to construct culverts.

Minor earthworks would also be required to construct the ancillary infrastructure and undertake the ancillary works associated with the proposal.

8.2.7 Testing and commissioning

Testing and commissioning (checking) of the rail line and communication/signalling systems would be undertaken to ensure that all systems and infrastructure are designed, installed, and operating according to ARTC's operational requirements.

8.2.8 Finishing works/reinstatement

All construction sites, compounds and access routes would be returned to the same or better condition than prior to construction commencing. Site reinstatement and rehabilitation would be undertaken progressively during the works and would include the following activities:

- demobilise site compounds and facilities
- remove all materials, waste and redundant structures from the works sites
- forming, and stabilising of spoil mounds
- decommission all temporary work site signs
- remove temporary fencing
- establish permanent fencing
- decommission site access roads that are no longer required
- restoration of disturbed areas as required, including revegetation where required.

Site rehabilitation would be undertaken in accordance with the rehabilitation plan, which would form a sub-plan of the CEMP (described in chapter 27).

8.3 Timing, staging and working hours

8.3.1 Timing and staging

An indicative construction program is shown in Figure 8.1. As described in section 8.1, construction along the existing rail corridor would be undertaken in three stages, subject to agreement with relevant stakeholders. The stages are shown in Figure 8.2. For each stage, rail traffic would be diverted as described in Table 8.1.

Construction of the Parkes north west connection and the Brolgan Road overbridge would be undertaken in parallel with stages one and two along the existing rail corridor.

For the works along the existing rail corridor, it is anticipated that it would take about eight to 10 weeks to construct a 4.5 to five kilometre section of track. This does not include location specific works such as culverts or the relocation of services and utilities.

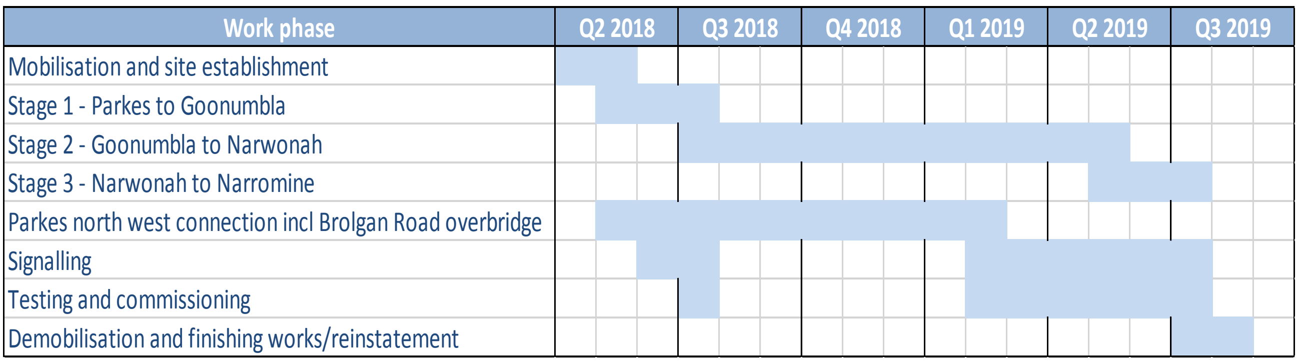
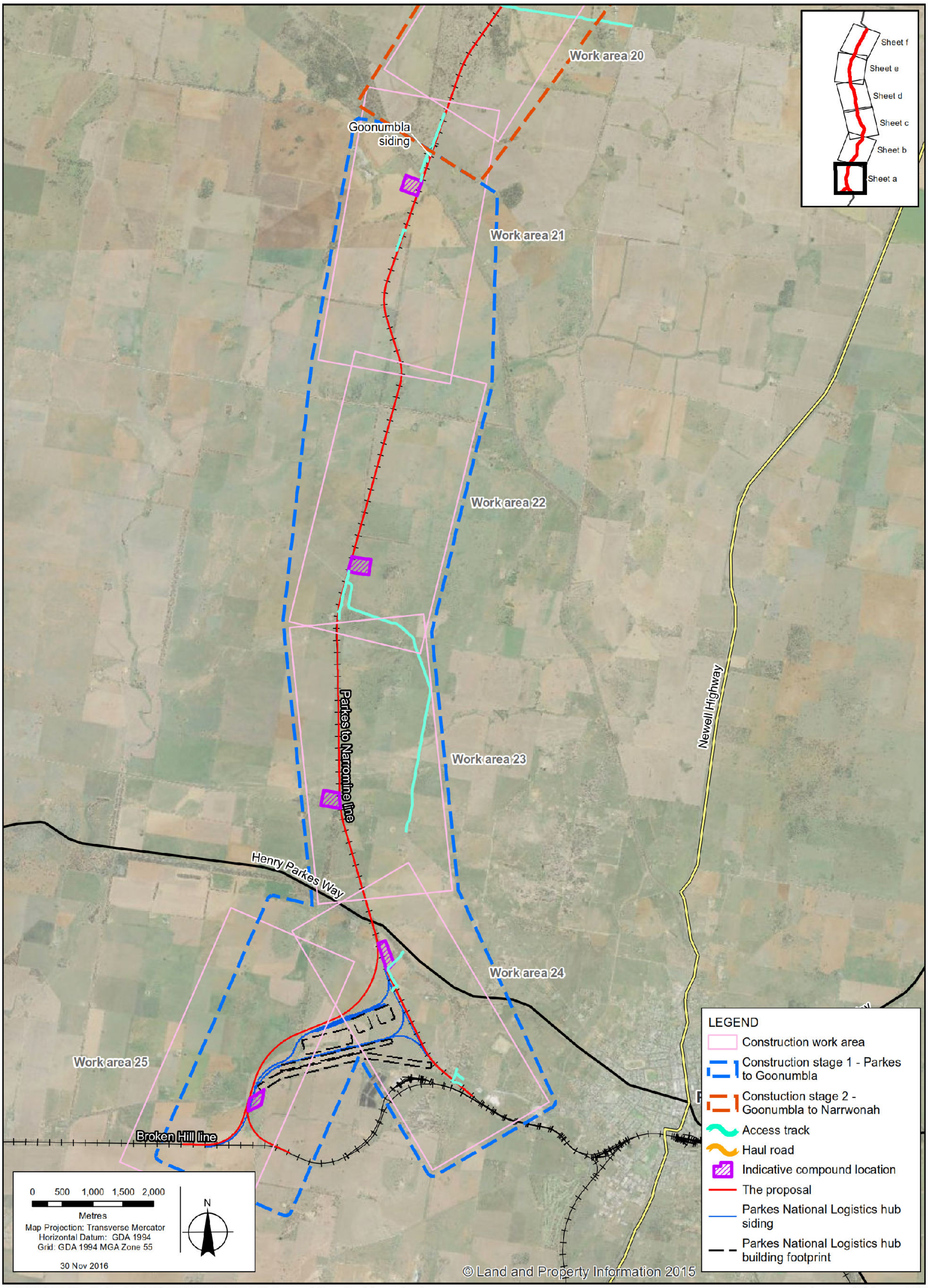


Figure 8.1 Indicative construction program



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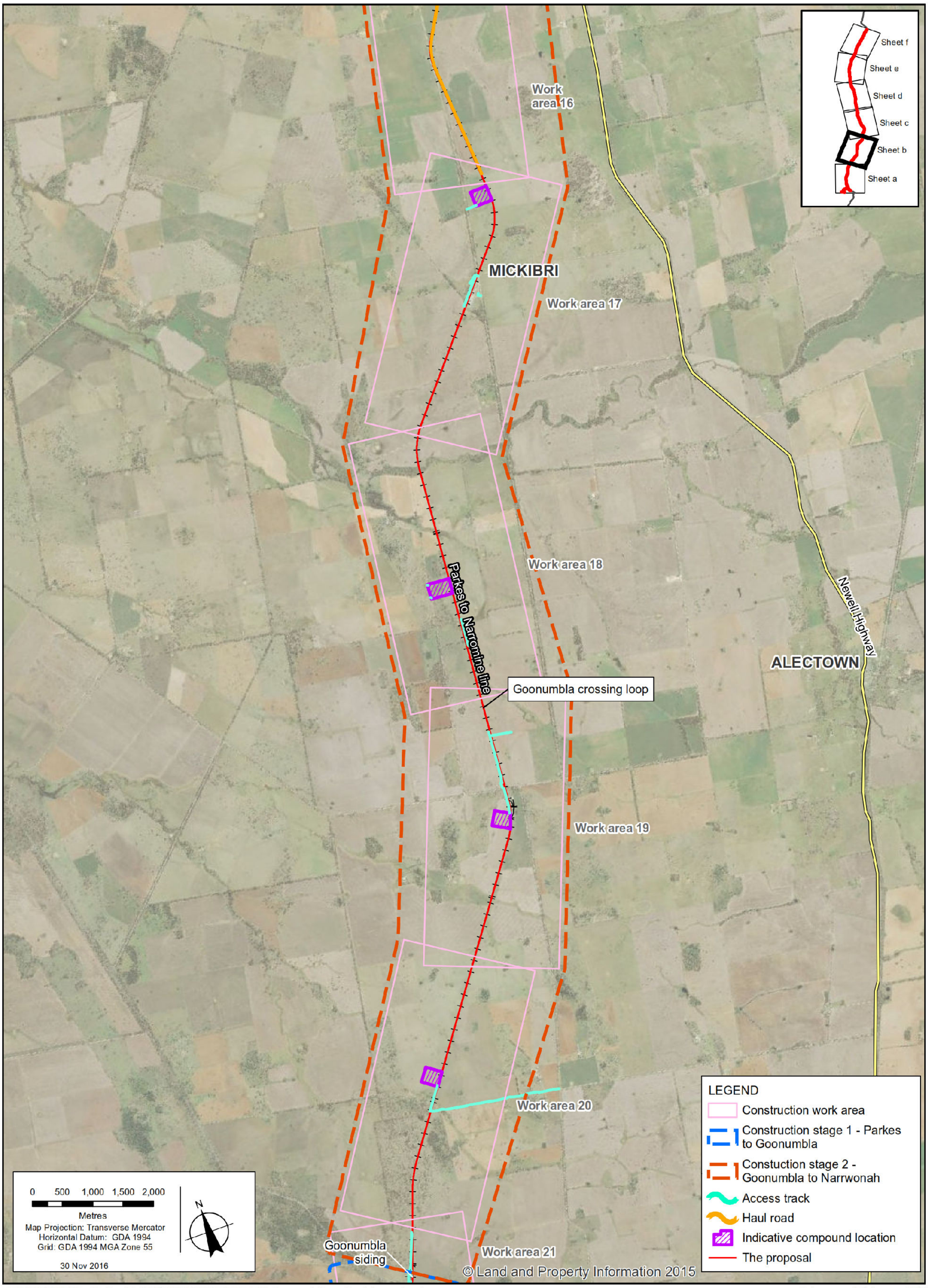
Data source: LPI, Imagery, 2012

Figure 8.2a

Construction work stages, work areas and compounds



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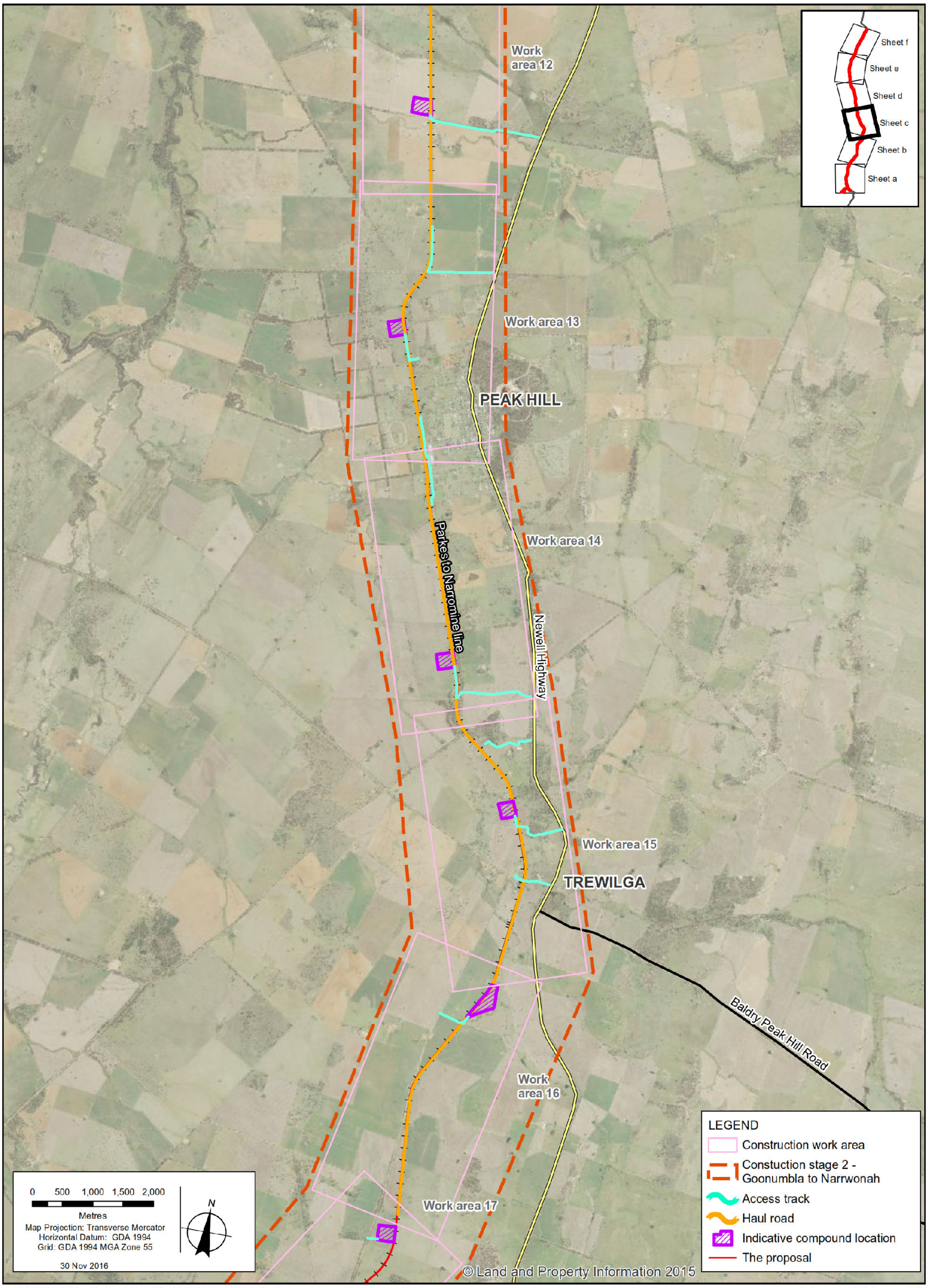
Data source: LPI, Imagery, 2012

Figure 8.2b
Construction work stages, work areas and compounds



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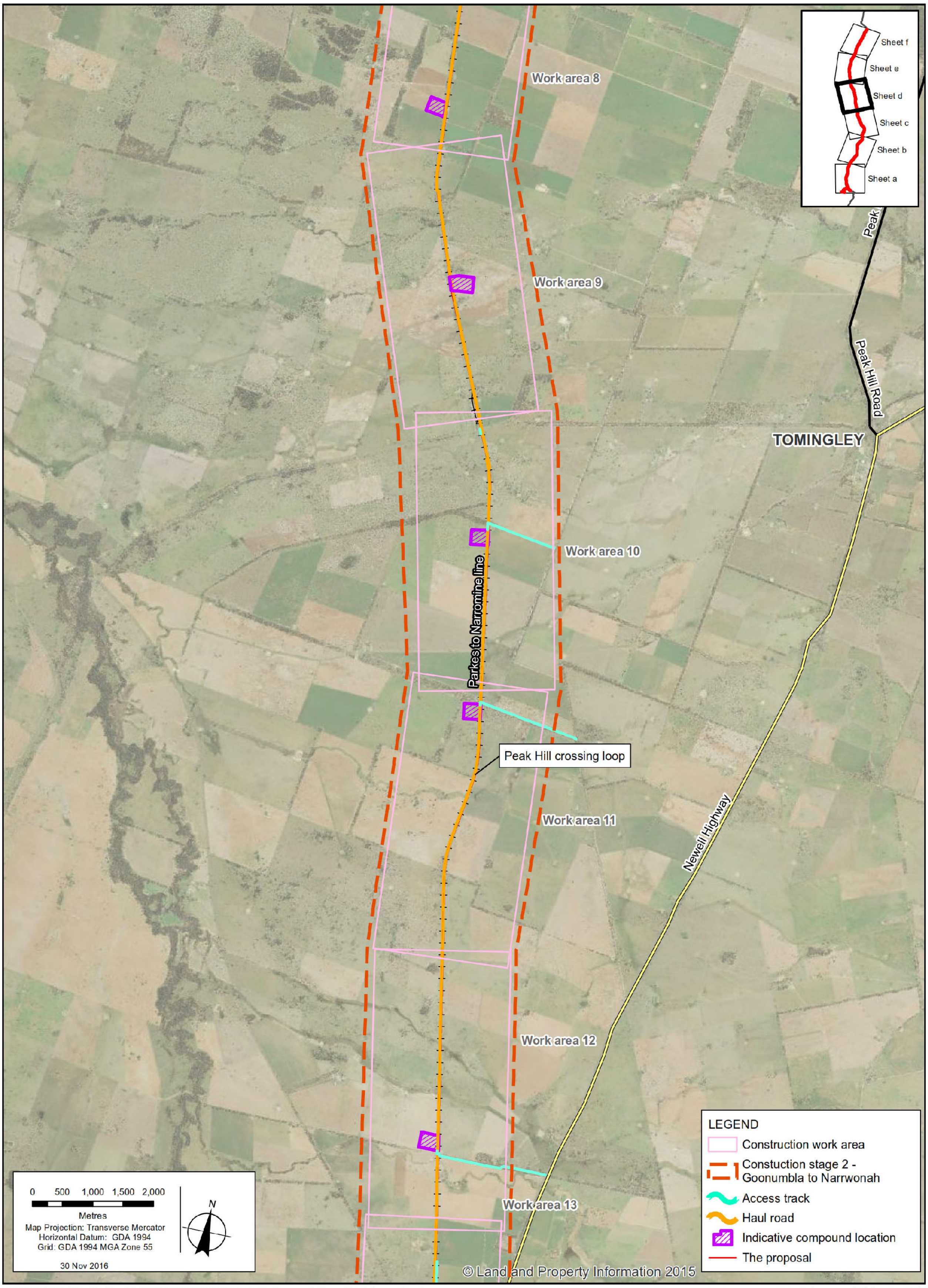
Data source: LPI, Imagery, 2012

Figure 8.2c
Construction work stages, work areas and compounds



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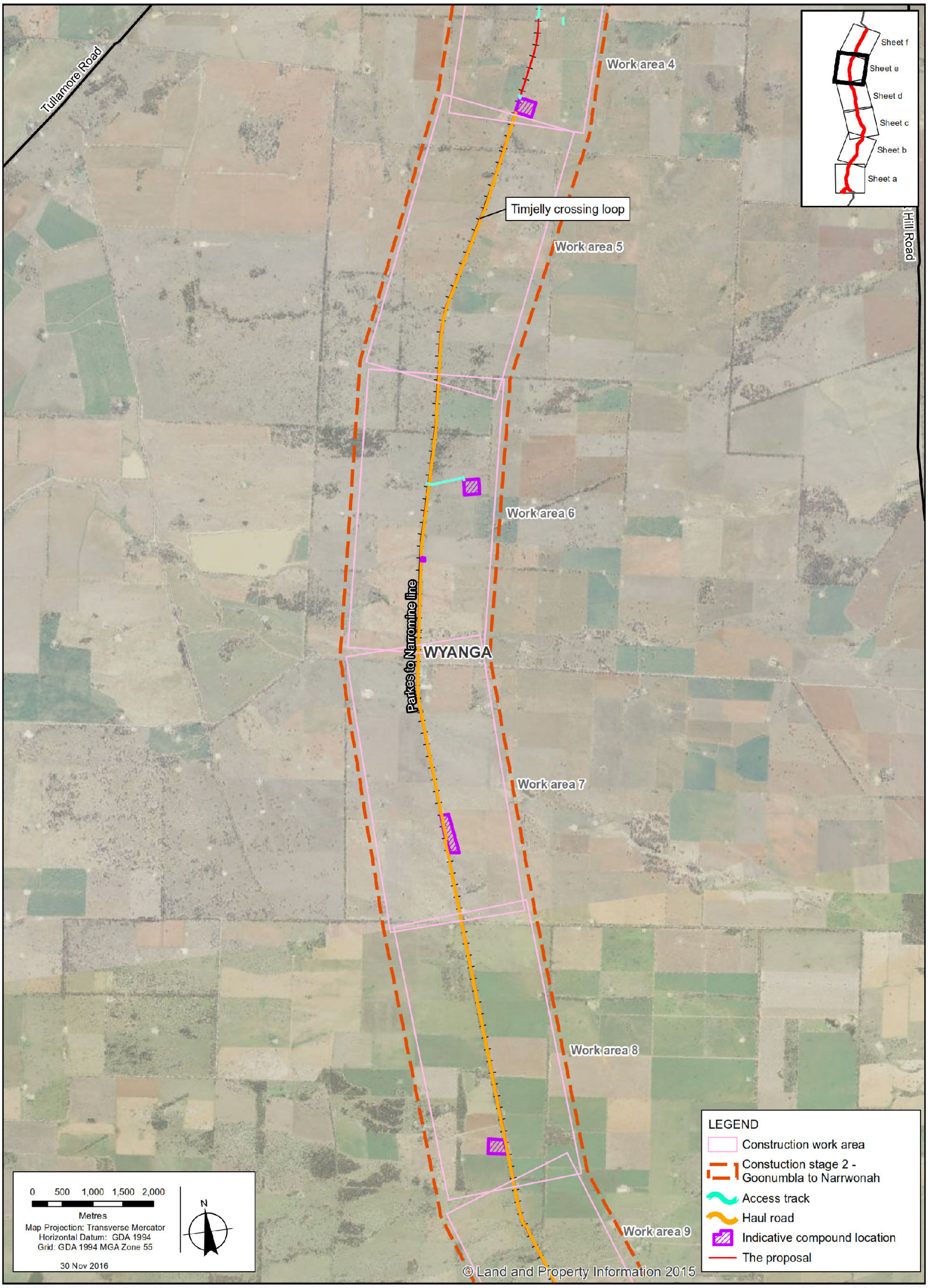
Data source: LPI, Imagery, 2012

Figure 8.2d

Construction work stages, work areas and compounds



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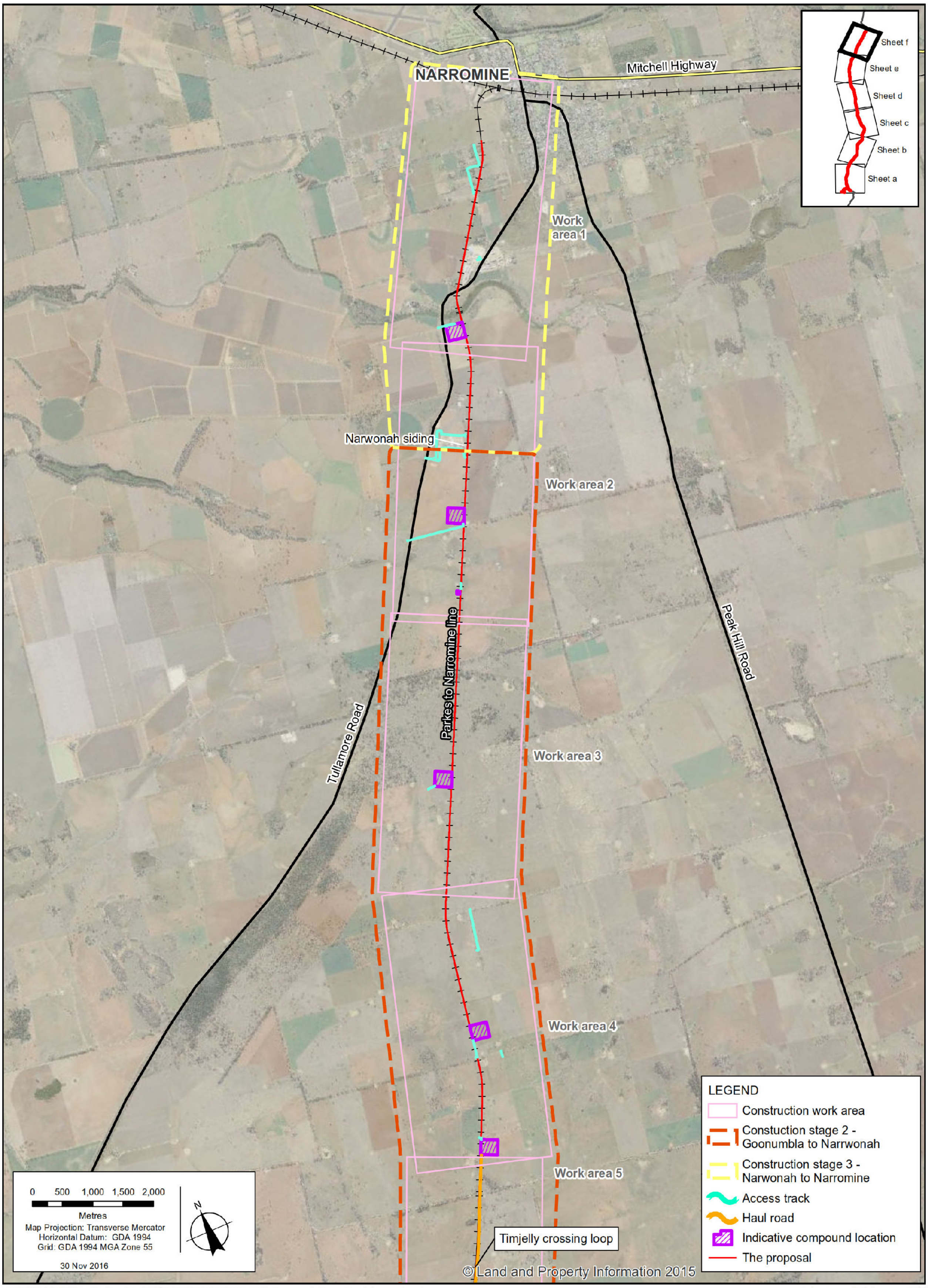
Data source: LPI, Imagery, 2012

Figure 8.2e

Construction work stages, work areas and compounds



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Data source: LPI, Imagery, 2012

Figure 8.2f

Construction work stages, work areas and compounds

Table 8.1 Construction staging for work in the existing rail corridor

Stage	Location	Distance (km)	Rail traffic
1 – Parkes to Goonumbla	Located between the southern end of the proposal site (described in section 2.2 and including the Parkes north west connection) and the Goonumbla siding, which is located about 17 km north of the southern end of the proposal side, just north of Bogan Road	17	Redirected north through Narromine via the Main Western line
2 – Goonumbla to Narwonah	Located between the Goonumbla siding, and the Narwonah grain siding, which is located about 5 km south of Narromine	85	Redirected south from Goonumbla and north from Narwonah
3 – Narwonah to Narromine	Located between the Narwonah grain siding and the northern end of the proposal site (described in section 2.2)	5	Redirected south from Narwonah

8.3.2 Working hours

Construction working hours

Construction work would be undertaken during the following primary proposal construction hours:

- Monday to Friday: 6 am to 6 pm
- Saturday: 6 am to 6 pm
- Sundays and public holidays: 6 am to 6 pm.

Works would also be undertaken during 24 hour possessions, where required.

Works during recommended standard working hours

Recommended standard hours for construction work are contained in the *Interim Construction Noise Guideline* (DECC, 2009) and are as follows:

- Monday to Friday: 7 am to 6 pm
- Saturday: 8 am to 1 pm
- Sundays and public holidays: no work.

Near residential receivers, activities resulting in impulsive or tonal noise emissions would be limited to these hours, except as permitted by the EPL.

Works outside recommended standard working hours

Construction activities would be undertaken outside recommended standard working hours during the following times:

- Monday to Friday: 6 am to 7 am
- Saturday: 6 am to 8 am and 1 pm to 6 pm
- Sundays and public holidays: 6 am to 6 pm
- 24 hours during possessions.

Work undertaken during these hours would include:

- work that meets the relevant noise and vibration criteria described in chapter 11
- where a negotiated agreement has been reached with affected receivers, where the prescribed noise and vibration levels cannot be achieved
- delivery of materials required by the police or other authorities for safety reasons
- work required in an emergency
- work approved through an EPL
- work approved through an 'out of hours work protocol' prepared as part of the CEMP, and in accordance with the conditions of approval for the proposal.

Work during possessions

Some minor works may also be undertaken during scheduled rail corridor possession periods (that is, the times that the movement of trains along the rail corridor are stopped for maintenance). This could include, for example, the connection of the tracks at either end of each stage, and some finishing works. During possessions, works may need to be undertaken on a 24 hour basis.

8.4 Construction compounds

Two types of compound areas are proposed; minor compound/storage areas and larger compound sites.

Minor compounds/storage areas are areas that would be used for the assembly of adjacent infrastructure such as culverts and turnouts. These compounds would be located within the rail corridor.

Larger compound sites would be established for general construction activities associated with each stage of work. For the purposes of the EIS, it is assumed that temporary compounds would be sited outside the existing rail corridor every 4.5 to five kilometres (one for each work area described in section 8.3.1). Indicative compound locations are shown in Figure 8.2.

Each larger compound site would contain:

- stockpiles
- track infrastructure laydown area
- bunded refuelling area
- fencing as required
- office area including parking, offices and ablutions
- mobile plant and equipment
- hazardous material storage.

The design of the proposal has been developed so that infrastructure would either be constructed in place (for example, welding of track) or prefabricated structures would be used (for example, culverts). Therefore, activities undertaken at compound sites would include the following:

- site office operations
- delivery and stockpiling of various construction materials including rail, sleepers, ballast, culverts and structural fill
- movement of plant and equipment
- maintenance of site environmental management controls.

Not all of the above activities would be undertaken at every compound site.

The location of compounds would be determined based on the following criteria:

- at least 50 metres from watercourses and outside the ARI 20-year flood zone
- where no or only minor clearing would be required, and not within areas identified as threatened communities or species habitat
- no significant impacts to utilities, primarily gas and electricity
- at least one kilometre from the nearest residence or other noise sensitive receiver where possible
- not on or near sites with known Aboriginal or non-Aboriginal heritage value
- minimise use of private land
- where safe access to the road network and rail corridor can be provided
- relatively flat land.

8.5 Construction resources

8.5.1 Workforce

For the majority of the construction period, the workforce would average about 150 people. For some limited items of work an additional short-term workforce may be required.

8.5.2 Materials

The proposal would require quantities of various materials including fill, ballast, concrete sleepers, rail, precast concrete units, ready mix concrete and water. The majority of these materials would be used during track formation works, with the exception of precast concrete units and ready mix concrete which would be used for construction of concrete structures including culverts and bridges.

Subject to confirmation and the gaining of any necessary approvals, the following local quarries are proposed to be used for structural fill, capping and ballast (ballast would be delivered by train, other materials by truck):

- Goonumbla quarry
- Unger quarry
- Narromine Council borrow pit.

This would be further investigated and confirmed during detailed design.

8.5.3 Plant and equipment

A range of plant and equipment would be used during construction. The final equipment and plant requirements would be identified by the construction contractor. An indicative list of plant and equipment that would be used for each construction stage is provided in Table 8.2.

Table 8.2 Indicative construction plant and equipment

Construction phase	Plant and equipment	
Establishment	▸ trucks ▸ cranes	▸ clearance equipment such as chainsaws and chippers
Utility relocations and property adjustments	▸ excavators ▸ rigid and articulated trucks ▸ jackhammers ▸ cranes ▸ concrete pumps ▸ welding equipment	▸ concrete saws ▸ light vehicles ▸ concrete trucks ▸ generators ▸ oxy-cutting equipment
Earthworks and drainage	▸ excavator ▸ jackhammers ▸ rigid and articulated trucks ▸ compactors ▸ water carts ▸ generators	▸ bulldozers ▸ boring machines ▸ graders ▸ profilers ▸ vibrating rollers ▸ trucks and trailers
Track works	▸ 25-30 tonne excavators ▸ 40 tonne dump truck ▸ vibratory roller ▸ water cart ▸ crane ▸ trucks and trailers	▸ graders ▸ bulldozer ▸ lighting ▸ skid steer loader ▸ front end loader
Road overbridge and pavement works	▸ excavators ▸ rigid and articulated trucks ▸ drilling rigs and boring machines ▸ cranes ▸ concrete trucks and pumps ▸ generators ▸ welding equipment ▸ trucks and trailers	▸ compactors ▸ graders ▸ paving machines ▸ slip-forming machines ▸ vibrating rollers ▸ water carts ▸ road marking machine
Finishing and landscaping	▸ milling machines ▸ piling machines ▸ trucks ▸ rollers	▸ generators ▸ oxy-cutting equipment ▸ sprayers ▸ trucks

8.5.4 Site servicing requirements

Utilities and services such as water, sewer, electricity and telecommunications would need to be supplied to each of the work and compound sites for use in site offices and amenities. Where these utilities are located close to the sites, opportunities to connect to existing sources would be explored with relevant providers, particularly for electricity. Where connections are not available, power would be provided by generators.

Water would be required for dust control, site compaction and reinstatement during construction. A number of potential water sources have been investigated, including extraction of groundwater or surface water, private bores and watercourses. This would be further explored prior to construction in consultation with local councils and landowners. Where water is not available, it would be transported to the sitpe via tanker truck and stored in temporary storage tanks. Potable water for human consumption would be supplied via bottled water or potable water tanks. Non-potable wash water would be supplied by the use of trailer-mounted storage tanks.

Portable toilet facilities would be used where existing infrastructure is unavailable and sewage pump out services utilised to remove waste off site.

8.6 Transport, access and haulage arrangements

8.6.1 Access to construction work areas

Access to the construction work areas would be from public roads or existing access routes which are located within the rail corridor. An access track runs parallel to the rail line along the majority of the alignment.

Potential access routes to each construction work area are listed in Table 8.3. Generally, access to construction stage 1 and the southern end of construction stage 2 would be from Parkes, while the northern construction areas would be accessed from Narromine or Dubbo.

Table 8.3 Potential construction access routes to work areas

Construction work area (as shown in Figure 8.2)	Primary route	Secondary route	Tertiary route
25 and 24	Dalton Street	Middleton Street	Brolgan Road
	Dalton Street → Henry Parkes Way	-	-
23	Dalton Street → Henry Parkes Way	Moulten Street	Back Trundle Road
22	Dalton Street → Henry Parkes Way	Moulten Street	Back Trundle Road → Nanardine Lane
	Newell Highway	Bogan Road	Wyatts Lane
21	Newell Highway	Bogan Road	-
20	Newell Highway	Bogan Road	Plowman Lane → access track
19	Newell Highway	Alectown West Road	-
	Newell Highway	Bogan Road	Plowman Lane

Construction work area (as shown in Figure 8.2)	Primary route	Secondary route	Tertiary route
18	Newell Highway	Alectown West Road	-
	Newell Highway	Alectown West Road	Mickibri Road → Barber Lane
17	Newell Highway	Alectown West Road	Mickibri Road
	Newell Highway	Claremont Lane	
16	Newell Highway	Claremont Lane	Mickibri Road
15	Newell Highway	Trewilga Road	-
	Newell Highway	Access track	-
14	Newell Highway	Access track	-
	Newell Highway	Whitton Park Road	-
13	Newell Highway	Whitton Park Road	Access track
	Newell Highway	Kitto's Bridge Road	-
12	Newell Highway	Access track	-
11	Newell Highway	Sharah's Access Road	-
10	Newell Highway	Tomingley West Road	Back Tomingley West Road → access track
	Newell Highway	Tomingley West Road	-
9	Newell Highway	Tomingley West Road	Peak Hill Railway Road
8	The McGrane Way	Peak Hill Railway Road	-
	Newell Highway	Tomingley West Road	Peak Hill Railway Road
7	The McGrane Way	Peak Hill Railway Road	-
	Newell Highway	Tomingley Road	Wyanga Road
6	The McGrane Way	Peak Hill Railway Road	-
	Newell Highway	Tomingley Road	Wyanga Road → Peak Hill Railway Road
5	The McGrane Way	Peak Hill Railway Road	-
	Newell Highway	Tomingley Road	Wyanga Road → Peak Hill Railway Road
4	The McGrane Way	Peak Hill Railway Road	-

Construction work area (as shown in Figure 8.2)	Primary route	Secondary route	Tertiary route
	Newell Highway	Tomingley Road	Wyanga Road → Peak Hill Railway Road
3	The McGrane Way	Peak Hill Railway Road	-
	Newell Highway	Tomingley Road	Narwonah Road
2	The McGrane Way	Access track	-
1	The McGrane Way	Access track	-
	Dandaloo Street	Old Backwater Road	-

8.6.2 Access to compounds

Access routes to compounds would be determined based on the following criteria:

- provision of a suitability wide road to achieve a single lane, two-way access
- provision of adequate turning circles for crane and heavy vehicles - at least a 25 metre turning radius capability
- minimal property impacts by using access alignments within and adjacent to the rail corridor and existing agreed property access roads as far as practicable
- provision of more than one access point where possible to allow access from either road direction.

8.6.3 Haul routes

While a detailed haulage program has not yet been developed, it is expected that the majority of the proposal's components would be delivered by rail from various locations. Other transport would be undertaken by heavy vehicles using the Newell Highway and Henry Parkes Way and then local roads and existing access roads along the rail corridor.

It is likely that rail components, including sleepers, ballast, and track, would be transported to the work areas via dedicated rail trains; while pre-fabricated concrete units, fill and equipment deliveries would most likely be via road from suppliers.

8.6.4 Construction traffic numbers

Construction vehicle movements would comprise both heavy and light vehicles as listed in Table 8.4.

Table 8.4 Vehicle movements for each stage of construction

Vehicle type		Numbers on site per day	Movements per day	Indicative peak hour movements (one-way)
Light vehicles	Cars and utilities	75	170	75
	Total light vehicles	***75***	***170***	***75***
Heavy vehicles	Light trucks	8	24	8
	25 seater buses	3	6	3

Vehicle type		Numbers on site per day	Movements per day	Indicative peak hour movements (one-way)
	Haulage and delivery trucks	28	200	28
	Total heavy vehicles	***39***	***230***	***39***

Light vehicle movements would largely be based on the amount of construction workers travelling to site each day. Based on an average workforce of 150 people, up to 150 private vehicles could travel to and from the proposal site per day. However, given the remote nature of many of the construction work areas, buses would be provided for construction workers. Workers are likely to use a combination of buses and light vehicles to travel to the proposal site.

8.7 Public utilities

Consultation with public utility authorities is being undertaken as part of the design process to identify and locate existing utilities, and incorporate utility authority requirements for relocations and/or adjustments.

Preliminary investigations have indicated that a number of utilities would need to be relocated or adjusted as part of the proposal. This would be undertaken in consultation with the utility authorities during detailed design.

Desktop review of ‘Dial Before You Dig’ data indicated that the proposal would impact on a number of services. Additional services investigations would be undertaken during detailed design. Consultation has commenced with the various utility providers regarding their requirements for relocation or protection of the services impacted by the proposal.

PART C: Environmental Impact Assessment

9. Traffic, transport and access

This chapter 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 full assessment report is provided as Technical Report 1.

9.1 Assessment approach

9.1.1 Methodology

The assessment involved:

- reviewing the concept design for the proposal
- reviewing existing road features, traffic, transport services, pedestrian and cyclist facilities, and available traffic survey data
- estimating the traffic that would be generated during construction
- assessing the potential impacts of construction, including impacts to the operation of the local road network, pedestrians, cyclists, and public transport
- assessing the potential impacts to the road network during operation
- assessing the potential travel time impacts at level crossings based on the expected train lengths, travel speeds and closure times
- assessing potential operational impacts on the wider transport network, including impacts to cyclists, pedestrians, and public transport
- providing mitigation measures to manage the potential impacts on traffic, transport and access.

Traffic modelling was undertaken for level crossings to identify the potential for delays. The level crossing model was based on the operational train characteristics for Inland Rail (length and speed), and the volume of road traffic.

9.1.2 Legislative and policy context to the assessment

The traffic and transport assessment was undertaken with reference to the following guidelines:

- *Guide to Traffic Management – Part 3 Traffic Studies and Analysis* (Austroads, 2007)
- *Guide to Traffic Generating Developments Version 2.2* (RTA, 2002)
- *Cycling Aspects of Austroads Guides* (Austroads, 2014)
- *NSW Bicycle Guidelines v 1.2* (RTA, 2005)
- *Planning Guidelines for Walking and Cycling* (DIPNR, 2004)
- *Construction of New Level Crossing Policy* (TfNSW, undated)
- *Railway crossings policy* (ONRSR, 2016).

The traffic, transport and access impact assessment report (Technical Report 1) describes the legislative and policy context for the assessment in detail, including the policy and standards specifically related to level crossings.

9.2 Existing environment

9.2.1 Road network

The road network within the study area consists mainly of local/rural roads and private property access roads. The road network is described below and shown in Figure 9.1.

Main roads

Newell Highway

The Newell Highway, which runs generally in a north–south direction through the study area, stretches 1,060 kilometres through NSW between the Victorian border town of Tocumwal and the Queensland border town of Goondiwindi. The Newell Highway, which is managed by Roads and Maritime, is part of the national highway network. The importance of this highway is recognised by the *Newell Highway Corridor Strategy* (NSW Government, 2015). Further information on the highway is provided in Technical Report 1.

The Newell Highway runs to the east of the proposal site between Parkes and Tomingley, passing through Peak Hill. At its closest point, just south of Peak Hill, the highway is located about 500 metres to the east of the proposal site. The highway does not cross the proposal site.

Outside built-up areas, the highway has a posted speed limit of 110 kilometres per hour, and generally comprises a single lane of travel in each direction on a single carriageway. Overtaking lanes are provided in some locations.

Further information on the Newell Highway in relation to the proposal site is provided in chapter 2.

Henry Parkes Way

Henry Parkes Way (part of Main Road 61) is regional transport corridor that runs in an east to west alignment, between Orange and Condobolin. It is a state owned road managed by Roads and Maritime. The proposal site crosses Henry Parkes Way about six kilometres north-west of Parkes. At this location, Henry Parkes Way comprises a single lane of travel in each direction on a single carriageway, with a posted speed limit of 100 kilometres per hour.

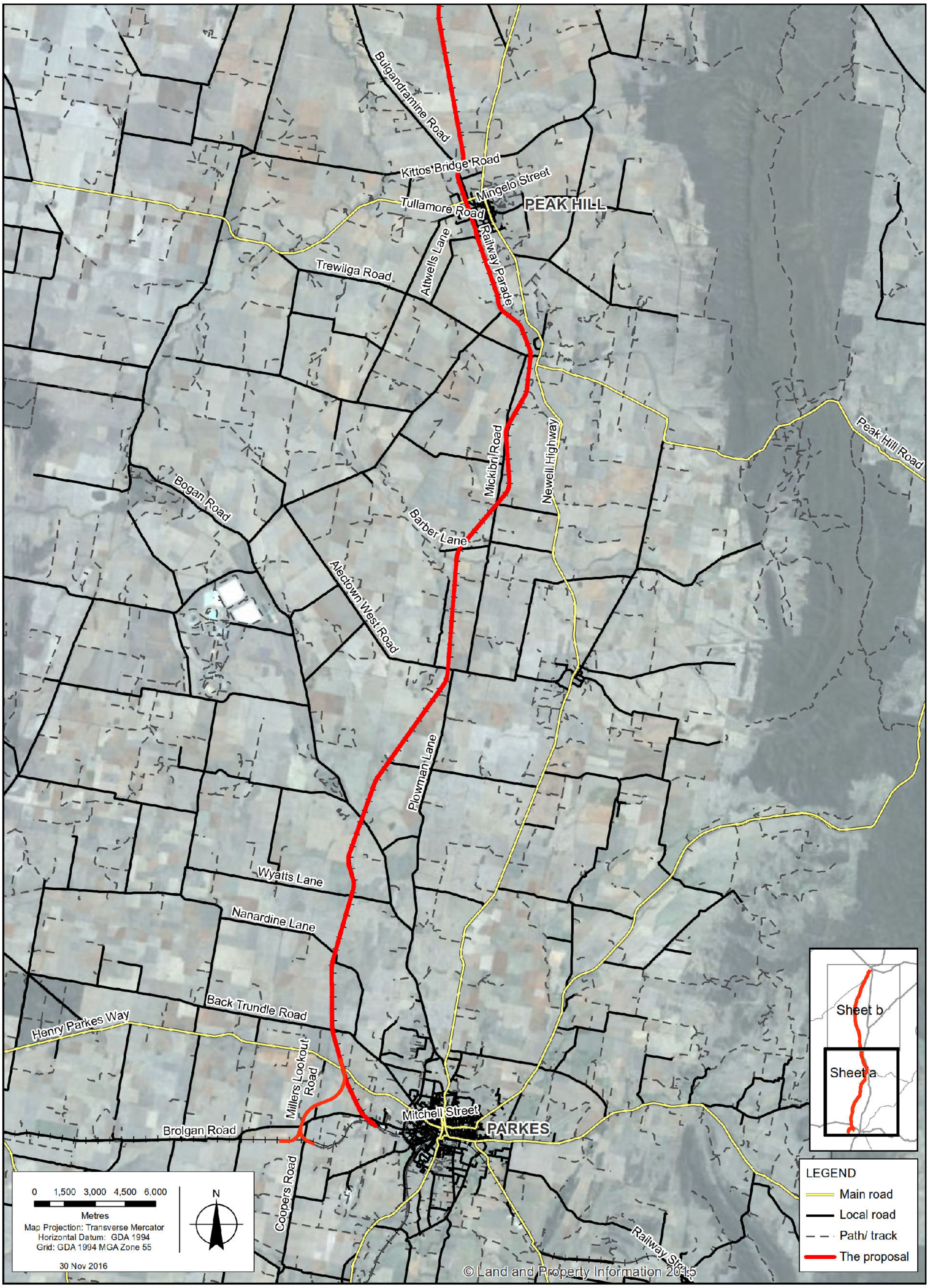
Mitchell Highway

The Mitchell Highway is a state owned road which runs east-west through Narromine to the north of the proposal site. The highway is located about 20 metres to the north of the proposal site at its northern extent.

Local roads and intersections

Local roads

The study area includes a network of local roads and private access roads through properties. The local road network provides direct access to properties and to the main road network. Local roads that cross the proposal site are listed (from north to south) in Table 9.1 and are shown on Figure 9.1. The proposal site is also crossed by a number of private roads/driveways, which provide access to and/or within properties surrounding or close to the proposal site.



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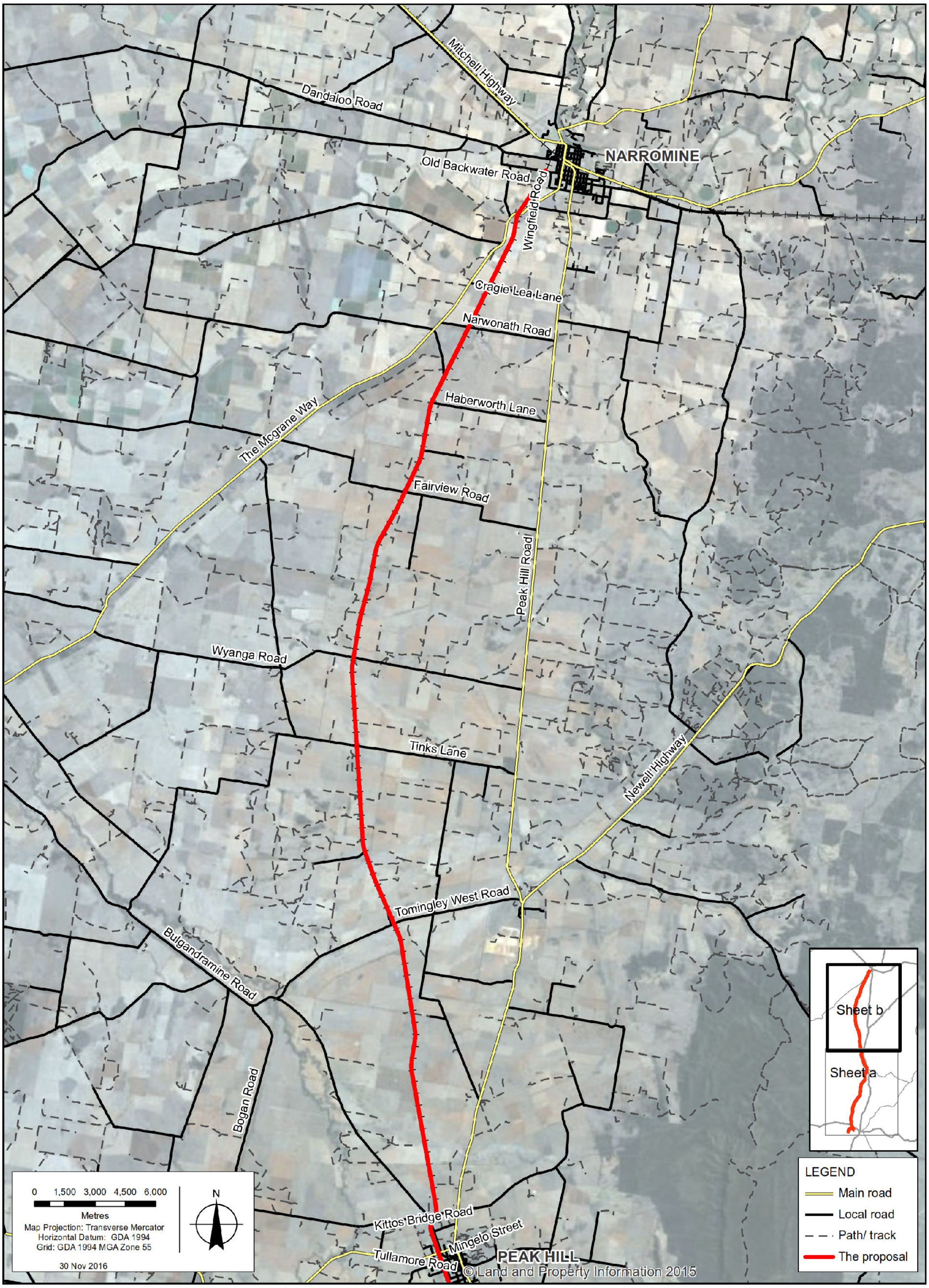
Data source: LPI, DTDB, Imagery, 2012

Figure 9.1a
Road network



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Data source: LPI, DTDB, Imagery, 2012

Figure 9.1b
Road network

Table 9.1 Local roads crossing the proposal site

Road name	Surface type	Shoulders	Line marking
Near Narromine			
Dandaloo Road	Sealed	No	Yes
Old Backwater Road	Sealed	No	No
Wingfield Road	Unsealed	No	No
Narromine to Peak Hill			
The McGrane Way (Tullamore to Narromine Road)	Sealed	No	Yes
Craigie Lea Lane	Unsealed	No	No
Narwonah Road	Sealed	No	No
Haberworth Lane	Unsealed	No	No
Fairview Road	Unsealed	No	No
Wyanga Road	Unsealed	No	No
Tinks Lane	Unsealed	No	No
Tomingley West Road	Sealed	No	No
Peak Hill to Parks			
Kittos Bridge Road	Unsealed	No	No
Bulgandramine Road	Sealed	No	No
Tullamore Road (Ingalba Street)	Sealed	No	Yes
Mingelo Street, Peak Hill	Sealed	No	No
Whitton Park Road (Attwells Lane)	Sealed	No	No
Trewilga Road	Unsealed	No	No
Mickibri Road	Unsealed	No	No
Barber Lane	Unsealed	No	No
Alectown West Road	Unsealed	No	No
Bogan Road	Sealed	No	Yes
Wyatts Lane	Unsealed	No	No
Nanardine Lane	Unsealed	No	No
Near Parkes			
Back Trundle Road	Sealed	No	Yes

Road name	Surface type	Shoulders	Line marking
Henry Parkes Way (Parkes to Condobolin Road)	Sealed	Yes	Yes
Millers Lookout Road	Unsealed	No	No
Brolgan Road	Sealed	Yes	Yes
Coopers Road	Unsealed	No	No

There are also a number of roads which run in close proximity to, but do not cross, the proposal site. These roads, which are listed in Table 9.2, may be used as part of construction site access arrangements.

Table 9.2 Roads located close to the proposal site

Road name	Surface type	Shoulders	Linemarking
Peak Hill Railway Road	Sealed	No	No
The McGrane Way	Sealed	No	Yes
Bulgandramine Road	Sealed	No	No
Newell Highway	Sealed	Yes	Yes
Railway Parade, Peak Hill	Unsealed	No	No
Mickibri Road	Unsealed	No	No
Plowman Lane	Unsealed	No	No

As described in section 7.3.1, the Parkes north west connection would cross Millers Lookout Road and Coopers Road. The northern section of Millers Lookout Road is an unsealed local road that intersects with Henry Parkes Way. The southern section is a narrow unsealed track that intersects with Brolgan Road via an access gate near Brolgan Road.

Coopers Road is an unsealed local road that intersects with Brolgan Road to the north, London Road about midway along, and Watts Lane to the south. Brolgan Road and London Road provide access to Parkes, and Watts Lane connects to the Newell Highway.

Intersections

A number of intersections are located on local roads near the proposal site. These are all priority controlled intersections (with give-way or stop signs), with very low traffic volumes on the side roads, and relatively low volumes on through movements. Intersections near the proposal site within the main towns and villages are listed in Table 9.3. The performance of these intersections was not quantified as part of the assessment. However, as a result of the low traffic volumes, it is expected that there would be little to no delay to existing road users.

Table 9.3 Key intersections located near the proposal site

Locality	Intersecting road	Intersecting road
Narromine	Peak Hill Railway Road	The McGrane Way
Narromine	Wingfield Road	The McGrane Way
Narromine	Wilsons Lane	The McGrane Way
Narromine	Dandalloo Road	Dandaloo Street
Tomingley	Tomingley West Road	Peak Hill Railway Road
Peak Hill	Tullamore Road	Bulgandramine Road
Peak Hill	Whitton Park Road	Railway Parade
Peak Hill	Whitton Park Road	Newell Highway
Peak Hill	Newell Highway	Trewilga Road
Peak Hill	Trewilga Road	Mickbiri Road
Alectown	Alectown west Road	Plowman Lane
Alectown	Alectown west Road	Mickbiri Road
Parkes	Henry Parkes Way	Brolgan Road
Parkes	Henry Parkes Way	Millers Lookout Road
Parkes	Brolgan Road	Harigan Avene/Westlime Road
Parkes	Brolgan Road	Coopers Road

Level crossings

There are 71 level crossings located along the proposal site – 33 on public roads and 38 on private roads or maintenance access tracks.

The duration of any delay at a level crossing is mainly related to train length and speed. At crossings with active control, a minimum pre-train warning time of 45 seconds, and a minimum five seconds once the train has passed, results in a total maximum delay under existing conditions of 122 seconds.

Further information on level crossings is provided in section 6.3.

Rail corridor access track

An internal access track used by maintenance vehicles runs along (within) the rail corridor for most of its length in the proposal site. Access to this track is provided off the local road network in a number of locations. Use of this track is restricted to authorised ARTC maintenance vehicles. The surface is unsealed.

Parking

There is no formal on-street or off-street parking provided along or near the proposal site. Rest areas are provided along the Newell Highway. Between Parkes and Tomingley, there are four rest areas designated for heavy and light vehicle access, and a further five suitable for light vehicles only.

9.2.2 Traffic volumes, level of service and safety

Traffic volumes

Limited traffic volume data is available for most roads in the study area, although based on road function, location and surrounding land use, existing traffic volumes are expected to range between 50 vehicles per day for lower order roads (which includes Peak Hill Railway Road), up to 2,000 vehicles per day on some of the more significant roads connection to Parkes.

The busiest road that would be used by construction traffic would be the Newell Highway, which would form the main access to the southern half of the proposal site (between Parkes and Peak Hill). Traffic counts (sourced from Roads and Maritime's traffic volume viewer) indicate that average annual daily traffic volumes are as follows:

- Tomingley – 2,800 in 2015:
  - 33 per cent are heavy vehicles
  - peak volumes of around 220 vehicles per hour (two-way) with traffic volumes relatively consistent between 9 am and 5 pm.
- Peak Hill (Caswell Street) – 6,100 in 2009:
  - peak volumes of 240 vehicles per hour in the peak direction, highest in the mid-morning.
- Parkes (south of Bogan Road) – 2,800 in 2009:
  - 31 per cent heavy vehicles
  - peak volumes of around 220 vehicles per hour (two-way) in the peak direction, relatively consistent across the middle of the day.

Traffic volumes on the road network are likely to increase during harvesting season. Harvesting of winter crops can begin in late October and continue through until January in higher rainfall areas (Australian Grain Magazine, July 2016). During this season, heavy vehicle usage on local and main roads increases as trucks transport grain, and tractors and harvesters move between properties. Farming machinery is generally much larger and slower than other vehicles using the roads.

Level of service

The performance of the road network is largely dependent on the operating performance of intersections which form critical capacity control points. Level of service is the standard measure used to assess the operational performance of the network and intersections. There are six levels of service, ranging from level of service A to level of service F. Level of service A represents the best performance, and level of service F the worst. A level of service of D or better is generally considered to be an acceptable level of service. Level of service E may also be acceptable during peak periods. Levels of service E or F generally refer to intersections operating at, or close to capacity.

A level of service assessment was undertaken for the Newell Highway, using the methodology outlined in the *Guide to Traffic Management – Part 3 Traffic Studies and Analysis* (Austroads, 2007) for two-lane, two-way roads. For the busiest of the above segments (at Peak Hill) the highway currently operates at level of service B (allowing for 1.2 per cent per annum growth in the peak hour volume since the 2009 count). This indicates that average delays are less than 15 seconds and the segment has good operation.

Approximate volume thresholds have been identified for each level of service band, for key road types, as an indication of the volume of traffic each road type is able to accommodate. These volume thresholds are listed in Table 9.4.

Table 9.4 Indicative maximum one way vehicle volumes for level of service bands

	Road description (vehicles per hour)		
Level of service band	**Newell Highway (2-lane, wide sealed shoulders)**	**Henry Parkes Way (2-lane, narrow sealed shoulders)**	**Local road (no centre line, no shoulders)**
A	250	150	150
B	500	500	900
C	900	900	1450
D	1500	1500	2000

Road safety

Five year crash history data (2009-2013) for key roads in the study area was obtained from the Transport for NSW Centre for Road Safety, and is listed in Table 9.5.

Table 9.5 Crash history 2009-2013

Road	Fatality	Serious	Moderate	Minor	Total
Newell Highway[1]					
Dubbo - Tomingley	3	10	6	0	19
Tomingley - Peak Hill	0	4	3	0	7
Peak Hill (town)	1	1			2
Peak Hill - Alectown	1	3	1	3	8
Alectown - Parkes	0	3	2	5	10
Newell Highway total	*5*	*21*	*12*	*8*	46
Old Backwater Road	0	1	0	0	1
Tomingley Road	0	2	1	1	4
Plowman Lane	0	1	0	0	1
Bogan Road	0	0	2	0	2
Henry Parkes Way	0	2	2	0	4
Brolgan Road	0	1	1	1	3

Note 1: Excludes urban areas in Dubbo and Parkes

The majority of crashes occurred on the Newell Highway, which is to be expected given the higher volumes of traffic along the highway compared to other roads. The high proportion of serious and moderate injury crashes is also noted, and is likely to be a factor of higher vehicle speeds on rural roads.

9.2.3 Other transport facilities

Public transport

In addition to passenger trains servicing Parkes via the Broken Hill line (described in chapter 2), there are a number of intercity coach (bus) services. Parkes is serviced by four to five coach services per day. This includes services to Dubbo and Orange. Narromine's coach network has a service between Dubbo and Bourke or Broken Hill, with four services most days. These regional services operate along the Newell Highway.

There are also local buses, including school services, operating around Parkes, Peak Hill, and Narromine. School buses cross the proposal site via level crossings on various routes including:

- Dandaloo Road
- Kitto's Bridge Road
- Tullamore Road
- Trewilga Road
- Bogan Road
- Henry Parkes Way.

Rail infrastructure and train movements

Existing rail infrastructure and train movements are described in chapter 2.

Pedestrians and cyclists

There are no formal pedestrian or cyclist paths crossing or located in the immediate vicinity of the proposal site. The remote nature of the proposal site means that pedestrian and cyclist activity is low.

9.3 Impact assessment

9.3.1 Risk assessment

Potential impacts

The environmental risk assessment undertaken for the proposal (summarised in Appendix B) included potential risks associated with traffic, transport and access. Potential risks were considered according to the impacts that may be generated by the construction and/or operation of the proposal. The likelihood, consequence and overall risk level of each potential risk were assessed, and avoidance and management measures were defined for each potential risk. Further information on the risk assessment, including the approach, methodology, and the full results, is provided in Appendix B.

The assessed risk level for the majority of potential risks to traffic and transport was between low and high. Risks with an assessed level of medium or above include:

- construction traffic impacts, including temporary delays to local and regional traffic
- impacts to emergency services through delays in access due to works
- impacts on access to private properties
- impacts to rural roads unsuitable for construction traffic
- increase in travel times due to increase in level crossing waiting times associated with increasing length and frequency of trains.

How potential impacts have been and would be avoided

Potential impacts on traffic, transport and access would continue to be avoided by:

- designing, constructing and operating the proposal to minimise the potential for impacts outside the rail corridor
- managing the potential impacts on traffic, transport and access in accordance with relevant design, legislative, and policy requirements, including those described in section 9.1.2
- implementing the traffic, transport and access mitigation measures provided in section 9.4.

Level crossings not impacted by the proposal would continue to operate as normal, with warning devices and other controls installed in accordance with ARTC's *Level Crossing Design* standard.

Interactions between vehicles on the road network would continue to be defined by road rules and the physical configuration of the road. In most cases all construction activities would be located clear of the existing road network. Any short-term impacts associated with construction vehicle access or works at particular sites would be managed by the traffic management arrangements put in place by the construction contractor, as described in section 9.4.

9.3.2 Construction impacts

Traffic and road network impacts

Traffic impacts

Construction would generate additional vehicle movements, including light and heavy vehicles. Light vehicles would generally be generated by construction workers moving to and from the construction work areas and/or compounds. Heavy vehicle movements would generally be trucks delivering materials. The estimated amount of construction traffic generation is described in chapter 8.

Construction of the proposal would result in a temporary increase in heavy and light vehicle movements on the local road network. The extent of impacts would depend on the location of the works, and the origin of material and/or workers.

Daily traffic generation associated with construction would be around 400 individual vehicle movements, including 230 heavy vehicle movements. The peak hour for traffic generation would occur at the beginning and end of each shift, with up to 114 vehicle movements (one way), including around 39 heavy vehicles.

The Newell Highway is the busiest road in the study area likely to be used for construction access. An additional 100 vehicles per hour would bring the total peak hour volume to around 360 vehicles per hour. This would be a 38 per cent increase, noting that trucks have a disproportionate impact compared to light vehicles. This is well within the threshold for a route with a level of service B. The anticipated maximum hourly volume on potential access roads is within the threshold for level of service B.

Proposed works on level crossings may result in disruptions to local traffic and short term access restrictions to private property. Where this occurs, alternative access arrangements would be provided and/or appropriate traffic controls implemented.

A large portion of the proposal's earthworks would be associated with construction of the Parkes north west connection. This means that there would be an increased amount of vehicle movement associated with spoil delivery in this area. The design of the Parkes north west connection has taken this into consideration, and the cutting and embankment are both located to the north of Brolgan Road within greenfield areas, which would be acquired as part of the proposal. Therefore, vehicle movements associated with spoil movement would be carried out off-road, and would not impact on the operation of Brolgan Road and the surrounding road network.

Measures to manage the potential for construction traffic impacts are provided in section 9.4.

Road network impacts

The surrounding road network is not expected to be significantly impacted by construction traffic. This is because the roads have sufficient capacity to absorb the increased traffic, and delays or closure at crossings and intersections would have a localised impact only due to the low volumes on affected roads. During the peak construction activity, a level of service B is expected to be achieved on all affected roads.

It is expected that construction vehicle movements would be spread out across the day, particularly delivery trucks. This would also assist in minimising delays for vehicles turning from side roads at intersections along the construction access routes.

Construction of the Brolgan Road overbridge would have localised minor impacts on Brolgan Road traffic, including access to Coopers Road. The new bridge would be mainly constructed on a separate alignment which would minimise disruption to the road network.

However, localised sections may need to be deviated for short periods to achieve safety clearances from the construction of the embankment. This may cause delays to road users. Construction works would be scheduled and controlled to minimise the potential for impacts.

Measures to manage the potential for impacts on the road network during construction are provided in section 9.4.

Parking impacts

Light vehicle parking for construction workers would be provided within construction compounds, and/within the rail corridor, and would not impact surrounding roads or properties. Parking would be adequate to accommodate the peak demands associated with construction. Parking locations would be detailed in the CEMP. Provision of buses for workers would reduce the number of light vehicles that would need to travel to individual construction sites, and corresponding parking requirements.

Access impacts

A description of the indicative construction methodology is provided in chapter 8. Construction would move progressively along the proposal site. Given the length of the proposal site, the access routes that would be used for construction traffic would vary depending on the origin of construction vehicles and the location of each construction work site.

As described in chapter 8, construction vehicle access to work areas would be by means of the existing road network and the access track within the rail corridor as far as possible. New temporary access tracks may be required in some locations.

Access points from the public road network would be selected such that an adequate sight distance and a safe access path are available. Further investigation of access locations would be undertaken during detailed design. All construction accesses would be designed in accordance with relevant standards and the requirements of the road owner, with adequate sight lines to ensure they operate in a safe and efficient manner. In addition, access would be provided wherever practicable from secondary roads to minimise the potential for impacts to the arterial road network.

Measures to manage the potential for impacts to access are provided in section 9.4.

Other transport impacts

Public transport impacts

Coaches between Parkes and Condobolin cross the Henry Parkes Way level crossing. While construction works are underway in this area, there may be some short term delays to some services.

As with other traffic, public and school buses may be impacted by the increase in traffic on the road network. However, given the relatively small number of services in the area, this would be a minor impact.

The proposal would not impact the stopping patterns of passenger trains using the Broken Hill line.

Impacts to train paths

Construction activities would result in temporary impacts on existing rail operations. During each construction stage, rail operations would be altered as outlined in section 8.3. This may result in additional train activity on some parts of the rail network which could result in delays at some level crossings. However, as the maximum length of trains would not change the length of delays are not likely to increase significantly.

The possession strategy would be developed in consultation with affected train operations, track stakeholders and relevant government departments so that the impacts on existing rail operations are minimised where possible.

Pedestrian and cyclist impacts

The main pedestrian and cyclist safety issues that may arise are:

- at construction site access and egress points where construction vehicles may interface with pedestrians using any surrounding footpaths, and any locations where footpath widths would reduce around construction sites
- the introduction of additional heavy vehicles to the road network has the potential to increase safety risks for pedestrians and cyclists.

Given the low volume of pedestrian and cyclist activity in and around the proposal site, and the remote nature of the majority of the works, there are not expected to be any significant impacts to pedestrian and cyclists.

9.3.3 Operation impacts

Traffic and road network impacts

During operation, some maintenance/operational traffic would be generated. However, this would be minimal, and is estimated to comprise about two to three trips to the proposal site per week. Occasionally there may be larger maintenance efforts required. The potential for significant traffic impacts is unlikely.

As described in chapter 5, the need for the proposal has been driven by continued growth in both road and rail freight volumes. Operation of the proposal would have a positive impact on the road network, particularly along major transport routes such as the Newell Highway, by decreasing the amount of heavy vehicles on the road. This has the potential to reduce travel times for road users and improve road safety.

Overall, the proposal is expected to have a positive impact on traffic, by relocating some of the road freight task to rail, thereby reducing the number of heavy vehicles on main roads.

Level crossings

The proposed works at level crossings involve a mix of retaining/refurbishing existing crossings, consolidation of some crossings, upgrading the level of control, or installing a gated crossing. At this stage of the planning process, 19 crossings have been identified as requiring further investigation and consultation in relation to consolidation options. These are mainly private crossings where alternative access is available, or access is no longer required. Further information on the level crossing strategy, including the next steps, is provided in section 6.3.3.

The main traffic impact of the proposal would be impacts on travel time as a result of increased train activity at level crossings. Table 9.6 lists the estimated duration of delays. The delays shown would increase only if the maximum length of trains increase, and may actually reduce if train speeds increase.

Table 9.6 Level crossing delays per train

Year and train length[1]	Maximum delay at crossing (seconds)[2]
Existing	122
Year 2040	109

Notes 1: Train speed 90 kilometres per hour existing and 110 kilometres per hour in 2040
2: 45 second pre-train and 5 second post-train down times (active controls) is a conservative duration in excess of the ARTC's Level Crossing Design standards

The frequency of trains, and therefore likelihood of delays, would also increase over time as the number of trains using Inland Rail increases. Given the local nature of most affected roads, this impact is expected to affect a small volume of cars and have a localised impact only. The potential for queued vehicles to impact on adjacent intersections is considered to be very low.

On the busier roads crossed by the proposal site, such as Henry Parkes Way, there is sufficient room for traffic to queue without obstructing any major junctions.

Longer trains could be used along the rail alignment as a result of the proposal. If this happens, there would be an increase in the duration of time for which road traffic could be delayed while a train crosses a level crossing.

Parking impacts

There is not expected to be any impacts on parking as a result of the proposal.

Impacts to access

Road crossings

As described in section 7.3.1, the Parkes north west connection would cross Millers Lookout Road and Coopers Road. The need for any road realignments would be determined during the detailed design phase following further investigations and consultation with relevant stakeholders (including Parkes Shire Council).

Alternative access to Coopers Road is available using Brolgan Road or London Road. The travel distance to Parkes is about the same using either road, from a location about 2.1 kilometres south of the Broken Hill line. That is, for any trips starting south of this point, the route via London Road, which is not affected by the crossing of Coopers Road, is shorter than the route via Brolgan Road. For a couple of properties, the travel distance to Parkes could increase, with a travel distance of up to 2.1 kilometres longer than the existing situation. This increase is not considered a significant impact, in the context of the number of people who would be affected, and the existing travel distance to Parkes.

The section of Millers Lookout Road that would be impacted has minimal traffic activity. Alternative access is available via Henry Parkes Way.

Brolgan Road overbridge

Construction of the Brolgan Road overbridge would leave a short 'bypassed' section of Brolgan Road about 1.1 kilometres long to the south of the overbridge. This section of road would be retained for local access purposes (to be confirmed in consultation with Parkes Shire Council). The configuration of the connection between the old Brolgan Road alignment and the new alignment would be finalised during detailed design.

Access to the rail corridor

During operation, minimal impacts to access are anticipated as access to the rail corridor would be via existing corridor access points.

Other transport impacts

Public transport impacts

Coaches between Parkes and Condobolin would cross the Henry Parkes Way level crossing. Due to the increased number of trains, there is a greater chance that coach services would need to stop at a level crossing and experience a delay of up to three minutes. This is a minor delay for coach services travelling long distances (100 kilometres between Parkes and Condobolin) and is therefore expected to have minimal impact on overall travel time.

No other public transport services are expected to be impacted by the proposal. It would not impact on the operation of existing passenger trains using the Broken Hill line.

Impacts to operation of freight trains

Prior to the opening of Inland Rail as a whole, the proposal would be used by existing rail traffic. The upgrades to the rail infrastructure would allow for an increase in train operating speeds between Parkes and Narromine. Proposed train speeds would vary according to axle loads, and range from 80 kilometres per hour (30 tonne) to 115 kilometres per hour (21 tonne). This is an improvement on existing train speeds, which are currently limited to a maximum of 90 kilometres per hour to 100 kilometres per hour, with local speed restrictions due to existing track condition.

The proposal would result in an increase in the number of freight trains travelling along the Parkes to Narromine line and the Broken Hill line. Further information on the operation of the proposal is provided in section 7.6.

Pedestrian and cyclist impacts

Given the low volume of pedestrian and cyclist activity in the study area, there is not expected to be any significant impacts to pedestrian and cyclists as a result of the proposal. An increase in the number of trains would result in an increase in the potential for a pedestrian or cyclist to encounter a train, however the likelihood of adverse impact remains low.

Measures to manage the potential for operational traffic impacts are provided in section 9.4.

9.4 Mitigation and management

9.4.1 Approach to mitigation and management

A traffic, transport and access management sub-plan would be prepared as part of the CEMP, and construction of the proposal would be undertaken in accordance with this plan.

All operational activities would be undertaken in accordance with ARTC's standard operating procedures and the EPL relevant to the proposal.

9.4.2 Consideration of the interactions between mitigation measures

All mitigation measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

9.4.3 Summary of mitigation measures

To mitigate the potential for traffic, transport and access impacts, the following measures would be implemented.

Table 9.7 Summary of mitigation measures

Stage	Impact	Mitigation measures
Detailed design/pre-construction	Traffic, transport and access	The detailed design of the proposal would minimise the potential for impacts to the surrounding road and transport network, and property accesses. Where any legal access to a property is permanently affected and a property has no other legal means of access, alternative access to and from a public road would be provided to an equivalent standard where feasible and practicable. Where an alternative access is not feasible or practicable, and a property is left with no access to a public road, negotiations would be undertaken with the relevant property owner for acquisition of the property in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*.
	Consultation	Input would be sought from relevant stakeholders (including Parkes Shire Council, Narromine Shire Council, and Roads and Maritime) prior to finalising the detailed design of those aspects of the proposal that impact on the operation of road infrastructure under the management of these stakeholders.
	Level crossings	Level crossings would be provided with warning signage, line marking, and other relevant controls; in accordance with the relevant national and ARTC standards.
Pre-construction/construction	General impacts of construction activities on traffic, transport, access, pedestrians and cyclists	A traffic, transport and access management sub-plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for impacts on the community and the operation of the surrounding road and transport environment. It would address all the aspects of construction relating to the movement of vehicles, pedestrians and cyclists, and the operation of the surrounding road network, including: - construction site traffic control, parking and access arrangements - construction material, equipment and spoil haulage, including arrangements for oversize vehicles - road pavement and access road condition management - management of impacts to public transport, including school buses, pedestrian and cyclist access, and safety - management of impacts to access for surrounding residents and business owners/operators - arrangements for level crossings during construction - road and driver safety. The traffic, transport and access management sub-plan would be developed in consultation with (where relevant) Parkes Shire Council, Narromine Shire Council, Roads and Maritime, and public transport/bus operators.
Construction	Access to properties	Property access would be maintained throughout the construction period, with suitable alternative access arrangements provided where required.

Stage	Impact	Mitigation measures
	Consultation	Consultation with relevant stakeholders would be undertaken regularly to facilitate the efficient delivery of the proposal and to minimise congestion and inconvenience to road users. Stakeholders would include the relevant local council, bus operators, Roads and Maritime, emergency services, and affected property owners/occupants. The community would be notified in advance of any proposed road network changes through signage, the local media, and other appropriate forms of communication. Where changes to access arrangements are required, ARTC would advise property owners/occupiers and consult with them in advance regarding alternative access arrangements.
Operation	Level crossings	The operation of level crossings that have been subject to changes as part of the proposal would be reviewed after the proposal commences operation to confirm: • that the level of protection continues to be appropriate • that the infrastructure is appropriate for the traffic conditions.

10. Biodiversity

This chapter provides a summary of the terrestrial and aquatic biodiversity impact assessments of the proposal undertaken by Umwelt (Australia) Pty Limited (Umwelt). It describes the existing biodiversity environment (both terrestrial and aquatic), assesses the impacts of construction and operation, and provides mitigation measures. The biodiversity assessments include the terrestrial biodiversity assessment report (prepared in accordance with the Framework for Biodiversity Assessment (OEH, 2014a)) (full report is provided as Technical Report 2) and the aquatic ecology assessment (full report is provided as Technical Report 3).

The chapter also considers the potential impacts on EPBC Act matters, including a summary of the full assessment provided in the assessment of Commonwealth matters report (full report is provided as Technical Report 4).

10.1 Assessment approach

10.1.1 Methodology

The impacts of the proposal on biodiversity were assessed using the methodology in the *Framework for Biodiversity Assessment* (OEH, 2014a) (for terrestrial ecology) and relevant aquatic ecology guidelines. The biodiversity assessments involved desktop literature reviews of flora and fauna listed as occurring or potentially occurring in the study area, supported by detailed field surveys and assessment. The methodology used is described in detail in Technical Reports 2 and 3, and is summarised below.

Literature and database review

Existing information on the terrestrial and aquatic biodiversity of the study area was obtained from a range of sources, including databases, aerial photographs and maps, previous studies carried out in the area, and consultation with representatives of relevant government agencies/organisations and landowners.

Previous documents and reports relevant to the study area were reviewed, including regional and sub-regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys, and relevant ecological database searches.

Digital aerial photography was reviewed to identify spatial patterns in vegetation, land use, and landscape features.

Searches were undertaken of species databases to identify listed threatened species (under the TSC Act, EPBC Act, and the FM Act), known or likely to occur within the search area (a radius of ten kilometres around the existing rail corridor). The following databases were searched:

- Threatened Species Profile Database, accessed up to and including May 2016.
- The OEH Threatened Species Website for known/predicted threatened species in the Bogan-Macquarie and Lower Slopes Interim Biogeographic Regionalisation of Australia (IBRA) subregions, accessed in April 2016.
- PlantNET (Royal Botanic Gardens Sydney) database search for rare or threatened Australian plant species within the Parkes and Narromine LGAs, accessed in May 2016.
- The Protected Matters Search Tool for known/predicted threatened ecological communities listed under the EPBC Act, accessed in April 2016.

Field surveys

Field surveys were undertaken across a range of seasons and years. The survey design considered seasonality issues associated with maximising the opportunity of identifying threatened species with the potential to be impacted by the proposal. Surveys were undertaken on the following dates:

- 16 and 18 September 2014
- 15 to 16 October 2014
- 11 to 21 January 2016
- 2 to 5 May 2016.

Surveys were undertaken in the proposal site and the additional assessment areas, as described in section 2.2. Survey effort and habitat assessments were focused in known or potential habitat locations for threatened ecological communities, and potential habitat for threatened flora and fauna species. Surveys involved quadrats, plots, transects, random meanders, and rapid surveys. Further information on the surveys, including the locations of survey sites, is provided in Technical Reports 2 and 3.

Analysis and reporting

Vegetation mapping was undertaken using best-practice techniques to delineate plant communities. The BioBanking Credit Calculator Version 4.1 was applied in accordance with the *BioBanking Assessment Methodology* (OEH, 2014b) to identify the biodiversity credits that would be required to offset the impacts of the proposal. Potential fish habitats were classified in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).

As described in section 2.2.1, the biodiversity assessment considers the potential impacts of the proposal on biodiversity in the proposal site (described in chapter 2) and, to provide flexibility for the design (particularly in relation to culvert and level crossing upgrades), it also considers additional assessment areas outside the proposal site, including:

- an approximate 60 metre buffer around culverts
- an approximate 120 metre buffer around the locations of level crossings.

As described in section 2.2.1, the need for works in these areas would be determined during detailed design. Calculations undertaken using the BioBanking Credit Calculator were based on the biodiversity assessment area (that is, the proposal site plus the additional assessment areas).

10.1.2 Legislative and policy context to the assessment

The main legislation relevant to the assessment are the EPBC Act, TSC Act, FM Act, and *Noxious Weeds Act 1993*. These acts provide the statutory basis for listing threatened species and communities, and/or assessment requirements in relation to impacts to biodiversity.

The main policy relevant to biodiversity assessments for State significant development and infrastructure in NSW is the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014c), which provides guidance in relation to biodiversity offsetting for major project approvals. A key principle underpinning the policy is that offset requirements should be based on a reliable and transparent assessment of biodiversity losses and gains. The offsets policy is underpinned by the *Framework for Biodiversity Assessment*, which sets out the process for assessing biodiversity impacts as a result of a development, and determining the biodiversity offset requirements for those impacts.

The BioBanking Credit Calculator is a web tool that is used in conjunction with the *Framework for Biodiversity Assessment* to apply the *BioBanking Assessment Methodology.*

As noted in section 3.5, the proposal is a controlled action under the EPBC Act, with the controlling provision being 'listed threatened species and communities', specifically in relation to the potential for impacts to/removal of:

- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC
- known foraging habitat for the superb parrot
- potential foraging habitat for the swift parrot and regent honeyeater
- potential habitat for the flora species *Tylophora linearis* (a herbaceous climber).

The assessment and approval requirements under the EPBC Act are described in section 3.5.

The guidelines that apply to assessments of matters of national environmental significance under the EPBC Act include the *Matters of National Environmental Significance - Significant impact guidelines 1.1* (Department of Environment, 2013) and the *EPBC Act Environmental Offsets Policy* (DSEWPC, 2012).

10.2 Existing environment

10.2.1 General ecological context

The study area for the biodiversity assessment is typical of the South Western Slopes and Darling Riverine Plains bioregions. The study area is in the Lachlan River basin and north of the Lachlan River, with Goobang Creek the nearest named watercourse. The northern end is in the Macquarie River floodplain. The proposal site crosses a number of ephemeral watercourses. Further information on the hydrological context of the proposal site is provided in chapters 15 and 16.

The majority of the study area has been heavily modified by past and ongoing disturbances associated with the active rail corridor and surrounding rural and agricultural activities. Clearance and maintenance of the rail corridor has resulted in fragmentation, a high level of disturbance, and degradation of vegetation communities within the rail corridor. The majority of the proposal site is cleared or consists of non-native vegetation.

Patches of native vegetation are located within and near the proposal site, and are sometimes connected to small woodland patches in adjacent agricultural land. These patches generally comprise a woodland community, with the dominant canopy species including inland grey box (*Eucalyptus microcarpa*), fuzzy box (*Eucalyptus conica*), and yellow box (*Eucalyptus melliodora*). Patches of weeping myall (*Acacia pendula*) were also recorded.

10.2.2 Terrestrial biodiversity

Communities, habitats and species identified during field surveys

Plant communities

Nine native plant communities across 15 condition classes were identified during field surveys. These communities are listed in Table 10.1 and are shown in Figure 10.1. The most common native vegetation community is the Western Grey Box tall grassy woodland community. All of these communities have the potential to be affected by the proposal.

Table 10.1 Plant communities

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
Weeping Myall Open Woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	PCT26	*Moderate to good*	3.47	▸ Conforms to the TSC Act listed *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions* EEC ▸ 0.99 ha conforms to the EPBC Act listed *Weeping Myall Woodlands* EEC	Occurs as several small remnant or regenerating patches predominantly on red-brown clay soils. There is limited connectivity between patches due to the heavily disturbed nature of the biodiversity assessment area.
River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	PCT36	*Moderate to good*	0.87	Not listed	Occurs as one distinct patch bisected by the existing rail corridor and in the riparian zone along Burrill Creek near Peak Hill. This community is found on alluvial soils.
		Low	0.62	Not listed	Occurs as two distinct patches bisected by the existing rail corridor and in the riparian zone along Burrill Creek near Peak Hill. This community is found on alluvial soils with a heavily disturbed understorey.
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	PCT55	*Moderate to good*	1.12	Not listed	Mainly occurs on the clay soils associated with Tomingley Creek. The community is well-connected with vegetation beyond the existing rail corridor despite disturbance from adjacent land uses.

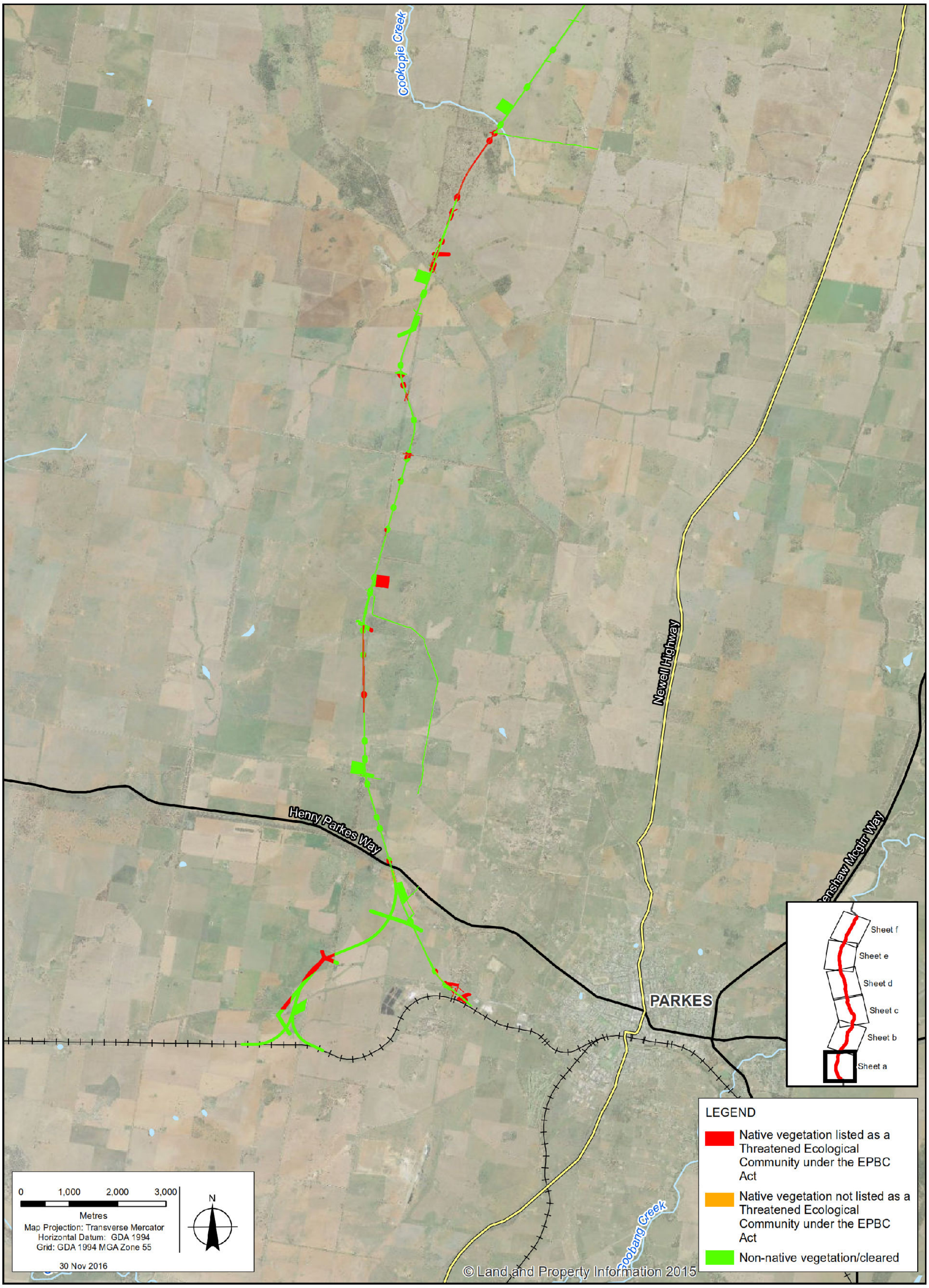
Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
		Moderate to good – derived native grasslands	7.12	Not listed	Mainly occurs on the clay soils associated with Tomingley Creek.
White Cypress Pine woodland on sandy loams in central NSW wheatbelt	PCT70	*Moderate to good*	1.95	Not listed	Mainly occurs as a small linear patch. The community occupies red clay soils and shares similarities with the upper storey characteristics of the Poplar Box grassy woodland community.
Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	PCT76	*Moderate to good*	10.13	- 7.33 hectares (ha) conforms to the TSC Act listed *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC - 9.44 ha conforms to the EPBC Act listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC	Occurs as several disturbed remnant patches. The largest patch is located in the southern portion of the biodiversity assessment area near Parkes. The community typically occurs on red to brown clay soils.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
		Moderate to good - derived native grasslands	32.06	- Conforms to the TSC Act listed *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC - Conforms to the EPBC Act listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC	Occurs adjacent to Western Grey Box tall Grassy Woodland patches and lacks a canopy due to historic clearing. The community is generally heavily disturbed.
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	PCT244	*Moderate to good*	3.38	Not listed	Occurs as several small remnant or regenerating patches throughout the biodiversity assessment area on red-brown clay soils. Although widespread, the patches are relatively isolated due to historic clearing.
		Moderate to good - derived native grasslands	14.45	Not listed	Occurs adjacent to Poplar Box Grassy Woodland patches, and typically lacks a significant canopy due to historic clearing. The community is generally heavily disturbed.
Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	PCT201	*Moderate to good*	1.88	- Conforms to the TSC Act listed *Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* EEC	Occurs as small remnant patches on clay soils and in slight depressions. The patches are isolated likely due to historic clearing.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	PCT267	*Moderate to good*	3.24	• Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC • Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies low rises and gentle slopes. The understorey is predominantly native with few non-native species. Recruitment of white box (Eucalyptus albens) is occurring.
		Moderate to good – derived native grasslands	9.46	• Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC • Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies low rises and gentle slopes. Occurs adjacent to Cypress Pine - Western Grey Box Woodland and lacks a canopy due to historic clearing. The community is generally heavily disturbed.
Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	PCT276	*Moderate to good*	7.16	• Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC • Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies alluvial plains and low hills on clay-loam soils. Patches within the biodiversity assessment area occur as isolated remnants.

Plant community type (PCT)	PCT[1] reference code	Condition	Total area (hectares)	Conservation status[2]	General description
		Moderate to good - derived native grasslands	13.96	- Conforms to the TSC Act listed *White Box Yellow Box Blakely's Red Gum Woodland* EEC - Conforms to the EPBC Act listed *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC	Occupies alluvial plains and low hills on clay-loam soils adjacent to patches of Yellow Box grassy tall woodland. Patches of this community occur as isolated remnants.
Cleared/non-native vegetation	-	-	712	-	The majority of the existing rail corridor is cleared or consists of non-native vegetation. The community is frequently subjected to disturbances from surrounding land uses, weed spraying and frequent mowing regimes. This community is characterised by a predominantly dense understorey of non-native grasses, forbs and herbs.

Notes
1: Plant community types are as per the NSW Vegetation Information System database
2: Conservation status indicates conformity to threatened ecological communities (TECs) listed by the TSC Act and/or the EPBC Act. EEC – endangered ecological community, CEEC – critically endangered ecological community.



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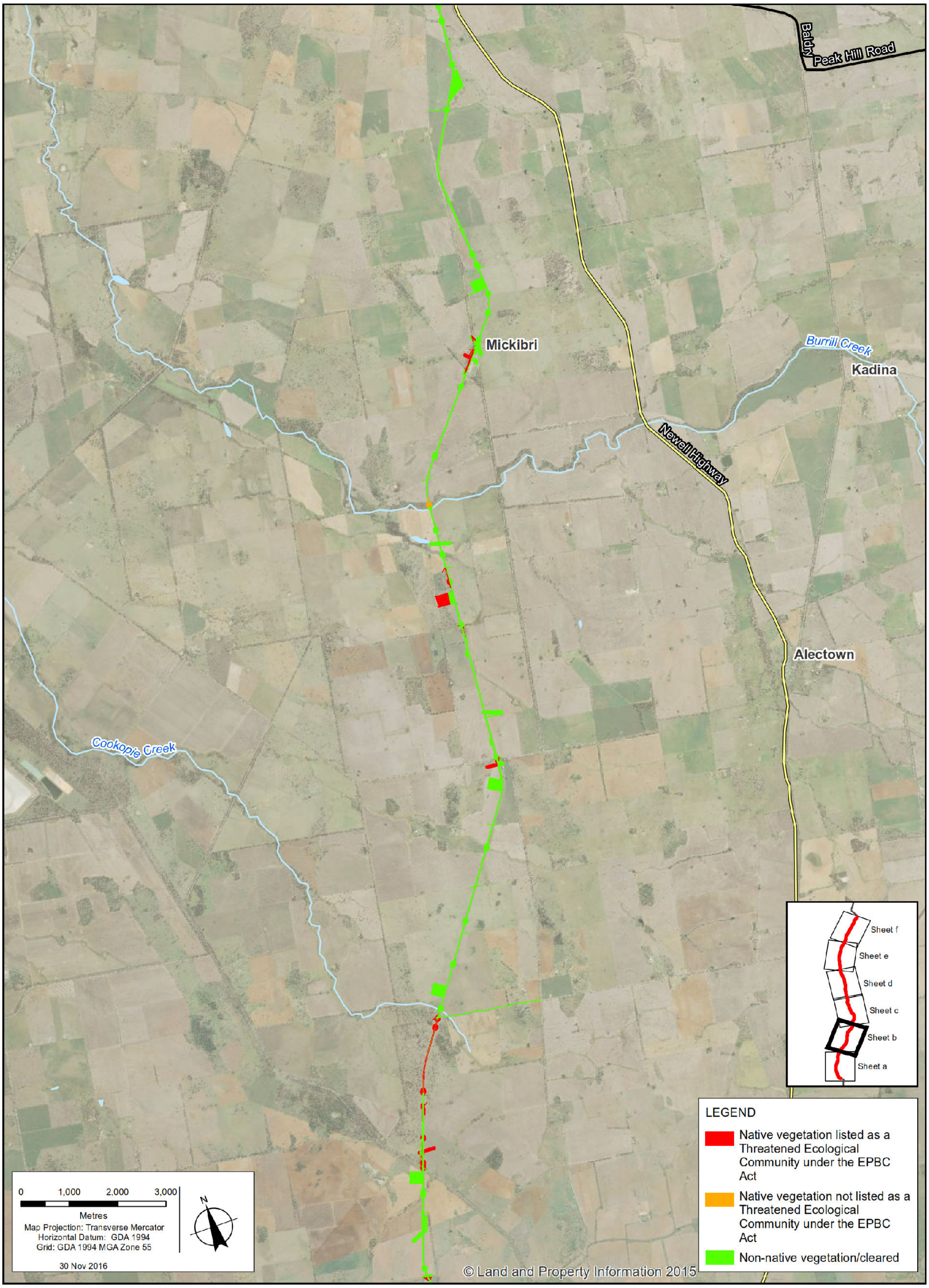
Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1a
Vegetation communities



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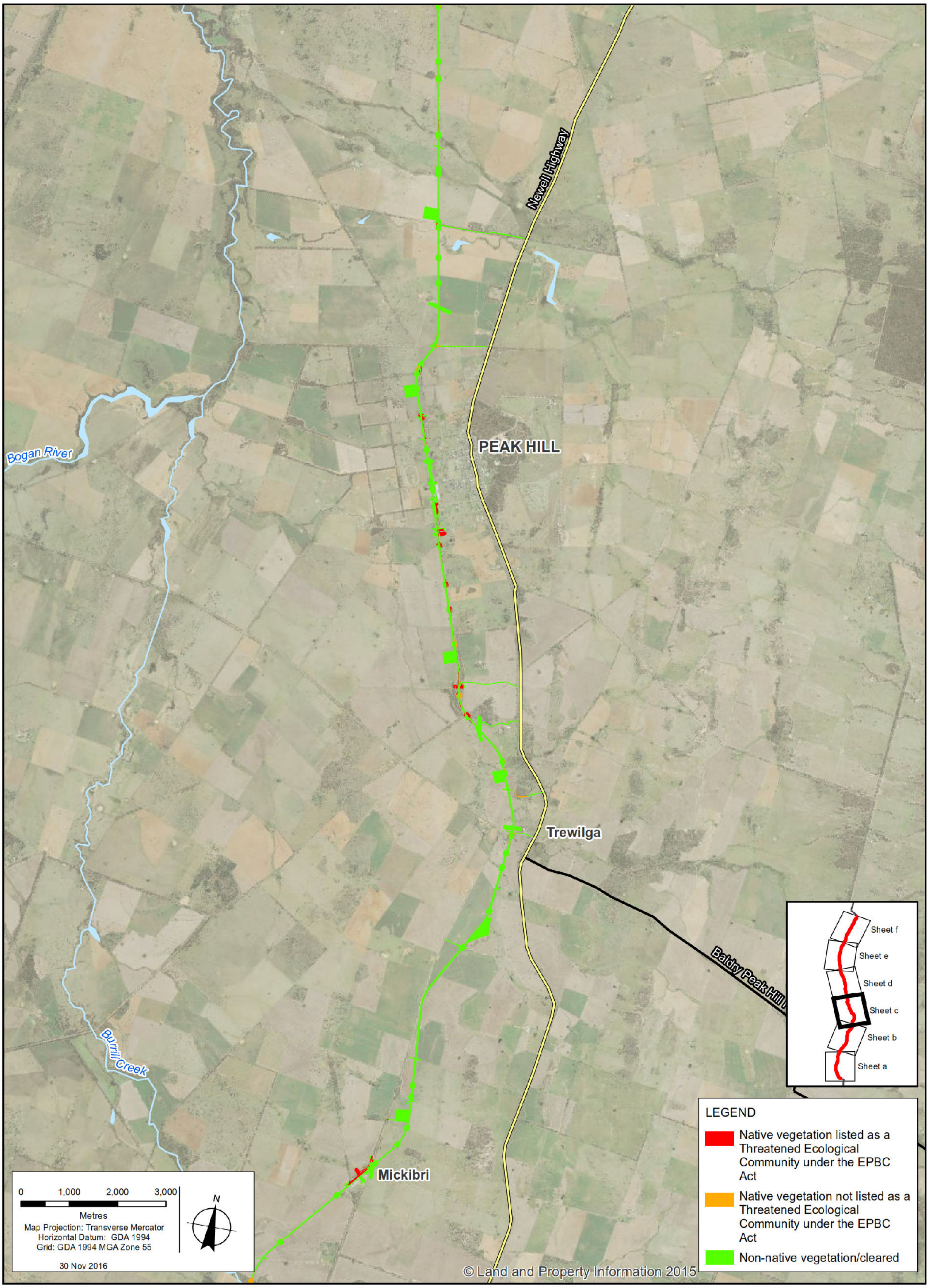
Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1b
Vegetation communities



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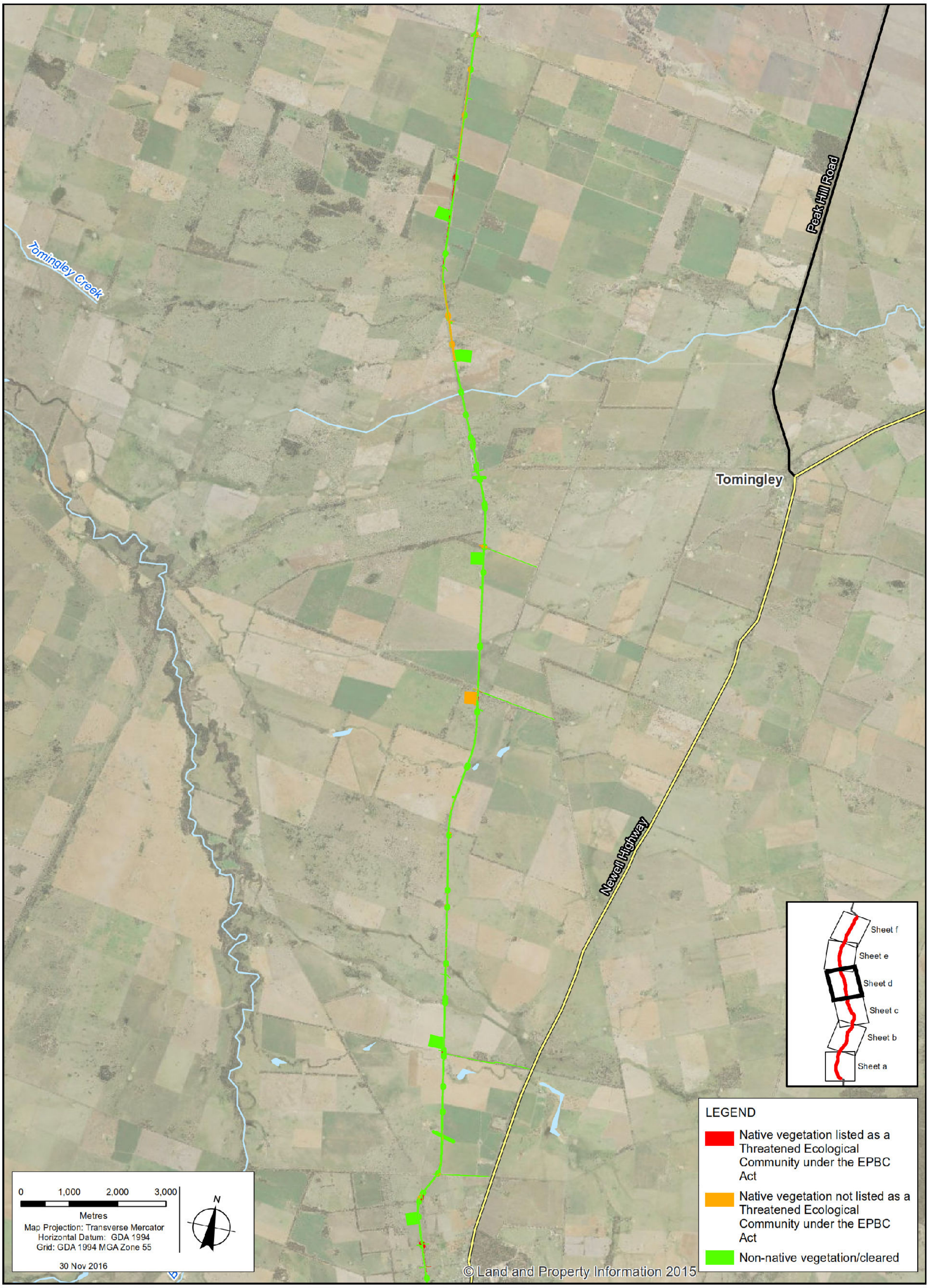
Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1c
Vegetation communities



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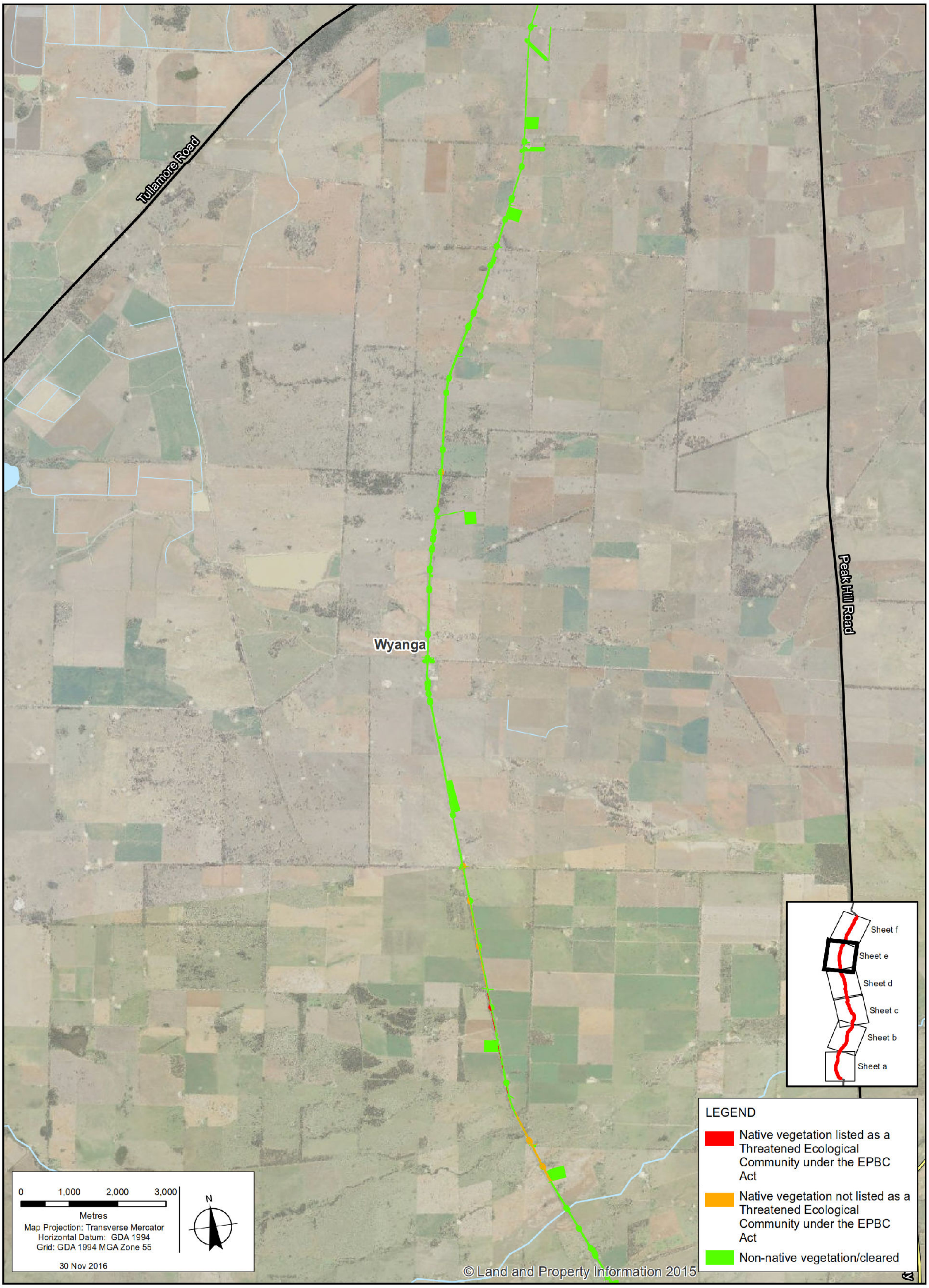
Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1d
Vegetation communities



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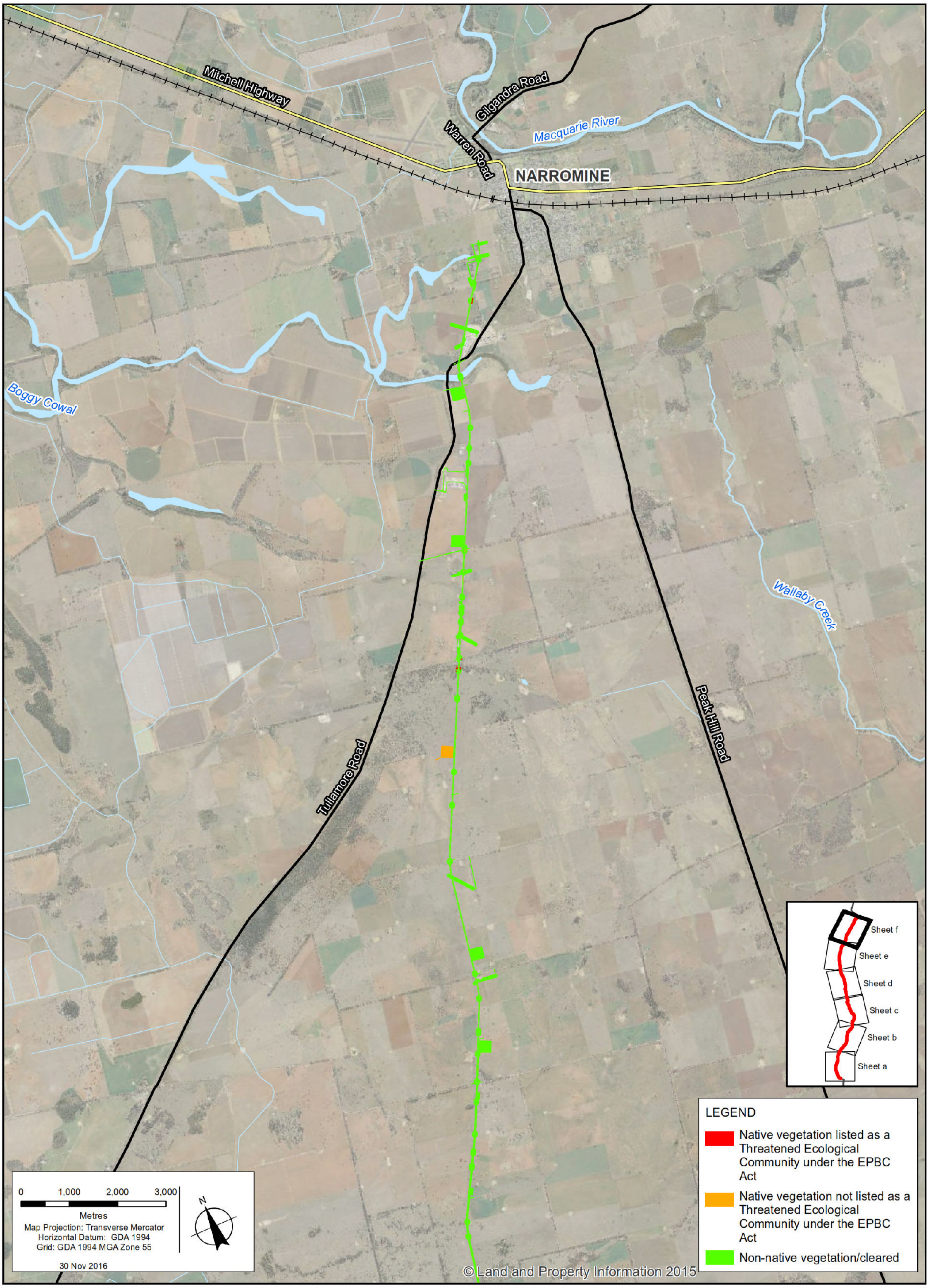
Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1e
Vegetation communities



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Data source: LPI, DCDB, Imagery, 2012. Umwelt, Vegetation Communities, 2016.

Figure 10.1f

Vegetation communities

Flora species

A total of 266 flora species were recorded during field surveys. Of the recorded species, 73 (27 per cent) are non-native. A full list of recorded species is provided in Technical Report 2.

Fauna habitats

The biodiversity assessment area occurs in a landscape that is dominated by crop land and introduced pastures, and contains only a small proportion of woodland and scattered tree cover. Patches of native woodland habitat exist sporadically and are typically associated with road verges or small woodland patches on farmland. As such, native fauna habitats within the biodiversity assessment area are minimal.

Several general fauna habitat types were identified during field surveys. Each of these habitat types has a range of characteristics that influence habitat value, and the range of fauna species that are likely to be identified. Sparse woodland areas may provide nesting resources for small birds or hollow resources for micro-bat species. Open grassland may provide a foraging resource for macropods, and a foraging and refuge habitat for reptile species. The broad habitat types recorded within the biodiversity assessment area consist of grasslands, scattered woodland, and riparian and aquatic habitat. Aquatic ecology is described in section 10.2.3.

Fauna species

A total of 66 fauna species were recorded during field surveys. This included 51 bird species, five amphibian species, and 10 mammal species. Commonly recorded species included the eastern grey kangaroo (*Macropus giganteus*), apostlebird (*Struthidea cinerea*), and red-rumped parrot (*Psephotus haematonotus*).

Of the fauna species recorded, three were introduced species, being the domestic dog (*Canis lupus familiaris*), brown hare (*Lepus capensis*), and sheep (*Ovis aries*).

A full list of recorded species is provided in Technical Report 2.

TSC Act protected matters and threatened species

Flora

None of the threatened flora species listed under the TSC Act that are known to occur in the study area were recorded during field surveys. The likelihood of threatened flora species occurring in the biodiversity assessment area is low given the level of disturbance described in section 10.2.1.

Fauna

Two fauna threatened species, listed as vulnerable under the TSC Act, were recorded in the biodiversity assessment area during field surveys – the superb parrot (*Polytelis swainsonii*) and the grey-crowned babbler (*Pomatostomus temporalis temporalis*).

While the koala (*Phascolarctos cinereus*) was not recorded during field surveys, the species has been previously recorded in the study area, and the biodiversity assessment area contains six known koala food tree species. A total of 18.88 hectares of suitable foraging habitat for the koala occurs within the biodiversity assessment area.

Threatened ecological communities

Five of the plant community types in the biodiversity assessment area (listed in Table 10.1) conform to four threatened ecological communities listed under the TSC Act, comprising:

- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions* EEC
- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC
- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* EEC
- *White Box Yellow Box Blakely's Red Gum Woodland* EEC.

No critical habitat listed under the TSC Act occurs within the biodiversity assessment area.

EPBC Act protected matters and threatened species

Flora

None of the threatened flora species listed under the EPBC Act that are known to occur in the study area were recorded during field surveys, and the likelihood of threatened flora species occurring in the biodiversity assessment area is low.

Fauna

The only threatened species listed under the EPBC Act that was recorded during field surveys is the superb parrot (*Polytelis swainsonii*), which is listed as vulnerable under the EPBC Act. Potential habitat exists within the biodiversity assessment area for five EPBC Act listed species – the superb parrot, the swift parrot, the regent honeyeater, painted honeyeater, koala, and the south-eastern long-eared bat (*Nyctophilus corbeni*).

No migratory species listed under the EPBC Act were considered to have the potential to be impacted by the proposal, as little or no suitable habitat is present within the biodiversity assessment area.

Threatened ecological communities

Five of the plant community types listed in Table 10.1 conform to three threatened ecological communities listed under the EPBC Act as endangered or critically endangered, where condition thresholds are met:

- *Weeping Myall Woodlands* EEC
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC
- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC.

Noxious weeds and exotic species

The majority of the biodiversity assessment area is cleared or contains non-native vegetation. Non-native vegetation in the biodiversity assessment area is characterised by a predominantly dense understorey of non-native grasses, forbs and herbs. Dominant non-native grasses typically include paspalum (*Paspalum dilatatum*), bearded oats (*Avena barbata*) and urochloa grass (*Urochloa panicoides*). Coffee senna (*Senna occidentalis*) is frequently present in the midstorey. Dominant non-native forbs and herbs include Patterson's curse (*Echium plantagineum*), red-flowered mallow (*Modiola caroliniana*), cobbler's pegs (*Bidens pilosa*), saffron thistle (*Carthamus lunatus*) and flaxleaf fleabane (*Conyza bonariensis*).

Noxious weeds that occur in the biodiversity assessment area include African boxthorn (*Lycium ferocissimum*), blue heliotrope (*Heliotropium amplexicaule*), galvinized burr (*Sclerolaena birchii*), Johnson grass (*Sorghum halepense*), Mexican poppy (*Argemone mexicana*), and tiger pear (*Opuntia aurantiaca*). Three weeds of national environmental significance were identified – African boxthorn, tiger pear, and silver-leaved nightshade (*Solanum elaeagnifolium*).

10.2.3 Aquatic ecology

General description of aquatic flora and fauna habitat

Watercourses that cross and/or are located near the proposal site are described in chapter 15. Most are either cleared or contain non-native vegetation. Few aquatic plant species, such as *Persicaria decipiens*, occur in the weed-dominated vegetation characterising the bed and banks of watercourses.

The majority of watercourses that cross the proposal site are first order streams with intermittent flow following rain events, little or poorly defined channels, and no aquatic flora species. These watercourses contain minimal aquatic fauna habitat with little or no defined drainage channels, and little or no flow or freestanding water. Some areas of intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (eg fish, yabbies) are present.

The location of key fish habitat is described in section 10.2.4. A full list of recorded species is provided in Technical Report 3.

Threatened species

The database searches identified a number of threatened species, endangered populations and aquatic matters of national environmental significance listed under the FM Act, TSC Act and/or EPBC Act in the study area. However, none of the listed threatened species or endangered populations were assessed as likely to occur within aquatic habitats in the watercourses in and around the proposal site.

Threatened ecological communities

The proposal site does not contain any threatened aquatic ecological communities. However, it occurs within the mapped distribution of two threatened communities listed as endangered under the FM Act:

- *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Darling River*
- *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River.*

Groundwater dependent ecosystems

Groundwater dependent ecosystems are ecosystems in which species composition and ecological processes are determined by groundwater (DLWC, 2002). Ephemeral waterways in the biodiversity assessment area are likely to be fed by both surface and groundwater, and the associated riparian vegetation is therefore likely to be dependent, at least in some part, on groundwater.

The River Red Gum Forest along Burrill Creek is likely to be a groundwater dependent ecosystem under the *NSW State Groundwater Dependent Ecosystems Policy* (DLWC, 2002).

10.2.4 Protected and sensitive lands

Protected areas

No protected areas, defined as areas/reserves managed by OEH and/or DPI NSW Fisheries under the *National Parks and Wildlife Act 1974*, are located near the proposal site. The nearest reserve is the Goobang National Park, located about nine kilometres to the east of the proposal site at the closet point.

Key fish habitat

Table 10.2 lists the areas of key fish habitat within/around the proposal site. These are areas classified as class 3 (minimal key fish habitat) or above, in accordance with the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).

All watercourses except for Burrill Creek are considered to have minimal habitat sensitivity and minimal key fish habitat. Burrill Creek is the only watercourse crossing the proposal site that was classifed as ‘type 2 moderately sensitive habitat’ and ‘class 2 moderate fish habitat’.

Table 10.2 Key fish habitat

Watercourse	Strahler stream order	Habitat sensitivity type[1]	Classification of watercourse for fish passage[1]
Unnamed tributary of Burrill Creek	Third order	Type 3 – Minimal	Class 3 - Minimal
Burrill Creek	Fifth order	Type 2 – Moderate	Class 2 - Moderate
Ten Mile Creek	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Barrabadeen Creek	Fifth order	Type 3 – Minimal	Class 3 - Minimal
Bulldog Creek	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Tomingley Creek	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Bradys Cowal	Fourth order	Type 3 – Minimal	Class 3 - Minimal
Backwater Cowal	Fourth order	Type 3 – Minimal	Class 3 - Minimal

Note 1: As per the Policy and guidelines for fish habitat conservation and management (DPI, 2013)

Critical habitat

No land or waters identified as critical habitat under the TSC Act, FM Act, or EPBC Act are located in the study area.

Biobank sites, private conservation lands and other lands identified as offsets.

No BioBank sites, private conservation land, or other lands identified as offsets are located in or in the vicinity of the study area.

10.3 Impact assessment

10.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (provided in Appendix B) included an assessment of the potential risks of the proposal in relation to biodiversity. The assessed risk level for the majority of potential risks to biodiversity was between low and medium. Risks with an assessed level of medium or above include:

- clearing of native vegetation resulting in loss of fauna habitat, habitat fragmentation and loss of connectivity
- direct impacts on terrestrial threatened species and endangered populations and communities from clearing
- direct impacts on aquatic threatened species and endangered populations and communities from clearing
- increased potential for the occurrence and spread of pest plants and animals during construction and maintenance from movement of vehicles, machinery and materials in and out of the site, particularly in greenfield sections such as the Parkes north west connection
- indirect impacts due to increased dust, sedimentation and erosion, noise, light

- disturbance to aquatic habitats and reduced water quality as a result of fugitive sediments and altered hydrology
- alterations to surface water flow regimes and interruptions to fish passage
- fauna mortality from vehicle strikes.

The SEARs (Attachment B) also identified the following specific matters as having potential to be impacted by the proposal and requiring further assessment:

- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigelow Belt South* EEC
- *White Box Yellow Box Blakely's Red Gum Grassy Woodland* EEC and CEEC
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* EEC
- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC
- a spear-grass (*Austrostipa wakoolica*)
- spiny peppercress (*Lepidium aschersonli*)
- small purple-pea (*Swainsona recta*)
- silky swainson-pea (*Swainsona sericea*).

The SEARs provide the requirements for the assessment of the potential impacts on these matters (listed in Table A.3 of Appendix A). Further information on relevant statutory requirements under the EPBC Act is provided in section 3.5.1.

How potential impacts have been avoided

The option development and assessment process for the Inland Rail location/route options is summarised in chapter 6. As noted in chapter 6, the shortlist of route options was subject to a detailed assessment, and the proposed alignment was refined based on evaluation of key considerations, including environmental impacts. The majority of Inland Rail (about 65 per cent) would be located on upgraded tracks in existing rail corridors, minimising as far as practicable the potential for biodiversity impacts.

The proposal minimises the potential for direct impacts, as the majority of works would be undertaken within areas subject to existing disturbance within the rail corridor. For works outside the corridor (the Parkes north to west connection), environmental impacts were included in the list of selection criteria used for the analysis of options (summarised in chapter 6).

Potential impacts on biodiversity would continue to be avoided by:

- designing, constructing, and operating the proposal to minimise the potential for impacts outside the rail corridor
- managing the potential impacts on biodiversity in accordance with relevant legislative and policy requirements, as described in section 10.1.2
- implementing the biodiversity mitigation measures provided in section 10.4
- implementing the noise, air quality, soils, and water quality mitigation measures provided in chapters 11, 13, 14 and 16.

10.3.2 Construction impacts – terrestrial ecology

Potential impacts on biodiversity during construction include:

- direct impacts as a result of permanent removal (clearing) or temporary disturbance of vegetation in the proposal site to enable the proposal to be constructed
- indirect impacts on flora and fauna located outside the proposal site as a result of activities within the proposal site.

Impacts on native vegetation

Direct impacts include the removal of vegetation for the location of permanent infrastructure. Clearing of vegetation would be required to construct and locate the infrastructure. Direct impacts also include temporary disturbance of vegetation. Vegetation has the potential to be temporarily disturbed for construction facilities such as compounds and temporary access tracks. Native vegetation occurring in these areas is not expected to be fully impacted (that is, not cleared), but would be subject to some disturbance, and is expected to recover. While the vegetation and habitats in these areas would be impacted in the short term, it is expected that these areas would regenerate following completion of construction and rehabilitation undertaken in accordance with the proposed rehabilitation strategy (described in section 10.4). As a result, these temporary impacts are not included in the calculation of biodiversity credits.

The assumptions used to calculate the potential impacts on terrestrial biodiversity are provided in Technical Report 2. This impact assessment is based on calculating potential vegetation removal using a conservative worst-case scenario. The actual amount of vegetation with the potential to be directly impacted would be subject to further refinement during the detailed design phase. The estimate of potential clearing would continue to be refined as the design of the project progresses, with the aim of reducing the potential clearing required.

The estimated areas of vegetation (according to plant community types) that would be directly impacted by the proposal are listed in Table 10.3. In summary, it is estimated that the proposal would result in:

- permanent removal or modification (clearing) of about 75.8 hectares of native vegetation
- temporary disturbance of about 35.3 hectares of native vegetation.

Table 10.3 Estimated area of each plant community type that would be impacted

Plant community type		Permanent disturbance area (ha)	Temporary disturbance area (ha)
Listed threatened ecological communities (under the TSC and/or EPBC Acts)			
Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	*Moderate to good*	3.16	0.31
Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	*Moderate to good*	8.58	1.55
	Derived native grassland	23.64	8.59
Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	*Moderate to good*	1.50	0.38
White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	*Moderate to good*	3.12	0.12
	Derived native grassland	9.35	0.11
Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	*Moderate to good*	3.40	3.76
	Derived native grassland	10.32	3.64

Plant community type		Permanent disturbance area (ha)	Temporary disturbance area (ha)
Area impacted - listed communities		**63.07**	**18.46**
Non-listed communities			
River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	*Moderate to good*	0.87	0
	Derived native grassland	0.62	0
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	*Moderate to good*	0.94	0.18
	Derived native grassland	6.13	0.99
White Cypress Pine woodland on sandy loams in central NSW wheatbelt	*Moderate to good*	1.54	0.41
Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	*Moderate to good*	1.41	1.97
	Derived native grassland	1.20	13.25
Area impacted – non-listed communities		**12.71**	**16.8**
Total area impacted		**75.78**	**35.26**

The largest areas of permanent impacts (more than five hectares removed) on native vegetation would occur within the following vegetation communities, all of which conform to threatened ecological communities listed under the TSC and/or EPBC Acts:

- Western Grey Box tall grassy woodland
- White Box – White Cypress Pine – Western Grey Box – derived native grassland
- Yellow Box grassy tall woodland – derived native grassland
- Western Grey Box tall grassy woodland derived native grassland.

Threatened ecological communities – TSC Act

The proposal would result in direct impacts to the following TSC Act listed threatened ecological communities:

- *Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions* EEC
- *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions* EEC
- *White Box Yellow Box Blakely's Red Gum Woodland* EEC
- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC.

The area impacted is listed in Table 10.3.

None of the communities in the biodiversity assessment area are considered to consist of an 'important area' of the EEC as defined by the *Framework for Biodiversity Assessment*. An important area comprises an area of a CEEC or EEC that is necessary for the community's long-term persistence and recovery. The areas of EECs within the biodiversity assessment area with the potential to be impacted by the proposal are unlikely to be necessary for the long-term persistence and recovery of the EECs overall. These areas occur as fragmented and disturbed patches, and do not constitute a large area in comparison with other stands of the EEC.

While the proposal would result in an increase in the level of fragmentation of the EECs at the local scale, the increase in fragmentation is considered to be negligible, given the already highly fragmented nature of the EECs in the study area.

To mitigate the potential impacts to biodiversity as a result of the proposal, biodiversity offsets would be provided in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, as described below and in section 10.4.1.

Threatened ecological communities – EPBC Act

The proposal would result in the following permanent impacts to EPBC Act listed threatened ecological communities:

- *Weeping Myall Open Woodlands* EEC – 0.99 hectares would be removed
- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC – 26.19 hectares would be removed
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC – 32.22 hectares would be removed.

To mitigate the potential impacts to biodiversity as a result of the proposal, biodiversity offsets would be provided, as described in Table 10.5 and section 10.4.1.

Flora species

Species listed under the TSC Act

As no threatened flora species were recorded during field surveys, and the likelihood of threatened flora species occurring in the biodiversity assessment area is low, the proposal is not expected to affect threatened flora species.

Species listed under the EPBC Act

Field surveys were undertaken within the biodiversity assessment area across a range of seasons and years. The survey design considered seasonality issues associated with maximising the opportunity of identifying threatened plant species. None of the EPBC Act threatened flora species that are known to occur in the study area were recorded during field surveys, and the likelihood of threatened flora species occurring in the biodiversity assessment area is considered low as a result of a lack of suitable habitat and a high level of disturbance.

The Australian Government Department of Environment and Energy determined that the proposal may result in a significant impact on *Tylophora linearis*. However, although this species was specifically targeted during the flora surveys, it was not identified. Potential habitat for the species is characterised as dry scrub and open forest, with records from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa*, *Eucalyptus sideroxylon*, *Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla, and Allocasuarina luehmannii*. The disturbed nature of much of the potential habitat occurring within the biodiversity assessment area limits the likelihood of this species occurring. However, due to the presence of the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC and White Cypress Pine woodland on Sandy Loams in Central NSW Weatbelt in the biodiversity assessment area, there is a low potential for this species to occur.

To mitigate the potential impacts to *Tylophora linearis* as a result of the proposal, biodiversity offsets would be provided for the *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* CEEC, as described in Table 10.5 and section 10.4.1.

Fauna species

Species listed under the TSC Act

Removal of the vegetation communities described above would impact on fauna habitats in the biodiversity assessment area. Up to 75 hectares of native plant communities would be removed during construction. Fauna habitat resources that would be removed include foraging and shelter resources.

Threatened fauna species recorded in the biodiversity assessment area are described in section 10.2.2. As per the *Framework for Biodiversity Assessment* methodology:

- The superb parrot is an ecosystem-credit species for habitat other than breeding habitat and is a species-credit species for breeding habitat only. Breeding habitat was not identified in the biodiversity assessment area and is not considered likely to occur.
- The grey-crowned babbler is an ecosystem-creditspecies predicted by the landscape features of the biodiversity assessment area.

The koala was not recorded during surveys but has been previously recorded in the study area. The biodiversity assessment area contains food tree species and suitable foraging habitat for the koala. The koala is a species credit species.

There are a range of additional threatened ecosystem-credit species that are predicted to occur in the biodiversity assessment area that were not recorded during the field investigations (refer to Table 5.1 in Technical Report 2). Potential habitat for these species will also be removed as a result of the proposal.

To mitigate the potential impacts of the proposal on the above threatened species that have been recorded or that are predicted to occur, biodiversity offsets would be provided, as described in Table 10.4 and section 10.4.1.

Species listed under the EPBC Act

Targeted surveys undertaken for the assessment recorded the superb parrot flying over the proposal area at three survey locations. Potential habitat was also identified for the EPBC Act listed swift parrot, regent honeyeater, painted honeyeater, koala, and the south-eastern long-eared bat.

A total of 66.72 hectares of foraging habitat for the superb parrot was identified in the biodiversity assessment area, and would be removed as part of the proposal. Although the proposal would result in the removal of known and potential habitat for the superb parrot, it is unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species would be likely to decline. Pre-clearing surveys and other mitigation measures would minimise the potential impacts on this species by minimising the impacts on the species habitat. Within the biodiversity assessment area, potential box-gum woodland habitat for the swift parrot and regent honeyeater is restricted to small linear patches and scattered trees, comprising an area of about 15 hectares. The swift parrot and regent honeyeater were not recorded during targeted surveys, and have not been previously recorded within 10 kilometres of the biodiversity assessment area. The biodiversity assessment area does not support breeding habitat for the swift parrot and does not occur within the known core breeding areas of the regent honeyeater, being the Bundarra-Barraba area of NSW, the Capertee Valley in NSW, and north-eastern Victoria. The removal of potential box-gum woodland habitat is not expected to result in a reduction in the area of occupancy of the swift parrot or regent honeyeater or lead to a long-term decrease in the size of either population.

To mitigate the potential impacts to the superb parrot, regent honeyeater and swift parrot as a result of the proposal, biodiversity offsets would be provided, as described in Table 10.5 and section 10.4.1. As discussed above, the koala was not recorded during surveys but has been previously recorded in the study area. The proposal will result in the removal of suitable foraging habitat for the koala. The koala is a species credit species and potential impacts resulting from habitat removal in the biodiversity assessment area will be offset through the retirement of species credits as detailed in Table 10.4.

The south-eastern long-eared bat was not recorded in the study area but is predicted to occur based on the habitat types present in the biodiversity assessment area. The south-eastern long-eared bat is an ecosystem credit species. Potential impacts to this species as a result of the proposal will be offset through the retirement of ecosystem credits as detailed in Table 10.4.

Biodiversity offsets

The number and type of biodiversity credits required to offset the impacts of the proposal have been calculated in accordance with the *Framework for Biodiversity Assessment*, and are listed in Table 10.4. The TSC Act and EPBC Act listed threatened ecological communities that these plant community types conform to are listed in Table 10.1. The ecosystem credits required for offsetting incorporate relevant offsets for the threatened ecological communities and ecosystem credit species recorded or predicted to occur required as a result of the clearing of native vegetation. Species credits are required for offsetting impacts on the koala.

Like-for-like credit retirement is to be undertaken for matters of national environmental significance affected by the proposal in accordance with the *Framework for Biodiversity Assessment* as indicated in Table 10.5.The final application of offset credits for relevant matters of national environmental significance following the like-for-like principal will be determined during detailed design. Species credits required to offset impacts on the koala are listed in Table 10.4.

The offsets would be delivered as outlined in the Phase 1 biodiversity offset strategy, described in section 10.4.1.

Table 10.4 Credits required for offsetting impacts

Plant community type/species	Credits required
Ecosystem credits	
PCT26 Weeping Myall open woodland of the Riverina Bioregion and NSW South Western Slopes Bioregion	146
PCT36 River Red Gum tall to very tall open forest / woodland wetland on rivers on floodplains mainly in the Darling Riverine Plains Bioregion	54
PCT55 Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions	342
PCT70 White Cypress Pine woodland on sandy loams in central NSW wheatbelt	38
PCT76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	1,029
PCT244 Poplar Box grassy woodland on alluvial clay-loam soils mainly in the temperate (hot summer) climate zone of central NSW (wheatbelt)	114
PCT201 Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	70
PCT267 White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	185
PCT276 Yellow Box grassy tall woodland on alluvium or parna loams and clays on flats in NSW South Western Slopes Bioregion	583
Total ecosystem credits required for offsetting	2,561
Species credits	
Koala	491
Total species credits required for offsetting	491

Table 10.5 Summary of the offset requirement for relevant matters of national environmental significance

Matters of national environmental significance	Like-for-like offset In accordance with NSW FBA
White Box Yellow Box – Blakely's Red Gum Woodland and Derived Native Grassland CEEC	Subject to the revision of credits as part of the detailed design process, 768 ecosystem credits will be retired to offset impacts to this CEEC, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC	Subject to the revision of credits as part of the detailed design process, 1029 ecosystem credits will be retired to offset impacts to this EEC, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Tylophora linearis	Subject to the revision of credits as part of the detailed design process, 442 ecosystem credits will be retired to offset impacts to White Box Yellow Box – Blakely's Red Gum Woodland CEEC, which provides potential habitat for this species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Superb parrot	Subject to the revision of credits as part of the detailed design process, 2,561 ecosystem credits will be retired to offset impacts to the habitat of this threatened species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Regent honeyeater	Subject to the revision of credits as part of the detailed design process, 877 ecosystem credits will be retired to offset impacts to habitat for this species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.
Swift parrot	Subject to the revision of credits as part of the detailed design process, 877 ecosystem credits will be retired to offset impacts to habitat for this species, in accordance with the Biodiversity Offset Strategy and the NSW FBA.

Indirect impacts

Indirect impacts could include the following:

- Edge effects – can occur in adjoining or adjacent areas of vegetation and habitat as a result of weed growth, increased noise and light, erosion and sedimentation, and can result from vegetation clearance, where a new edge is created between vegetation and cleared areas, or from widening or extending of cleared easements through existing vegetation.
- Light and noise – could impact breeding, foraging and roosting activities where fauna are located close to construction activities.
- Erosion, sedimentation, and dust generation – uncontrolled erosion can cause weed problems, reduce habitat values, and stifle plant growth.
- Weeds – dispersal of weed propagules (seeds, stems and pollen) into areas of native vegetation through erosion (wind and water) and the movement of workers and vehicles.

- Plant pathogens – potential spread of soil-borne pathogens of native plants (for example, Phytophthora (*Phytophthora cinnamomi*) spread on machinery.
- Disease – potential spread of Chytrid fungus into local native frog populations, through soil and water carried on machinery and by the movement of workers between different areas.
- Fauna injury and mortality – as a result of vegetation clearing (particularly hollow-bearing trees), boulder removal and excavations.

These impacts can be readily managed through the implementation of standard construction soil and water management measures (listed in chapters 14 and 16), and the mitigation measures listed in section 10.4. With the implementation of these measures, no significant indirect impacts on biodiversity are predicted.

Summary of potential impacts on biodiversity values not covered by the Framework for Biodiversity Assessment

Biodiversity values not considered by the *Framework for Biodiversity Assessment* include marine mammals, wandering sea birds, and biodiversity endemic to Lord Howe Island. None of these occur or have the potential to occur within the biodiversity assessment area, and as such do not require further consideration.

In addition, the *Framework for Biodiversity Assessment* does not assess the direct impacts of a proposal that are not associated with clearing of vegetation. The main impact related to the proposal would be vehicle (train) strike during operation (considered in section 10.3.4).

The impacts on potentially groundwater dependent ecosystems are summarised in section 10.3.3. As the proposal does not involve substantial excavations that are likely to interfere with groundwater, the risk of impacts to groundwater and groundwater dependent ecosystems is low.

The impacts on aquatic ecology are provided in Technical Report 3 and summarised in section 10.3.3.

Summary of potential impacts on EECs, threatened species and/or populations listed in Attachment B to the SEARs

EECs

The proposal would impact on the EECs specifically identified in the SEARs. The impacts to EECs are summarised in Table 10.3. It is unlikely that the proposal would impact these communities in such a way as to change the characteristic and functionally important species, impact their quality and integrity, or fragment an important area of the community in the study area.

Table 5.4 of Technical Report 2 provides detailed information for the threatened ecological communities identified in the SEARs as requiring further consideration.

To mitigate the potential impacts to EECs as a result of the proposal, biodiversity offsets would be provided in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*, as described in section 10.4.1.

Threatened species

No known populations of the threatened species identified in the SEARs as requiring further consideration occur within the biodiversity assessment area, and no change in known habitat would occur as a result of the proposal. These species would not be impacted by the proposal.

Potential impacts on biodiversity values that require further consideration

Under the *Framework for Biodiversity Assessment*, certain impacts on biodiversity values may require further consideration by the consent authority. These are impacts that are considered to be complicated or severe and include:

- impacts on landscape features
- impacts on native vegetation that are likely to cause the extinction, or significantly reduce the viability, of an EEC/CEEC from an IBRA subregion
- impacts on critical habitat or on threatened species or populations that are likely to cause the extinction, or significantly reduce the viability, of a species or population from an IBRA subregion.

The proposal would not result in any of the above severe impacts.

Key threatening processes

The proposal is not classified as a key threatening process.The proposal may contribute to the following key threatening processes through clearing and edge effects:

- aggressive exclusion of birds by noisy miners (*Manorina melanocephala*)
- clearing of native vegetation
- loss of hollow-bearing trees
- removal of dead wood and dead trees
- competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*)
- predation by the European red fox (*Vulpes vulpes*)
- invasion of native plant communities by exotic perennial grasses.

The mitigation and management of the impacts of the proposal, including measures to mitigate contributions to the above key threatening processes where appropriate, are described in section 10.4.

10.3.3 Construction impacts – aquatic ecology

Potential impacts on aquatic ecology include:

- removal of riparian vegetation on the banks of watercourses to replace some of the culverts
- temporary obstruction of fish passage associated with any vehicle access across watercourses and culvert works
- impacts to fish within any semi-permanent pools within the proposal site
- any impacts to water quality during construction (described in chapter 16) has the potential to impact on aquatic ecology in receiving watercourses.

These potential impacts would be minimised by the implementation of appropriate design features to minimise watercourse impacts (described in chapters 15 and 16), the soil and water mitigation measures provided in chapters 14 to 16, and the mitigation measures provided in section 10.4. It is noted that only Burrill Creek is considered to have more than a minimal potential for key fish habitat.

As no listed threatened species, endangered populations or aquatic matters of national environmental significance are assessed as likely to occur within aquatic habitats in the watercourses in and around the proposal site, no impacts are predicted.

As noted in section 10.2.3, the proposal site is located within the mapped distribution of two aquatic threatened ecological communities. An assessment of significance of the potential impact on these communities was undertaken and is provided in Technical Report 3. The assessment concluded that the proposal is unlikely to have an adverse impact on either of these communities, with the adoption of appropriately designed fish friendly crossing structures and other mitigation measures to further reduce impacts.

10.3.4 Operation impacts

Increased rail movements may result in adverse impacts on locally occurring fauna species, particularly terrestrial mobile species as a result of vehicle strikes. Although there would be an increase in the number of trains using the operational rail line, no significant vehicle strike impacts are predicted.

Weed species could be inadvertently brought into the proposal site with imported materials, or could invade naturally through removal of native vegetation. Mitigation measures outlined in section 10.4 would minimise the potential for weed encroachment into surrounding areas around the proposal site.

No other operational activities, such as maintenance inspections or monitoring, are expected to impact on native flora and fauna or other biodiversity values.

10.4 Mitigation and management

10.4.1 Approach to mitigation and management

ARTC is committed to minimising the environmental impact of the proposal and is investigating opportunities to reduce actual impact areas where practicable. The area that would be directly impacted by construction activities would depend on factors such as presence of significant vegetation, constructability, construction management and safety considerations, landform, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable. The exact amount of clearance (within the proposal site) would be refined during detailed design.

ARTC has, where possible, altered the proposal to avoid and minimise ecological impacts in the proposal planning stage, and a range of impact mitigation strategies have been included in the proposal to mitigate the impact on ecological values prior to the consideration of offsetting requirements. Further refinement will be made during detailed design, where possible, to minimise ecological impacts.

Biodiversity offsets

ARTC is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable loss of biodiversity values as a result of the proposal under the *NSW Biodiversity Offsets Policy for Major Projects*.

The proposal will include the retirement of credits calculated in accordance with the NSW *Framework for Biodiversity Assessment* (provided in section 10.3.2). This includes all plant community types that would be directly and permanently impacted as a result of the proposal. The retirement of credits associated with the plant community types occurring in the biodiversity assessment area also ensures that the habitat for threatened fauna and flora species are offset as part of the proposal.

In accordance with the *Framework for Biodiversity Assessment*, there are two options, which can be used separately or together to fulfil offset requirements:

- securing like for like offsets to retire credits
- contributing to supplementary measures.

Analysis undertaken to date suggests that potential offsets would be identified within either the subregion in which the proposal site is located, or an adjoining subregion.

Biodiversity offset strategy for the proposal

A Phase 1 biodiversity offset strategy has been developed for the proposal and is provided in Appendix L. The strategy is summarised below.

The approach to biodiversity offsets for the proposal has been developed in accordance with the FBA, and based on the calculated offset credits described in section 10.3.2. This will provide for the offset requirements (for both plant community types and species requiring offsets) in accordance with the *NSW Biodiversity Offsets Policy for Major Projects*.

Efforts to secure these credits will continue throughout the detailed design of the proposal. The tasks undertaken and proposed are summarised in Table 10.6.

Table 10.6 Proposal biodiversity offset strategy tasks

Step	Actions
Check for available credits	The OEH biodiversity credits register was checked on 15 December 2016 to determine if ecosystem credits matching the proposal offset requirements have been issued and are available.
Check for expressions of interest	The OEH Biobank site expression of interest register was checked on 16 December 2016 to determine if a landholder may have credits matching the proposal offset requirements, but have not yet issued those credits.
Identify potential like for like offset sites	A desktop analysis was undertaken in December 2016.
Put a request on the credits wanted list	A 'credits wanted' request will be prepared and submitted on the OEH credits wanted register for the approximate number and type of credits required for the proposal once these are confirmed with assessing agencies. Estimated to occur early 2017.
Test landholder interest	If the proposal is approved, contact would be made with shortlisted landholders to determine their interest in entering into a BioBanking agreement and selling credits to ARTC.
Validate offset credits	Potential offset sites would be ground-truthed to validate the presence of ecosystem and/or species credit requirements, and assess overall suitability as an offset. Shortlisted offset properties would then be taken to the next level of assessment.
Investigate options for supplementary measures and estimate costs	The indicative cost of supplementary measures is estimated with similar credits already sold as part of the BioBanking scheme acting as a guide to pricing.

A search of the OEH biodiversity credits register and expression of interest register in December 2016 identified there were no suitable ecosystem credits available for purchase in the impact subregions or adjoining regions that satisfy the *Framework Biodiversity Assessment* criteria for the proposal. For koalas, there are three offset sites on the OEH credit register for the whole of NSW available for use. Two are classified with a credit status of 'Issued' and have a combined credit number of 1,074, which would meet the proposal's requirements.

To assess offset availability more broadly, a spatial analysis of OEH's vegetation information system database and mapping has been undertaken. The results of the spatial analysis indicate that there are mapped areas of each plant community type requiring offsets within at least one of the impact subregions. In addition, each impacted plant community type has been identified and mapped within at least two of the adjoining subregions that can also be considered for offsetting purposes.

The analysis shows there is opportunity to identify potential offsets for affected plant community types within either the impacted subregion or adjoining subregion.

10.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to minimise potential impacts associated with noise, air quality, soils, hydrology, and water quality and would also assist in mitigating the potential impacts to biodiversity. These mitigation measures are detailed in chapters 11 and 13 to 16.

The rehabilitation strategy would also assist in mitigating identified land use, and landscape and visual impacts.

10.4.3 Summary of mitigation measures

To mitigate the potential impacts to biodiversity, the following measures would be implemented.

Table 10.7 Biodiversity mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Biodiversity offset strategy	The biodiversity offset strategy (phase 1) for the proposal would be finalised, in accordance with the requirements of the *Framework for Biodiversity Assessment* (OEH, 2014a) and the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014c). The offset strategy would be approved by the Department of Planning and Environment prior to the commencement of construction work that would result in the disturbance of relevant ecological communities, threatened species, or their habitat, unless otherwise agreed.
	Direct impacts to biodiversity	Detailed design and construction planning would minimise the construction footprint and avoid impacts to native vegetation as far as practicable.
	Riparian vegetation	Compounds would be located an appropriate distance from riparian vegetation to avoid impacts on aquatic habitat. This includes (for the proposal site) a minimum of 50 metres for type 2 class 2 and 3 watercourses (Burrill Creek), and 10 to 50 metres for type 3 class 2 to 4 watercourses (other watercourses). Direct impacts to in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable.
	Fish passage	Detailed design and construction planning would minimise the potential for impacts to fish passage. To ensure that fish passage is maintained, watercourse crossing structures would be designed in accordance with the guideline *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003) and the minimum design requirements specified in Table 4.1 of Technical Report 3.
Pre-construction/ construction	General biodiversity impacts	A biodiversity management sub-plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for biodiversity impacts. The sub-plan would address: - a pre-clearance survey and tree-felling procedure - procedures to manage micro-bats - avoiding impacts on surrounding vegetation - weed management - dewatering of standing pools in watercourses - measures to minimise impacts on aquatic ecology.

Stage	Impact	Mitigation measures
	Rehabilitation strategy	A rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas following the completion of construction. The strategy would include: ▸ clear objectives and timeframes for rehabilitation works (including the biodiversity outcomes to be achieved) ▸ details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives ▸ identification of flora species and sources ▸ procedures for monitoring the success of rehabilitation ▸ corrective actions should the outcomes of rehabilitation not conform to the objectives adopted.
	Pre-clearing surveys	Pre-clearing surveys and inspections would be undertaken prior to construction. The surveys and inspections, and any subsequent relocation of species, would be undertaken in accordance with the biodiversity management sub-plan in the CEMP.
Construction	Avoidance of impacts	Areas of biodiversity value outside the proposal site would be marked on plans, and fenced or signposted where practicable, to prevent unnecessary disturbance.
	Weed management	Noxious weeds would be managed in accordance with the *Noxious Weeds Act 1993*. Weeds of national environmental significance would be managed in accordance with the *Weeds of National Significance Weed Management Guide*. Any herbicides would be applied such that impacts on surrounding agricultural properties are avoided.
	Rehabilitation	Rehabilitation of disturbed areas would be undertaken progressively and in accordance with the rehabilitation strategy.
Operation	Fish passage	Culverts would be regularly inspected and maintained to minimise blockage of fish passage.
	Weed management	Annual inspections would be undertaken for weed infestations and to assess the need for control measures. Any outbreak of noxious and/or weeds of national environmental significance would be managed in accordance with the *Noxious Weeds Act 1993*, the *Weeds of National Significance Weed Management Guide,* and the requirements of relevant authorities.

11. Noise and vibration (amenity impacts)

This chapter provides a summary of the noise and vibration assessment of the proposal as it relates to the potential for amenity impacts. It describes the existing environment, assesses the impacts of construction and operation, and provides recommended mitigation and management measures. The full noise and vibration assessment report is provided as Technical Report 5.

This chapter focuses on the potential for audible noise impacts, and human comfort impacts as a result of vibration. Structural noise and vibration impacts are considered in chapter 12.

11.1 Assessment approach

11.1.1 Methodology

The noise and vibration assessment:

- identifies noise and vibration sensitive receivers
- identifies existing noise and vibration levels in the study area
- identifies the main potential noise and vibration sources during construction and operation
- establishes amenity-related noise and human comfort vibration criteria/management levels to:
  - provide a basis for assessing the potential for impacts during construction
  - provide a basis for assessing the potential for impacts during operation, based on the current design
  - use as the basis for monitoring during construction and operation.
- assesses the potential for noise and vibration to exceed the applicable criteria and impact on the amenity of sensitive receivers
- provides amenity related noise and vibration mitigation measures.

A summary of the main tasks involved in the assessment is provided in the following sections. Further information is provided in Technical Report 5.

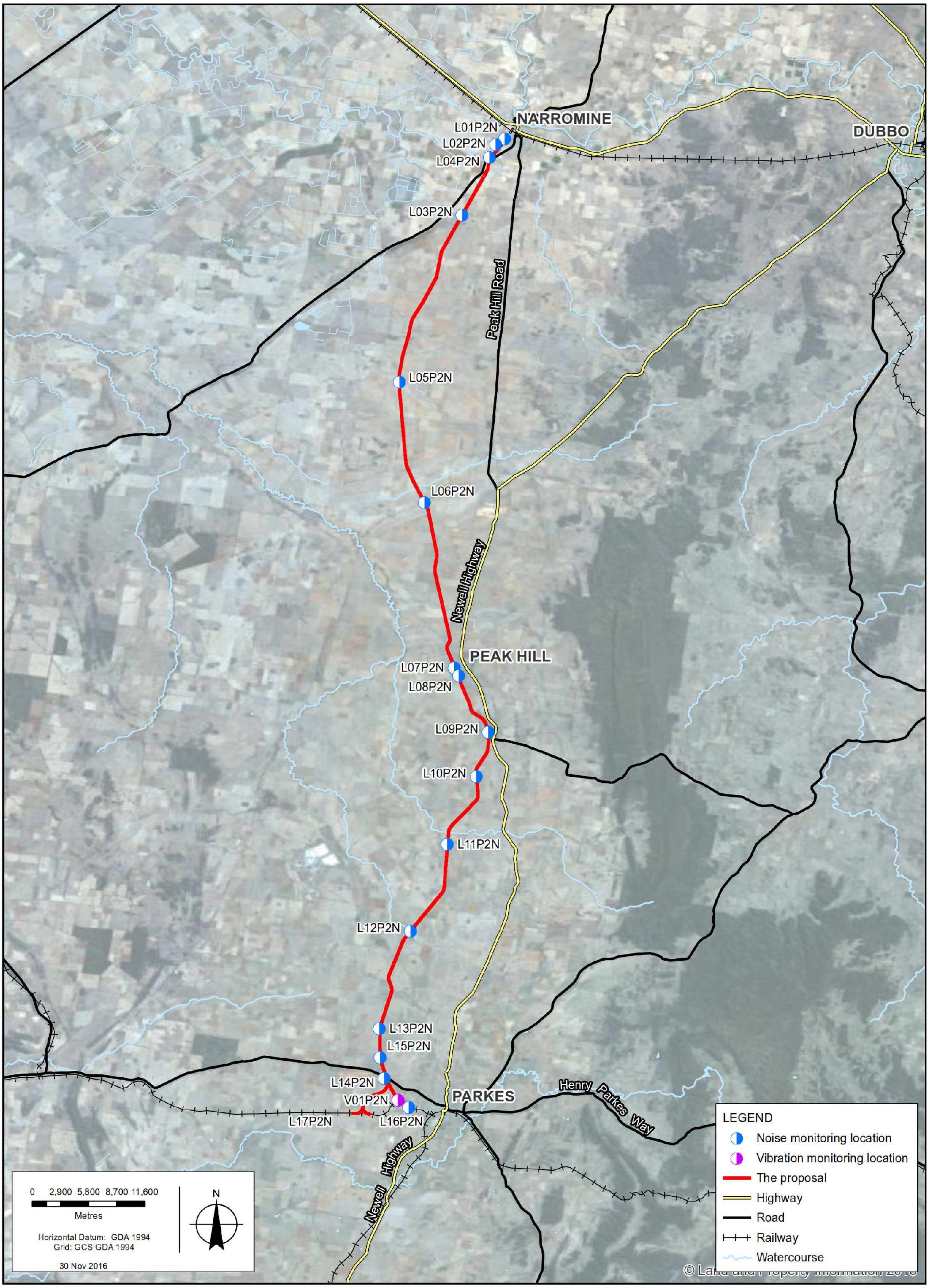
The study area for the noise and vibration assessment is defined as the area that extends about two kilometres from the centreline of the proposal site.

Identification of noise and vibration sensitive receivers

Potentially sensitive receivers are those that may be affected by changes in noise and vibration levels within the study area. Noise and vibration sensitive receivers were identified based on the type of land use, the activities undertaken, and the nature of the building, by using aerial imagery and geospatial information. Sensitive receivers are described in section 11.3.

Measuring background noise and vibration to determine existing levels

Unattended noise monitoring was undertaken at nine residential properties and eight locations within the proposal site considered to be representative of the existing ambient (background) noise environment. Monitoring was undertaken at various times between 2 September 2015 and 6 April 2016. Monitoring locations are shown in Figure 11.1.



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Data source: LPI, DCDB, Aerial, 2012.

Figure 11.1
Noise and vibration monitoring locations

Attended noise monitoring was also undertaken at the same locations between 21 March 2016 and 6 April 2016 to supplement the noise logger data and identify dominant noise sources.

Vibration measurements were undertaken at one monitoring location adjacent to the proposal site from 22 March 2016 to 23 March 2016. The vibration logger was set up about 15 metres from the existing rail corridor in a location where existing train movements were likely to be the dominant source of vibration levels.

Existing train pass-by noise levels were calculated by reviewing and analysing data from the unattended noise loggers located adjacent to the existing rail corridor.

Construction noise

Construction working hours are described in section 8.3. An assessment of the potential for construction noise (amenity) impacts was undertaken in accordance with the *Interim Construction Noise Guideline* (DECC, 2009). Noise emissions were assessed during both primary proposal construction hours and outside the primary proposal construction hours. The methodology involved the following tasks:

- Construction noise rating background levels were calculated based on monitoring data and were used to establish the construction noise management levels (that is, the construction noise criteria) in accordance with the *Interim Construction Noise Guideline*. Criteria for road traffic noise were established based on the *Road Noise Policy* (DECCW, 2011).
- Representative sound power levels for likely construction activities and machinery were obtained from the *Construction Noise Strategy* (Transport for NSW, 2012c) and *AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites.* Noise propagation calculations were then carried out to assess the potential impacts.
- Where noise levels were predicted to exceed the construction noise management levels, mitigation measures were recommended.

Construction vibration

Vibration from construction plant and equipment was predicted and assessed based on *Assessing Vibration: A Technical Guideline* (DEC, 2006a), *British Standard* (BS) *5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration* and *BS 6472:1992 Evaluation of human exposure to vibration in buildings.*

Where vibration levels were predicted to exceed the vibration criteria, mitigation measures were recommended.

Operational noise

Operational noise was assessed in accordance with the *Rail Infrastructure Noise Guideline* (EPA, 2013) ('the RING'). Assessment results were presented for the following modelling scenarios:

1. No build and build scenarios for the year in which the existing train operations recommence following construction (2020).
2. No build and build scenarios when Inland Rail commences operation (2025).
3. No build and build scenarios for the 'design year' – 2040.

Operational (airborne) noise goals were derived from the RING. Airborne noise is defined as noise that reaches a receiver through the air. The RING presents non-mandatory noise goals that trigger the need for an assessment to be conducted. If triggered, the operational noise assessment is required to address the potential noise impacts, and consider mitigation measures that may be feasibly and reasonably applied to mitigate the impacts.

The *Environmental Management System Guide: Noise and Vibration from Rail Facilities* (Sydney Trains, 2013) provides guidance on assessment of sleep disturbance based on the *Industrial Noise Policy* (EPA, 2000).

Operational vibration

Assessing vibration: a technical guideline (DEC, 2006a) outlines methods of assessing potential impacts and ways to manage vibration from rail operations, such as ground induced vibration created by train movements.

The ground-borne noise trigger levels in the RING were also used. Ground-borne noise is generally only a potential issue where noise levels are higher than the airborne noise levels, such as for underground railways. As there are no underground sections associated with the proposal, the risk of potential adverse ground-borne noise impacts is considered to be low.

Mitigation measures

Mitigation measures are provided to avoid or minimise identified impacts. These include standard measures used on similar projects which have been shown to be effective in reducing impacts. They also include project-specific measures which would need to be reviewed as the design progresses to determine whether they are feasible and reasonable to be implemented.

The terms 'feasible' and 'reasonable' are defined by the *Interim Construction Noise Guideline* and the RING. A measure is feasible if it can be engineered and is practical to build, given project constraints such as safety and maintenance requirements. Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects (including costs) of the measure.

11.1.2 Legislative and policy context to the assessment

In addition to the guidelines and standards described above, other relevant documents include:

- *Environmental Noise Management Manual* (RTA, 2001)
- *NSW Industrial Noise Policy* (EPA, 2000)
- *Construction Noise Strategy* (Transport for NSW, 2012)
- *AS 1055.1-1997 Acoustics – Description and measurement of environmental noise*
- *AS 2436–2010 Guide to noise and vibration control on construction, demolition and maintenance sites*
- *Transit noise and vibration impact assessment* (USA Federal Transit Administration, 2006).

11.2 Noise and vibration management levels/criteria - amenity

11.2.1 Construction noise management levels

Table 11.1 lists the construction noise management levels for the proposal. It is noted that, based on the *Interim Construction Noise Guideline*:

- the 'noise affected' management level represents the level above which there may be some community reaction to noise
- the 'highly noise affected' management level represents the level above which there may be strong community reaction to noise.

Table 11.1 Construction noise management levels

Receiver	Period	Times	Background level (dB(A)) $L_{A90(period)}$[1]	Management level (dB(A)) $L_{Aeq(15 min)}$[2]
Residential	Standard hours	Mon-Fri: 7am – 6pm Sat: 8am – 1pm Sun/public holidays: no works	30	Noise affected level: 40 Highly noise affected level: 75
	Outside standard hours - evening	Mon-Fri: 6pm – 10pm Sat: 1pm – 10pm Sun/public holidays: 8am – 6pm	30	Noise affected level: 35
	Outside standard hours - night/early morning	Mon-Fri: 10pm – 7am Sat: 10pm – 8am Sun/public holidays: 6pm – 7am	30	Noise affected level: 35
Industrial	When in use	-	n/a	75 dB(A)

Source: *Interim Construction Noise Guideline (DECC 2009)*

Notes: 1: The Industrial Noise Policy states that where the rating background level is less than 30 dB(A), then it is set to 30 dB(A)
2: The noise affected management level is the background noise level plus 10 dB(A) during recommended standard working hours and the background noise level plus 5 dB(A) outside recommended standard hours.

Proposal specific construction noise management level

The proposed construction working hours are described in section 8.3. Construction would be undertaken both during and outside standard construction hours defined by the *Interim Construction Noise Guideline,* and individual activities may span across time periods. As a result, the more stringent construction noise management level of 35 dB(A) has been adopted as the proposal specific management level.

11.2.2 Construction traffic noise criteria

Table 11.2 lists the construction road traffic noise criteria for residential land uses.

Table 11.2 Construction road traffic noise criteria (residential land uses)

Road category	Type of proposal/land use	Assessment criteria (dB(A)) (external)[1]	
		Day (7am –10pm)	Night (10pm – 7am)
Freeway/arterial road/sub- arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 $L_{Aeq\ (15\ hour)}$	55 $L_{Aeq\ (9\ hour)}$
Local road	Existing residences affected by additional traffic on existing local roads generated by land use developments	55 $L_{Aeq\ (1\ hour)}$	50 $L_{Aeq\ (1\ hour)}$

Source: *Road Noise Policy (OEH, 2011)*

Note 1: Section 2.4 of the *Road Noise Policy* indicates that, where existing road traffic noise levels already exceed the assessment criteria, an increase of less than two dB(A) represents a minor impact that is barely perceptible to the average person.

11.2.3 Operational rail noise criteria

Based on the RING, predicted rail noise levels need to exceed the criteria ('trigger values') listed in Table 11.3 to initiate an assessment of noise impacts and mitigation measures.

For the assessment, the proposal was categorised as follows:

- redevelopment of an existing heavy rail line – track works
- new rail line development - the Parkes north west connection.

For residential receivers, the criteria have two components – L_{Aeq} (assessed over the day or night) and L_{Amax} (train pass by events).

Table 11.3 Rail traffic noise criteria – residential land uses

Type of development	Noise criteria (dB(A)) (external)	
	Day (7am –10pm)	Night (10pm – 7am)
Redevelopment of existing rail line	Development increases existing $L_{Aeq(period)}$ rail noise levels by 2 dB or more, or existing L_{Amax} rail noise levels by 3 dB or more, and predicted rail noise levels exceed:	
	65 $L_{Aeq(15h)}$ OR 85 L_{AFmax}	60 $L_{Aeq(9h)}$ OR 85 L_{AFmax}
New rail line	Predicted rail noise levels exceed:	
	60 $L_{Aeq(15h)}$ OR 80 L_{AFmax}	55 $L_{AEq(9h)}$ OR 80 L_{AFmax}

Source: *Rail Infrastructure Noise Guideline (RING) (EPA, 2013).*

In accordance with the RING, other non-residential sensitive land uses (including hospitals, schools and outdoor recreational areas) have their own specific noise trigger levels for rail redevelopments, applicable when the facility or space is in use. The criteria for other sensitive land uses are listed in Table 11.4.

Table 11.4 Rail traffic noise criteria – non-residential land uses

Land use	New rail line development noise criteria (dB(A)) (when in use)[1]	Redevelopment of existing rail line noise criteria (dB(A)) (when in use)[1]
	Resulting rail noise levels exceed:	Development increases existing $L_{Aeq(period)}$ rail noise levels by 2 dB or more, and resulting rail noise levels exceed:
Schools, educational institutions and child care centres	40 $L_{Aeq(1h)}$ (internal)	45 $L_{Aeq(1h)}$ (internal)
Places of worship	40 $L_{Aeq(1h)}$ (internal)	45 $L_{Aeq(1h)}$ (internal)
Hospital wards	35 $L_{Aeq(1h)}$ (internal)	40 $L_{Aeq(1h)}$ (internal)
Hospitals – other uses	60 $L_{Aeq(1h)}$ (external)	65 $L_{Aeq(1h)}$ (external)

Land use	New rail line development noise criteria (dB(A)) (when in use)[1]	Redevelopment of existing rail line noise criteria (dB(A)) (when in use)[1]
Open space – Passive use	60 $L_{Aeq(15h)}$ (external)	65 $L_{Aeq(15h)}$ (external)
Open space – Active use	65 $L_{Aeq(15h)}$ (external)	65 $L_{Aeq(15h)}$ (external)

Source: *Rail Infrastructure Noise Guideline* (EPA, 2013).
Note 1: The RING allows for an open window to provide ventilation. Noise trigger levels for these receivers are applicable as internal or external levels depending on the land use. As construction materials and the facade acoustic performance of these buildings is unknown and may vary, a conservative 10 dB reduction in noise between the external level and internal level has been assumed.

11.2.4 Sleep disturbance

Sleep disturbance criteria are based on the *Road Noise Policy,* which suggests that internal noise levels below 50 dB(A) L_{Amax} to 55 dB(A) L_{Amax} are unlikely to cause awakening reactions, and one or two events per night, with internal noise levels of 65 dB(A) L_{Amax} to 70 dB(A) L_{Amax} (inside dwellings), are not likely to significantly affect health and wellbeing.

11.2.5 Human comfort vibration criteria

Construction typically generates ground vibration of an intermittent nature. Acceptable vibration levels, defined by *Assessing vibration: A technical guideline*, are listed in Table 11.5 for each type of sensitive receiver.

Table 11.5 Acceptable vibration values for intermittent vibration

Receiver	Daytime[1] (m/s$^{1.75}$)		Night-time[1] (m/s$^{1.75}$)	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Source: *Assessing vibration: A technical guideline* (DEC, 2006a)

Notes: 1. Daytime is 7am to 10pm, and night-time is 10pm to 7am.

2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be need to assess intermittent values against the continuous or impulsive criteria for critical areas.

Humans are capable of detecting vibration levels well below those that risk causing damage to a building. The degrees of perception for humans are suggested by the vibration level categories provided in *BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration,* as listed in Table 11.6.

Table 11.6 Guidance on the effects of vibration levels

Approximate vibration level (mm/s)	Degree of perception
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1	It is likely that vibration of this level in residential environments would cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Source: *BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration*

11.3 Existing environment

11.3.1 Sensitive receivers

As described in chapter 2, the majority of the proposal site passes through rural land. Sensitive receivers are concentrated in the main towns (Parkes, Peak Hill, and Narromine), with scattered residential receivers located on rural properties surrounding the proposal site. Receiver locations are shown in Figure 11.2. The closest residential receiver is located about 45 metres from the proposal site.

Non-residential noise receivers include two places of worship, three educational facilities, one medical facility, six active and two passive recreation areas. A number of commercial and industrial facilities are also located near the proposal site, and are subject to assessment for construction noise only.

The baseline noise monitoring results indicate that background noise levels are dominated by natural sounds, usually wind through long grass or trees, with occasional train pass-by noise events.

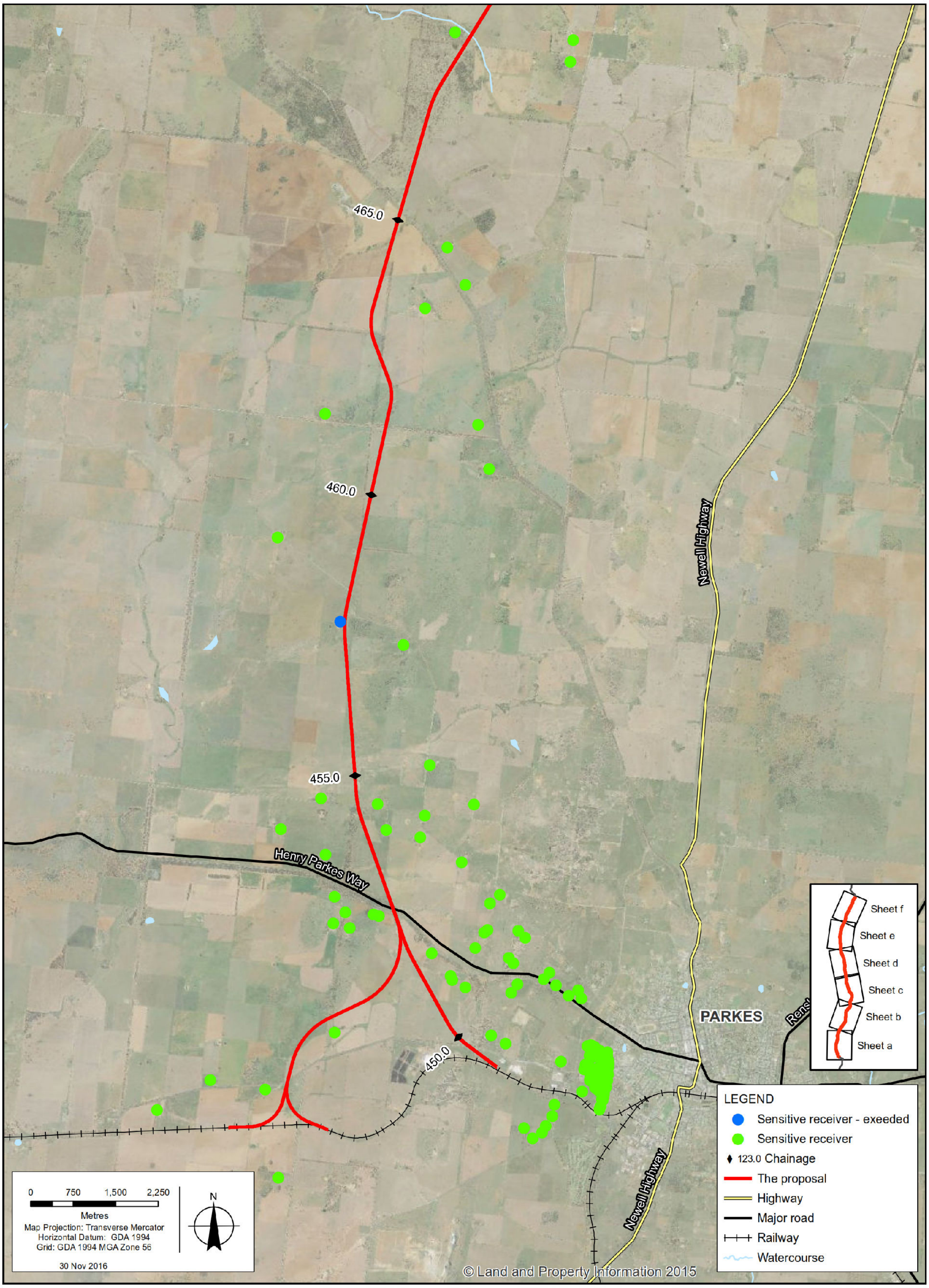
Further information on sensitive receivers and detailed noise monitoring results are provided in Technical Report 5.

Train pass-by noise levels

Existing train pass-by noise levels recorded by the noise loggers ranged from a sound exposure level of 80 dB(A) (at a logger located 420 metres from the existing rail corridor) to a sound exposure level of 97 dB(A) (recorded by two loggers located 10 and 35 metres from the corridor). The recorded duration of train pass-by events ranged from 24 to 74 seconds.

11.3.2 Vibration

Vibration levels of about one to 1.3 millimetres per second were recorded at the vibration logger during train pass-by events. Between pass-by events, background vibration levels were about 0.1 millimetres per second.



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Data source: Data Custodian, Data Set Name/Title, Version/Date.

Figure 11.2a

Sensitive receiver locations

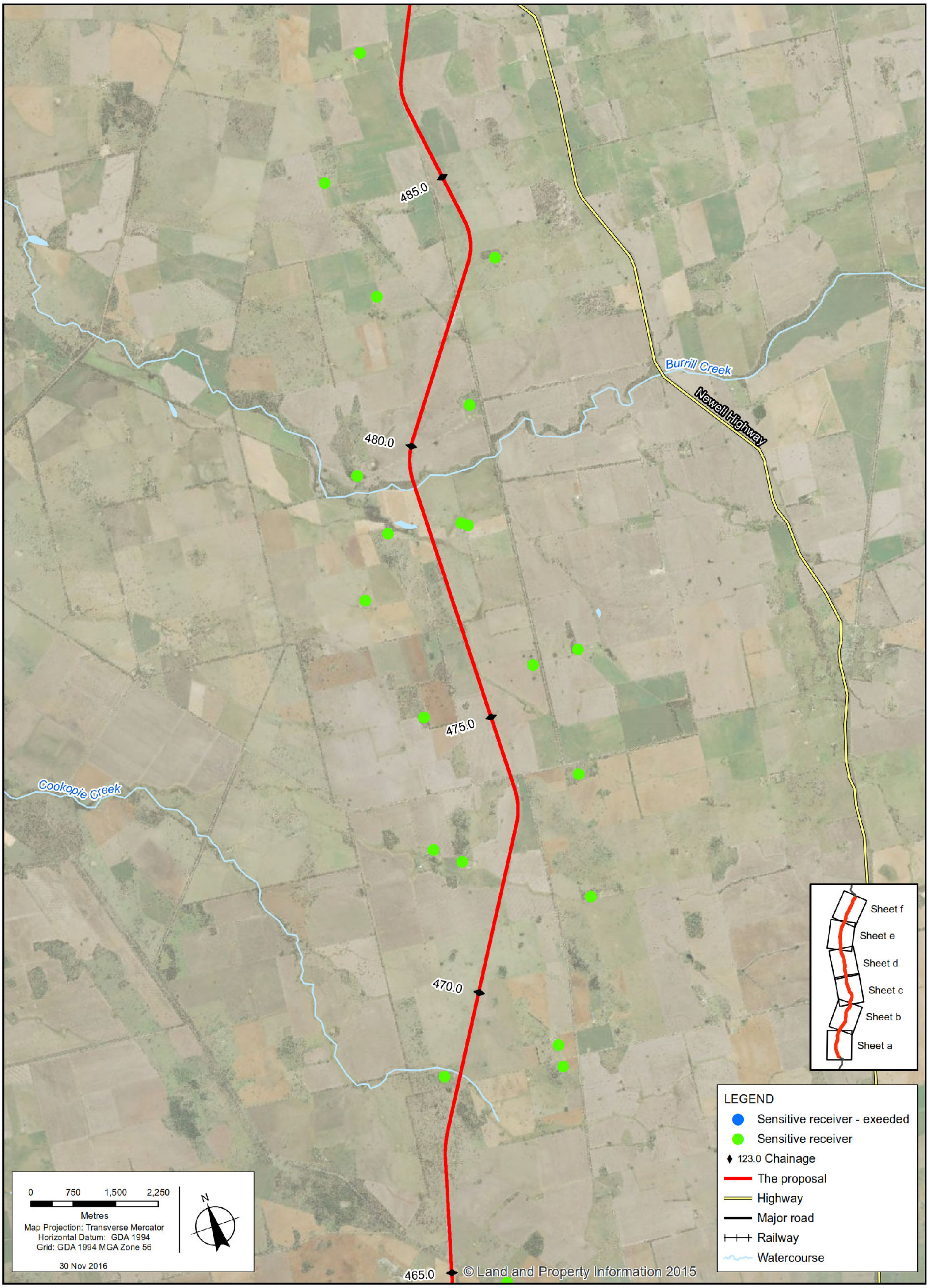

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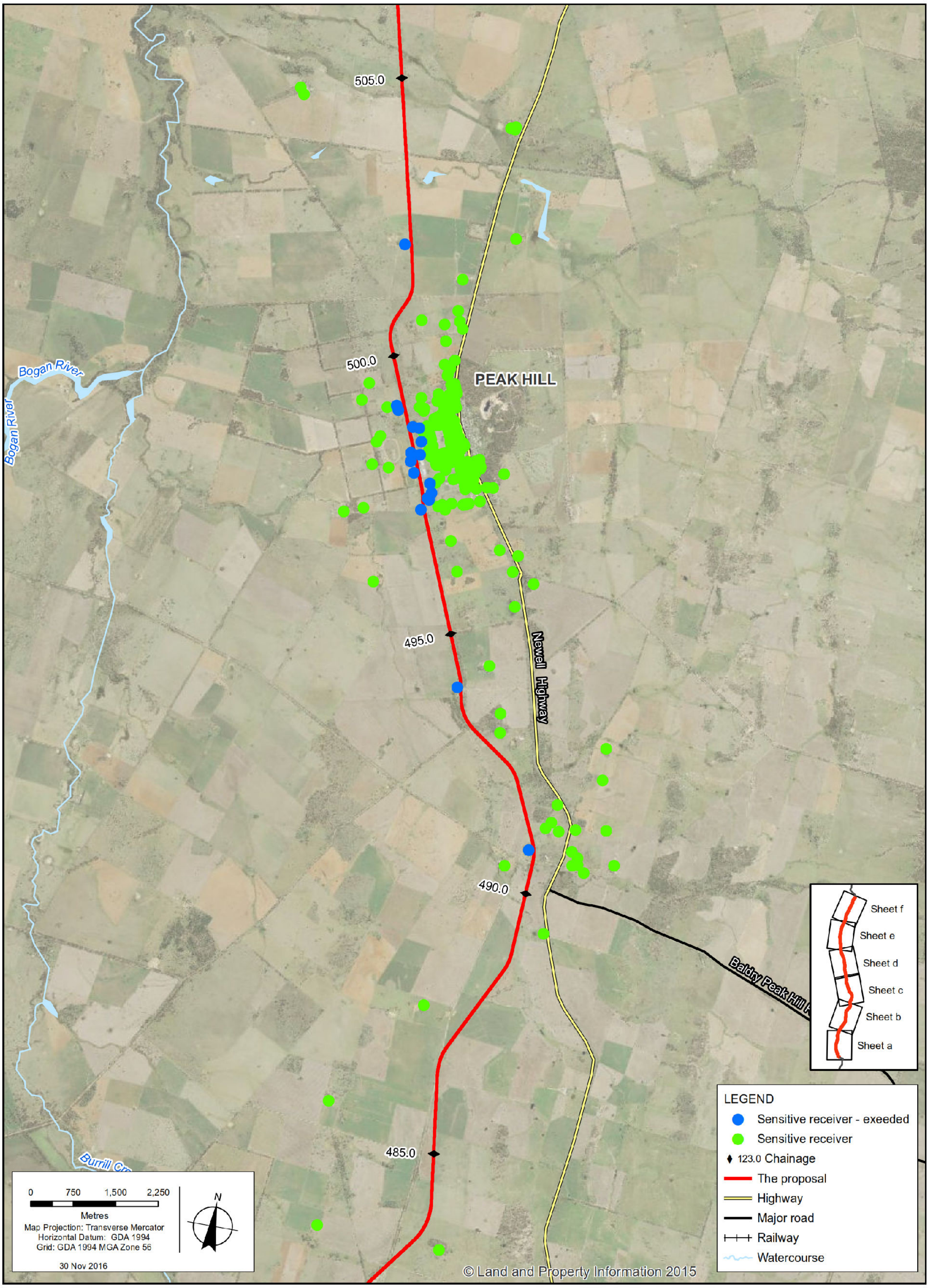
Figure 11.2b

Sensitive receiver locations



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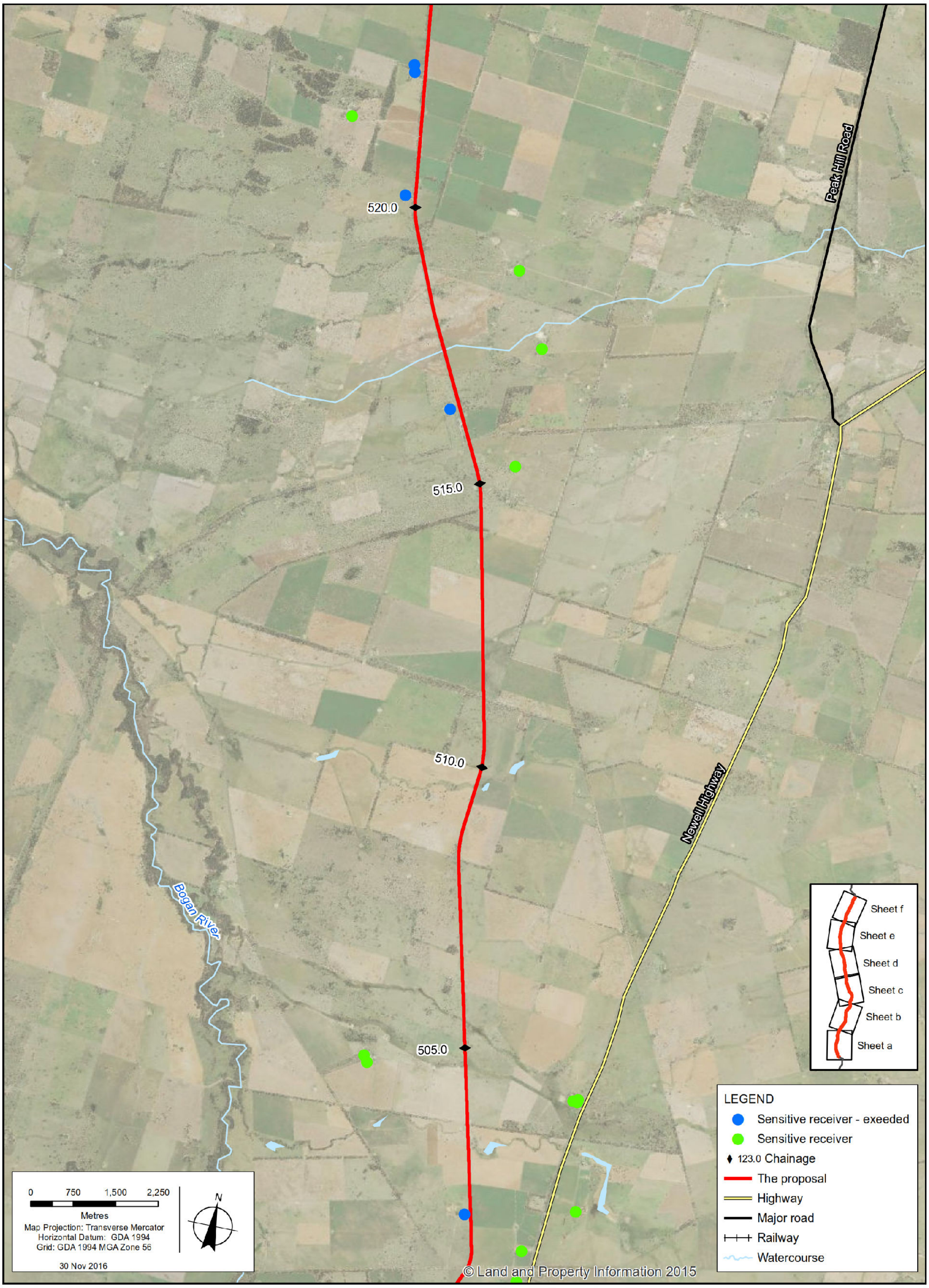
Data source: Data Custodian, Data Set Name/Title, Version/Date.

Figure 11.2c
Sensitive receiver locations



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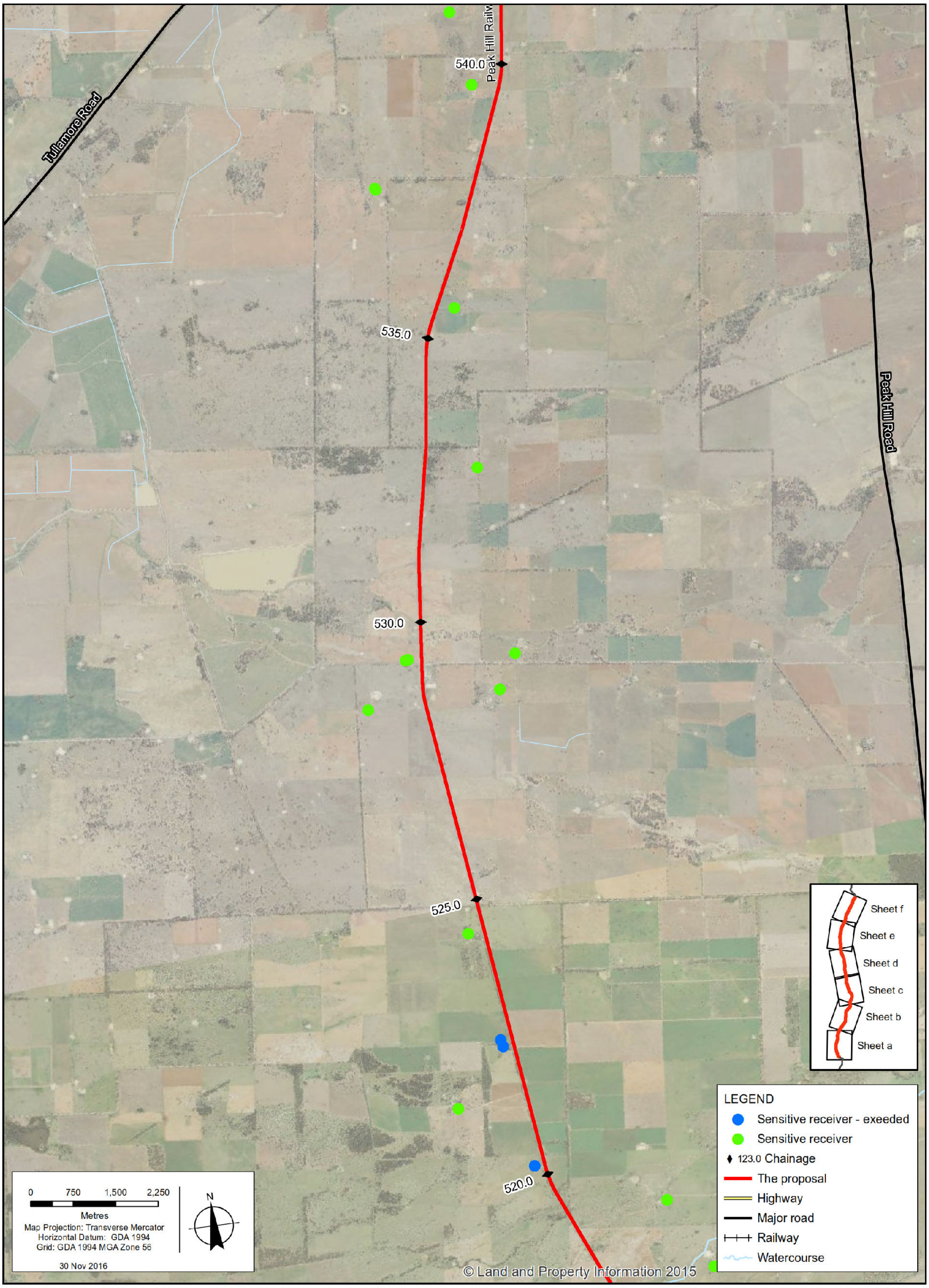
Data source: Data Custodian, Data Set Name/Title, Version/Date.

Figure 11.2d
Sensitive receiver locations



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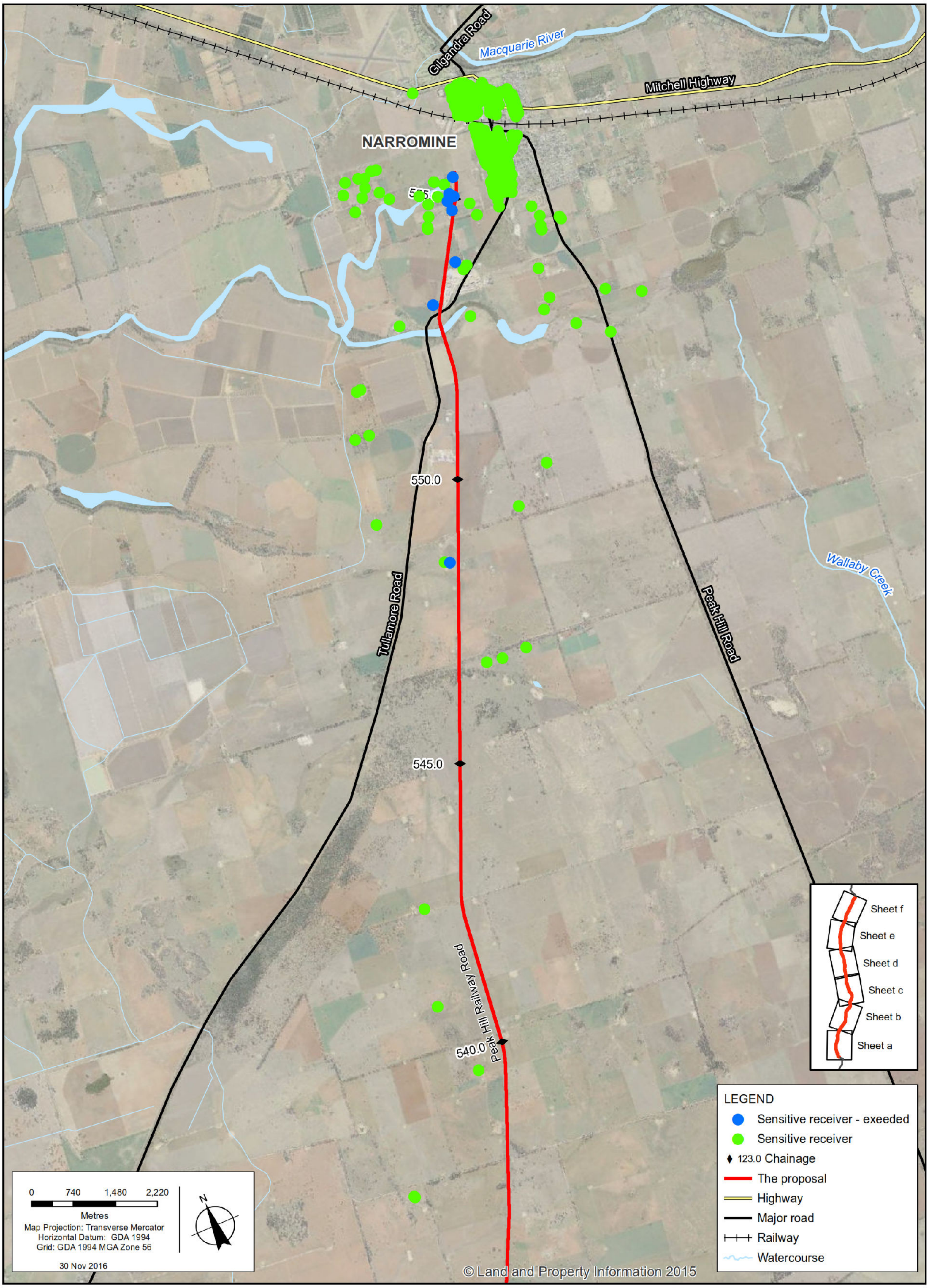
Data source: Data Custodian, Data Set Name/Title, Version/Date.

Figure 11.2e
Sensitive receiver locations



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Data source: Data Custodian, Data Set Name/Title, Version/Date.

Figure 11.2f

Sensitive receiver locations

11.4 Impact assessment

11.4.1 Risk assessment

The environmental risk assessment for the proposal (Appendix B) included an assessment of the potential amenity risks as a result of noise and vibration. Risks with an assessed level of medium or above included:

- noise impacts on local residents and sensitive receivers from construction activities, particularly during work outside recommended standard working hours
- noise impacts on local residents and sensitive receivers from construction traffic
- noise impacts on local residents and sensitive receivers from the operation of trains.

How potential impacts would be avoided

Potential noise and vibration (amenity) impacts would be avoided by:

- designing, constructing and operating the proposal to minimise the potential for noise and vibration (amenity) impacts
- implementing the Inland Rail Noise and Vibration Management Strategy and developing specific noise mitigation approaches in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, described in section 11.5.1
- implementation of mitigation measures listed in section 11.5.

11.4.2 Construction noise

Construction typically requires the use of heavy machinery which can generate high noise and vibration levels at nearby receivers. The potential impacts may vary greatly depending on the intensity and location of construction activities, the type of equipment used, existing background noise, intervening terrain, and prevailing weather conditions.

In accordance with the assessment guidelines, potential noise impacts were predicted with a focus on those activities with the highest potential to cause noise impacts, and assuming that the loudest two items of plant for each activity operate continuously. As a result, the predictions identify worst case construction noise levels, which may not be reached, or only reached infrequently.

Potential noise emissions from construction activities were modelled for identified sensitive receivers based on various construction scenarios. The different construction scenarios represent different equipment noise levels, providing an indication of how noise levels may change across the proposal site. Waste management (excavation, handling, on-site storage and transport) has been considered in each construction scenario, where relevant to that activity. Modelling was undertaken to predict the potential impacts during the primary proposal construction hours.

As a result of the modelling, adopted activity sound power levels were determined. These range from 109 dB(A) for level crossing works, to 120 dB(A) for earthworks. It was estimated that the majority of activities would generate a sound power level of around 115 to 118 dB(A).

Table 11.7 lists the predicted exceedances of the noise management levels for each activity modelled, and the numbers of receivers where the 'noise affected' level may be exceeded.

Where noise is above the proposal specific construction noise management level, all feasible and reasonable work practices to minimise noise need to be implemented, and all potentially affected receivers need to be informed. If no quieter work method is feasible and reasonable, consultation with the impacted residence would be undertaken to explain the duration and noise levels of the works and any respite periods that would be provided.

Table 11.7 Construction activity noise management level exceedances

Construction activity	Maximum predicted level of exceedance above 35 (dB(A))	Number of receivers with predicted exceedances
Track works	33	294
Culvert works	25	264
Crossing loops	18	135
Level crossing – major upgrade	24	59
Level crossing – minor upgrade	21	20
Parkes north west connection – site establishment	14	9
Parkes north west connection – earthworks	18	23
Parkes north west connection – track works	14	9
Brolgan Road overbridge	18	2
Post construction	28	99

Note: 1. As defined by DECC, 2009

The results of the construction noise assessment are summarised below.

Impacts of construction of the key proposal features

Track works

Activities that encompass the entire proposal site, such as site establishment (includes construction compound activities as described in section 8.4), track works, and drainage construction, are predicted to exceed the proposal specific construction management level:

- between Parkes and Peak Hill – at 29 receivers with impacts up to 27 dB
- within Peak Hill – at 123 receivers with impacts up to 30 dB
- between Peak Hill and Narromine – at 76 receivers with impacts up to 33 dB.

Construction would progress along the proposal site, and noise impacts would be experienced for a relatively short time at most locations. Construction in each work area would be completed within about eight to 10 weeks.

Level crossing changes

Level crossing works are predicted to exceed the proposal specific construction management level:

- between Parkes and Peak Hill at nine receivers with impacts up to 13 dB
- within Peak Hill at 37 receivers with impacts up to 24 dB
- between Peak Hill and Narromine at 14 receivers with impacts up to 19 dB.

Culvert works

Culvert works are predicted to exceed the proposal specific construction management level:

- between Parkes and Peak Hill at 23 receivers with impacts up to 10 dB
- within Peak Hill at 119 receivers with impacts up to 18 dB
- between Peak Hill and Narromine at 67 receivers with impacts up to 25 dB.

Crossing loops

Construction of the crossing loops is predicted to exceed the proposal specific construction management level:

- between Parkes and Peak Hill at one receiver with impacts up to two dB
- within Peak Hill at 105 receivers with impacts up to 17 dB
- between Peak Hill and Narromine at 7 receivers with impacts up to 18 dB.

Parkes north west connection

Construction of the Parkes north west connection is predicted to exceed the proposal specific construction noise management levels at 18 receivers with impacts up to 18 dB.

Brolgan Road overbridge

Construction of the Brolgan Road overbridge is predicted to exceed the proposal noise management levels at two receivers with impacts up to 18 dB.

Feasible and reasonable mitigation measures would be required to minimise the potential impacts predicted, as described in section 11.5.

Impacts of construction in relation to working hours

Construction working hours, and the activities that would be undertaken during each, are described in section 8.3. Where exceedances of construction management levels are predicted, reasonable and feasible mitigation measures would be implemented to reduce the significance of impacts.

Impacts of works

The assessment concluded that:

- rail line redevelopment construction activities are predicted to exceed the noise management level at receivers nearest to the construction footprint. Impacted receivers are within about 700 metres of the works and includes up to 228 identified noise sensitive residential receiver locations. Noise levels are predicted to exceed the proposal specific construction management level by up to 33 dB.
- new rail line construction works at the Parkes north west connection are predicted to exceed the proposal specific construction management level by up to 18 dB at 23 noise sensitive receivers.
- construction of the Brolgan road overbridge is predicted to exceed the proposal specific construction management level by about 18 dB at two residential receivers.
- construction is not predicted to exceed the noise management level for non-residential sensitive receivers.

Sleep disturbance

The results of modelling indicate that the sleep disturbance criteria is predicted to be exceeded for:

- track works – exceedances at 13 receivers
- level crossing track works – exceedances at two receivers
- culvert works – exceedances at two receivers
- post construction works – exceedances at seven receivers.

Construction traffic noise

The increase in noise levels due to construction traffic is estimated to be less than one dB which would not be noticeable at receivers.

Feasible and reasonable mitigation measures would be implemented to minimise the potential impacts predicted, as described in section 11.5.

11.4.3 Construction vibration

Safe working buffer distances

Typical vibration levels generated by various construction plant are listed in Table 11.8.

Table 11.8 Predicted vibration levels from construction equipment

Vibration source	Approximate vibration levels (mm/s) based on distances to source			
	10 m	20 m	50 m	100 m
Roller	6.0	3.4	1.7	1.0
15 tonne vibratory roller	8.0	4.6	2.2	1.3
7 tonne compactor	6.0	3.4	1.7	1.0
Dozer	4.0	2.3	1.1	0.6
Backhoe	1.0	0.6	0.3	0.2
Excavator	2.1	1.2	0.6	0.3
Piling (impact)	30	17.2	8.3	4.8
Piling (vibratory)[1]	16.8	7.3	2.4	1.1
Piling (bored)[1]	7.4	4.3	2.1	1.2

Note 1: Based on levels derived from *BS 5228:2009. Bored piling through stones or other obstruction*. Vibratory piling based on relationship provided in Table E.1.

Based on these typical vibration levels, safe working buffer distances to comply with the human comfort vibration criteria are listed in Table 11.9. In multi-level buildings, vibration may be amplified through the structure to the upper floors. A doubling of the buffer distances provided in Table 11.9 would provide a conservative allowance for this possible effect.

Table 11.9 Vibration safe working buffer distances

Activity	Human comfort buffer distance (m) (1.0mm/s)[1]
General construction activities	
Roller	90
15 tonne vibratory roller	140
7 tonne compactor	90
Dozer	60
Backhoe	10
Excavator	25
Piling	
Piling (impact)	700
Piling (vibratory)[2]	110
Piling (bored)[2]	120

Notes 1: Based on advice given in *BS 7385:1993 – Evaluation and measurement of vibration in buildings*.

2: Based on levels derived from *BS 5228-2*.

Works in the rail corridor and at crossing loops

During general construction works, vibration may be perceptible at certain times within 140 metres of the works. Twenty residential receivers were identified within this distance, including six near Narromine, 10 near Peak Hill, and four scattered along the proposal site.

Construction would progress along the proposal site, and vibration impacts would be experienced for relatively short times at most locations. Construction in each work area would be completed within about eight to 10 weeks.

Feasible and reasonable mitigation measures would be implemented to minimise the potential impacts predicted, as described in section 11.5.

Works involving bridge construction

Piling would be required to construct the Brolgan Road overbridge. Vibration impacts due to boring of the piles has the potential to impact receivers located up to 120 metres from the works. The piling activities are anticipated near the bridge span, which is located more than 400 metres from the nearest vibration sensitive receiver, therefore no human comfort impacts are predicted.

Impacts during different working hours

Impacts of works during the primary proposal construction hours

For works during the primary proposal construction hours, the assessment concluded that vibration may be perceptible at 20 residential receiver locations. Where vibration generating activities are proposed within 140 metres of an occupied residence, mitigation would be implemented where feasible and reasonable.

Impact of works outside proposed construction hours

Receivers are likely to have higher sensitivity to vibration experienced outside the proposed working hours compared to that experienced during proposed hours. For works outside the proposed hours, mitigation would be considered and implemented where feasible and reasonable where vibration generating activities are proposed within 140 metres of an occupied residence.

11.4.4 Operational noise

Noise generated by operation of the rail vehicles

As noted in section 11.2.3, the predicted rail noise levels need to exceed the RING trigger values listed in Table 11.3 to initiate an assessment of noise impacts and mitigation measures. Modelling was undertaken to compare the existing no build (2020) noise levels with the predicted noise levels for the future build scenarios (2025 and 2040).

Modelling indicated that RING trigger values for night noise criteria would be exceeded:

- at 14 locations for the 2025 scenario
- at 28 locations for the 2040 scenario.

It is noted that the 2019 no build scenario represents the 2025 and 2040 no build scenarios, since there are no predicted changes in operational conditions/parameters without the proposal proceeding.

Most of the exceedances are predicated in and around Peak Hill. This is because there is a higher concentration of receivers located close to the proposal site at Peak Hill.

No exceedances of the RING trigger values were predicted for operation of the Parkes north west connection.

Further information in relation to exceedances at individual locations is provided in Technical Report 5.

Feasible and reasonable mitigation measures would be implemented to minimise the potential impacts predicted, as described in section 11.5.

Horn noise

Horns are an important safety device and are a normal part of train operations. Trains are generally required to sound their horns as they pass through level crossings and at certain other times. ARTC's *Locomotive Specific Interface Requirements (WOS 01.300)* provides minimum and maximum levels for horn noise. It is acknowledged that noise emitted by train horns can be a source of annoyance for the general public. The minimum distance from the horn required to achieve the RING trigger value is listed in Table 11.10.

Table 11.10 Estimated distance from train horn to achieve the RING L_{Amax} trigger value

Item	High noise level horn	Low noise level horn	
Speed	Stationary	Stationary	Stationary
External noise limit	88 dB(A) minimum, measured 200 m in front	85 dB(A) minimum, measured 100 m in front	90 dB(A) maximum, measured 100 m in front
Minimum distance to achieve L_{Amax} 85 dB(A)	282 m	100 m	180 m

Source: *ARTC's Locomotive Specific Interface Requirements (WOS 01.300).*

During operation, an increase in the number of horn events is expected due to the projected increase in train numbers. However, a number of level crossings would be removed as part of the proposal. Therefore, the number of locations requiring horn usage would decrease along the total length of the proposal site.

11.4.5 Operational vibration

Ground-borne rail vibration from heavy rail infrastructure can adversely affect sensitive receivers situated close to a rail line. Vibration can contribute to annoyance and human comfort impacts at levels which are often only slightly higher than the limit of perception.

The vibration assessment predicted that daytime vibration levels for human comfort levels would be acceptable at distances of more than 11 metres from the track, while night-time levels are predicted to be acceptable at distances of more than 17 metres from the track.

The nearest receiver is located about 45 metres from the proposal site. Therefore, no receivers would be expected to experience amenity related vibration impacts during either the day or night.

11.5 Mitigation and management

11.5.1 Approach to mitigation and management

ARTC has developed the Inland Rail Noise and Vibration Management Strategy (provided in Appendix M) to guide assessment and construction of new and upgraded infrastructure and the operation of Inland Rail. The strategy:

- considers relevant legislation, licences and guidelines for NSW, Victoria and Queensland
- aims for consistency in the management of noise and vibration between states
- integrates with existing ARTC policies and guidelines.

Management of noise and vibration during construction and operation of the proposal would consider the strategy to ensure consistency with Inland Rail.

Construction

The Inland Rail NSW Construction Noise and Vibration Management Framework (provided in Appendix H) has been developed in accordance with the Inland Rail Noise and Vibration Strategy, to show how construction noise and vibration will be managed for Inland Rail. It provides a framework for managing construction noise and vibration impacts in accordance with the ICNG, to provide a consistent approach to management and mitigation across Inland Rail in NSW.

Specifically the Inland Rail NSW Construction Noise and Vibration Management Framework identifies the requirements and methodology to develop Construction Noise and Vibration Impact Statements. These would be prepared prior to specific construction activities and based on a more detailed understanding of the construction methods, including the size and type of construction equipment, duration and timing of works, and detailed reviews of local receivers if required. A Construction Noise and Vibration Impact Statement would include:

- a more detailed understanding of surrounding receivers, including particularly sensitive receivers such as education and child care, and vibration sensitive medical, imaging, and scientific equipment
- application of appropriate noise and vibration criteria for each receiver type
- an assessment of the potential noise and vibration impacts as a result of different construction activities
- minimum requirements in relation to standard noise and vibration mitigation measures
- noise and vibration auditing and monitoring requirements
- additional mitigation measures to be implemented when exceedances to the noise management levels are likely to occur - these measures are aimed at pro-active engagement with potentially affected receivers, provision of respite periods, and alternative accommodation for defined exceedance levels.

The proposal would be constructed in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, the CEMP, site-specific Construction Noise and Vibration Impact Statements, the conditions of approval for the proposal, and the construction EPL.

Operation

An operational noise and vibration review would be prepared to detail how the predicted operation impacts would be mitigated. The operational noise and vibration review would define the further design work and iterative noise modelling required during detailed design to identify feasible and reasonable mitigation measures for operational noise. This would involve consideration of the mitigation options described below. The final form of the mitigation options would be determined during detailed design.

The operational noise and vibration review would:

- confirm predicted project noise and vibration levels at sensitive receivers, which may include the results of façade testing for non-residential receivers
- assess feasible and reasonable noise and vibration measures in a hierarchical manner, consistent with RING
- identify options for controlling noise and vibration at the source and/or receiver, including location, type, and timing of implementation (as described below)
- specify noise and vibration abatement measures for all relevant sensitive receivers
- include a consultation strategy to seek feedback from directly affected stakeholders on the proposed noise and vibration abatement measures
- include a timetable for delivery of abatement prior to operation
- outline post-operational monitoring to verify noise and vibration predictions.

The proposal would be operated in accordance with the operational noise and vibration review, the conditions of approval for the proposal, and the EPL for Inland Rail.

Where exceedances of criteria for non-residential sensitive receivers have been predicted, this would be verified during detailed design, and would involve further investigation of the façade performance at these receivers.

The predicted noise and vibration levels, and the noise and vibration mitigation measures, would be confirmed during the detailed design phase.

To validate the predicted noise levels, monitoring would be undertaken after the commencement of operation of Inland Rail as a whole. Monitoring would confirm compliances with the predicted noise levels, as modified by the review of feasible and reasonable mitigation measures undertaken at the completion of detailed design.

If the results of modelling indicate that the predicted operational noise and vibration levels are being exceeded, then additional feasible and reasonable mitigation measures would be implemented in consultation with affected property owners.

Options for operational noise impact mitigation

The assessment predicts that mitigation measures would be required for operational rail noise at affected sensitive receivers. Three main strategies are used to reduce noise and vibration impacts:

- controlling noise and vibration at the source
- controlling noise and vibration on the source to receiver transmission path
- controlling noise and vibration at the receiver.

Strategies would be assessed against a range of issues to determine whether they are feasible and reasonable, including:

- cost of construction and ongoing maintenance
- potential environmental, visual and social impacts
- consideration of feedback from relevant stakeholders and landowners.

The RING recommends that control strategies should be considered in a hierarchical manner so that all measures which reduce noise at the source are exhausted before property based measures are considered.

Preliminary information on a range of potential noise mitigation options is provided in Table 11.11. These mitigation options would be considered as part of the detailed design of the proposal. Further information on the approach to noise and vibration mitigation is provided in Technical Report 5.

Table 11.11 Potential operational noise mitigation options

Mitigation option	Description
Rail dampers	Rail dampers are preformed elements made of an elastic material containing steel strips. Dampers are placed on the sides of the tracks, dampening the vibration of the rails as the train passes over them and reducing noise emissions. Noise reduction in the order of two to five dB(A) can be achieved, depending on the rail roughness (the smoother the rail, the less attenuation). However, this is only valid when the wheel-rail interface is the main noise source. In the context of freight train pass-bys, rail dampers would not attenuate L_{Amax} levels, which are normally dominated by locomotive noise, but would reduce wagon noise.
Track lubrication	Trackside lubrication strategies can be implemented to improve the performance of the track and reduce noise, particularly from rail squeal and flanging on tight curves. This can result in a substantial noise reduction in L_{Aeq}, and L_{Amax} noise levels. However, there are very few tight radius curves in the proposal, so track lubrication would have limited application.
Noise barriers/earth mounds	Noise barriers are typically constructed on the edge of the rail corridor to shield sensitive receivers from the noise generated by the operation of rail vehicles. Depending on the situation, noise barriers can achieve a 10 to 15 dB(A) attenuation. Noise barriers can result in cost and visual impacts. They are generally preferable where noise attenuation at a larger number of receivers is required, and are not typically cost-effective for a small number of receivers. Earth mounds can sometimes be used as noise barriers, and can provide effective mitigation of noise if sufficient spoil and space for the required height is available. However, earth mounds generally provide less attenuation of noise than noise barriers, and require a larger area to reach a sufficient height. During detailed design the potential to utilise the proposed spoil mounds (described in section 7.4.2) as noise barriers would be investigated.
Architectural treatment	Architectural treatment involves implementing measures at affected residences to reduce noise levels. Measures can include installing thicker window glazing, roof insulation, door and window acoustic seals, mechanical/forced ventilation, and/or boundary fences. The performance of architectural treatment depends on the condition and design of the residence. Architectural treatment is often the most practical option where individual receivers require noise mitigation and other mitigation options are not considered feasible and reasonable.

11.5.2 Summary of mitigation measures

To mitigate the potential for noise and vibration impacts, the following measures would be implemented.

Table 11.12 Summary of mitigation measures

Stage	Impact	Mitigation measures
Detailed design/pre-construction	Noise and vibration control	The proposal would be designed with the aim of achieving the operational noise and vibration criteria identified by the noise and vibration assessment.
		An operational noise and vibration review would be undertaken as described in section 11.5.1 to guide the approach to identifying feasible and reasonable mitigation measures to incorporate in the detailed design.
Pre-construction/ construction	Construction noise and vibration management	The Inland Rail NSW Construction Noise and Vibration Management Framework would be implemented, and the proposal would be constructed, with the aim of achieving the construction noise management levels and vibration criteria identified by the noise and vibration assessment. All feasible and reasonable noise and vibration mitigation measures would be implemented. Any activities that could exceed the construction noise management levels would be identified and managed in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework and the CEMP. Notification of impacts would be undertaken in accordance with the consultation plan for the proposal.
Construction	Work outside proposed construction hours	An out-of-hours work protocol would be developed to guide the assessment and management of works outside the primary proposal construction hours.
Operation	Operational noise and vibration	The proposal would be operated with the aim of achieving the operational noise and vibration criteria identified by the noise and vibration assessment, the requirements of the conditions of approval, and the relevant environment protection licence.
	Monitoring	Once Inland Rail has commenced operation, operational noise and vibration compliance monitoring would be undertaken at representative locations to compare actual noise performance against that predicted by the noise and vibration assessment. Compliance monitoring requirements would be defined as part of the operational noise and vibration review. The results of monitoring would be included in an operational noise and vibration compliance report, prepared in accordance with the conditions of approval.

12. Vibration (structural) impacts

This chapter provides a summary of the noise and vibration assessment of the proposal as it relates to the potential for structural impacts on buildings or objects. It describes the existing environment, assesses the impacts of construction and operation, and provides recommended mitigation measures. The full noise and vibration assessment report is provided as Technical Report 5.

This chapter focuses on the potential for structural impacts only, mainly as a result of vibration. The potential for amenity-related noise and vibration impacts is considered in chapter 11.

12.1 Assessment approach

12.1.1 Methodology

Vibration impacts described in this chapter are those with the potential to result in structural damage to buildings or other structures. The structural vibration assessment:

- identifies vibration sensitive receivers
- identifies the main potential vibration sources during construction and operation
- establishes structural vibration criteria/management levels to provide a basis for:
  - assessing the potential for impacts during construction
  - assessing the potential for impacts during operation
  - establishing the levels that would be used to refine the design of the proposal
  - monitoring during construction and operation.
- assesses the potential for vibration to exceed the applicable criteria
- provides vibration (structural) mitigation measures.

As there is no blasting proposed during construction, there is no risk of damage due to blast-induced vibration or overpressure.

Vibration monitoring for the assessment is described in section 11.1.1.

Identification of vibration sensitive receivers

Potentially sensitive receivers are those that may be affected by changes in vibration levels. Vibration sensitive receivers were identified based on the activities proposed to be undertaken and the nature of the building or structure. Sensitive receivers are summarised in section 12.3.2.

Construction vibration

Vibration from construction was assessed at identified sensitive receivers (buildings and heritage items). The methodology for the construction vibration assessment included the following tasks:

- Typical vibration levels for different construction equipment were sourced from the *Environmental Noise Management Manual* (RTA, 2001), *BS 5228.2 Code of Practice for noise and vibration control on construction and open sites: Part 2 Vibration* and the *Construction Noise Strategy* (Transport for NSW, 2012c).
- Vibration from construction plant and equipment was predicted and assessed, and criteria established, based on *Assessing Vibration: a technical guideline* (DEC, 2006a) and the German standard *DIN 4150-3:1999-02 Structural Vibration – Part 3: Effects of vibration on structures*.
- A quantitative assessment was undertaken of potential vibration impacts from the proposed construction equipment. Predictions of vibration impacts were made using distance attenuation calculations.
- Where vibration levels were predicted to exceed threshold levels, appropriate construction vibration mitigation measures were provided.

Operational vibration

Operational vibration criteria were established based on *Assessing Vibration: a technical guideline* (DEC, 2006a). An assessment of operational vibration impacts was undertaken using the assessment methodology provided in the RING. The assessment was based on measured rail vibration levels and the proposed changes in operation, such as the increase in rail movements, track realignments, new track, and effect on train speeds due to the proposal.

12.1.2 Legislative and policy context to the assessment

Other guidelines and policies relevant to the assessment include:

- *Environmental Management System Guide: Noise and Vibration from Rail Facilities* (Sydney Trains, 2013)
- *BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration*
- *AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites*
- *Transit noise and vibration impact assessment* (Federal Transit Administration, 2006).

12.2 Vibration management criteria

12.2.1 Structural damage criteria

Minimum safe levels of short term vibration are listed in Table 12.1. In accordance with DIN 4150-3, a measured value exceeding the safe level does not necessarily lead to damage. However, further investigations are required if these values are likely to be significantly exceeded.

Table 12.1 Guideline values for short term vibration on structures

Type of structure	Guideline values for velocity, vi(t) (mm/s)[1]		
	1 Hz to 10 Hz[2]		1 Hz to 10 Hz[2]
Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy.	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (such as heritage listed buildings under preservation order).	3	3 to 8	8 to 10

Source: *DIN 4150-3:1999-02 Structural Vibration – Part 3: Effects of vibration on structures*

Notes 1: The term v_i refers to vibration levels in any of the x, y or z axes.

2: In the absence of confirmation of the hertz level, the lowest guideline levels are considered (i.e. 1 to 10 Hz).

3. At frequencies above 100 Hz, the values given in this column may be used as minimum values.

12.3 Existing environment

12.3.1 Existing vibration levels

As noted in section 11.3.2, vibration levels of about one to 1.3 millimetres per second were recorded at the vibration logger during train pass-by events. Between pass-by events, background vibration levels were about 0.1 millimetres per second.

12.3.2 Sensitive receivers

For the purposes of the structural vibration assessment, sensitive receivers include:

- dwellings and buildings of similar design
- buildings used for commercial purposes, industrial buildings, and buildings of similar design
- activities involving use the use of vibration-sensitive equipment
- heritage listed buildings or items (including Aboriginal places and items of environmental heritage).

The most common sensitive receiver are residential dwellings.

Heritage listed items are described in chapters 17 and 18. No heritage listed items are located within or close to the proposal site. The closest listed item is the 'Peak Hill Police Station and Official Residence', which is located 750 metres to east of the proposal site. A potential heritage item, Wyanga cottage, is located about 15 metres to the west of the existing tracks. There are no Aboriginal places of heritage significance or listed items of Aboriginal heritage with the potential to be impacted by vibration located within or close to the proposal site.

12.4 Impact assessment

12.4.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (Appendix B) included an assessment of the potential structural risks from vibration. Potential risks were rated between low and medium, and included:

- damage to structures from vibration caused by construction activities
- damage to structures from vibration caused by the operation of trains.

How potential impacts would be avoided

Potential vibration impacts would be avoided by:

- designing, constructing and operating the proposal to minimise the potential for vibration (structural) impacts, including the implementation of mitigation measures in section 12.5
- developing specific mitigation approaches in accordance with the strategy described in section 12.5
- implementation of mitigation measures listed in section 12.5.

12.4.2 Construction impacts

The operation of construction plant and equipment has the potential to generate vibration at a level that could result in structural damage to buildings located close to the proposal site.

Typical vibration levels generated by various construction plant are listed in Table 11.8. Based on these typical vibration levels, safe working buffer distances to comply with the human comfort vibration criteria are listed in Table 12.2.

Table 12.2 Vibration safe working distances

Activity	Safe working distance (m)	
	For heritage buildings *(criteria: 3 mm/s)*	For standard dwellings *(criteria: 5 mm/s)*
General construction activities		
Roller	24	13
15 tonne vibratory roller	35	18
7 tonne compactor	24	13
Dozer	15	8
Backhoe	3	2
Excavator	7	4
Piling		
Piling (impact)	180	100
Piling (vibratory)	50	30
Piling (bored)	35	17

General construction activities

The expected magnitude of ground vibration from general construction activities would not be sufficient to cause damage if works are undertaken at distances greater than 18 metres from standard buildings, and distances greater than 35 metres from heritage structures.

The closest residential receiver is located about 45 metres from the proposal site. This distance is beyond the safe working distances for relevant construction activities, as listed in Table 12.2. As a result, structural damage is not predicted for standard dwellings.

Heritage listed items are located a sufficient distance from the proposal site such that no impacts are predicted. The heritage assessment (described in chapter 18) notes that a potential heritage item, Wyanga cottage is in disrepair and at risk of collapse. This structure is located about 15 metres to the west of the existing tracks, within the safe working distances for heritage structures listed in Table 12.2. Vibration as a result of construction, particularly the movement of dozers, backhoes or excavators, may impact the structure. Mitigation measures would be implemented to minimise the significance of potential impacts, as described in section 12.5 and 18.4.

Piling

Pilling may be required to construct the Brolgan Road overbridge. There are no heritage items located in the vicinity of the proposal site for the overbridge. The nearest vibration sensitive building is located more than 400 metres from the proposed piling location, therefore no impacts are predicted.

12.4.3 Operational impacts

Vibration from the operation of rail infrastructure can impact sensitive structures located close to the rail line. Vibration can cause buildings, windows, and other fixtures to shake, and can interfere with vibration-sensitive equipment. The level of vibration experienced at a receiver is a function of the energy of the vibration source, the propagation through the ground, and the coupling of the ground to the receiver structure or building. Building damage is not usually likely for operation of rail projects.

The vibration level generated by trains during operation is predicted to be similar to that currently experienced at the nearest sensitive receivers. As noted in section 11.3.2, vibration levels of about one to 1.3 millimetres per second were recorded during train pass-by events at the vibration logger located 15 metres from the proposal site. This level is significantly lower than the structural damage criteria of five millimetres per second for typical dwellings, and three millimetres per second for heritage structures. The closest residential receiver is located about 45 metres from the proposal site.

Operation of the proposal would involve increasing the operational load capacity from 23 to 30 tonnes. This increase is not predicted to result in any significant increases in vibration levels at the closest receivers.

The proposal is not expected to increase operational vibration levels noticeably, and is not expected to exceed structural damage criteria. While no specific mitigation measures are considered necessary, track features such as crossovers, turnouts, and rail joints have the potential to increase vibration levels, and should be avoided near vibration sensitive structures where practicable.

12.5 Mitigation and management

12.5.1 Approach to mitigation and management

As described in section 11.5, the approach to vibration management during construction and operation would consider the overarching Inland Rail Noise and Vibration Management Strategy (provided in Appendix M). The approach to managing vibration during construction would be guided by the Inland Rail NSW Construction Noise and Vibration Management Framework (provided in Appendix H).

12.5.2 Summary of mitigation measures

To mitigate the potential for structural vibration impacts, the following measures would be implemented.

Table 12.3 Summary of mitigation measures

Stage	Impact	Mitigation measures
Detailed design/pre-construction	Vibration control	The proposal would be designed with the aim of achieving the vibration criteria identified by the noise and vibration assessment. Track features such as crossovers, turnouts, and rail joints would be avoided near vibration sensitive structures where practicable.
	Construction vibration	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and vibration monitoring would be carried out in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, to ensure vibration levels remain below appropriate limits for that structure.

Stage	Impact	Mitigation measures
	Operational noise and vibration review	An operational noise and vibration review would be undertaken as described in section 11.5.1 to guide the approach to identifying feasible and reasonable mitigation measures to incorporate in the detailed design.
Construction	Construction vibration management	The Inland Rail NSW Construction Noise and Vibration Management Framework would be implemented, and the proposal would be constructed, with the aim of achieving the construction vibration criteria identified by the vibration assessment.
		All feasible and reasonable vibration mitigation measures would be implemented. Any activities that could exceed the vibration criteria would be identified and managed in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework and the CEMP. Notification of impacts would be undertaken in accordance with the consultation plan for the proposal.
Operation	Operational vibration	The proposal would be operated with the aim of achieving the operational vibration criteria identified by the noise and vibration assessment, the requirements of any conditions of approval, and the relevant environment protection licence.

13. Air quality

This chapter provides the air quality impact assessment of the proposal. It describes the existing environment, assesses the impacts of construction and operation on air quality, and provides mitigation measures.

13.1 Assessment approach

13.1.1 Relevant pollutants

Air quality may be impacted by a number of pollutants, each of which has different emission sources and effects on human health and the environment. The air quality assessment of the proposal is focused on the highest-risk impacts with the potential to occur during construction and operation. During construction, there is the potential for impacts as a result of emissions of total suspended particulate matter in the form of airborne particulate matter (less than 10 microns in size – that is, PM_{10}) and dust deposition.

Fine particle emissions associated with exhausts from mobile plant and stationary engines used during construction activities are accounted for in the emission factors for earthmoving and handling used in the air quality assessment. Engine emission sources during construction are expected to be discontinuous, transient, and mobile.

Total suspended particles and dust deposition is usually assessed against annual assessment criteria, which is not relevant for a proposal where construction works progress along a proposal site. As a result, for this proposal, PM_{10} was considered to be the worst-case pollutant for construction activities when determining potential impacts and distances at which relevant criteria are achieved.

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 and particulate matter.

13.1.2 Methodology

The assessment involved:

- reviewing existing regional ambient air quality and meteorology
- undertaking a screening level construction air quality impact assessment
- identifying sensitive receivers near the proposal site that may be exposed to levels of construction dust above the relevant criteria
- qualitatively assessing the potential for air quality impacts during operation
- providing mitigation measures.

13.1.3 Legislative and policy context to the assessment

The POEO Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. Companies and property owners are legally bound to control emissions (including particulates and deposited dust) from construction sites under the POEO Act. Activities undertaken onsite must not contribute to environmental degradation, and pollution and air emissions must not exceed the standards. Where an EPL applies, air quality requirements (including criteria) will be specified by the licence. Further information on the POEO Act as it relates to the proposal is provided in chapter 3.

The *Protection of the Environment Operations (Clean Air) Regulation 2010* (the Clean Air Regulation) provides regulatory measures to control emissions from motor vehicles, fuels, and industry. The proposal would be operated to ensure it complies with the Clean Air Regulation.

Air quality impact assessment criteria are prescribed by the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005) (known as 'the Approved Methods'). These generally apply to stationary sources of air pollution. However, as the construction period for the proposal as a whole would be around 18 months, the particulates and deposited dust criteria in the Approved Methods were used for the assessment of potential construction impacts of the proposal.

Odour from stationary sources is assessed using the *Technical framework: Assessment and management of odour from stationary sources in NSW* (DEC, 2006). Odorous air emissions are not generally associated with locomotives and freight haulage, as the concentrations of odorous substances such as nitrogen dioxide (NO_2), sulphur dioxide (SO_2), and volatile organic compounds (VOCs) have relatively low odour thresholds, and are generally not detected at concentrations below their health-related air quality objectives.

The National Environment Protection Council of Environmental Ministers, now the National Environment Protection Council (NEPC), set uniform national standards for ambient air quality in February 2016. These are known as the *National Environment Protection (Ambient Air Quality) Measure* ('the Air NEPM'). The Air NEPM sets non-binding standards and ten-year goals (for 2026). The goal for the Air NEPM is a PM_{10} of 50 micrograms per cubic metre (µg/m^3) as a 24-hour average (no exceedances per year) and a $PM_{2.5}$ goal of 25 µg/m^3 as a 24-hour average.

The Air NEPM standards apply to regional air quality as it affects the general population. The standards do not apply in areas impacted by localised air emissions, such as industrial sources, construction activity, and heavily trafficked streets and roads.

Background concentrations of air pollutants are ideally obtained from ambient monitoring data collected at a proposal site in accordance with the Approved Methods. The Approved Methods recognises that this data is rare, and that data is typically obtained from monitoring sites as close as possible to a proposal site, where sources of air pollution resemble the existing sources at the proposal site.

13.2 Existing environment

13.2.1 Ambient (background) air quality

Regional air quality within the study area is mainly influenced by rural activities, vehicle emissions, mining and exploration activities, and limited industrial/processing activities. The National Pollutant Inventory lists three sources of emissions between Parkes and Narromine. Two of these are extractive industries from which the primary emissions are likely to be dust, with minor emissions of nitrogen oxides and volatile organic compounds. One industry is associated with mineral, metal and chemical wholesaling, where volatile organic compounds may be released.

There is no publicly available air quality monitoring data for the study area. The nearest air quality monitoring station that provides publicly available data is operated by OEH at Bathurst (located about 135 kilometres to the east of Parkes). Background air quality was derived using PM_{10} average and 70th percentile PM_{10} values for the last five years for Bathurst. These are provided in Appendix F.

A conservative approach was adopted for the assessment, and the highest 70th percentile PM_{10} value was used to represent background air quality for the study area. The highest 70th percentile PM_{10} was 16.9 µg/m^3, which is below the NSW annual average criteria of 30 µg/m^3.

Due to the inland location of the proposal site, and the lack of any concentrated emission sources, the ambient background levels of gaseous pollutants such as SO_2, NO_2 and CO was considered to be negligible, at a level of zero. Background levels of odours were also considered to be negligible.

13.2.2 Local meteorology

Climate data was obtained from the Bureau of Meteorology (BoM) Parkes Airport site (site number 065068). The data indicates that the study area has a warm temperate climate, with significant temperature variations between summer and winter. January is the hottest month at Parkes with a mean maximum temperature of 33.3 degrees, which drops to 14.2 degrees in July. Most of the annual 644 millimetres of rainfall occurs in summer, with autumn and winter usually drier. Wind speeds, which are of particular importance when determining the potential for dust impacts, are typically greater in spring and summer.

Local meteorology depends on local topography, land use, vegetation, and watercourses, and would vary along the proposal site. To conduct a conservative assessment, worst-case meteorology was assumed for dust dispersion, based on all possible wind directions and speeds.

Five-year wind roses were sourced for the study area (from willyweather.com.au) for Parkes airports.

As shown in Figure 13.1, the five year wind rose for Parkes Airport indicates that calm, light and gentle winds occur for nearly 80 per cent of the time, with 20 per cent of wind above 19.8 kilometres per hour. This is a level that could cause nuisance dust. Most high winds occur from the north-east and south-west quadrants, meaning that dust impacts would be more likely to occur opposite to these directions.

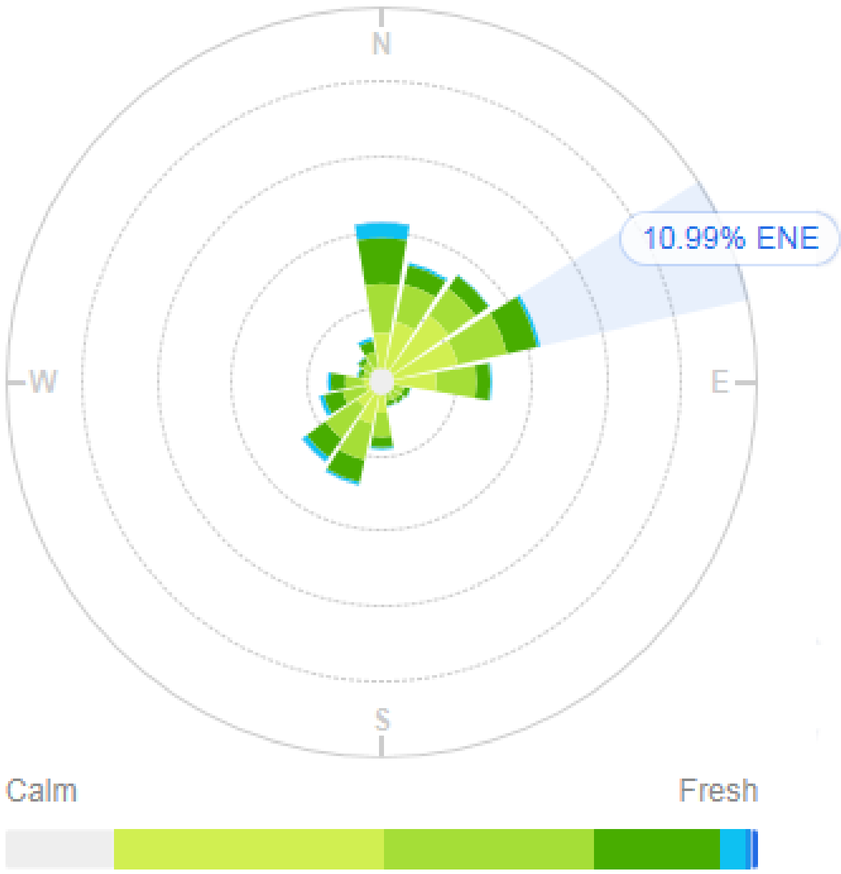


Figure 13.1 Five year wind rose for Parkes Airport

13.3 Assessment criteria

The air quality impact assessment criteria for the proposal are provided in Table 13.1.

The criteria for particulate matter (PM_{10}) and total suspended particles are prescribed by the Air NEPM and the Approved Methods respectively. PM_{10}, which has a 24-hour assessment criteria, is most relevant for assessing construction impacts. Dust deposition criteria are mainly used to assess the potential for amenity impacts. These criteria should to be met at existing or future off-site sensitive receptors. Particulate and dust deposition levels are provided as cumulative impacts, where the predicted impact of the proposal is added to the adopted background levels.

Assessment criteria relating to operation of the proposal (SO_2, NO_2, PM_{10}, $PM_{2.5}$, carbon monoxide, and benzene) are also provided in Table 13.1.

Table 13.1 Adopted air quality impact assessment criteria

Pollutant	Averaging period	Criteria[1]
PM_{10}	24 hours	50 $\mu g/m^3$
	Annual	25 $\mu g/m^3$
$PM_{2.5}$	24 hours	25 $\mu g/m^3$
	Annual	8 $\mu g/m^3$
Total suspended particles	Annual	90 $\mu g/m^3$
Dust deposition	Annual	2 g/m^2/month[2]
Sulfur dioxide (SO_2)	10 minutes	712 $\mu g/m^3$
	1 hour	570 $\mu g/m^3$
	24 hours	228 $\mu g/m^3$
	Annual	60 $\mu g/m^3$
Nitrogen dioxide (NO_2)	1 hour	246 $\mu g/m^3$
	Annual	62 $\mu g/m^3$
Carbon monoxide (CO)	15 minutes	100 mg/m^3
	1 hour	30 mg/m^3
	8 hours	10 mg/m^3
Benzene	1 hour	29 $\mu g/m^3$

Notes: 1: Based on the Air NEPM and the Approved Methods
2: Maximum increment. Maximum cumulative impact of 4 g/m^2/month

13.4 Impact assessment

13.4.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential air quality risks. The assessed risk level for the majority of potential risks to air quality was between low and medium. Risks with an assessed level of medium or above include:

- generation of dust during construction (from exposed soil/stockpiles, excavation, and vehicle movements)
- emissions from vehicles or plant during construction.

How potential impacts would be avoided

In general, potential air quality impacts would be avoided by:

- managing air quality in accordance with relevant legislative and policy requirements, as outlined in section 13.1.3
- managing air quality in accordance with the EPLs for construction and operation
- implementing the air quality mitigation measures provided in section 13.5.

13.4.2 Sensitive receivers

Residences, schools, sports grounds, medical clinics, hospitals, wetlands and some flora are considered to be sensitive receivers in relation to the potential health and amenity impacts of dust. Most of the proposal site traverses sparsely settled rural land. However, for short lengths, the proposal site would be located within/close to towns and residences. No wetlands are located in the vicinity of the proposal site. The potential for indirect impacts to biodiversity as a result of dust generation are considered in chapter 10.

The proposal would be generally located more than 200 metres from most residences and non-residential sensitive receivers. Based on a review of aerial photography and GIS mapping, 30 sensitive receivers, consisting of residences only, were identified within 200 metres of the proposal site for the purposes of the air quality assessment. Sensitive receivers are shown in Figure 13.2.

13.4.3 Construction impacts

The processes that have the potential to generate particulate matter during construction are:

- mechanical disturbance − dust emissions as a result of the operation/movement of construction vehicles and equipment, including disturbance associated with the excavation, handling and transport of waste.
- wind erosion − dust emissions from exposed, disturbed soil surfaces under high wind speeds, including erosion associated with the on-site storage of waste.

Fine particle emissions associated with exhausts from mobile plant and stationary engines used during construction activities were accounted for in the study's dust emission factors for earthmoving and handling.

Dust dispersion modelling

An emissions inventory for potential particulate sources was derived for the proposal and is provided in Appendix F. Table 13.2 summarises the estimated total dust emissions from the main identified sources. The site compound emissions were assumed to be from site establishment, not ongoing operation during construction. Dust impacts from spoil sites were not considered significant due to their small size and low level of potential emissions.

Table 13.2 Estimated emissions of PM_{10} during construction

Source of construction dust	Assumed dimensions for the purposes of the assessment (m)	Total emissions of PM_{10} (grams per second)
Construction in the rail corridor	30 x 100	0.11
Site compound	250 x 250	0.59
Spoil site	50 x 50	0.02

A screening level assessment was undertaken with consideration of the Approved Methods. The predicted worst-case 24 hour PM_{10} concentrations are presented in Appendix F as concentration versus distance graphs for the following scenarios:

- Scenario 1 – construction within the proposal site in areas where upgrades to formation are required, widening of embankments, and construction of the Parkes north west connection.
- Scenario 2 – construction within the proposal site where the track is being upgraded, significant earthworks are not expected, and the potential for dust impacts is lower than for Scenario 1.
- Scenario 3 – establishment of site compounds.

The calculations used a background dust level of 16.9 µg/m^3 and are worst case predictions, with the actual values dependent on background dust levels and local meteorology on any given day.

Modelling results

The results for scenario 1 show that the criteria of 50 µg/m^3 may be exceeded at a distance of up to 100 metres from the proposal site under worst case conditions. There are 13 sensitive receivers within 100 metres of the proposal site.

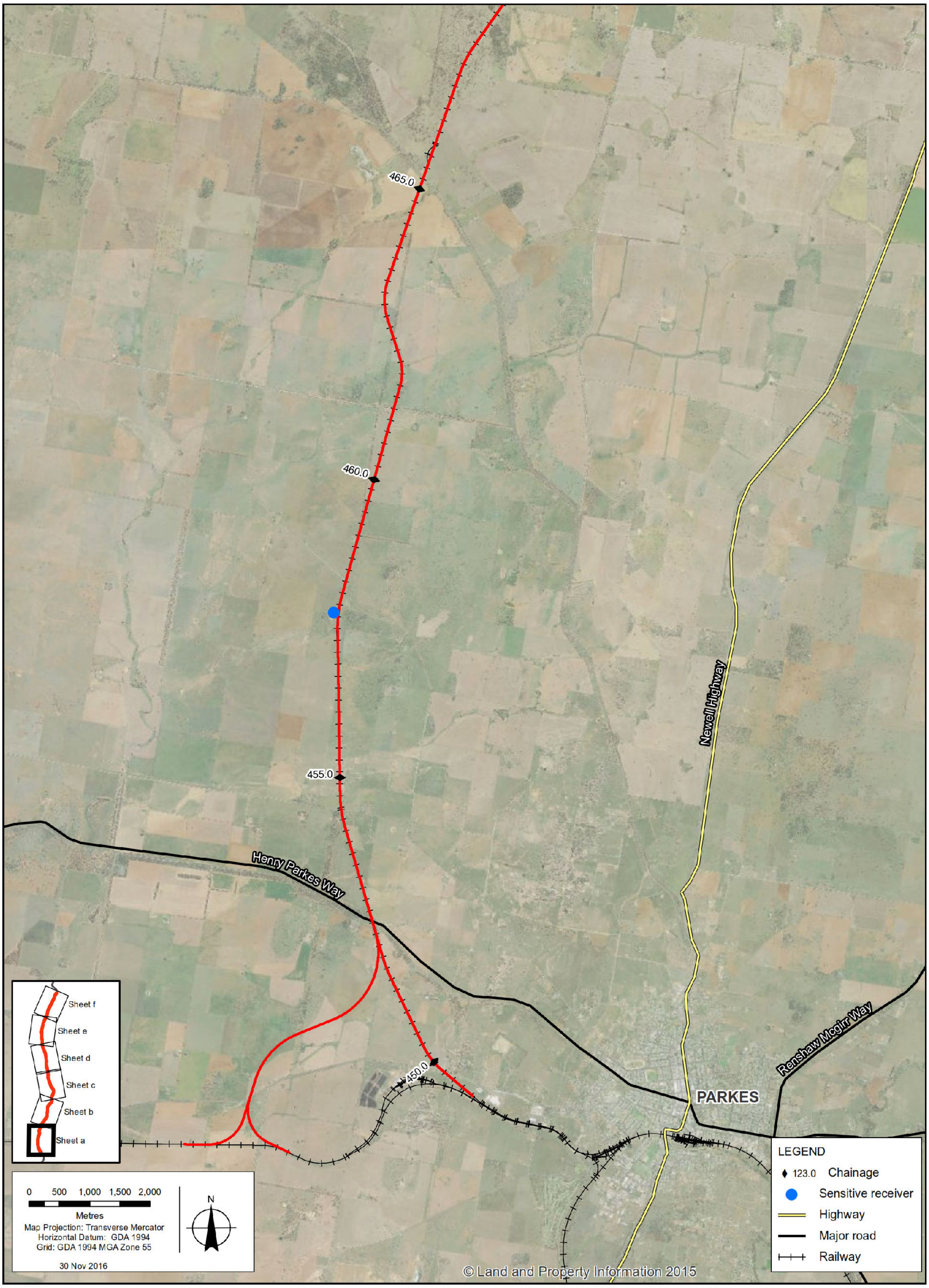
The results for scenario 2 show that the criteria of 50 µg/m^3 may be exceeded at a distance of up to 20 metres from the proposal site under worst case conditions. There are no sensitive receivers within 20 metres of the proposal site.

The impacts from construction along the proposal site would be short-term, as construction works would move along the proposal site, limiting the duration of potential impacts at any one location.

The results for scenario 3 show that the criteria of 50 µg/m^3 may be exceeded at a distance of up to 150 metres from compounds under worst case conditions. This impact would be temporary and short term, as once the site is established, the potential for dust impacts would be much lower. There are no sensitive receivers within 150 metres of any of the proposed compound sites.

Measures to manage the potential for construction air quality impacts are provided in section 13.5. The level and number of measures implemented would depend on the location of construction with respect to sensitive receivers and activities undertaken. During construction, additional dust control measures would be adopted for scenario 1 or during dry conditions if visible dust plumes are moving off-site towards sensitive receivers.

Based on the findings of the assessment, it is expected that the generation of dust emissions due to construction can effectively be mitigated by implementation of the mitigation measures outlined in in section 13.5.



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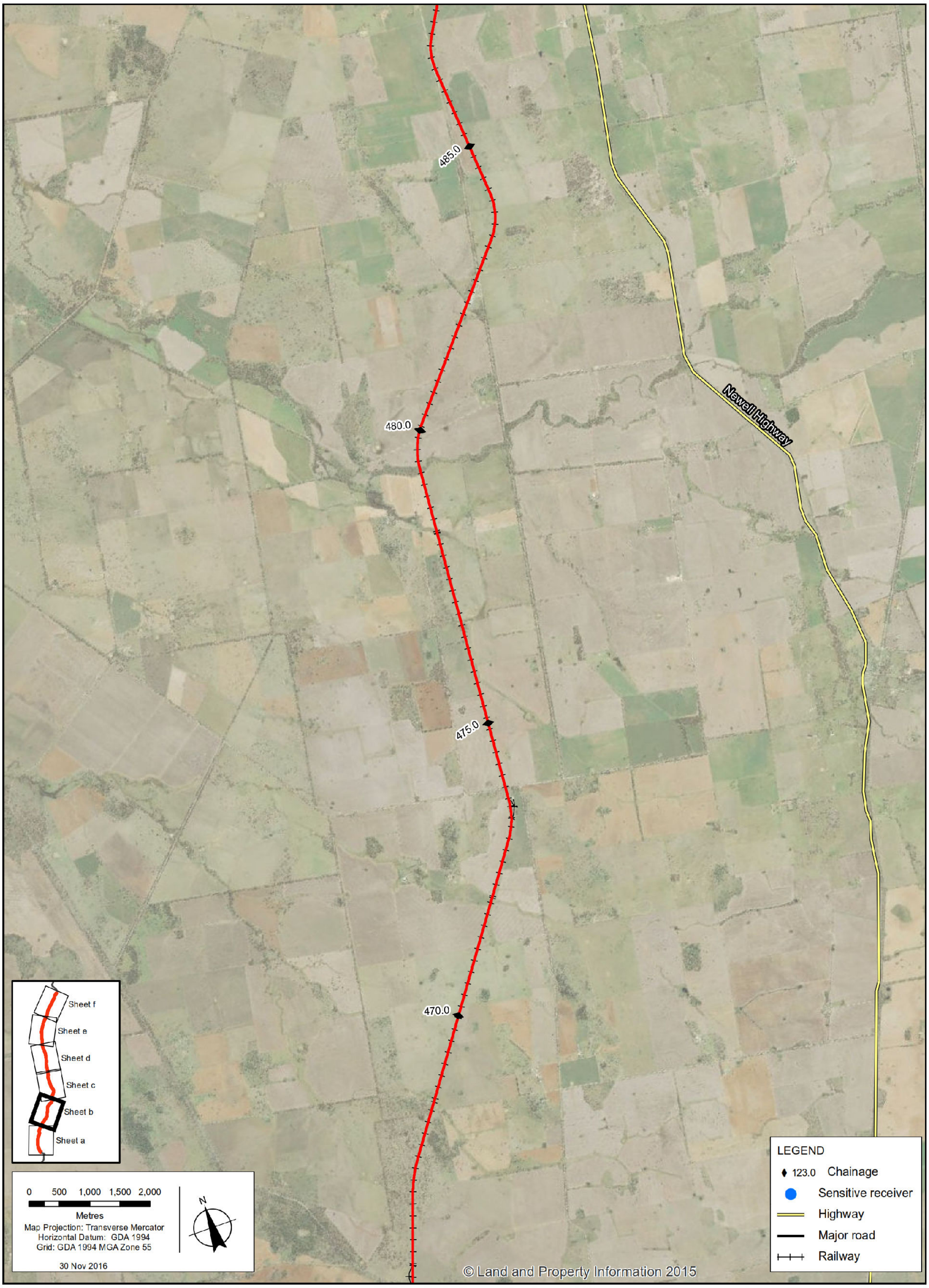
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2a
Air quality sensitive receiver locations



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2b
Air quality sensitive receiver locations

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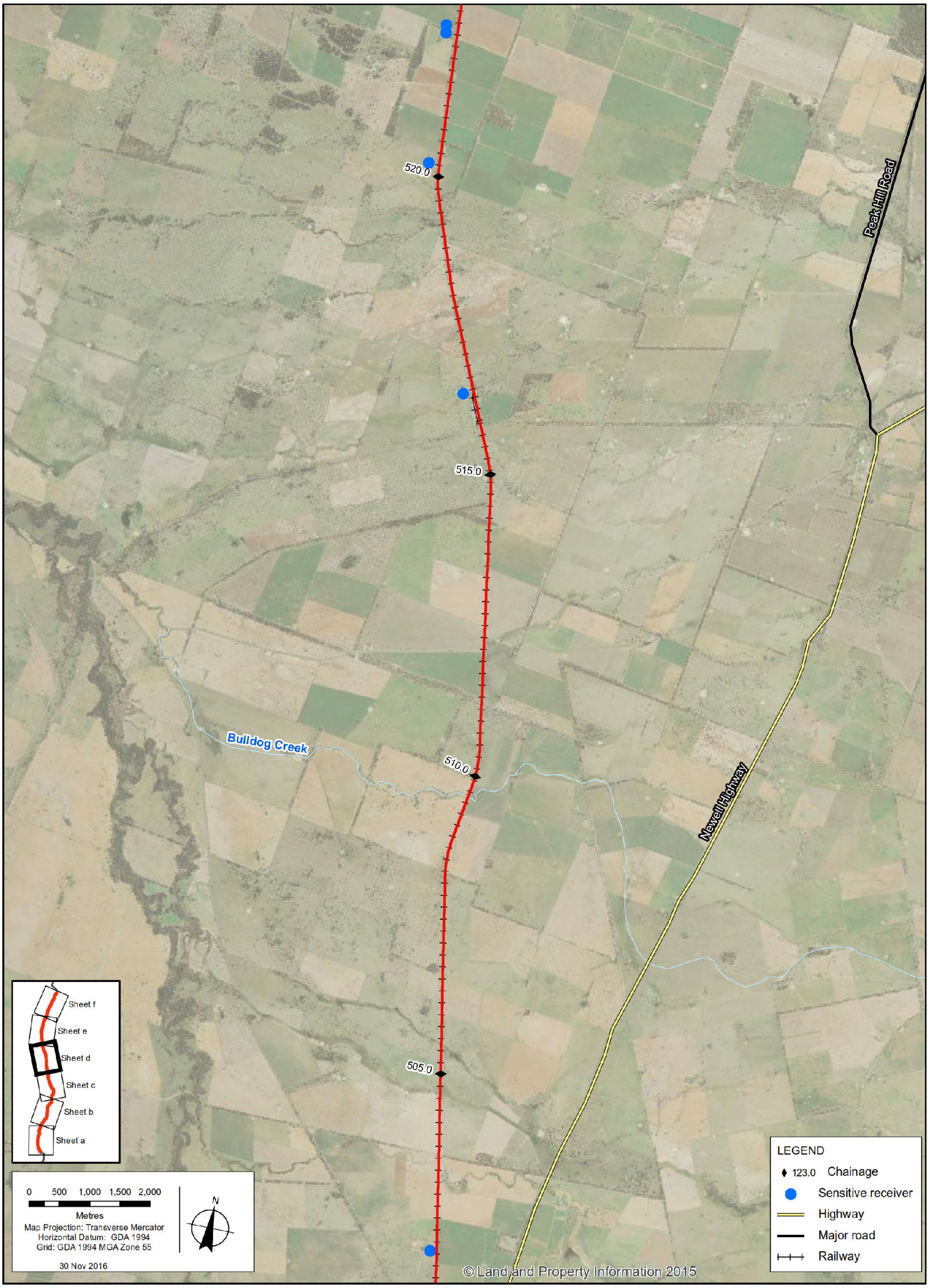
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2c
Air quality sensitive receiver locations



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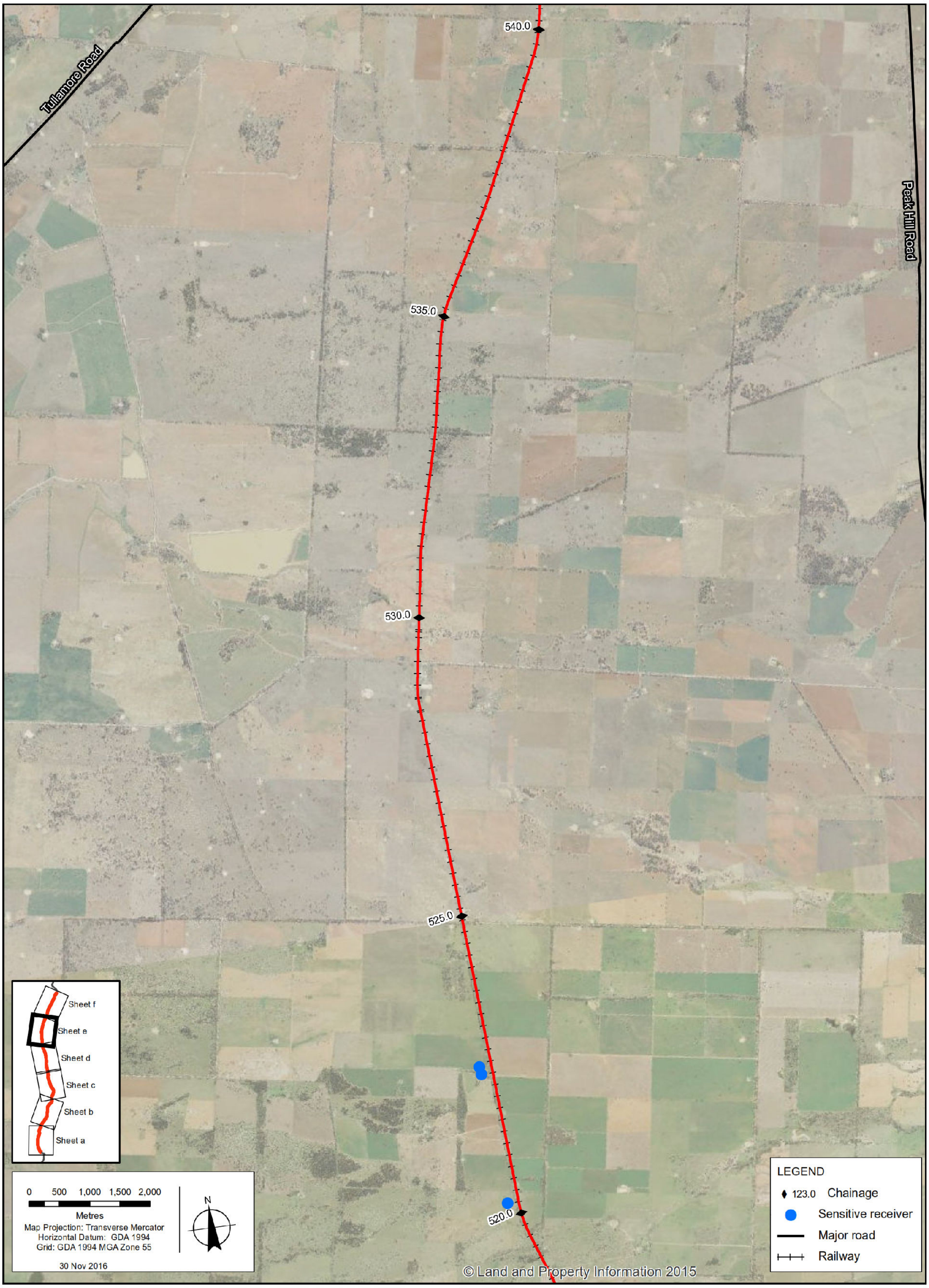
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2d
Air quality sensitive receiver locations



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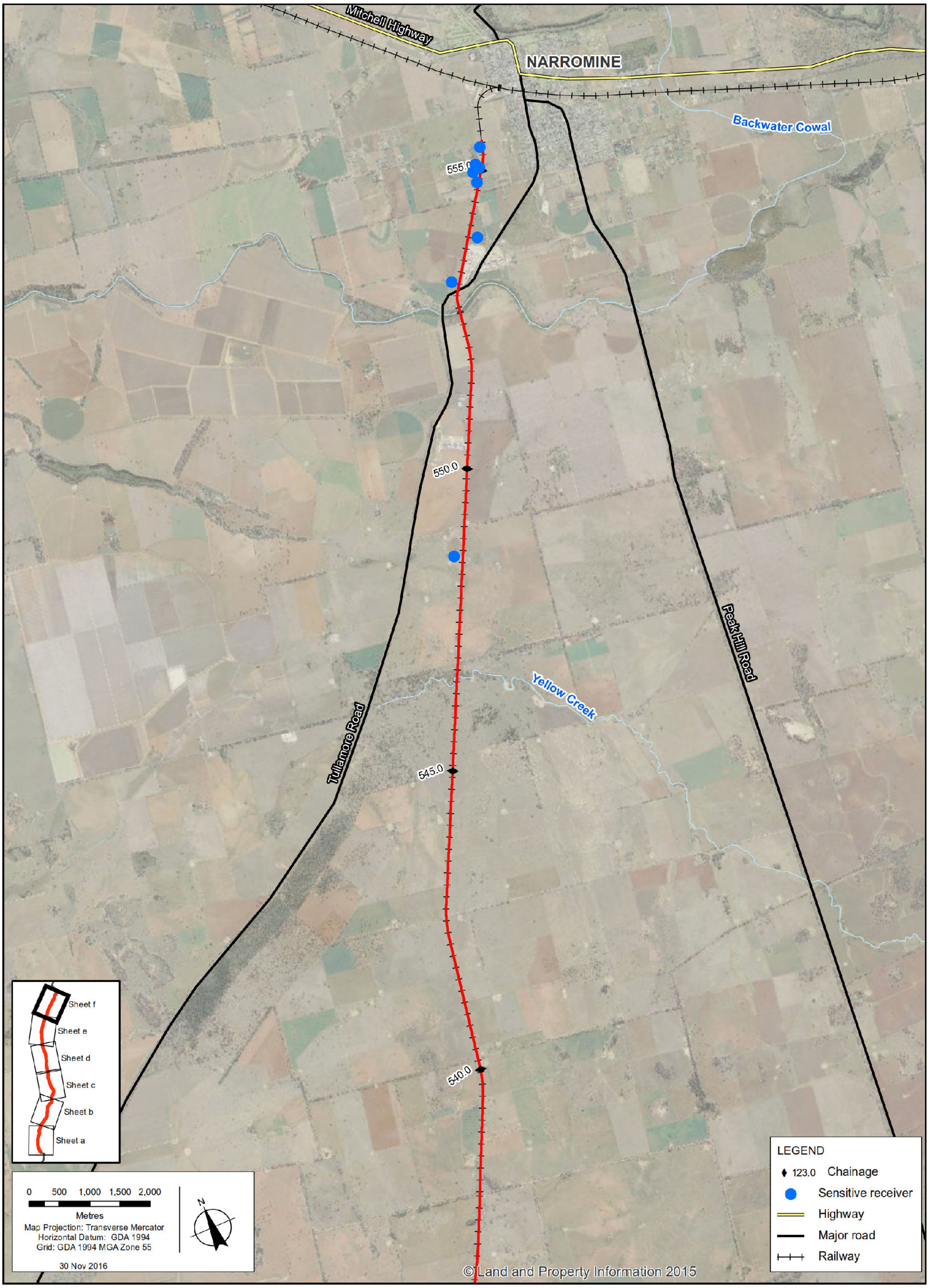
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2e
Air quality sensitive receiver locations



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2f

Air quality sensitive receiver locations

13.4.4 Operation impacts

Operation of the proposal would result in an increase in the number of freight trains travelling along the rail corridor. It is estimated that Inland Rail would be trafficked by an average of 8.5 trains per day in 2025, increasing to the estimated maximum of 15 trains per day in 2040. This rail traffic would be in addition to the existing rail traffic using the Parkes to Narromine line.

Diesel locomotives, like trucks and cars, emit nitrogen oxides and particulate matter to the air. Air quality impacts from busy rail corridors are generally only an issue in densely populated areas, with poor outdoor air circulation. *Development near rail corridors and busy roads – interim guideline* (Department of Planning, 2008), suggests that air quality should be a design consideration within 20 metres of a freeway or main road with moderate congestion levels. The guideline provides no specific reference to a distance from rail corridors.

The results of the *Northern Sydney Freight Corridor Strathfield Rail Underpass Air Quality Assessment* (Parsons Brinckerhoff, 2012) were reviewed with respect to the potential impacts of the operation of freight trains. It is noted that this assessment was for a rail line operating in an urban area with many more sensitive receivers. This assessment included air quality modelling of 81 class diesel locomotives undertaking a minimum of 32 movements per day (16 in each direction) at 75 kilometres per hour. The results of modelling indicated that, for all assessed pollutants (NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$ and benzene), the predicted levels were significantly below the impact assessment criteria at a distance of 50 metres from the track. The predicted increment of PM_{10} as a 24-hour average was 0.06 µg/m^3, and the increment of $PM_{2.5}$ was 2 µg/m^3, which complied with the assessment criteria at all sensitive receivers.

As the levels of operational rail traffic along the proposal site would be much lower than for the Northern Sydney Freight Corridor, the operational emissions as a result of the proposal are expected to be much lower. The emissions from use of the existing rail corridor as a result of the proposal would increase as a result of the increase in the number of trains travelling along the corridor, however the emissions are still expected to be below the relevant impact assessment criteria.

Air pollution from transport corridors decreases significantly with distance, and is expected to be negligible for the proposal.

13.4.5 Cumulative impacts

The construction impact assessment in section 13.4.3 includes existing dust levels in regional NSW. The results show cumulative dust levels, which include the background and predicted increment from construction in the study area. The assessment found that the predicted particulate levels from construction would be unlikely to extend farther than 150 metres from work areas, and would have insignificant cumulative impacts with other approved projects. Predicted particulate increment from construction would not impact on regional air quality, and would be localised to a few hundred metres of the construction works.

Operational air quality impacts are not expected at distances greater than 20 metres from the proposal site. There are no identified significant sources of air pollutants, within 20 metres of the proposal site, and cumulative impacts are not expected.

13.5 Mitigation and management

13.5.1 Approach to mitigation and management

An air quality management sub-plan would be prepared as part of the CEMP and implemented during construction to ensure that air quality impacts do not exceed relevant air quality criteria. The air quality management sub-plan would help ensure that dust and emissions are managed in an environmentally sound manner, and in accordance with statutory requirements.

During operation, air quality would be managed to achieve compliance with the operational environmental protection licence.

13.5.2 Consideration of the interactions between mitigation measures

Mitigation measures to control air quality impacts may overlap with the measures proposed for the control of erosion and sedimentation (described in chapters 5 and 26), as the major pollutant of concern is dust.

All mitigation measures for the proposal would be consolidated and described in the CEMP. The CEMP would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

13.5.3 Managing residual impacts

The mitigation and management measures proposed are expected to reduce the potential for impacts to air quality resulting from construction and operation. With the implementation of these measures, residual impacts are expected to be minimal.

13.5.4 Summary of mitigation measures

To mitigate the potential impacts to air quality, the following measures would be implemented.

Table 13.3 Air quality mitigation measures

Stage	Impact	Mitigation measures
Pre-construction/ construction	General air quality impacts	An air quality management sub-plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for air quality impacts on the local community and environment, and would address all aspects of construction, including: ▸ spoil handing ▸ machinery operating procedures ▸ soil treatments ▸ stockpile management ▸ haulage ▸ dust suppression ▸ monitoring.
	Construction activities and activities with earthworks that may cause dust impacts	Where sensitive receivers are located within 150 metres of construction works, or visible dust is generated from vehicles using access roads, road watering would be implemented.
Operation	Rail vehicle emissions	The proposal would be managed in accordance with the air quality management requirements specified in the EPL.
	Impacts during maintenance	Maintenance service vehicles and equipment would be maintained and operated in accordance with the manufacturers specifications.

14. Soils and contamination

This chapter provides the results of the soils and contamination assessment of the proposal as relevant to the EIS. It describes the existing soil environment, assesses the impacts of construction and operation, and provides recommended mitigation measures.

14.1 Assessment approach

14.1.1 Methodology

As an input to the design of the proposal, contamination and geotechnical assessments were undertaken to identify design constraints and the potential for human health impacts and/or environmental risks. These assessments were reviewed, and results relevant to the potential for soil and contamination impacts are provided in this chapter.

The contamination assessment undertaken as an input to the design included a desktop assessment to identify the potential for contamination along the proposal site, involving:

- a review of historical aerial photographs and a site visit to identify whether there are/have been any land uses that may have resulted in contamination issues
- searches of the NSW EPA Contaminated Sites Register and the list of sites which have been notified to the EPA
- a review of ARTC’s contaminated site register.

The geotechnical assessment undertaken as an input to the design involved excavating 172 test pits along the proposal site. For the contamination assessment, 36 soil test pits were excavated into the existing track formation. Test pit locations are shown on Figure 14.1. Soil samples were collected from the contamination test pits and submitted to a National Association of Testing Authorities (NATA) accredited laboratory for analysis of the following contaminants of potential concern:

- asbestos
- total recoverable hydrocarbons
- polycyclic aromatic hydrocarbons
- organochlorine pesticides
- heavy metals (arsenic, cadmium, chromium, copper, mercury, lead, nickel, and zinc)
- polychlorinated biphenyls.

A summary of the results of the assessments relevant to the EIS is provided in this chapter.

14.1.2 Legislative and policy context to the assessment

Assessment framework

The contamination assessment was undertaken in accordance with guidelines made under section 105 of the *Contaminated Land Management Act 1997* (the CLM Act). These and other relevant guidelines include:

- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011a)
- *Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (EPA, 2015a)
- *Contaminated Sites: Sampling Design Guidelines* (EPA, 1995)
- *National Environment Protection (Assessment of Site Contamination) Measure 1999*, 2013 amendment (the NEPM)
- *Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 2008)
- *Managing Land Contamination Planning Guidelines SEPP 55 – Remediation of Land* (Department of urban Affairs and Planning and EPA, 1998).

Assessment criteria

The assessment criteria (investigation levels) for the contamination assessment were taken from the following guideline levels provided by the NEPM (refer to Schedule B1 of the NEPM):

- Health investigation levels:
  - to assess human health risk via all relevant pathways of exposure
  - the level adopted for this assessment was D – commercial/industrial use.
- Health screening levels:
  - for hydrocarbon vapour intrusion under different land use scenarios
  - the level adopted for this assessment was D – commercial/industrial use.

The desktop assessment did not identify a potential risk to ecological receptors from contaminated soils during construction. Therefore, ecological screening/investigation levels were not adopted as assessment criteria.

Asbestos

The assessment criteria for asbestos was taken from the NEPM and *Managing asbestos in or on soil* (WorkCover, 2014). These provide guidance on what constitutes an 'acceptable' level of asbestos in soil. The NEPM emphasises that the assessment and management of asbestos contamination should take into account the condition of the asbestos materials, the potential for damage, and resulting release of asbestos fibres. Bonded asbestos in sound condition represents a low human health risk. However, both friable and fibrous asbestos materials have a significantly higher potential to generate, or be associated with, free asbestos fibres, and may represent a significant human health risk if disturbed and fibres are made airborne.

Waste classification

A preliminary soil waste classification was completed to guide any offsite soil disposal that may be required. The analyte concentrations in the tested soil samples were compared to the criteria in Table 2 of the *Waste Classification Guidelines, Part 1: Classifying Waste* (EPA, 2014). Further information on the application of the waste classification guidelines is provided in chapter 24.

14.2 Existing environment

14.2.1 Geological and soil settings

The proposal site crosses flat to undulating rises along the lower western slopes of a north-south trending range. The range is associated with the meta-sedimentary units of the Hervey syncline in the south, and the granitic Bulga Range in the north.

The proposal site is located in the Central Lachlan Fold Belt. Near surface materials include Tertiary to Quaternary aged red silty alluvium over intermittently outcropping folded and faulted Silurian and Ordovician aged sedimentary and minor metamorphic sequences.

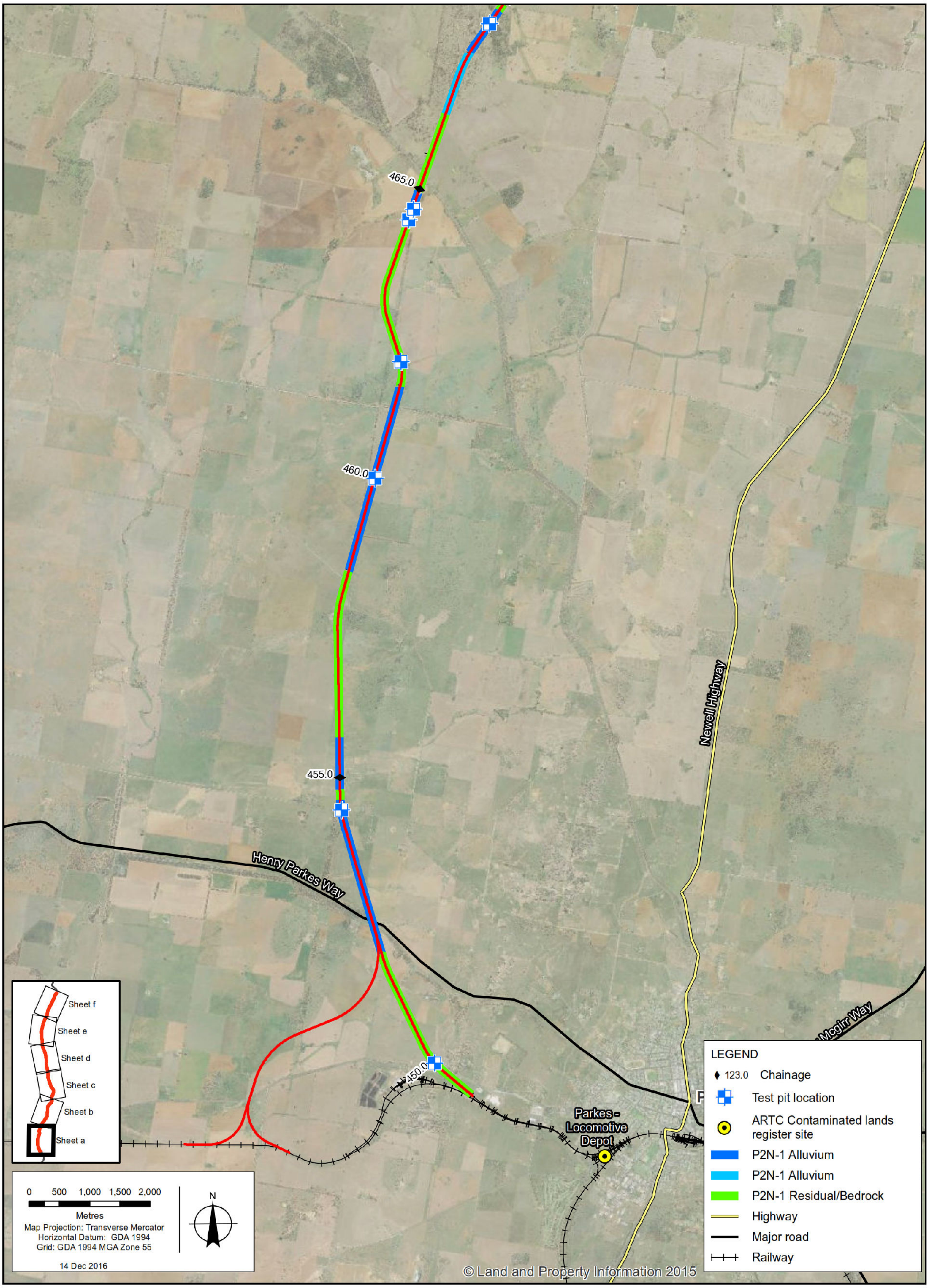
Thick reactive brown and grey clay soils are predominantly associated with the near level terrain north of Peak Hill. The undulating terrain south of Peak Hill consists of moderately thick red and brown sandy and silty clay soils. Soil types are shown on Figure 14.1.

Based on regional groundwater bore information, groundwater is anticipated to be located between seven and 60 metres below the ground surface, but generally over 20 metres below the ground surface. Subsurface conditions noted during the contamination and geotechnical assessments are listed in Table 13.1.

Of the soils present in the proposal site, the main potential issue relates to dispersive soils, which are located north of Peak Hill. The presence of gullying or other erosion features in the study area was not noted.

Table 14.1 Summary of subsurface conditions

Subsurface type	Depth encountered (metres)	Generalised description
Ballast – encountered in track formation only		
Top ballast	0.2 to 0.5	Gravel, coarse angular to sub-angular igneous gravel. Clean to moderately fouled.
Sub-ballast	0.2 to 0.75	Gravel, fine to coarse grained, angular to sub angular basalt. Typically, with sand. Fouled to highly fouled.
Fill		
Ash fill (in track formation only)	0.44 to 0.9	Clayey sand, low plasticity fines with gravel and minor clay. Comprising coal and carbonaceous shale.
Clay fill	0.05 to 1.3	Clay, generally encountered as sandy, or trace with sand or gravel, medium to high plasticity, typically derived from local alluvium or residual soil.
Natural soil		
Topsoil	0.05 to 0.65	Clay, typically encountered as sandy, or trace to with sand or gravel, with organics and roots, medium to high plasticity.
Alluvium	0.15 to greater than 2.4	Clay variably encountered as sandy or gravelly, or trace to with sand or gravel, medium to high plasticity.
Colluvium	0.8 to 1.1	Clay, trace gravel or with sand, medium to high plasticity.
Residual	0.9 to greater than 2.4	Clay, varyingly encountered as trace to with gravel or sand, medium to high plasticity.
Bedrock		
Sandstone	Greater than 1.1 to greater than 2.3	Fine to medium grained, extremely to highly weathered, and extremely low to very low strength.
Siltstone	Greater than 1.2 to greater than 2.3	Thinly laminated to laminated, with possibly slight metamorphic textures, typically extremely to highly weathered, and extremely low to very low strength.
Basalt	Greater than 0.4 to greater than 2.2	Generally extremely to highly weathered, and extremely low to low strength.



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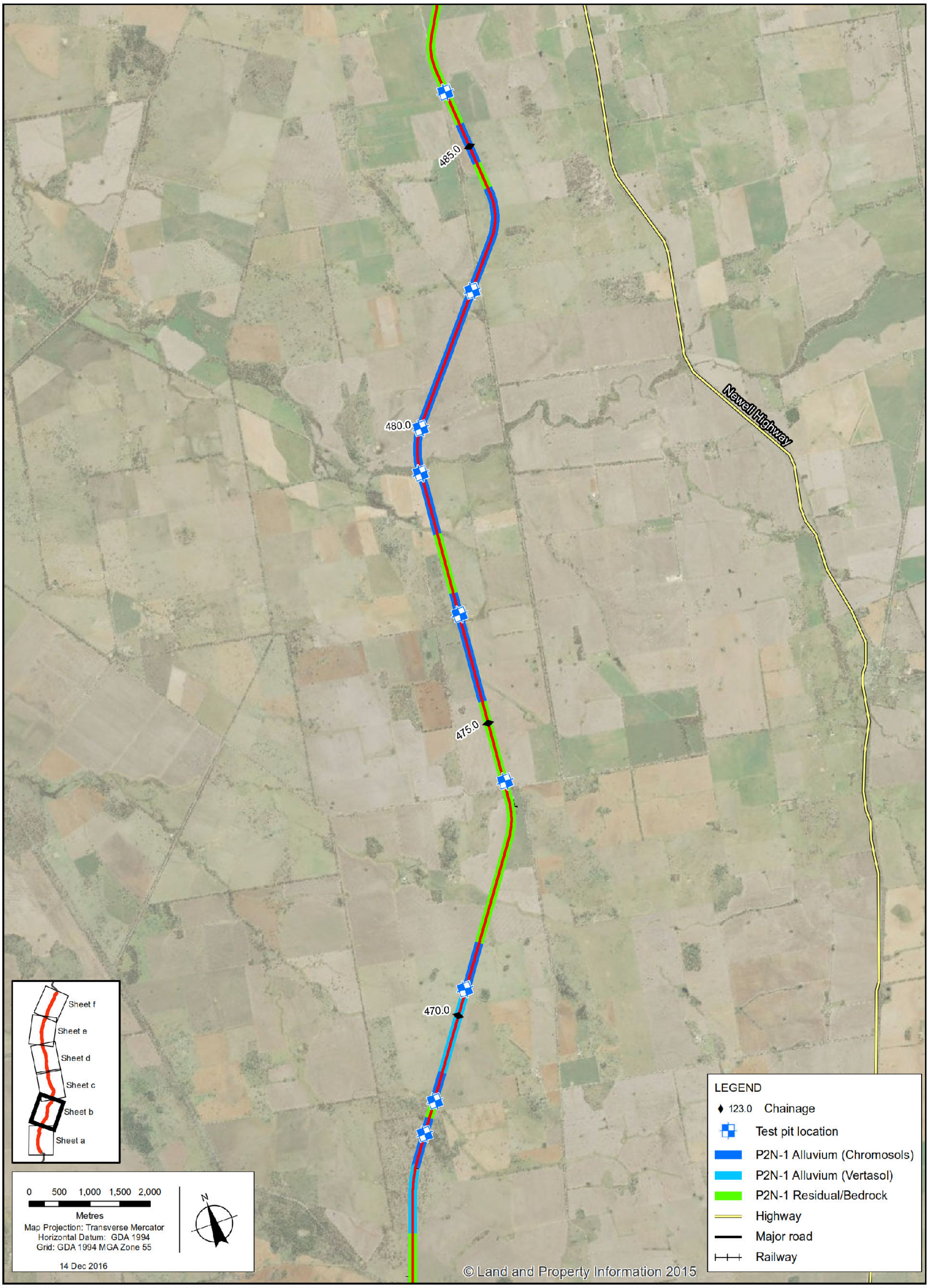
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1a

Soils and contamination



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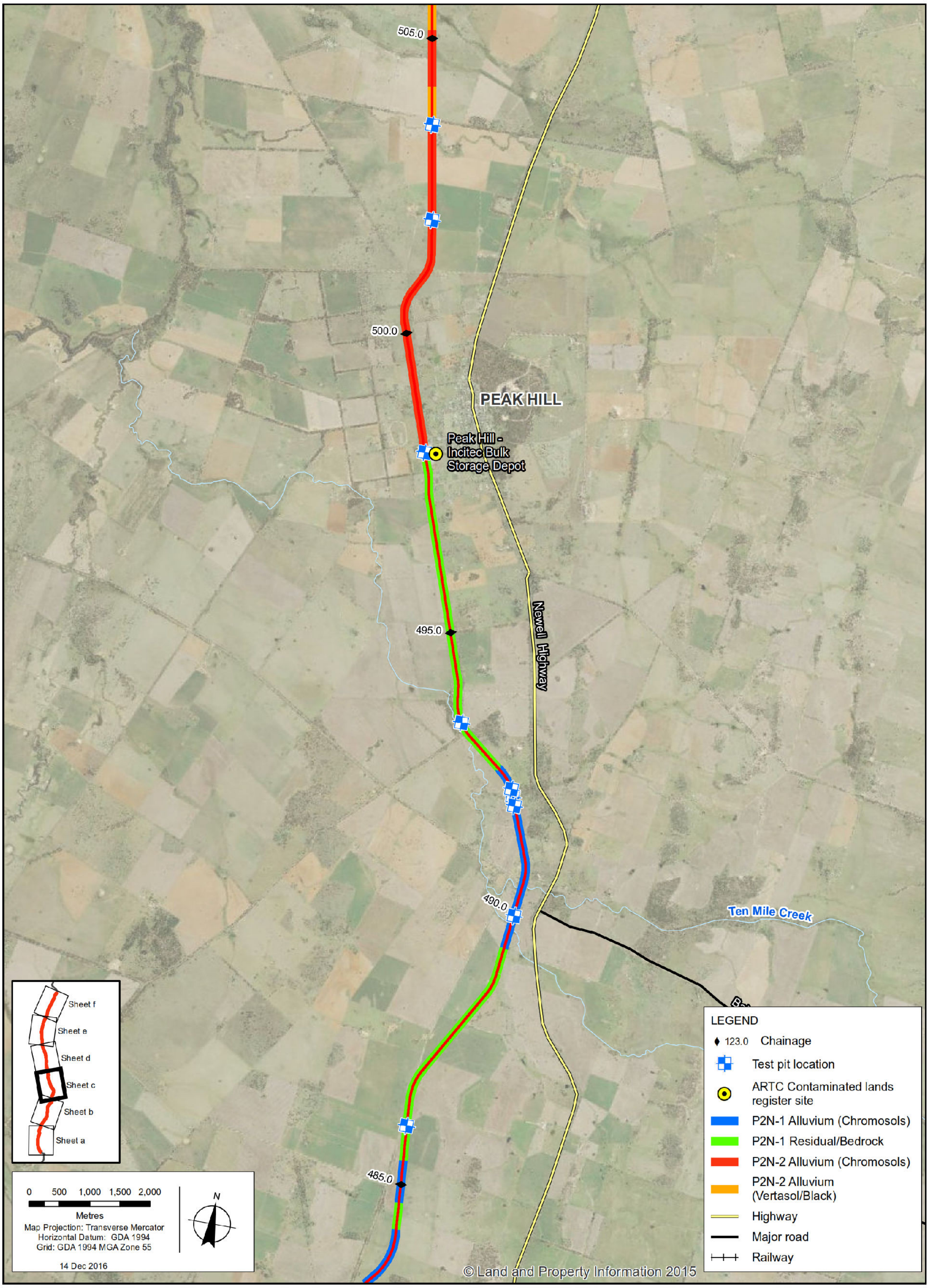
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1b
Soils and contamination



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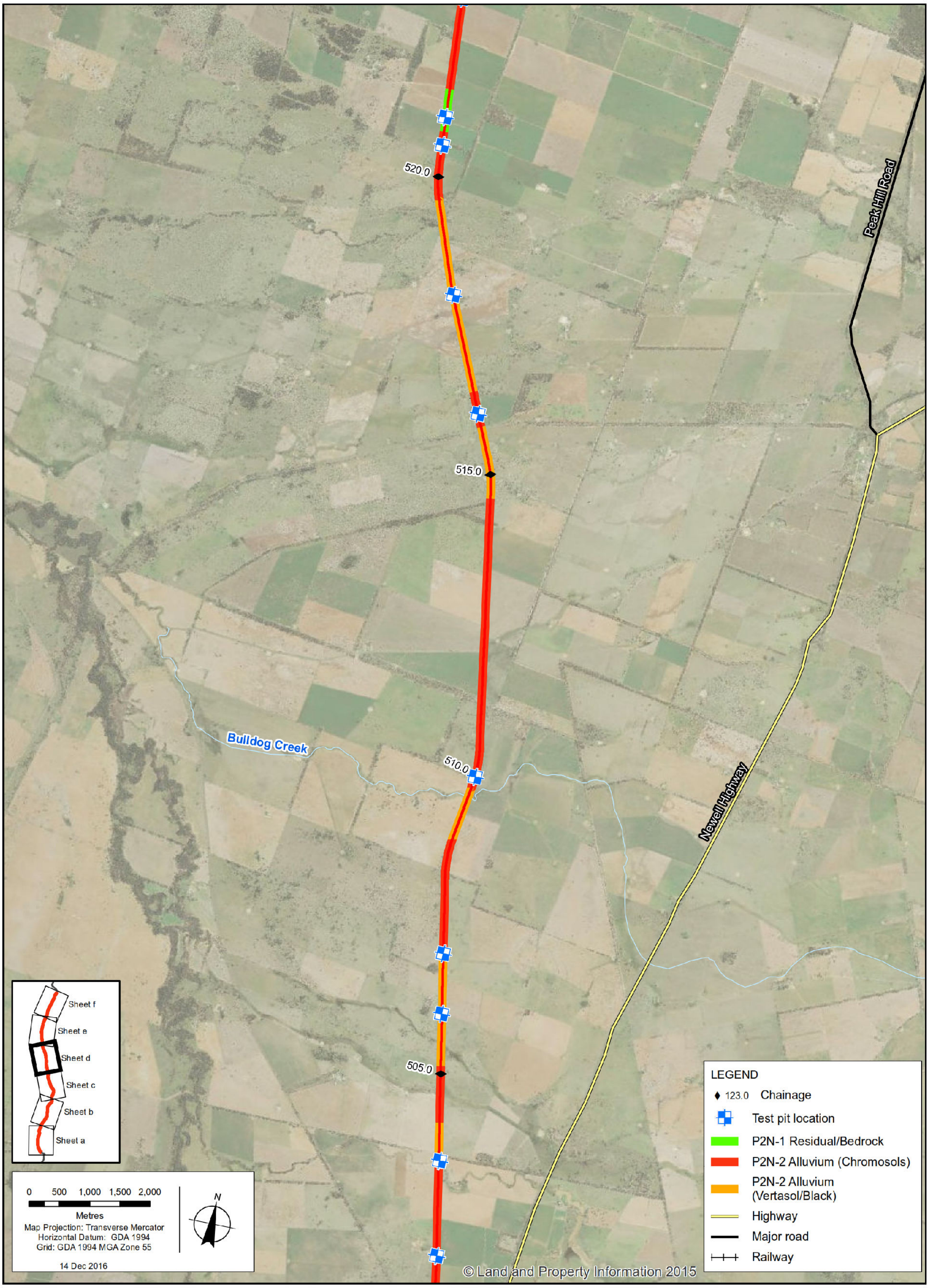
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1c
Soils and contamination



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1d
Soils and contamination

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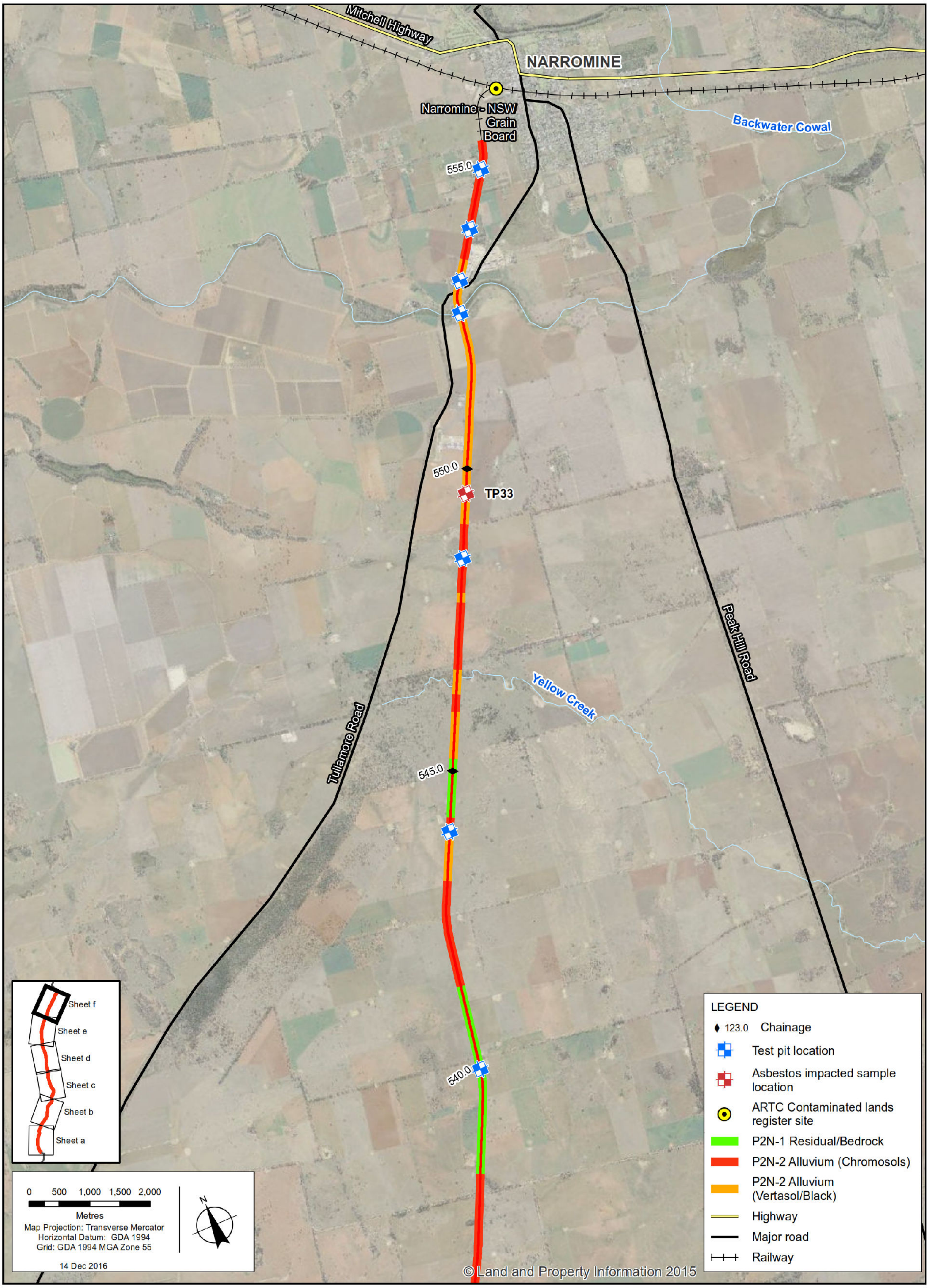
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1e
Soils and contamination



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1f
Soils and contamination

Acid sulfate soils

Acid sulfate soils are the common name given to naturally occurring sediments that contain iron sulfide minerals. If the soils are drained, excavated or exposed to air, the sulfides react with oxygen to form sulfuric acid. Acid sulfate soils are widespread around coastal regions and are locally associated with saline sulfate-rich groundwater in some agricultural areas, or with freshwater wetlands. Given the distance of the proposal site from the coast and its elevation, no acid sulfate soils are expected or known to occur. A review of the Australian Soil Resource Information System undertaken on 17 June 2016 (CSIRO, 2016) found that the proposal site is located in an area of low probability to no known occurrence of acid sulfate soils. The potential to encounter acid sulfate soils during construction has therefore not been considered further.

Saline soils

Areas prone to salinity are usually at low positions in the landscape, such as in valley floors and along floodplains. The OEH NSW Soil and Land Information System contains data points identifying evidence of soil salinity where soils have been sampled previously. A review of this database undertaken on 17 June 2016 (eSPADE, 2016) indicated that generally no salting was evident at sample locations in the vicinity of the proposal site (within one kilometre). Salting was evident at isolated locations in the region, the closest being about 2.5 kilometres to the east of the proposal near Trewilga, however these are likely associated with farming practices and are site-specific. The findings of the geotechnical laboratory analysis of soil samples was consistent with this. The potential to encounter saline soils during construction has therefore not been considered further.

14.2.2 Potential for contamination

There are no sites listed on the EPA's Contaminated Sites Register or list of notified sites within/close to the proposal site. Three sites listed on ARTC's contaminated sites register are located within/close to the proposal site. These sites have been leased from ARTC for use as service stations, grain or fuel storage. The locations of these sites are shown on Figure 14.1.

Based on the land uses immediately surrounding the proposal site (described in chapters 2 and 20) and the findings of the desktop assessment, potential sources of contamination in the vicinity of the proposal site are considered to include:

- agricultural activities – which may be associated with hydrocarbons, pesticides and hazardous materials from demolition, deterioration of old buildings, and/or landfilling
- unknown fill and waste materials – which may be associated with various hazardous materials, including asbestos, heavy metals, pesticides, and hydrocarbons
- imported fill and ballast within the rail corridor – which may be associated with asbestos, hydrocarbons, heavy metals, and polycyclic aromatic hydrocarbons
- industrial activities adjacent to the rail corridor – which may be associated with hydrocarbons, oils, chemical storage, heavy metals, and hazardous building materials.

The targeted site investigations found no visual or olfactory evidence of contamination in any of the test pits. Illegal dumping of waste materials was observed, including storage containers that may contain, or have contained, chemicals or fuel.

All samples except one had laboratory results below the limit of reliability and below the relevant human health screening criteria.

One site recorded the presence of chrysotile asbestos in sandy gravel fill material. This site (reference TP33) is located in the existing rail corridor about five kilometres south-west of Narromine (shown on Figure 14.1). The potential source of this asbestos was considered to be the dilapidated building located adjacent to the site. Soils in the vicinity of this location would be classified as special waste (asbestos) in accordance with the *Waste Classification Guidelines* (EPA, 2014). Soils sampled at other test pit locations along the corridor are consistent with a general solid waste classification.

The contamination assessment confirmed that the soils are suitable to remain within the proposal site for the use proposed (that is, for railway purposes). Based on the findings of the contamination assessment, the proposal site does not contain gross contamination, and does not meet the criteria requiring it to be notified to the EPA under section 60 of the CLM Act.

14.3 Impact assessment

The following assessment considers the potential for soil and contamination impacts as a result of the construction and operation of the proposal. The potential for impacts to water quality as a result of soil erosion, run-off, and potential contamination is considered in chapter 16. The potential for impacts as a result of the transport of hazardous materials and dangerous goods is considered in chapter 25.

14.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential for soils and contamination risks. The assessed risk level for the majority of potential risks to soils, and from contamination, was between low and medium. Risks with an assessed level of medium or above include:

- impacts associated with the disturbance of contaminated soils during construction
- increased erosion and sedimentation due to excavation activities and vehicle movement
- contamination of soils/groundwater due to spills and leaks during construction
- changes to the surface, including as a result of vegetation removal and the creation of embankments, increasing the potential for erosion and sedimentation.

How potential impacts would be avoided

In general, potential soils and contamination impacts would be avoided by:

- managing contamination in accordance with relevant legislative and policy requirements, as described in section 14.1.2
- designing, constructing and operating the proposal to minimise impacts from soil issues
- implementing the soil and contamination mitigation measures described in section 14.4.

14.3.2 Construction impacts

Soil

Excavation and ground disturbance activities, if not adequately managed, could have the following impacts:

- erosion of exposed soil and stockpiled materials, particularly in areas where dispersive soils are present
- dust generation from excavation, backfilling and vehicle movements over exposed soil
- an increase in sediment loads entering the stormwater system and/or local runoff, and therefore nearby receiving waterways
- increase salinity levels in soil.

These impacts are considered to be minimal, as exposure of soils would be temporary and short-term in duration. It is expected that the majority of excavated spoil, consisting of either ballast, fill, or natural soils, would be reused during track formation works, or used to construct spoil mounds within the rail corridor (as described in chapter 8). Excess spoil not able to be used for either backfill or spoil mounds due to the presence of contamination would be stockpiled in a suitable location for transport and disposal off-site at an appropriately licensed waste facility.

The following construction activities have the potential to directly impact on the soil environment.

Earthworks and vegetation removal

Construction would temporarily expose the ground surface through vegetation removal, and excavation of construction footprints for structures, including culverts. The temporary exposure of these areas to water runoff and wind could increase soil erosion potential, particularly where construction is undertaken in areas which are characterised by dispersive soils. In addition, the removal of vegetation and top soils could increase the amount of water infiltration, particularly in areas of perched groundwater (see chapter 15), causing the water table to rise and bringing salt to the root zone and soil surface. Increased salinity in soils can affect plant health, leading to a loss of productive species and a dominance of salt-tolerant species.

Periods of heavy and frequent rainfall could also lead to increased runoff and flooding. Loose material may be eroded during rainfall events by runoff, increasing the potential for movement of soils and sedimentation of local drainage lines. This may in turn influence the vegetation and habitat of adjacent areas by smothering groundcover vegetation or by changing soil surface characteristics.

The potential for soil erosion and runoff impacts would be minimised by the implementation of the mitigation measures described in section 14.4.

Reinstatement

Reinstatement activities would require minor earthworks that could lead to the erosion of disturbed soils where they are not stabilised appropriately.

Vehicle movements, including machinery and support vehicles

Vehicles and machinery used during construction could result in compaction or erosion of surface soils, and/or transport excess material onto sealed roads. These impacts would be minimised by the implementation of the mitigation measures described in section 14.4.

Contamination

As described in section 14.2.2, potentially contaminating land uses are present along and in the vicinity of the proposal site. If land associated with these land uses is disturbed, there is the potential for off-site contamination. Exposure or disturbance of contaminants may have the following potential for impacts:

- direct contact and/or inhalation by site workers, users and visitors
- impacts to surrounding environmental receivers (including surrounding ecosystems and flora and fauna, where present)
- mobilisation and migration of surface and subsurface contaminants via leaching, runoff and/or subsurface flow, impacting nearby soils, surface water, and groundwater.

Based on the results of the targeted site investigations, there is minimal potential for contamination to be encountered during construction. There is the risk of exposure to site workers if the dilapidated building located next to site TP33 needs to be removed. No residences are located within 100 metres of site TP33, therefore the potential for off-site impacts to sensitive receivers is considered to be low.

Unexpected soil contamination could also be encountered, the evidence of which could include:

- unexpected staining or odours
- potential asbestos containing materials
- unexpected underground storage tanks, buried drums or machinery, etc.

There is also potential for chemical and fuel spills during construction as a result of the operation and movement of construction plant and vehicles, which may result in localised contamination of soils and/or groundwater.

These impacts would be managed by implementing the mitigation measures described in section 14.4.

14.3.3 Operation impacts

Contamination

During operation, there is a risk of accidental spillage of petroleum, chemicals or other hazardous materials as a result of leakage or rail accidents. Spills could pollute downstream waterways and groundwater if unmitigated. The potential for contamination is considered to be low, based on the amount of vehicles and equipment which would likely be used during maintenance. This impact would be minimised by implementing existing ARTC procedures to manage spills.

Soil

During operation, erosion of dispersive soils to the north of Peak Hill could result in silting of drainage infrastructure, including culverts. To manage this potential operational impact, dispersive soils would be treated where exposed in cut batters, culvert crossings, and drainage lines during construction. Additional operational impacts from unsuitable soils would be minimised by taking soil types into account during design and construction.

Maintenance and repair activities may require excavation and ground disturbance, which could result in short term impacts similar to those described in section 14.3.2. These impacts would be managed by implementing the mitigation measures described in section 14.4.

14.4 Mitigation and management

14.4.1 Approach to mitigation and management

Soil

Site-specific analysis would be undertaken during detailed design as an input to the design of the proposal and appropriate treatment measures (as required). Design documents would specify construction procedures to identify and address 'unsuitable' subgrade soils.

Prior to construction, a soil and water management sub-plan would be prepared as part of the CEMP in accordance with relevant guidelines, including *Managing Urban Stormwater Volume 1* (Landcom, 2004) and *Volume 2C* (DECC, 2008).

Auditing and monitoring would be undertaken during construction to ensure that the CEMP and relevant sub-plans are being implemented.

Contamination

A contamination and hazardous materials sub-plan would be developed as part of the CEMP to detail how potential and actual contaminated soils and materials would be managed to minimise the potential for on and off-site impacts. An unexpected finds protocol would be developed as part of the sub-plan to ensure that any unexpected contamination encountered during construction does not expose workers, site users, and/or the environment to contamination in excess of regulatory guideline levels.

The unexpected finds protocol would outline the activities to be undertaken in the event that previously undetected contamination is identified, which would include making the site safe, carrying out an assessment of the finds, and managing the finds based on the results of the assessment.

A waste management plan would also be developed as part of the CEMP, as described in chapter 24. The waste management plan would include an asbestos management component to ensure waste materials which contain asbestos are appropriately managed.

The health and safety plan (described in section 25.4) would also include measures to help minimise the exposure of workers to potentially contaminated soil, including material containing asbestos.

Further information on the approach to environmental management during construction is provided in chapter 26.

14.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to control impacts associated with soil and contamination may overlap with measures proposed for the control of air quality, health and safety, and waste management impacts. All mitigation measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

14.4.3 Summary of mitigation measures

To mitigate the potential for soil and contamination impacts, the following measures would be implemented.

Table 14.2 Summary of mitigation measures

Stage	Impact	Mitigation measures
Detailed design	Structural integrity	Foundation and batter design would include engineering measures to minimise operational risks from shrink swell, dispersive, and/or low strength soils.
	Dilapidated building near site TP33	The presence of asbestos in this building would be confirmed through a hazardous material survey, and any removal required would be undertaken in accordance with *How to Safely Remove Asbestos Code of Practice* (Safe Work Australia, 2016).
Pre-construction/ construction	General soil and erosion management	A soil and water management sub-plan would be prepared as part of the CEMP. It would include a detailed list of measures that would be implemented during construction to minimise the potential for soil and contamination impacts, including: ▸ allocation of general site practices and responsibilities ▸ material management practices ▸ stockpiling and topsoil management, including prompt stabilisation of spoil mounds and treatment of dispersive soils in mounds (for example, through mixing of gypsum) ▸ surface water and erosion control practices that take into account site-specific soil types (for example, dispersive soils).
	Contamination	A contamination and hazardous materials sub-plan would be prepared and implemented as part of the CEMP. It would include: ▸ measures to minimise the potential for contamination impacts on the local community and environment ▸ procedures for incident management and managing unexpected contamination finds (an unexpected finds protocol).

Stage	Impact	Mitigation measures
Operation	Soil erosion and sedimentation	During any maintenance work where soils are exposed, sediment and erosion control devices would be installed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
	Contamination	ARTC's existing spill response procedures would be reviewed to determine applicability and suitability during operation. The adopted procedure would include measures to minimise the potential for impacts on the local community and the environment as a result of any leaks and spills.

15. Hydrology and flooding

This chapter provides a summary of the hydrology and flooding impact assessment of the proposal. It describes the existing environment, assesses the impacts of construction and operation, and provides recommended mitigation measures. The full assessment report is provided as Technical Report 6.

15.1 Assessment approach

15.1.1 Methodology

Surface water and drainage infrastructure assessment

The surface water assessment involved:

- a review of background information relevant to the study area including previous studies, mapping, survey data, topography, and climatic data
- modelling of local catchment surface flow rates for the rail corridor
- a hydrologic analysis as described below
- identifying and assessing construction and operational activities that may impact on the surface water hydrology of watercourses within the proposal site
- identifying management and mitigation measures to manage potential impacts.

Flooding assessment

The hydrologic analysis involved identifying the existing structures to establish the base (existing) flooding conditions. For the existing base case condition, the geometry and form of each structure was analysed based on existing data. The local catchment area draining to each of the structure locations was determined.

Design rainfalls were applied to each local catchment to determine the peak rate of runoff from the catchments for a broad range of design rainfall durations. The predicted flood extent was mapped for a range of rainfall conditions. Hydrologic and hydraulic modelling was undertaken to examine the effect of the existing railway line on flooding, and enable the potential impact of the proposal to be assessed. Modelling considered the location and level of existing and proposed structures (mainly culverts) that enable water to flow through the rail formation and drain to downstream watercourses.

The proposal includes upgrading an existing rail corridor across floodplains. The proposal would be designed to convey flood flows in the same location as the existing rail corridor, to minimise changes to flow patterns. While culverts in the proposal site would be replaced the locations of culverts would not change from the existing scenario and flow patterns would be generally maintained. Therefore, changes to flow patterns have not been assessed. The flood management objectives for this assessment were considered in conjunction with the selection of the adopted rail level (top of the rail track).

Potential flood impacts were assessed by modelling the flooding behaviour of the existing rail corridor compared to the proposal. Flood modelling was undertaken for a range of design flood events, including the 50, 20, 10, five, two, and one per cent AEP events, and the probable maximum flood (PMF). The PMF is defined as an extreme flood deemed to be the maximum flood likely to occur in a particular catchment.

Flooding conditions for the 0.5 per cent and 0.2 per cent AEP events were also considered to represent climate change scenarios.

Flood modelling results were overlaid on aerial photography to identify potential impacts to land use, including built up areas, farm infrastructure, cropping areas, grazing, and forested areas, likely evacuation routes, and flood refuges. This allowed the magnitude of the predicted impacts to be identified for a range of flooding parameters.

The hydrologic analysis has only considered flood events resulting from rainfall on individual, and small groups of catchments immediately upstream of the existing rail corridor. The modelling of local (upstream) catchment flooding was considered to represent the conditions under which the new formation and track would have the greatest influence on flood levels. Downstream conditions were not assessed for the following reasons:

- the proposal site is already used for rail infrastructure, and culverts and bridge would be generally upgraded in their existing location. As a result, the pattern of flooding and drainage downstream of the rail corridor is expected to be largely unaffected
- if more extensive flood modelling was undertaken, broader flood processes (eg major river flooding, tailwater affects, etc) would dominate the results, rather than the impacts of the proposal
- increasing the extent of inundation upstream would result in a corresponding reduction in extent downstream
- by assuming that water would flow unimpeded through the culverts, the maximum potential flow velocities (that is, the worst case scenario) were estimated. This assisted in the identification of scour protection requirements without requiring downstream modelling.

While floodwaters from the Macquarie River spilling into Backwater Cowal or from the Macquarie River floodplain flowing onto into the Bogan River floodplain (Bradys Cowal) could impact the flooding conditions along the rail corridor the potential flow interaction of regional flood events with the local catchments was not considered during this assessment. During the detailed design further assessment would be undertaken to understand the interactions between Macquarie River, Backwater Cowal and the Bogan River.

Further information on the methodology is provided in Technical Report 6.

15.1.2 Legislative and policy context to the assessment

The following legislation, policies and guidelines were taken into consideration as part of the hydrology and flooding assessment:

- *Floodplain Development Manual: the management of flood liable land* (DIPNR, 2005)
- *Floodplain Risk Management Guideline: Practical Consideration of Climate Change* (DECC, 2007)
- *Planning circular: New guideline and changes to section 117 direction and EP&A Regulation on flood prone land* (Department of Planning, 2007)
- *Flood Policy for Developments in Urban Floodplains*, Adopted February 2011 (Narromine Shire Council, 2011)
- *Parkes Shire Local Flood Plan* (SES, 2014a)
- *Narromine Shire Local Flood Plan* (SES, 2014b)
- *Lower Macquarie Groundwater Sources Water Sharing Plan*
- *Lachlan Regulated River Water Sharing Plan*
- *Lachlan Unregulated and Alluvial Water Sources Water Sharing Plan*
- *Macquarie Bogan Unregulated and Alluvial Water Sources Water Sharing Plan*
- *Macquarie and Cudgegong Regulated Rivers Water Sharing Plan.*

Water sharing plans for the Macquarie-Bogan and Lachlan river basins were also considered, with the Lachlan Unregulated and Alluvial Water Sources Water Sharing Plan and the Macquarie Bogan Unregulated and Alluvial Water Sources Water Sharing Plan most relevant in terms of the potential impacts of the proposal.

Flood evacuation planning in the study area is addressed in *Parkes Shire Local Flood Plan* (SES, 2014a) and the *Narromine Shire Local Flood Plan* (SES, 2014b). These documents identify the critical flood conditions in the two LGAs. Additionally, Narromine Shire Council has adopted the *Floodplain Risk Management Plan and Study* (Narromine Shire Council, 2009) and *Flood Policy* (Lyall & Associates, 2010) which guide floodplain risk management in the town of Narromine (to the north of the proposal site). No floodplain risk management study was publically available for the Parkes Shire Council.

15.2 Existing environment

15.2.1 Regional context – river and basin systems

The majority of the proposal site is located within the Macquarie-Bogan River basin. A small portion of the proposal site, between the southern end and about seven kilometres north-west of Parkes, is located within the Lachlan River basin. The location of the boundary between the two basins is shown on Figure 15.1.

At its closest point, the Macquarie River is about 900 metres north of the proposal site near Narromine. The Macquarie River starts south of Bathurst at the junction of the Campbells River and Davies Creek, and travels north-west past the towns of Wellington, Dubbo, and Narromine to the Macquarie Marshes. The Macquarie Marshes drain via the lower Barwon River into the Darling River and the Murray Darling Basin.

The Bogan River is the other major river located within the Macquarie-Bogan River basin. The Bogan River is located about 11 kilometres west of the proposal site, making it a receiving environment rather than a potential contributor to flooding. The Bogan River drains via the lower Barwon River into the Darling River and the Murray Darling Basin.

At its closest point, the Lachlan River is about 27 kilometres metres south of the proposal site. The Lachlan River starts as a chain of lakes formed by the confluence of the Hannans Creek and Mutmutbilly Creek catchments. Travelling west, the river system passes south of Parkes. Ridgey Creek, the closet significant tributary of the Lachlan River, is located about one kilometre east of the proposal site. Goobang Creek, which forms part of the Lachlan River basin, flows through Parkes.

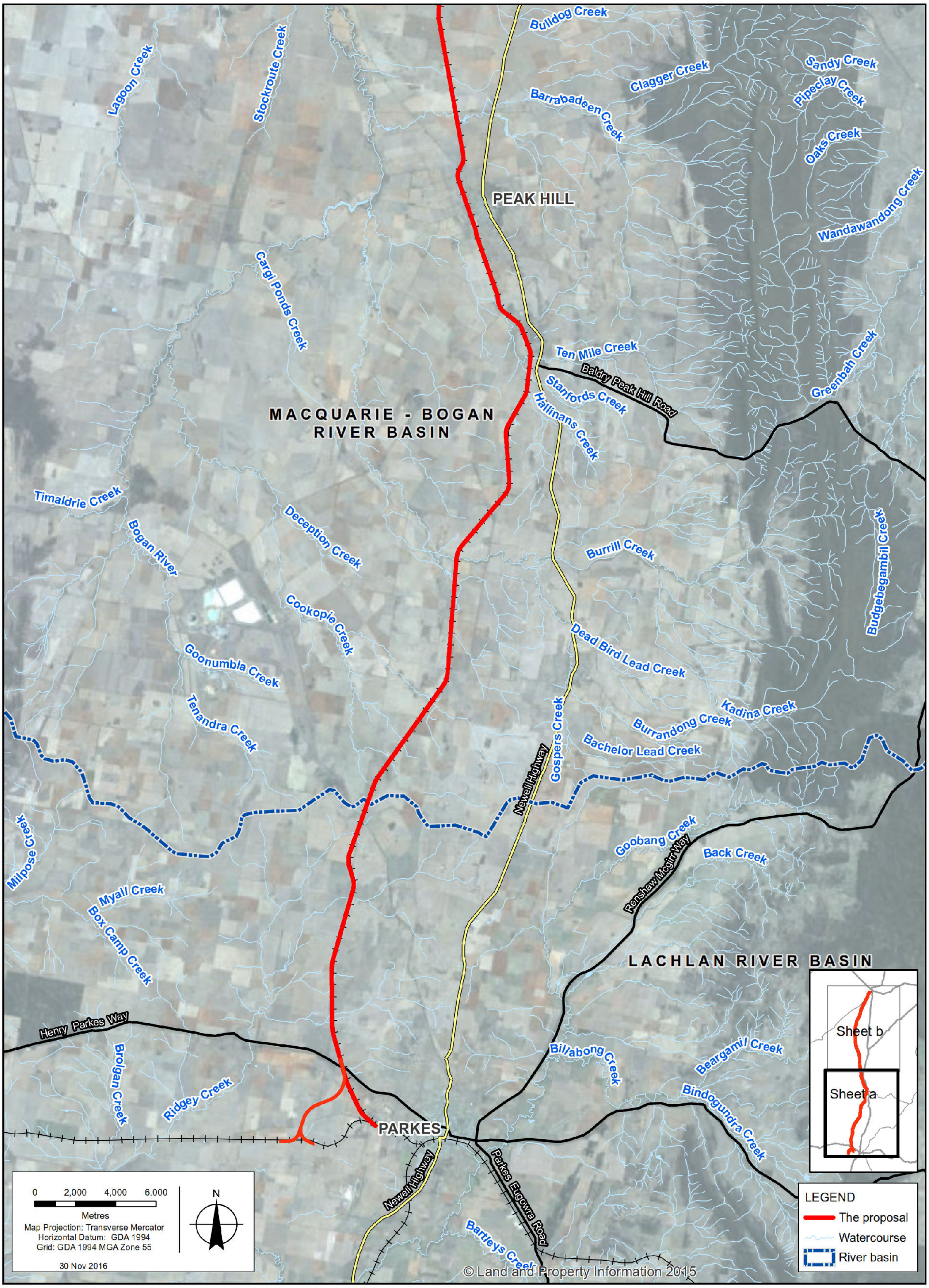
Except during major floods, the Lachlan River terminates in the west as a large, expansive system of wetlands known as the Great Cumbung Swamp. During major floods, the Lachlan River flows into the Murray Darling Basin.

15.2.2 Watercourses

Figure 15.1 shows the watercourses in the vicinity of the proposal site. A total of 15 watercourses of stream order three or above (based on the Strahler stream classification system) cross the proposal site. These are listed in Table 15.1. Further information on these watercourses is provided in Technical Report 6.

Most of these watercourses are in moderate to poor condition as a result of historical disturbances associated with agricultural practices. Reaches of the watercourses in poor condition are typically channelised to improve drainage and limit flood extents. These reaches can also display evidence of ongoing channel erosion.

The existing rail corridor and associated infrastructure has had minor localised impacts on watercourse form. This consists mainly of an increased propensity for scour and erosion immediately downstream of watercourse crossing structures.



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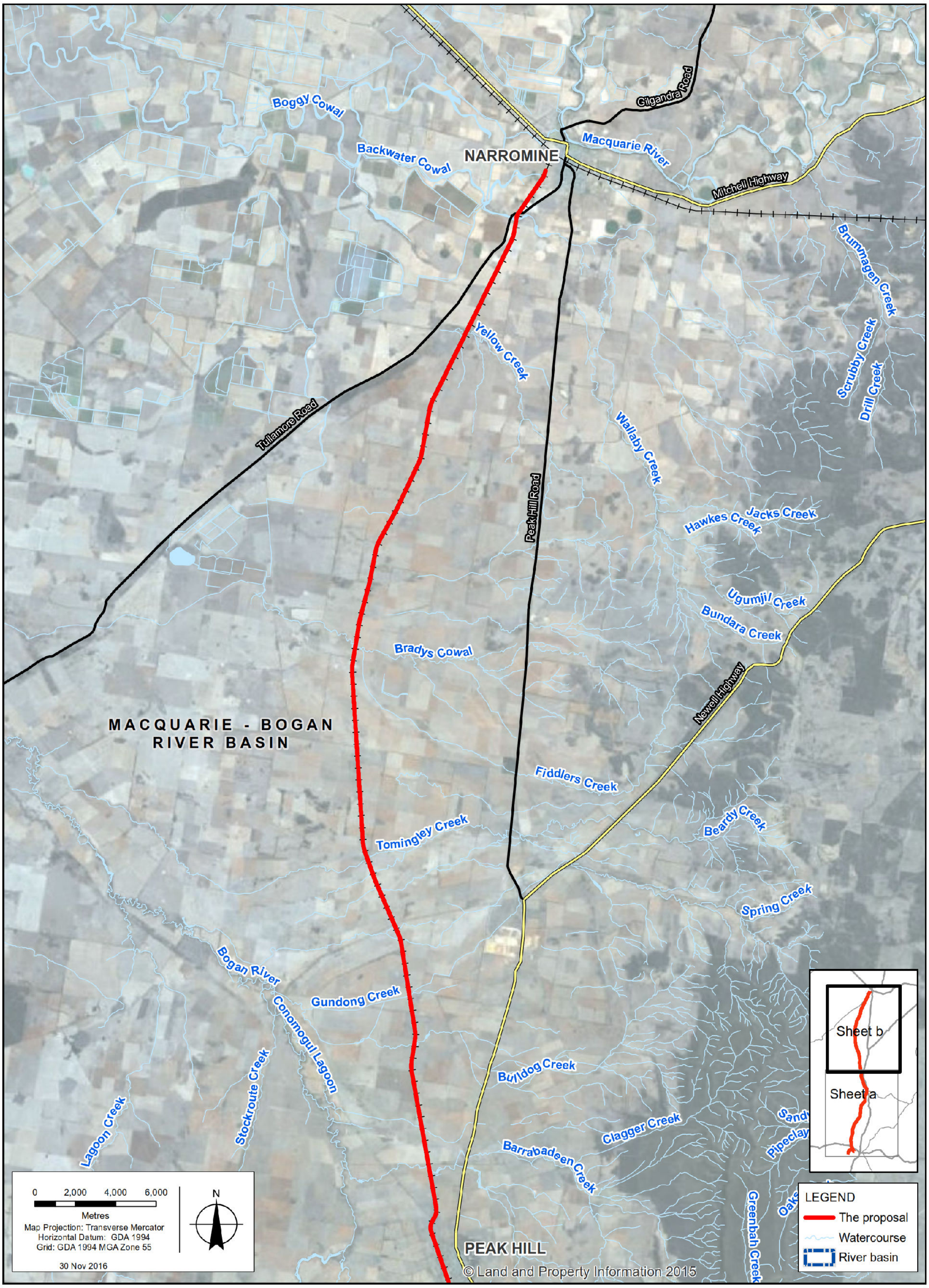
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, DCDB, 2012

Figure 15.1a

River basins and watercourses



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, DCDB, 2012

Figure 15.1b

River basins and watercourses

Table 15.1 Watercourses crossing the proposal site

Catchment	Watercourse	Flow regime	Stream order	Style	Condition
Lachlan	Un-named	Ephemeral	3	Valley fill	Poor
Lachlan	Un-named	Ephemeral	3	Channelised fill	Moderate
Bogan	Un-named	Ephemeral	3	Channelised fill	Moderate
Bogan	Un-named	Ephemeral	3	Valley fill	Moderate
Bogan	Burrill Creek	Ephemeral	5	Low sinuosity fine grained	Good
Bogan	Stanfords Creek	Ephemeral	4	Channelised fill	Poor
Bogan	Ten Mile Creek	Ephemeral	4	Low sinuosity fine grained	Moderate
Bogan	Barrabadeen Creek	Ephemeral	5	Low sinuosity fine grained	Poor
Bogan	Bulldog Creek	Ephemeral	4	Valley fill	Moderate
Bogan	Un-named	Ephemeral	4	Valley fill	Poor
Bogan	Gundong Creek	Ephemeral	4	Channelised fill	Poor
Bogan	Tomingley Creek	Ephemeral	4	Valley fill	Good
Bogan	Brady's Cowal	Ephemeral	4	Low sinuosity fine grained	Moderate
Macquarie	Yellow Creek	Ephemeral	3	Valley fill	Moderate
Macquarie	Backwater Cowal	Ephemeral	5	Valley fill	Moderate

15.2.3 Groundwater

A total of 19 registered groundwater bores are located within 250 metres of the proposal site. The nearest bore is located 25 metres from the proposal site. A number of the identified bores had cancelled licences. Most of the bores (14) are registered for a combination of stock, domestic or irrigation use. Other bores are registered as town water supply (two bores), test bore (one bore), and two bores were unknown.

The majority of the bores are located in the vicinity of Narromine and intercept alluvial sediments associated with Macquarie River. Groundwater levels would be expected to rise and fall depending on rainfall.

To the south of Narromine, the study area is underlain by fractured rock associated with the Lachlan Fold Belt. Groundwater bores intercepting the fractured siltstone and sandstone rock aquifer are deeper than 70 metres below ground level. Groundwater in the fractured rock aquifer is not expected to be present in the vicinity of the ground surface.

Shallow alluvial sediments with a depth of less than 10 to 20 metres below ground level may be intercepted along watercourses. These perched shallow groundwater sources would be recharged by rainfall infiltration, with groundwater levels expected to rise following rainfall events.

15.2.4 Flooding

In general, the study area is characterised by relatively flat land. The existing rail corridor is subject to flooding, which in some locations overtops the rail track and does not comply with ARTC's design requirements for flood immunity. In the Parkes LGA, in which the Parkes north west connection is situated, flooding is reported as occurring in any season and is generally contained within the creek lines and adjacent flat areas.

A summary of the results of the flood modelling undertaken for the assessment is provided below. Further information and full modelling results are provided in Technical Report 6.

Flood planning in the urban area of Narromine is guided by Narromine Shire Council's *Flood Policy for Developments in Urban Floodplains*. This policy is not relevant to rural areas.

Location and extent of overtopping

Rail

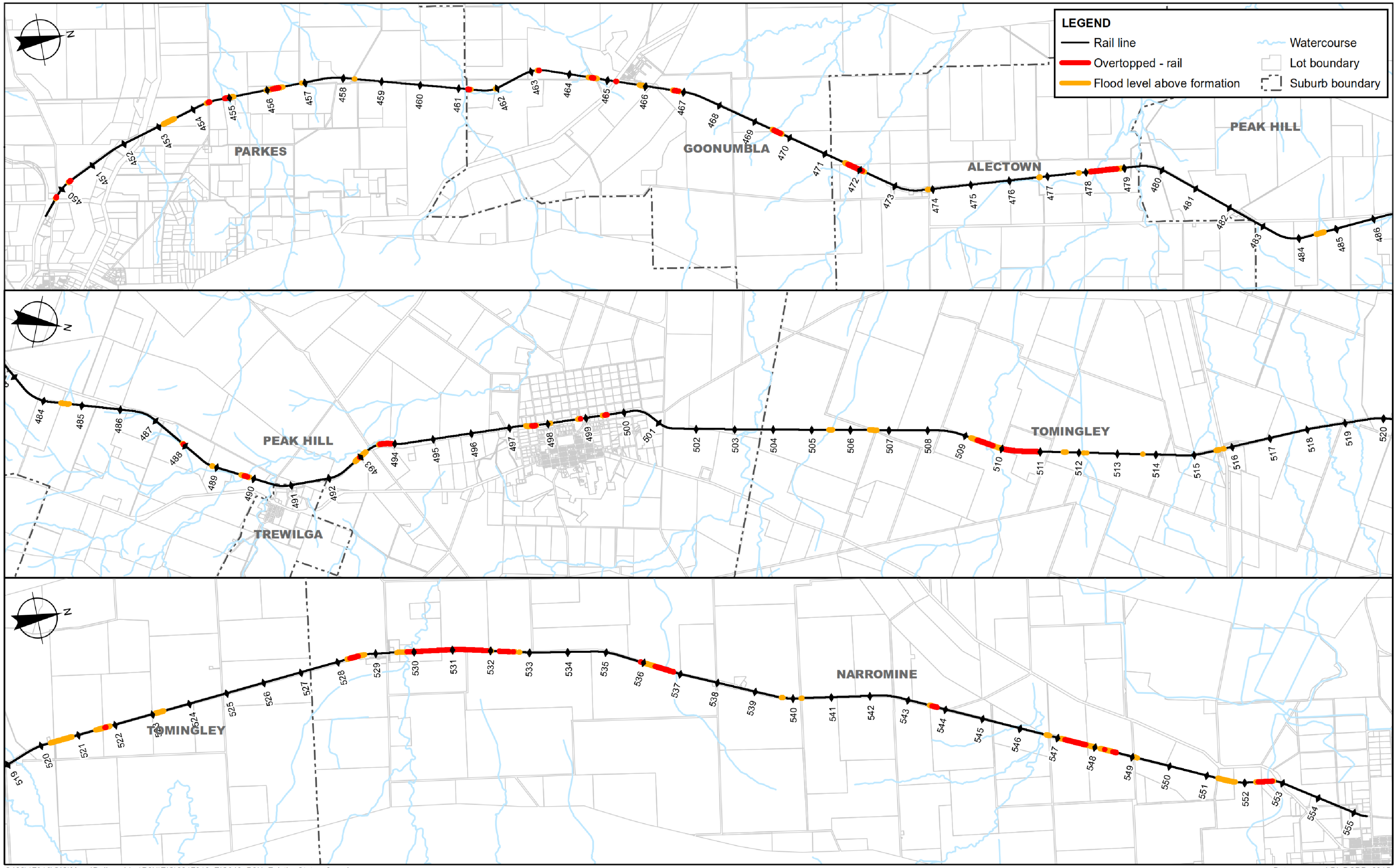
During the maximum modelled flood event, it is predicted that about 7.2 kilometres of the existing rail corridor would be overtopped, and the maximum water depth over the rail level would be 0.5 metres. The predicated overtopping locations along the existing rail corridor for the one per cent AEP event are shown in red on Figure 15.2.

Table 15.2 provides a summary of the length and maximum depth of rail overtopping (where floods rise above the rail level) for a range of modelled flood events. The maximum event modelled was the one per cent AEP flood event – a one per cent AEP means that there is a one in 100 probability of a flood event of that size occurring in any given year (equivalent to a 100 year ARI flood event).

Table 15.2 Summary of overtopping in flood events

Design event (% AEP)	Length of rail overtopping (km)	Maximum overtopping depth (m)
50	0.07	0.22
20	1.04	0.29
10	2.18	0.33
5	3.04	0.40
2	4.76	0.49
1	7.18	0.54

ARTC's technical requirements require that the ballast for the upgraded track needs to be above the modelled one per cent AEP local flood level. Table 15.3 lists the extent of compliance with ARTC's requirements using three different depths of ballast from the top of the rail level to the top of the formation. This is because the depth of the ballast of the existing rail corridor is not accurately known and varies along the length of the rail corridor.



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Data source: LPI, DCDB, 2015.

Figure 15.2
Predicted rail overtopping locations

Table 15.3 Summary of compliance with ARTC requirements

Design event (% AEP)	Length of rail overtopping (km)		
	Assumed 720 mm depth to top formation	Assumed 600 mm depth to top formation	Assumed 400 mm depth to top of formation
50	17.71	13.58	7.79
20	21.01	16.68	9.89
10	22.98	18.37	11.74
5	25.32	21.04	13.92
2	31.67	25.90	18.64
1	35.12	28.37	20.62

As is expected, smaller events result in less overtopping of the rail level, at fewer locations. For the maximum flood event the predicted length of non-compliance with ARTC's requirements ranges from 20.6 to 35.1 kilometres.

Level crossings

The flood modelling indicates that six public level crossings would be overtopped during flood events up to and including the one per cent AEP (listed in Table 15.4).

Table 15.4 Level crossing overtopping

Public level crossing	Level crossing overtopping (m)					
	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Brolgan Road	0.01	0.04	0.04	0.13	0.24	0.29
Back Tradle Road	-	-	-	-	-	-0.03
Wyatts Lane	-	-	-	-	0.29	0.38
Bogan Road	0.04	0.19	0.20	0.21	0.22	0.23
Atwells Lane	-	-	-	0.04	0.08	0.11
Tullamore Road	-	-	-	0.02	0.02	0.02

Roads

Modelling was used to identify locations where public roads in the study area are predicted to be impacted by flooding. The results are summarised in Table 15.5. In total, 355 metres of existing roads are predicted to be flooded, and the maximum water depth is predicted to be about 0.8 metres at Tomingley Road.

These predicted closure locations are in close agreement with information provided by the local State Emergency Services (SES, 2014a and 2014b).

Table 15.5 Road overtopping – existing situation

Road	Maximum depth of overtopping (m)						Maximum length of overtopping (m)
	50% AEP	20 % AEP	10% AEP	5% AEP	2% AEP	1% AEP	
Alectown West Road	0	0.006	0.016	0.026	0.036	0.046	7
Bogan Road	0	0.095	0.105	0.115	0.125	0.135	2
Bulgandramine Road	0.017	0.073	0.083	0.093	0.103	0.113	61
Peak Hill Railway Road	0	0	0	0	0.085	0.085	40
Tomingley Road	0	0	0	0	0.468	0.782	80
Tomingley West Road	0	0	0	0	0.176	0.329	110
Wyanga Road	0	0	0	0.002	0.080	0.136	55
Total							355

Flooding upstream of the existing rail corridor

Flood extents

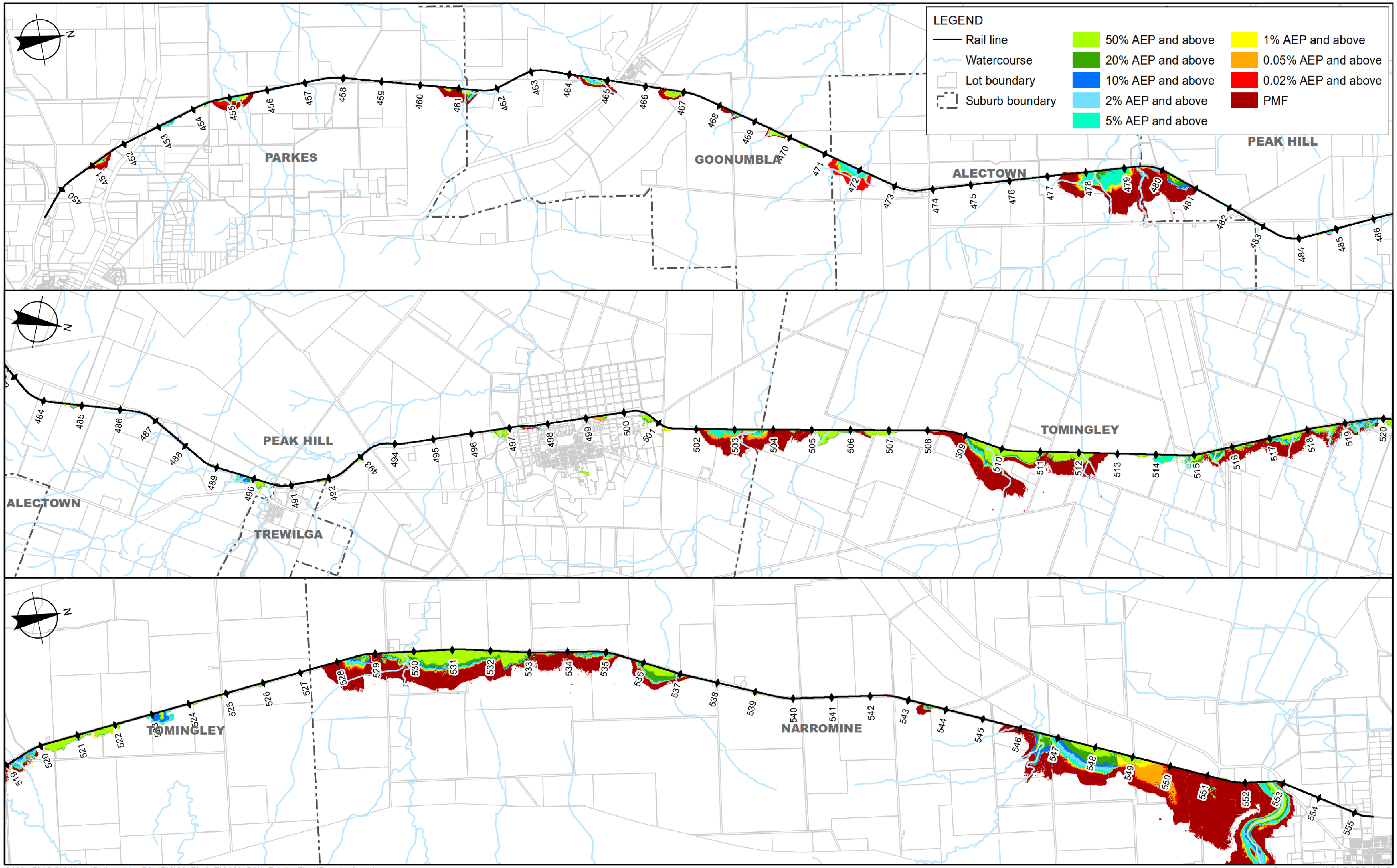
The predicted flood levels for the existing rail corridor were modelled for a range of events as described in section 15.1.1.

Figure 15.3 shows the extent of predicted floods upstream of the existing rail corridor.

Table 15.6 lists the areas of land that would be inundated by events up to the PMF.

Table 15.6 Areas of upstream flooding – existing rail corridor

Design event (% AEP)	Area of inundation (ha)
50	355.9
20	480.1
10	553.3
5	648.2
2	840.0
1	938.0
0.5	1,044.8
0.2	1,146.5
Probable maximum flood	2,720.8



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Data source: LPI, DCDB, 2015.

Figure 15.3
Existing flooding extents

Flood velocities

Flow velocities on the floodplain would generally be low during flood events that do not overtop the existing rail level. There would be a localised increase in velocity immediately upstream of culverts as the water approaches and enters the structure. The approach velocities are not expected to exceed about 1.5 metres per second. The velocity in defined watercourses would be greater than that on broad floodplain areas, and is predicted to be less than two metres per second except in very localised areas. These predicted velocities are not anticipated to result in watercourse instability.

During flood events that overtop the rail level, there would be a progressively larger proportion of the flow that would pass overland than through the culverts. As a result, there would not be a significant increase in the flow velocity over the floodplain areas.

Periods of flooding

The periods/duration of flooding are related to the area of the catchment. It generally takes about nine hours for flood levels to fall to less than 0.1 metres deep at culverts for smaller catchments, and up to 36 hours for larger catchments. Regional flood events, which are typically a result of flooding from major rivers and watercourses after rainfall over a significant portion of catchment, can extend for several days or more.

Flooding downstream of the existing rail corridor

Flood events

In most areas downstream of the existing rail corridor there is expected to be a reduction in flood levels up to the one per cent AEP flood event. There may be localised changes in flood levels immediately downstream of structures, but these are expected to be confined to the existing rail corridor.

Flood velocities

During flood events that do not overtop the existing rail level, the flow downstream of culverts would generally be confined within watercourses.

When floods overtop the rail level (assuming the ballast does not erode), there would be a localised relatively high velocity of flow down the downstream face of the rail track and formation. As the rail level is generally not very high, it is anticipated that the velocity on the face of the track and formation is unlikely to exceed about 2.5 metres per second. This could erode the downstream face of the track and formation.

Historical records show the rail ballast generally fails and washes out, at least for part of the overtopping length, prior to or about the same time as the rail is overtopped. This could result in a flow on the downstream formation of the rail line of up to about two metres per second.

Periods of flooding

Watercourses downstream of the existing rail corridor are likely to be inundated for similar periods to those upstream.

Building impacts

A review of aerial photography indicates that no buildings currently are likely to be impacted by the predicted one per cent AEP flood events.

15.3 Impact assessment

15.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential risks associated with hydrology and flooding. The assessed level for the majority of potential risks was medium to high. Risks with an assessed level of medium or above included:

- impact of flooding on unprotected areas during construction resulting in wash-outs or erosion
- temporary impact to the behaviour of local surface water systems during construction
- presence of or change to structures associated with the proposal could impact upstream and downstream local flood behaviour
- change to structures associated with the proposal and track height could impact upstream and downstream regional flood behaviour
- changes to flow patterns and altered hydrology due to construction in watercourses
- blockages of flow paths affecting low flows through construction within watercourses and through erosion and sedimentation control structures
- sedimentation and changes to geomorphology in watercourses
- impacts on upstream and downstream drainage due to the introduction of structures such as embankments and culverts
- direct and indirect impacts on waterfront land as defined by the *Water Management Act 2000.*

The proposal would impact on flooding in the study area, because it involves raising the height of tracks to provide flood immunity – for the proposal, this is defined as the one per cent AEP flood event. The proposal would form a raised rail level across the floodplain.

How potential impacts would be avoided/minimised

The proposal has been designed to avoid and minimise potential flooding impacts and modifications to surface and groundwater flows. The strategies that have been, and would continue to be, implemented include the following:

- key infrastructure would not be located within the one per cent AEP flood prone areas or where it is not practical to design for a flood immunity greater than one per cent AEP
- culverts would be upgraded to permit an appropriate flow and minimise the potential for adverse flooding impacts, as described in section 7.2.2
- swales would be constructed along the outside edges of the track and formation to minimise the potential for water infiltration into the formation
- culverts would be installed prior to, or concurrent with track works
- standardised culvert shapes have been adopted to facilitate the use of pre-cast structures. This would minimise the amount of works required on site, and therefore the potential impact on watercourses. This would also reduce water usage at the proposal site
- spoil mounds would be designed and located to minimise impacts on flows as they are directed toward culverts or where they discharge from culverts.

15.3.2 Construction impacts - hydrology

Impacts on natural processes within rivers and floodplains

The proposal would require works within and around ephemeral watercourses, including:

- installing erosion protection measures in accordance with the CEMP
- construction of culverts as described in chapter 8
- rehabilitating the disturbed area once works are complete.

If inadequately managed, work in watercourses has the potential to change the flow regime, impact aquatic ecology (considered in chapter 10), and contribute to erosion, sedimentation and water quality impacts (considered in chapter 16).

During construction there is also the potential for works to be impacted by flooding. As described in section 15.3.1, the proposal has been designed to minimise the duration of onsite work in watercourses, which would enable increased flexibility when scheduling works around forecast rain periods.

The potential for impacts would be minimised by implementing the mitigation measures provided in section 15.4 and 16.4.

Impacts on the form and stability of watercourses

Construction of the proposal would result in a small increase in impervious areas (such as construction compounds), which would have the potential to increase the volume of water flowing to watercourses. However, the change in impervious area would be negligible compared to the overall catchment area.

Construction would involve temporary diversions to transfer runoff around worksites. This may involve excavations and embankments that would alter localised flow patterns and impact the stability of surrounding surface watercourses. These changes would be temporary and limited to the construction phase. The landform would be restored as near as practicable to the pre-works condition following construction.

Increases in overland flow, and/or changes to surface water flow patterns, could result in increased erosion and siltation of watercourses in the proposal site, as considered in chapter 16. The majority of watercourses which cross the proposal site are ephemeral and in poor condition, therefore any impacts to surface water hydrology and flow regimes as a result of construction would be limited in extent.

Impacts on natural hydrological attributes and conveyance capacity

Surface water at construction sites would be managed by implementing standard erosion and sediment control measures in accordance with *Managing Urban Stormwater: Soils and Construction* volumes 1 and 2.

Wastewater could result from the following activities/sources:

- use of site amenities at construction compounds
- dewatering of groundwater from excavations
- use of vehicle wash down areas.

Wastewater from site amenities would be removed via vacuum trucks on a regular basis, and would be disposed of in accordance with relevant regulatory requirements.

Wastewater from other construction activities would be initially contained on site to confirm it meets relevant water quality requirements (considered in chapter 16). Discharge of wastewater to surface water would consider the hydrological attributes of the receiving watercourse, including whether the receiving waterway has sufficient flow volume and velocity to incorporate and disperse the potential discharge.

The potential to encounter groundwater during construction is considered below.

Water take from all surface and groundwater sources

As described in chapter 8, water would be required during construction to control dust, compact soil, undertake site concrete works and establish vegetation. Estimated water demand would be in the order of 75 to 100 megalitres. The actual amount of water required at the time of construction would depend on final design details, weather, and the adopted construction methodology.

Likely water sources were identified, subject to the gaining of applicable approvals and access agreements, and there being sufficient water at each site. These water sources include:

- potable water from Parkes and Narromine councils' supplies – five megalitres from each
- groundwater from private bores near chainages 708, 716, 724, 738, 748 and 778 (each within five kilometres of the proposal site) – three megalitres per bore
- recycled/treated water from Parkes North and Peak Hill mines – 10 to 15 megalitres from each mine
- water from private dams near chainages 730, 782 and 798 – 10 megalitres from each dam
- water extracted from various locations along the Macquarie River – 10 megalitres.

Use of water from these sources would be subject to relevant approvals, access agreements, and the amount of water available at the time of construction.

Water extraction from bores could reduce the availability of water to landowners for irrigation and affect surface water and groundwater flow regimes. This impact would be short term, as a number of sources would be used along the length of the proposal site, and water sources would recharge following rainfall.

Groundwater extracted from bores during construction may have a short term impact on flows within the alluvial layer as a result of water used during construction. The lateral extent of impacts would be localised around individual extraction locations, and is unlikely to extend more than about 50 metres from the extraction point. Existing private bores would be used for the extraction of groundwater.

Measures are provided in section 15.4 to minimise the potential impacts of water usage during construction.

Water usage could also increase infiltration rates and surface water runoff in the proposal site. The impact of this additional discharge is expected to be minimal, as the additional flow and infiltration would be negligible compared to regional rainfall levels. Any impacts would be short term. Impacts to water quality are considered in chapter 16.

Excavation would generally not exceed one metre below ground surface and groundwater is unlikely to be encountered during the majority of works. However, there is the potential for shallow groundwater to be encountered during construction of bridges. As the groundwater is likely to be perched and recharged via rainfall, any impacts would be short term.

A residual redirection of alluvial flows may occur around the piers, although this is unlikely to extend more than five metres from individual piers. As a result, this would be a minor, localised impact.

15.3.3 Construction impacts – flooding

Any detrimental increases in the potential flood affectation of properties, assets, and infrastructure

The presence of construction compounds in floodplains has the potential to impact on surrounding properties. The layout of construction work sites and compounds would be prepared with consideration of overland flow paths, avoiding flood liable land where possible to avoid detrimental impacts.

During construction, there is also the potential for works to be impacted by flooding. As described in section 15.3.1, the proposal has been designed to minimise the duration of on-site work in watercourses, which would enable increased flexibility when scheduling works around forecast rain periods.

Soil and water management measures would be implemented in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction Volume 2C* (DECC, 2008), to minimise any potential impacts resulting from flooding during construction. Where possible, construction would be staged to minimise the duration of the works and exposure to wet weather periods.

Beyond the potential impacts described above, the impact of construction on flood behaviour is expected to be negligible compared to regional flood levels and behaviour.

15.3.4 Operation impacts - hydrology

The proposal would impact the hydrology and hydraulics of the study area during operation. This is because the existing rail corridor would be raised across the floodplain, and upgraded structures would be required to enable surface water to flow under the rail formation.

Impacts on natural processes within rivers and floodplains

The proposal would raise the height of the rail formation, which would impact the surface water flows across the floodplain. This would change the upstream flooding regime and result in more concentrated flows through culverts that discharge to downstream watercourses. Raising the formation also has the potential to change the frequency of flow interaction between adjacent catchments upstream of the proposal site.

The proposal could also modify flow paths across floodplains as a result of the installation of replacement of additional culverts and bridges. Changes to such structures could change the pattern of cross drainage from upslope to downslopes areas, which may change the patterns of erosion and scouring within existing watercourses and drainage lines, and within the broader floodplain area. These impacts are likely to be minimal, because the culverts and bridges have been designed to convey flows at rates similar to those for the existing rail corridor. This would minimise surface water redirections or restrictions.

The proposal would have minimal impact on groundwater during operation. Replacing the drainage structures in the proposal site would generally have a beneficial effect on water flow, including groundwater recharge potential. The change in ponding duration upstream of the proposal is not sufficiently long such that it would impact on the infiltration volume of water into groundwater.

Impacts on the form and stability of watercourses

The proposal could result in increases in erosion and siltation and an associated reduction in stability of riverbanks and watercourses, due to increased flood levels and velocities upstream and downstream of culverts and underbridges. The potential for these changes are considered below.

It is predicted that there would be a negligible change in upstream flood velocities with the proposal in place, because the same floodplain processes would apply. Velocities on the floodplain would continue to be low, and would be higher immediately upstream of a culvert. The approach velocities are not expected to exceed 1.5 metres per second.

The upstream velocity in defined watercourses would be larger than that on broad floodplain areas. For these locations, the velocity is predicted to be less than two metres per second, except in very localised areas.

The predicted low velocities are not anticipated to create watercourse instability. It is estimated that the average velocities of flows to the new structures would increase by less than 0.1 metres per second. As a result, the proposal is unlikely to impact on the geomorphology of watercourses upstream of the proposal site.

While upstream velocities are not expected to change appreciably, downstream of the culverts there is the potential for peak flow velocities to increase by between 0.5 and one metre per second, as a result of increased flood levels upstream at some structures.

The increase in water flowing through culverts has the potential to result in erosion and impacts to downstream stream stability. The results of the assessment predict that, without mitigation, these impacts could result in increased erosion and scour at a number of locations downstream of culverts. A rock energy dissipation layer (a rock blanket) is proposed across the full width of culverts to reduce the flow velocity of water exiting the culverts prior to discharging onto the ground. Further modelling would be undertaken during detailed design to confirm the locations and required erosion protection.

Impacts on natural hydrological attributes and conveyance capacity

Surface water during maintenance activities would be managed by implementing standard erosion and sediment control measures in accordance with *Managing Urban Stormwater: Soils and Construction* volumes 1 and 2C.

There are not expected to be any activities undertaken during operation that would generate wastewater requiring discharge.

Water take from all surface and groundwater sources

No water would be required from surface and groundwater sources during operation of the proposal. Any water required during maintenance activities would be trucked to site in accordance with ARTC's existing maintenance procedures.

Maintenance activities are not expected to require excavation to depths at which groundwater may be encountered.

15.3.5 Operational impacts – flooding

Any detrimental increases in the potential flood affectation of other properties, assets and infrastructure

Rail overtopping

Modelling of the potential impacts of the proposal indicates that the length of the rail corridor that would be overtopped in the one per cent AEP event would substantially reduce compared to the existing situation. The predicted length of overtopping would reduce by 94 per cent, from 7,175 metres to 406 metres.

Overtopping locations for the one per cent AEP event are shown in red in Figure 15.4. These locations coincide with the location of level crossings.

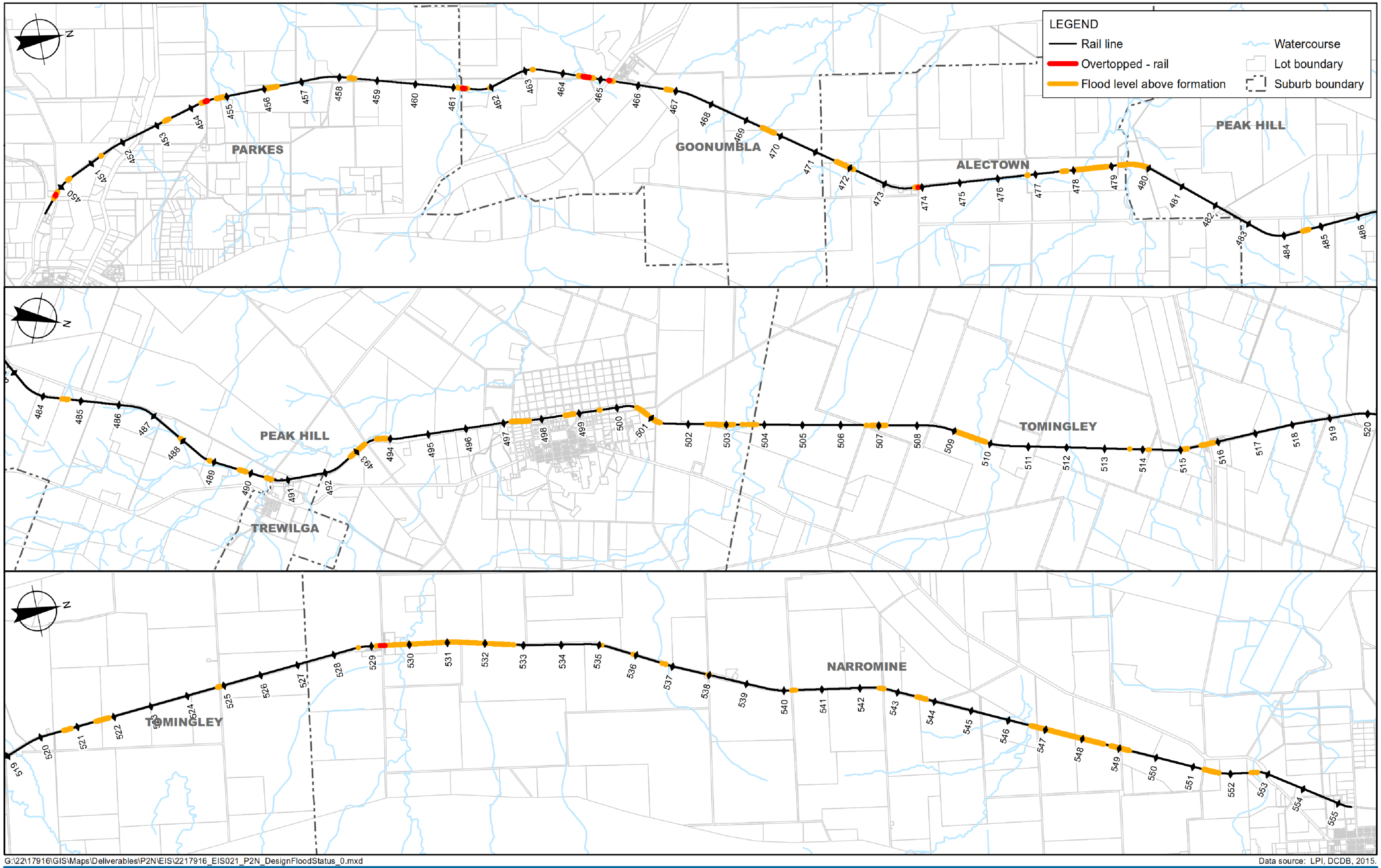

Figure 15.4
Rail overtopping during operation

Public road overtopping

Table 15.7 lists the predicted locations where public roads would be overtopped with the proposal in place. The results indicate that:

- no new roads would be inundated
- the depth of overtopping is similar to the existing situation for most roads
- overtopping of Wyanga Road and Peak Hill Railway Road is predicted to increase in both depth (an increase of 0.51 metres and 0.11 metres, respectively) and length (an increase of 141 metres and 30 metres, respectively), for the one per cent AEP event.

The total length of overtopping during the one per cent AEP flood event would increase by 76 metres. This is considered to be a minor additional impact, as the increase would be limited to only two of the roads that are currently impacted by flooding – Peak Hill Railway Road and Wyanga Road.

Figure 15.5 shows the locations and extent of the predicted locations where public roads would be overtopped for the proposal compared with the existing situation.

Table 15.7 Road overtopping

Road	Maximum depth of overtopping (m)						Maximum length overtopping (m)
	50% AEP	20 % AEP	10% AEP	5% AEP	2% AEP	1% AEP	
Alectown West Road	0	0.01	0.02	0.03	0.04	0.05	7
Bogan Road	0	0.05	0.11	0.12	0.13	0.14	2
Bulgandramine Road	0	0.03	0.08	0.09	0.10	0.11	61
Peak Hill Railway Road	0	0	0	0	0.11	0.20	70
Tomingley Road	0	0	0	0	0	0	0
Tomingley West Road	0	0	0.11	0.31	0.32	0.33	110
Wyanga Road	0	0	0	0.13	0.57	0.65	181
Total							431

Adjacent land impacts – flood extents

Figure 15.6 shows the change in the flooding extents during the one per cent AEP flood event, when compared to the existing situation. Table 15.8 lists the land area that would be impacted by a range of flooding for events compared to the existing situation. With the proposal in place, it is predicted that the area of upstream flooding would:

- reduce for events up to and including the two per cent AEP event
- increase for events exceeding the two per cent AEP event.

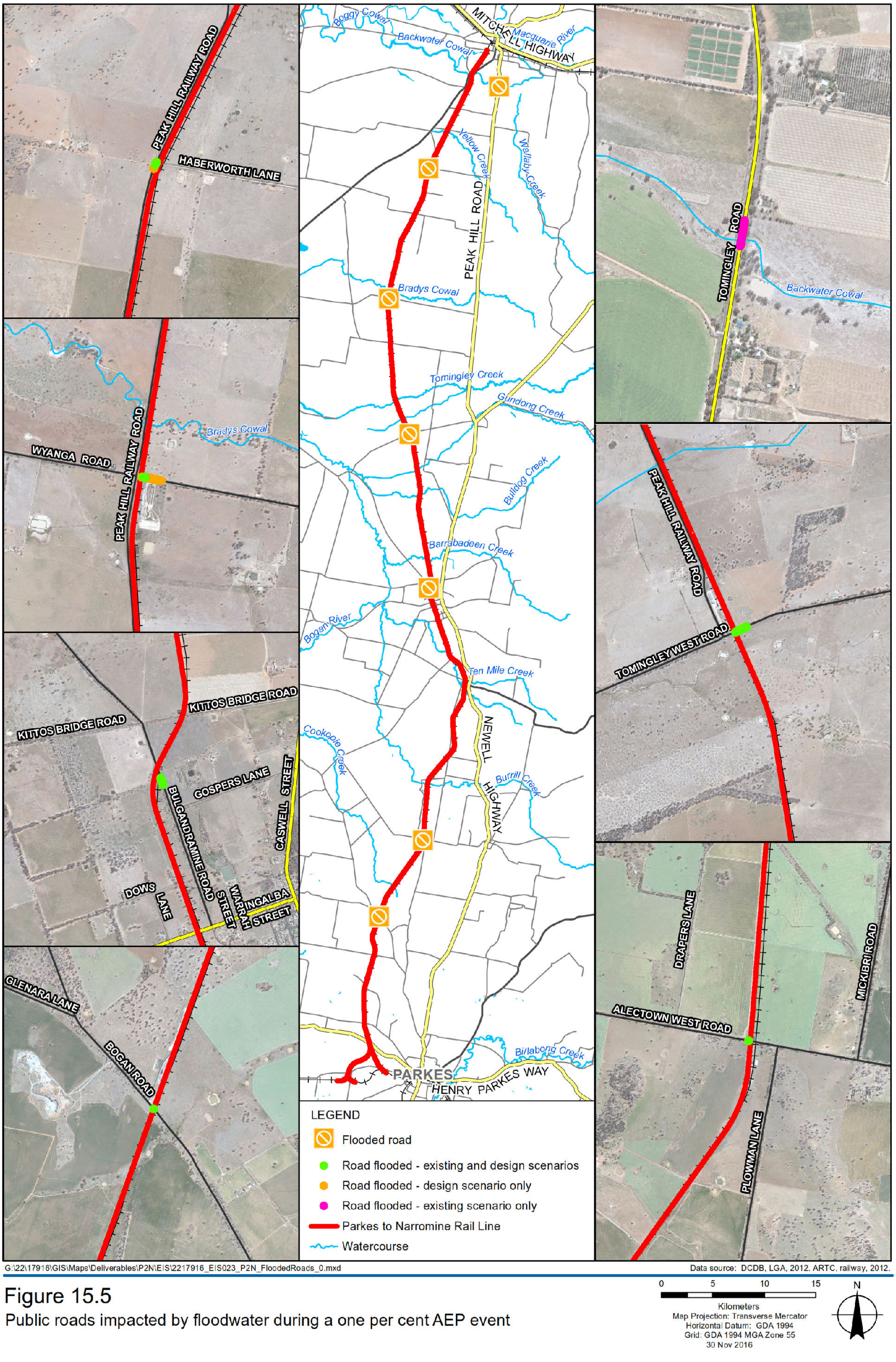

Figure 15.5
Public roads impacted by floodwater during a one per cent AEP event

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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 15.6a
Change in flood extents for the proposal

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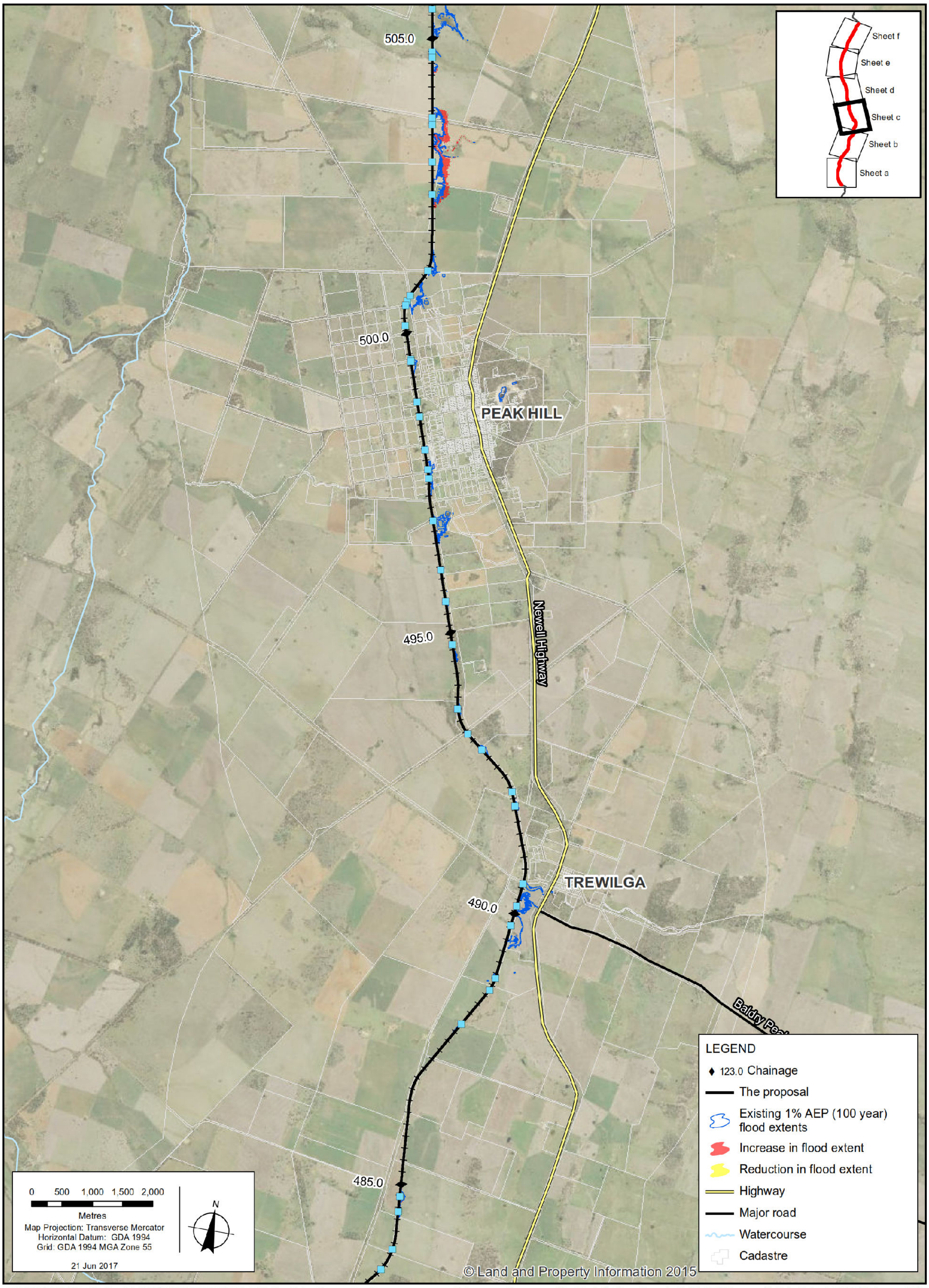
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 15.6b
Change in flood extents for the proposal



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 15.6c
Change in flood extents for the proposal

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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 15.6d
Change in flood extents for the proposal

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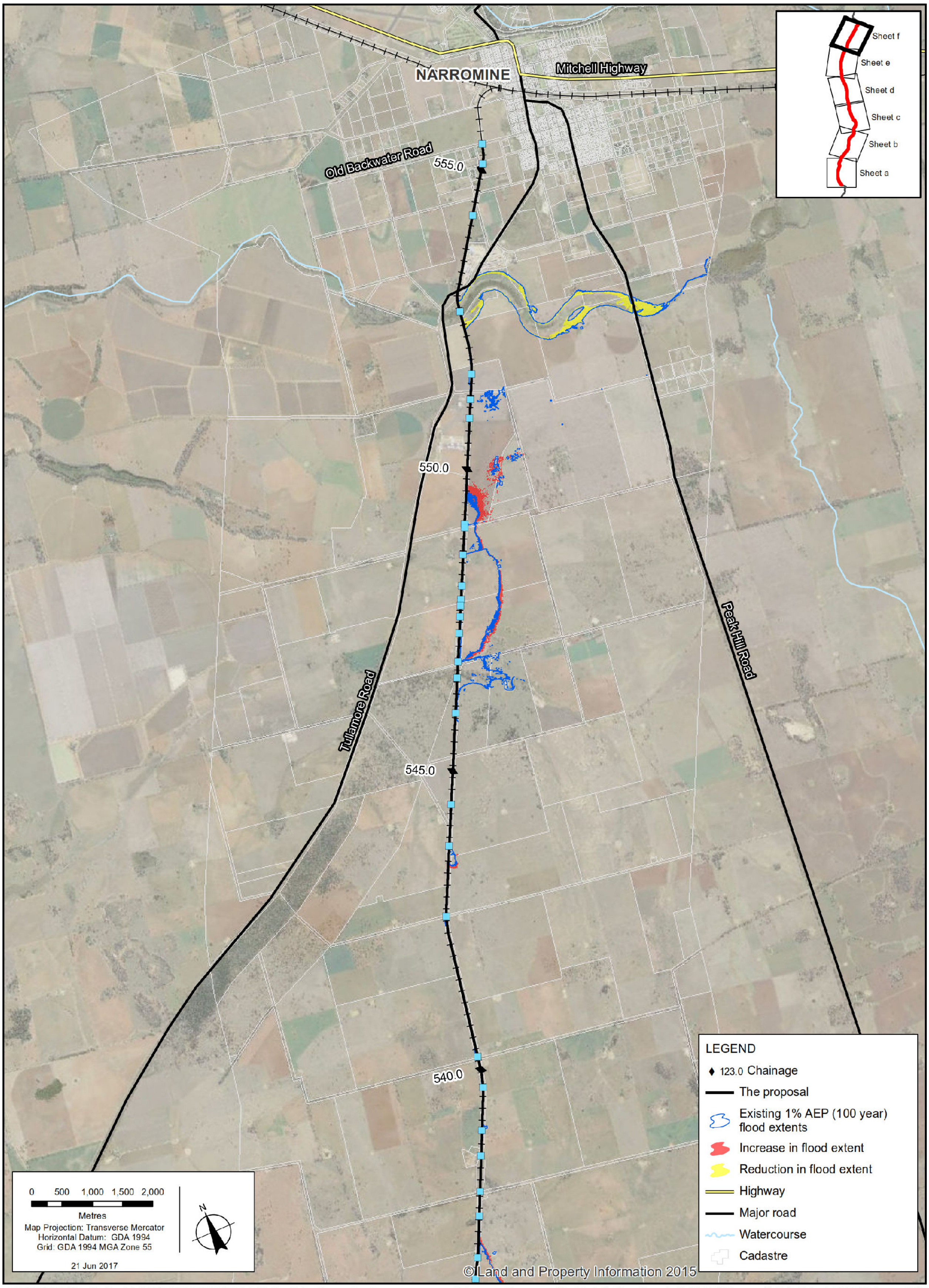
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 15.6e
Change in flood extents for the proposal



G:\22\17916\GIS\Maps\Deliverables\P2N\EIS\2217916_EIS035_P2N_FloodExtentChange_0.mxd

Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 15.6f

Change in flood extents for the proposal

Table 15.8 Areas of upstream flooding

Design event (% AEP)	Area of inundation for the existing rail corridor (ha)	Area of inundation for the proposal (ha)	Change in area of inundation due to the proposal (ha)
50	355.9	242.0	-113.9
20	480.1	363.9	-116.2
10	553.3	454.8	-98.5
5	648.2	579.9	-68.3
2	840.0	821.9	-18.1
1	938.0	1,036.5	98.5
0.5	1,044.8	1,146.2	101.4
0.2	1,146.5	1,283.3	136.8
PMF	2,720.8	3,162.1	441.3

The proposal is predicted to reduce flood levels in most areas downstream of the proposal site for events up to the one per cent AEP event. There may be very localised changes in levels immediately downstream of structures, but these are expected to be confined to the existing rail corridor.

Potential impacts on land use due to the predicted changes in flood extents are described in chapter 20.

Adjacent land impacts - period of flooding

Periods of flooding for local catchment flood events are predicted to be slightly longer than the existing situation. This is because all water runoff for events up to the one per cent event would flow through culverts. However, the increase in size of the culverts relative to the existing structures would mitigate this potential impact. Typically, the increased duration of ponding is likely to be up to about nine hours.

Parkes north west connection

The rail level and culvert sizes for the Parkes north west connection would be consistent with the rest of the proposal site. However, given that this area does not currently contain any rail infrastructure, the resultant change in landform would have an impact on surface hydrology and flood levels. The extent of impact would be further assessed during detailed design and the proposal would be designed to minimise flooding impacts to the adjacent land, as well as changes to surface water flow regimes as the result of drainage structure installation.

Building and property impacts

No buildings are predicted to be inundated for the one per cent AEP flood event with the proposal in place.

Consistency with applicable Council floodplain risk management plans

As described in section 15.1.2 there is a floodplain risk management plan available for the Narromine LGA. However, it only covers the town of Narromine, which is outside the proposal site. No floodplain risk management plan is publically available for the Parkes LGA.

The flooding assessment identified those areas where the proposal is likely to affect the extent and depths of flooding. As generally required by a council's floodplain risk management plan, these changes to flooding responses were considered in terms of impacts to property (including buildings) and access (flooding of public roads). The impacts to property and access were considered by Technical Report 6, as summarised in this chapter.

Compatibility with the flood hazard of the land

Floods can create hazardous conditions, including fast flowing, shallow water, or slow-flowing deep water, in which humans are vulnerable. It is the human interaction with the floodplain and the associated exposure to flood hazards that creates flood risk. Without the human element there would be no risk to the community. Flood hazards can include direct impacts to people (fast currents sweeping them away) or impacts to the built environment, including community infrastructure such as roads and rail.

The proposal site generally passes through rural land, with land uses that are less sensitive to flood hazards. This is because there are less people and infrastructure likely to be impacted. Additionally, the modelling indicates that flood depths and velocities due to the proposal are not expected to appreciably change the existing flood hazard in rural areas, and changes in flood levels are not generally expected to adversely affect flooding of roads.

Compatibility with the hydraulic functions of flow conveyance in flood ways and storage areas of the land

The proposal would generally maintain the location of bridges and culverts, with the capacity of new structures generally exceeding that of the existing structures. Therefore, it is considered that the function of flow conveyance in floodways would be preserved or improved.

The proposal would also generally maintain the existing alignment of the rail line and the location of culverts, and works outside of the corridor would be limited (with the exception of the Parkes north west connection). As a result, the existing areas of flood storage would generally be maintained, albeit with some changes to flood levels and extents (both increases and decreases) at some locations including Parkes north west connection. Overall, the function of flood storage areas is expected to be maintained as a result of the proposal.

Downstream velocity and scour potential

There is predicted to be an increase in the extent of erosion downstream of culverts at around 20 locations, and erosion is likely to extend up to 100 metres downstream of a structure at these locations. Increased erosion could affect flow regimes and water quality. Watercourses located downstream of many culverts already exhibit signs of erosion. Rock protection is proposed immediately downstream of structures to reduce the flow velocity and distribute flow laterally. During detailed design, each location would be reviewed in detail to provide site specific erosion protection to mitigate this potential impact. Visual monitoring would also be undertaken during construction to assess the effectiveness of erosion protection devices, particularly following rainfall, and further measures would be installed if required.

Impacts of flooding on existing emergency management arrangements

Vehicles can become unstable when flood depths on roads exceed 0.3 metres (NSW Government, 2005) leading to road closure. Therefore, emergency management/evacuation arrangements may be impacted where flood depths on roads increase, or where the location of road flooding changes, coinciding with potential community evacuation and emergency management routes.

Comparing the results in Table 15.7 to those for the existing conditions in Table 15.5, it is evident that the proposal would have minimal impact on the closure of potential evacuation and management routes.

Modelling indicates that, during the one per cent AEP event, flood depths could exceed 0.3 metres at two locations – Tomingley West Road and Wyanga Road. For Tomingley West Road there would be no change compared to the existing situation. Tomingley Road is currently closed during existing conditions, so the proposal would improve conditions along this road by making it passable with care during the one per cent AEP event. For Wyanga Road, the proposal would have the potential to cause road closure during the one per cent AEP, which is passable with care during existing conditions.

Conditions at Alectown West Road, Bogan Road, Bulgandramine Road, and Peak Hill Railway Road would stay the same, with those roads remaining passable with care during the one per cent AEP flood event.

It is considered that the overall impact of the proposal on road closures would not impact existing emergency management arrangements.

Ongoing liaison with local councils, Roads and Maritime Services, and emergency services organisations would be undertaken as part of the detailed design phase to identify potential opportunities to improve the impacts of the proposal on road flooding.

Social and economic costs to the community as a consequence of flooding

Given that the increase in flood levels would only occur at areas already subject to flooding, the proposal would not require changes to existing infrastructure or community emergency management arrangements for flooding. As a result, there would not be increased social and/or economic costs to the community as consequence of flooding.

15.4 Mitigation and management

15.4.1 Approach to mitigation and management

As described in section 15.3.1, the proposal would incorporate a number of design features to avoid and/or minimise the potential impacts on flooding and watercourses.

Flood modelling has indicated that, despite the implementation of the design features described in section 15.3.1, there may still be some impacts to watercourses downstream of culverts and land upstream during flood events equal and larger to the one per cent AEP event. Further modelling would be undertaken during detailed design and the design refined such that the proposal would not worsen existing flooding characteristics, where feasible.

Mitigation measures are provided below to mitigate the impacts that are not avoided by the proposal design.

15.4.2 Summary of mitigation measures

To mitigate the potential hydrology and flooding impacts of the proposal, the following measures would be implemented.

Table 15.9 Hydrology and flooding mitigation measures

Stage	Impact/issue	Mitigation measures
Detailed design/ pre-construction	Flooding	The design features listed in section 15.3.1 would continue to be refined to not worsen existing flooding characteristics, where feasible and reasonable, up to and including the one per cent AEP event. Detailed flood modelling would consider potential changes to: ▸ upstream flood extents ▸ level crossing and road flood levels and extent ▸ overland flow paths and storage effects due to spoil mounds and other proposal infrastructure

Stage	Impact/issue	Mitigation measures
		▸ flood evacuation routes Flood modelling to support detailed design would be carried out in accordance with the guidelines listed in section 15.1.2.
		Flood modelling and mitigation would consider future floodplain risk management plans, and would be undertaken in consultation with the relevant local council, the Office of Environment and Heritage, and State Emergency Services.
	Downstream watercourse stability	Further modelling would be undertaken during detailed design to confirm the locations downstream of culverts that require erosion protection, and the extent and type of protection required.
	Emergency responses	Where feasible, facilities and routes identified as being critical to emergency response operations would be protected from the probable maximum flood level.
	Water usage (private bores and surface water)	Detailed design and construction planning would aim to minimise the use of potable water during construction. Appropriate sources for construction water would be determined prior to construction in consultation with relevant stakeholders, and appropriate approvals and agreements would be sought for the extraction of water.
Construction	Flooding	Construction planning and the layout of construction work sites and compounds would be carried out with consideration of overland flow paths and flood risk, avoiding flood liable land and flood events where possible.
	Water usage (private bores and surface water)	Monitoring would be undertaken during extraction to ensure volumes stipulated by license requirements and/or private landholder agreements are not exceeded.

16. Water quality

This chapter provides a summary of the water quality impact assessment of the proposal. It describes the existing environment, assesses the impacts of construction and operation, and provides recommended mitigation measures. The full assessment report is provided as Technical Report 7.

16.1 Assessment approach

16.1.1 Methodology

A qualitative water quality assessment was undertaken, involving:

- reviewing design information
- reviewing existing conditions using GIS mapping to identify locations of sensitive receiving environments, such as channels, watercourses, wetlands, national parks, conservation areas, and nature reserves
- identifying water quality objectives for the catchments in which the proposal site is located from the *NSW Water Quality and River Flow Objectives* website
- reviewing the existing and the proposed corridor hydrological conditions (described in chapter 15) to identify risks to water quality that are related to hydrology
- assessing the potential impacts of the proposal on water quality
- identifying measures that could be used to mitigate the impact of construction and operation.

16.1.2 Legislative and policy context to the assessment

The main NSW legislation relevant to water quality are the POEO Act, the *Water Management Act* 2000 and the *Water Act 1912*.

Section 120 of the POEO Act prohibits the pollution of waters by any person. Under section 122, the holding of an environment protection licence is a defence against accidental pollution of watercourses. The Act permits (but does not require) an EPL to be obtained for a non-scheduled activity for the purpose of regulating water pollution resulting from that activity. As noted in section 3.4.3, ARTC holds an EPL to carry out railway systems activities on certain parts of the NSW rail network. With respect to water quality, the licence requires ARTC to comply with section 120 of the POEO Act.

The *Water Management Act 2000* and *Water Act 1912* control the extraction of water, the use of water, the construction of works such as dames and weirs, and the carrying out of activities in or near water sources in NSW. The provisions of the *Water Management Act 2000* are being progressively implemented to replace the *Water Act 1912*.

The area in which the proposal site is located is subject to the water sharing plan for the *Lachlan Unregulated and Alluvial Water Sources*. This is a statutory instrument made under section 50 of the *Water Management Act 2000*, which includes rules for protecting the environment, water extractions, managing licence holders' water accounts, and water trading in the plan area.

As the proposal is State significant infrastructure, an activity approval is not required to undertake works in or near waterfront land (described in section 3.4). However, the design and construction of the proposal would take into account the Office of Water's *Guidelines for Controlled Activities on Waterfront Land*.

The *NSW Aquifer Interference Policy* (NSW Office of Water, 2012) explains the water licensing and impact assessment processes for aquifer interference activities under the *Water Management Act 2000* and other relevant legislation. Further information is provided in section 3.4.

The *National Water Quality Management Strategy* is a nationally agreed set of policies, processes, and 21 guidelines documents developed jointly by the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC). The strategy establishes objectives to achieve sustainable use of the nation's water resources by protecting and enhancing their quality. The strategy contains healthy river guidelines for the protection of lowland river aquatic ecosystems.

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (known as the ANZECC 2000 guidelines) (ANZECC/ARMCANZ, 2000a) forms part of the strategy. This document sets water quality guidelines (numerical concentration limits or descriptive statements) for a range of ecosystem types, water uses (environmental values), and water quality indicators for Australian waters.

In 2006, water quality and river flow objectives were developed for 31 river catchments in NSW based on the ANZECC 2000 guidelines. The objectives (the *NSW Water Quality and River Flow Objectives*) are the agreed environmental values and long-term goals for NSW's surface water receptors. Guidance to using the ANZECC 2000 guidelines and the NSW water quality objectives is provided by *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006d).

16.2 Existing environment

16.2.1 Catchments and water quality

The majority of the proposal site is located within the Macquarie-Bogan River basin. A small portion of the proposal site, between the southern end and about seven kilometres north-west of Parkes, is located within the Lachlan River basin.

A total of 15 ephemeral watercourses with a stream order of three or above cross the proposal site. Flow occurs in these watercourses during and after rainfall events, and the watercourses dry out between rainfall events.

Further information on the existing hydrological environment is provided in section 15.2.

16.2.2 Existing water quality

There is no existing water quality data for the watercourses crossing the proposal site. No data has been collected as part of this assessment due to the ephemeral nature of the watercourses.

The *National Water Quality Assessment 2011* (SKM, 2011) classified the water quality of the Lachlan and Macquarie-Bogan river catchments as being relatively poor (refer to Table 16.1), exceeding the ANZECC 2000 guidelines for a number of criteria. This was based on data from 15 sites in the Lachlan River catchment and 17 sites in the Macquarie-Bogan River catchment. The *2015 NSW State of the Environment report* (EPA, 2015b) indicates that, for monitored watercourses in the central western region, there was a reduction in electrical conductivity values between 2011–12 and 2014–15, and a reduction in *Escherichia coli* bacterium (E. coli) counts between 2012–13 and 2014–15.

Table 16.1 Existing water quality data

Parameter	Lachlan River catchment	Macquarie-Bogan river catchment
Turbidity	Fair - 31% of samples exceeded guideline values	Good - 76% of samples complied with ANZECC 2000 guideline values
Salinity	Fair - 50% of samples exceeded guideline values	Poor - Range 92-1,140 µS/cm
pH	Good - 85% of samples within catchment within guideline values	Fair

Parameter	Lachlan River catchment	Macquarie-Bogan river catchment
Total nitrogen	Very poor - 96% of samples did not meet guideline values Median values at sites ranged from 456-860 µg/L	Very poor - Median values at sites ranged from 370-1,1200 µg/L
Total phosphorus	Poor - 72% of samples did not meet guideline values Median values at sites ranged from 12-83 µg/L	Very poor - Median values at sites ranged from 21-154 µg/L

16.2.3 Water quality objectives and criteria

The *NSW Water Quality and River Flow Objectives* provides water quality objectives for the Macquarie-Bogan and Lachlan river catchments, for the protection of:

- aquatic ecosystems
- visual amenity
- primary contact recreation
- secondary contact recreation
- livestock water supply
- irrigation water supply
- homestead water supply.

The water quality objective for aquatic ecosystems is to 'maintain or improve the ecological condition of waterbodies and their riparian zones over the long term'. The indicators and criteria (trigger values) for this objective are listed in Table 16.2. These are based on the ANZECC 2000 guideline default trigger values for the protection of aquatic ecosystems in slightly disturbed river ecosystems in south-eastern Australia.

Table 16.2 Trigger values for water quality parameters

Indicator	Criteria (lowland rivers)
Total phosphorus	50 µg/L
Total nitrogen	500 µg/L
Chlorophyll-a	5 g/L
Turbidity	6−50 NTU
Salinity (electrical conductivity)	125−2,200 µS/cm
Dissolved oxygen (per cent saturation)	85−110 %
pH	6.5−8.5
Oils and petroleum hydrocarbons	Insufficient data to give trigger value although the EPL is likely to require no visible oils or sheen in discharge water

A detailed list of the indicators and criteria for the other water quality objectives for the Lachlan and Macquarie-Bogan catchments is provided in Technical Report 7. The drinking water objectives were not considered due to the predominantly rural land use in the study area and the potential for water to be extracted for multiple uses. Drinking water objectives apply to all current and future licensed offtake points for town water supply, and to specific sections of rivers that contribute to drinking water storages or immediately upstream of town water supply offtake points. The objectives also apply to sub-catchments or groundwater used for town water supplies. No drinking water supply points were identified within the proposal site.

The Macquarie-Bogan River and Lachlan River catchments contain the following environmental values (DPI (Water), 2017):

- the Ramsar listed Macquarie Marshes, which is an important ecological site located about 200 kilometres downstream of Narromine in the Macquarie-Bogan River catchment
- nine wetlands, which are featured in the Directory of Important Wetlands In Australia, including Lake Cowal, Lake Brewster, Booligal wetlands and Great Cumbung Swamp (Lachlan River catchment). None of these wetlands are located within 100 kilometres of the proposal site.

16.3 Impact assessment

16.3.1 Risk assessment

Sensitive receiving environments

A sensitive receiving environment is one that has a high conservation value, or supports human uses of water that are particularly sensitive to degraded water quality (DECC, 2008). With regard to the potential impacts of the proposal, sensitive receiving environments are considered to include:

- nationally important wetlands
- National parks, nature reserves and state conservations areas
- threatened ecological communities associated with aquatic ecosystems
- known and potential habitats for threatened fish
- key fish habitats
- recreational swimming areas
- areas that contribute to drinking water catchments.

The watercourses in the proposal site are ephemeral and do not contain any significant sensitive environments. However, as described in chapter 10, a number of rivers and creeks that cross the proposal site, including Burril Creek, Ten Mile Creek, and Bradys Cowal, are key fish habitats, and a number of threatened species have been identified. Additionally, the watercourses in the proposal site are within the catchments of the Lachlan, Macquarie and Bogan rivers. These catchments are sensitive receiving environments that contain the environmental values described in section 16.2.3.

The design control measures considered in this section, and the mitigation measures provided in section 16.4, have been developed to protect the identified sensitive receiving environments and their associated environmental values, where relevant to the proposal.

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential risks to water quality associated with the construction and operation of the proposal. The assessed level for the majority of potential water quality risks was medium to high. Risks with an assessed level of medium or above include:

- reduced water quality (including increased total suspended solids and turbidity) as a result of erosion and sedimentation near watercourses
- contamination due to spills and leaks
- impacts on groundwater quality and quantity during drawdown/extraction
- modification to existing drainage infrastructure resulting in water quality impacts
- impact to surface water quality and receiving environments due to increased runoff from impervious areas.

How potential impacts would be avoided and minimised

As the watercourses crossing the proposal site are ephemeral the main potential for impacts would occur during and following rainfall events. Potential impacts on water quality would be minimised by managing water quality in accordance with the requirements of the POEO Act and the environment protection licence for the proposal.

Potential impacts that are unable to be avoided would be minimised by designing, constructing, and operating the proposal so that potential impacts on hydrology are minimised, which in turn mitigates the potential for water quality to be impacted by increases in sediment loads in runoff.

This would include the following:

- designing flow discharge points (structures) to include erosion controls, such as rock protection, to slow flow velocities and minimise the risk of erosion as surface water enter and exits the structure
- designing culverts to have a minimal impact on existing surface flow paths across the proposal route
- locating structures in positions that are natural low points along the proposal site to avoid creating new water storage areas and facilitate fish passage
- incorporating protection measures, such as sedimentation basins, water quality ponds, and spill basins as required
- designing batters and retaining structures using appropriate slope gradients to minimise erosion, or using terracing
- design of ballast drainage to discharge to suitable outlets and control points
- selection of fill material for embankments to minimise the risk of erosion.

The design of the proposal has taken into account the requirements of relevant water sharing plans by:

- including culverts that would minimise the need for excavation and potential shallow aquifer interaction
- restricting the potential amount of water extraction for construction purposes (described in section 15.3.2).

Implementing the water quality mitigation measures provided in section 16.4.3 would also minimise the potential for water quality impacts. These measures would minimise the potential impacts on relevant water sharing plans (listed in 16.1.2).

Implementation of the design control measures identified above and the water quality measures provided in section 16.4.3 would enable the proposal to be designed, constructed, and operated to avoid or minimise water pollution, and protect human health and the environment.

16.3.2 Construction impacts

Potential water quality impacts

Construction presents a risk to downstream water quality if management measures are not implemented, monitored, and maintained throughout the construction period. If inadequately managed, construction activities can impact water quality if they disturb soil or watercourses, result in the uncontrolled discharges of substances to watercourses, or generate contamination.

Potential sources of water quality impacts include:

- increased sediment loads from exposed soil transported off-site to downstream watercourses during rainfall events
- increased sediment loads from discharge of sediment laden water from dewatering of excavations
- increased levels of nutrients, metals and other pollutants, transported in sediments to downstream watercourses or via discharge of water to watercourses
- chemicals, oils, grease and petroleum hydrocarbon spills from construction machinery directly polluting downstream watercourses
- litter from construction activities polluting downstream watercourses
- contamination of watercourses due to runoff from contaminated land.

The downstream effects of water quality impacts include:

- smothering aquatic life and/or inhibiting photosynthesis conditions for aquatic and riparian flora
- impacts to breeding and spawning conditions of aquatic fauna
- changes to water temperature due to reduced light penetration
- impacts to the ecosystems of downstream sensitive watercourses, wetlands and floodplains
- increased turbidity levels above the design levels of water treatment infrastructure
- reduced visibility in recreation areas.

The potential for soil and contamination impacts during construction are considered in chapter 14. Waste management impacts and mitigation measures are considered in chapter 24. The main potential sources of water quality impacts for the proposal are considered in the following sections.

Changes to surface water flows

Changes to surface water flows can impact water quality – an increase in flow rate and volume can lead to increased erosion and turbidity. The potential impacts of changes to surface water flows are considered in chapter 15.

Works in watercourses

The proposal involves works in watercourses to upgrade culverts and undertake track works. These works would disturb bed and bank substrates, and potentially lead to localised erosion and sediment transport downstream. As described in section 15.3.1, the proposal includes a number of design features, particularly in relation to culvert upgrades, to minimise the potential for impacts to watercourses and therefore water quality. This includes the use of pre-fabricated concrete culverts to minimise the extent of disturbance to watercourses.

Earthworks, stockpiling, and general runoff from construction sites

Excavations and the construction of embankments can impact water quality in downstream watercourses as a result of erosion. Runoff from stockpiles has the potential to impact downstream water quality during rainfall if the stockpiles are not managed appropriately. Sediments from the stockpiles could wash into watercourses, increasing levels of turbidity. This in turn could have the following impacts on human health and the environment:

- reduce the aesthetic quality of receiving watercourses
- harm fish and other aquatic life by reducing food supplies, affecting gill function and degrading spawning beds
- reduce light penetration and visibility
- increase surface water temperature.

Stockpiling cleared vegetation creates a risk of tannins leaching into watercourses, resulting in an increased organic load. Discharge of water high in tannins can increase the biological oxygen demand of the receiving environment, which may in turn result in a decrease in available dissolved oxygen. Once discharged to the environment, tannins may also reduce visibility, light penetration, and change the pH of receiving waters. These impacts may affect aquatic ecosystems in receiving environments.

Sediment loads in watercourses can increase in the vicinity of hard surfaces (such as roads) and compacted areas (such as construction laydown sites) due to increased surface runoff.

The mitigation measures provided in sections 13.4 and 16.4 would be implemented to minimise the potential for water quality impacts as a result of earthworks, stockpiling, and general runoff from construction sites. In general, with implementation of the mitigation measures provided, water quality impacts due to construction runoff would be negligible when compared to runoff from surrounding agricultural properties following a regional rainfall event.

Pollutant laden runoff or discharge to surface water

Identify and estimate the quality and quantity of all pollutants

In addition to the above, the proposal has the potential to introduce the following pollutants to surrounding watercourses:

- nitrogen and phosphorous – due to use of pesticides and herbicides for weed control
- chemicals, oils, grease, and petroleum hydrocarbons – due to any leaks and spills during construction or the discharge of water from vehicle wash down areas.

By implementing management measures provided in the CEMP, pollutant runoff due to leaks and spills and weed control would be minimal, and would be unlikely to cause long-term harm to human health or the environment.

The exact volume of discharge water and discharge points would be identified prior to construction. Discharge points would take into consideration the hydrological attributes of the receiving watercourse, including whether there is sufficient flow volume and velocity to incorporate the discharge volume.

Maintaining or achieving the water quality objectives

The water quality objectives and their relevance to the proposal are defined in Technical Report 7 (Table 2-2) for both the Lachlan and Macquarie-Bogan river systems, and are summarised in Table 16.2 for those pollutants that the proposal may introduce into the water cycle.

As described in section 16.2 the existing water quality is poor and generally does not meet the water quality objectives provided in Table 16.2. The poor quality is likely to reflect existing soil conditions and agricultural land use practices in the area surrounding the proposal site.

The majority of watercourses in the study area are ephemeral, and agricultural land uses dominate the study area. Therefore, it is considered unlikely that construction and operation of the proposal would have a significant influence on water quality in surrounding watercourses. Any water quality impacts would be short-term only.

However, the proposal would be constructed and operated in accordance with the relevant EPLs. This would mean that any discharge water would meet the water quality objectives provided in Table 16.2 and would be of better quality then that in the surrounding watercourses.

Construction and operation would also be undertaken in accordance with the management measures provided in section 16.4, which would minimise the potential for the proposal to reduce the quality of water in the surrounding watercourses.

Additionally, the proposal (particularly the proposed replacement of culverts and raising of track formation to greater than the level of the one per cent AEP catchment flood event) would mean that flow in watercourses is generally maintained and, with suitable erosion and scour protection measures, potential erosion downstream from culverts would be generally reduced. This would have a beneficial impact on water quality in the study area, with the quality of water more likely to meet the relevant objectives. Implementation of the design control measures identified in section 16.3.1 would not prevent or hinder the development or implementation of any future strategies that may assist in meeting overall water quality objectives for the catchments over the long term.

Groundwater quality

As existing groundwater is predominately perched and recharged by rainfall infiltration (described in section 15.2.3), the volumes of dewatering are likely to be minimal, resulting in minimal long term impacts. Potential risks to groundwater quality from changes to surface water include:

- contamination by hydrocarbons from accidental fuel and chemical spills
- contaminants contained in turbid runoff from unpaved surfaces.

Surface water from site runoff may infiltrate and impact groundwater sources. As the infiltration process is generally effective in filtering polluting particles and sediment, the risk of contamination of groundwater from any pollutants bound in particulate form in surface water, such as heavy metals, is generally low.

Soluble pollutants, such as pH altering solutes, salts and nitrates, as well as soluble hydrocarbons, can infiltrate soils and contaminate the groundwater system. Under certain pH conditions, metals may also become soluble and could infiltrate groundwater.

The mitigation measures provided in section 16.4 would be implemented to minimise the potential for groundwater quality impacts.

16.3.3 Operation impacts

Potential water quality impacts during operation could occur as a result of changes to hydrology or contamination of runoff. The release of toxicants and litter into watercourses during operation (including during maintenance activities) has the potential to impact on surface water quality and consequently on aquatic ecosystems. This also has the potential to impact on other water quality objectives by reducing visual and recreational amenity. During operation, the main risk to surface water from the release of pollutants is from spills or the release of litter and toxicants such as heavy metals, petroleum hydrocarbons and PAHs from vehicles, surface run-off from tracks, and maintenance of rail vehicles. The potential for contamination impacts as a result of accidental spills during operation is considered in section 14.3.3.

The watercourses crossed by the proposal are all moderately disturbed as a result of existing land use practices, and any contribution of contaminants due to surface runoff from the proposal is anticipated to be minimal.

During operation, surface water runoff would be controlled through a drainage system that connects to cross drainage infrastructure at existing drainage lines and watercourses. The drainage system would include scour protection at culvert outlets to minimise the potential for scouring and erosion. Where appropriate, culvert outlets would be lined to minimise scouring.

As described in section 15.3.4, without mitigation, the increase in water flowing through culverts has the potential to result in erosion in some locations. Further modelling would be undertaken during detailed design to confirm the locations and required erosion protection.

16.4 Mitigation and management

16.4.1 Approach to mitigation and management

The main risks to water quality are associated with erosion and sedimentation, and works within ephemeral watercourses. The soil and water management sub-plan prepared as part of the CEMP would include management measures that are commonly implemented during construction of linear infrastructure projects to manage issues associated with erosion and sedimentation that have the potential to impact on water quality. The soil and water management plan would be prepared and implemented in accordance with *Soils and Construction - Managing Urban Stormwater Volume 1* (Landcom 2004) and Volume 2C (DECC 2008). In accordance with these publications management measures would be designed to cope with a ten per cent AEP rainfall event.

Where discharge to surface watercourses is required, a monitoring program would be developed and implemented to assess water quality prior to discharge. Due to the ephemeral nature of the majority of the watercourses discharge to, and monitoring of, surface water would consider the hydrological attributes of the receiving watercourse.

During operation, water quality would be managed to comply with the operational environmental protection licence for the proposal.

16.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to control impacts on water quality may overlap with mitigation measures proposed for the control of soil and contamination, hydrology and flooding, health and safety, waste management impacts.

All mitigation measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

16.4.3 Summary of mitigation measures

In addition to the measures provided to manage the potential for soil and contamination impacts (in section 14.4), the following measures would be implemented.

Table 16.3 Water quality mitigation measures

Stage	Impact/issue	Mitigation measures
Detailed design/ pre-construction	Water quality	The design features listed in section 16.3.1 would continue to be refined and implemented to minimise the potential impacts of the proposal on water quality.
	Surface water monitoring framework	A surface water monitoring framework would be developed and implemented, to monitor water quality at discharge points and selected locations in watercourses where works are being undertaken. The framework would include the relevant water quality objectives, parameters, and criteria from Technical Report 7, and specific monitoring locations which have been identified based on the hydrological attributes of the receiving watercourse, in consultation with DPI (Water) and the EPA.

Stage	Impact/issue	Mitigation measures
Construction	Soil erosion and sedimentation	A soil and water management sub-plan would be prepared as part of the CEMP. It would include a detailed list of measures that would be implemented during construction to minimise the potential for soil, water quality and contamination impacts, including: ▸ allocation of general site practices and responsibilities ▸ material management practices ▸ stockpiling and topsoil management ▸ surface water and erosion control practices.
	Surface water monitoring	Water quality would be monitored during construction in accordance with the surface water monitoring framework.
	Discharge to surface water	Discharge to surface water would be undertaken in accordance with the construction EPL, and would consider the hydrological attributes of the receiving watercourse.
Operation	Water quality	The proposal would be managed in accordance with the water quality management requirements specified in the environmental protection licence for ARTC and ARTC's Environmental Management System.

17. Aboriginal heritage

This chapter provides a summary of the Aboriginal cultural heritage assessment and archaeological assessmentof the proposal undertaken by Umwelt. It describes the existing Aboriginal heritage environment, assesses the potential impacts of the proposal, and provides recommended mitigation measures. The full report is Technical Report 8.

17.1 Assessment approach

17.1.1 Methodology

The assessment involved:

- A desktop review of archaeological literature and data to determine if Aboriginal sites have been previously identified within the study area, including a search/review of:
  - Aboriginal Heritage Information Management System (AHIMS) in September 2015 and July 2016 for a 500 metre buffer around the proposal site
  - EPBC Act Protected Matters Search Tool to identify any federally listed Aboriginal heritage sites or places near the proposal site
  - the Parkes and Narromine local environmental plans
  - previous archaeological investigations.
- consultation with registered Aboriginal parties (described below)
- a field survey to identify any visible surface evidence of cultural heritage sites and landforms (described below)
- developing a predictive model to assist in determining archaeological potential
- assessing the potential impacts of the proposal, and preparing the Aboriginal Cultural Heritage Assessment in accordance with the guidelines and requirements described in section 17.1.2.

The Aboriginal heritage assessment considered the potential impacts of the proposal on Aboriginal heritage in the proposal site (described in chapter 2) and, to provide flexibility for the design of culvert and level crossing upgrades, it also considered the following additional assessment areas outside the proposal site:

- an approximate 60 metre buffer around culverts
- an approximate 120 metre buffer around the locations of level crossings.

As described in chapter 2, the need for works in these areas would be determined during detailed design, and may be subject to further archaeological investigation and assessment in accordance with the recommendations of the Aboriginal Cultural Heritage Assessment. These areas do not currently form the proposal site for the purposes of the EIS.

Aboriginal consultation

Aboriginal consultation has been undertaken in accordance with the requirements of *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECC, 2010). This included:

- Notification of the proposal, assessment, and registration of interest, involving:
  - placing advertisements in relevant newspapers (including local newspapers and the Koori Mail) in December 2015

- sending letters to agencies on 9 December 2015 requesting the identification of Aboriginal parties with cultural interest/knowledge in the study area
- sending letters to Aboriginal parties identified by agencies on 8 January 2016 providing notification of the assessment and an opportunity to register their interest for consultation - nine Aboriginal parties registered an interest and are the Aboriginal stakeholders for the proposal.

- Presentation of information about the proposal:
  - a draft copy of the assessment methodology (with a request for comments) and a meeting invite was sent to registered Aboriginal parties
  - meetings were held with registered Aboriginal parties in May 2016.
- registered Aboriginal parties were invited to participate in the field survey, and representatives from five stakeholders participated
- review of draft cultural heritage assessment report - a copy of the draft Cultural Heritage Assessment Report (Technical Report 8) was sent to registered Aboriginal parties for comment.

Further details, including advertisement and meeting dates, and copies of letters and responses, are provided in Technical Report 8.

Site survey

The study team conducted a targeted site survey between 25 July and 2 August 2016. The survey was undertaken in accordance with the requirements for archaeological survey as established in *Code of Practice for Archaeological investigation of Aboriginal objects* (DECCW now OEH 2010). The survey was designed to ensure an adequate sample of landforms within the proposal area.

The survey consisted of vehicle and pedestrian surveys. The vehicle survey was used to obtain a broader understanding of the general environment of the proposal site and was considered appropriate given the highly disturbed nature of the majority of the existing rail corridor. The pedestrian survey focussed on areas of greatest archaeological sensitivity, including previously recorded AHIMS sites and landforms associated with watercourses crossing the proposal site.

The survey also considered the additional assessment areas described above.

17.1.2 Legislative and policy context to the assessment

The main piece of legislation relevant to Aboriginal heritage in NSW is the *National Parks and Wildlife Act 1974* (the NPW Act) and the supporting regulation. The NPW Act defines an Aboriginal object as ‘any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales.’

Under Section 84 of the NPW Act, an Aboriginal place must be declared by the Minister as a place that, in the opinion of the Minister, is or was of special significance with respect to Aboriginal culture. Section 86(4) of the NPW Act states that a person must not harm or desecrate an Aboriginal place.

Under the NPW Act, it is an offence to harm or desecrate an Aboriginal object or Aboriginal place. Under section 87(1) of the Act, it is a defence to a prosecution offence if the harm or desecration of an Aboriginal object was authorised by an Aboriginal Heritage Impact Permit (AHIP) and the activities were carried out in accordance with that AHIP. As described in chapter 3, the provisions of the EP&A Act provide an exemption from the requirement for an AHIP for activities approved as State significant infrastructure, however, the other provisions of the NPW Act still apply.

The NPW Act requires due diligence to be exercised to check if Aboriginal sites would be harmed by works. Aboriginal sites recorded by the AHIMS include:

- Aboriginal objects (as defined under the NPW Act) or groups of objects
- an area of land containing Aboriginal objects
- a ‘potential archaeological deposit’ (or PAD) which is an area where, based on previous investigation, Aboriginal objects are likely to be present

- a declared Aboriginal Place as defined under the NPW Act, which may or may not contain Aboriginal objects
- an Aboriginal site that has been partially or completely destroyed under the conditions of a past consent.

The EPBC Act also provides provisions to list and protect Aboriginal sites or places considered to be of national significance. No Aboriginal sites or places listed under the EPBC Act were identified in the study area, and therefore there are no requirements under the EPBC Act relevant to the assessment.

The assessment was undertaken in accordance with:

- the requirements of the NPW Act
- *Code of practice for archaeological investigation of Aboriginal objects in New South Wales* (DECC, 2010b)
- *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECC, 2010a)
- *Guide to investigating assessing and reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011).

17.2 Existing environment

A summary of the historical context and existing environment with respect to Aboriginal heritage is provided in this section. Further information is provided in Technical Report 8.

17.2.1 Aboriginal historical context

According to Tindale's 1974 map of Aboriginal Australia, the proposal site extends over the country of the Wiradjuri people and the Wongaibon people. Tindale's map indicates that a section of the proposal site from Parkes to Alectown is within the country of the Wiradjuri. Previous archaeological assessments have identified that many Aboriginal people with ties to the Peak Hill area consider themselves to be Wiradjuri descendants, and the Wiradjuri language was the dominant language at the nearby Bulgandramine Aboriginal Station. It is noted that the boundaries identified by Tindale (1974) are not accepted as being accurate by many Aboriginal people and anthropologists, and should not be considered as clearly defined and accepted boundaries.

The earliest historical records relating to Aboriginal people in the study area date from 1817, when Oxley and Cunningham camped on the Bogan River and noted the presence of deposits of freshwater mussel shell and stone artefacts, and identified the existence of a spring on Gundong Creek that was used by Aboriginal people.

17.2.2 Aboriginal sites identified

Listed sites

The results of the AHIMS search identified 19 listed sites within 50 metres of the proposal site. Five of these sites are mapped as occuring within the proposal site.

Three of the sites (sites 35-6-0062, 35-6-0063, and 35-6-0065) were not identified during field surveys. These sites were identified and assessed for a proposed gas pipeline (assessment report not available for review). The pipeline is now constructed, and it is possible the sites were salvaged prior to construction. However, as the sites are listed on the AHIMS database they have been considered by the Aboriginal heritage assessment.

Artefacts associated with the following listed sites were identified within the proposal site during field surveys:

- GDM 1 (site 35-3-0206) – the recorded site consists of a scatter of 20 artefacts of quartz flakes and broken coarse volcanic flakes. Two artefacts were identified within the proposal site.
- P2N IA1 (site 43-3-0111) – a single silcrete flake located on an access track on the bank of a tributary of Ridgey Creek was identified. This site was identified during preliminary investigations for the proposal and re-identified during the field survey adjacent to the proposal site.

The following listed sites are located adjacent to the proposal site, and their location was confirmed during field surveys:

- GDM 2 (site 35-3-0207) – a scarred tree located within an area of archaeological potential on Backwater Cowal adjacent to the proposal site.
- GDM 3 (site 35-3-0208) – a scatter of 29 artefacts consisting of quartz with the exception of one broken quartzite flake. The artefacts include a bipolar quartz core and are distributed over a large access track exposure bordering the existing rail line. No artefacts were identified in the proposal site.

Aboriginal places

No Aboriginal places declared under section 84 of the NPW Act, or Aboriginal places of heritage significance defined by the *Standard Instrument – Principal Local Environmental Plan,* are located within or near the proposal site.

Two Aboriginal places are located to the north of Narromine – the Bridge Reserve and Mack Reserve, located about two and five kilometres metres to the north of the proposal site, respectively. Both of these places are fringe camps where Aboriginal people lived between the 1860s and 1960s.

New sites identified during the survey

No new unlisted Aboriginal sites were identified in the proposal site during the site survey.

17.2.3 Native title

A search of the Native Title Tribunal records on 31 March 2016 identified no native title claims relevant to the proposal site, and no Indigenous Land-Use Agreements registered or notified by the Native Title Tribunal.

17.2.4 Archaeological potential of the proposal site

The regional archaeological pattern indicates that stone artefact scatters and scarred trees are the most likely site types in the study area. Stone artefact scatters would be most frequent in number and would be larger in proximity to reliable sources of water. Scarred trees may occur anywhere within the proposal site where mature native trees are found, and are most likely to occur on box or river red gums.

Quarry sites may also occur where suitable rock outcrops are present.

The proposal site has been subject to significant disturbance. Within the existing rail corridor, the construction and maintenance of the existing rail line is likely to have resulted in the removal/relocation of archaeological evidence that may have been present. Similarly, there is limited archaeological potential in agricultural land surrounding the existing rail corridor, as this area has been impacted by historical and current agricultural practices.

Due to the extent of disturbance within the existing rail corridor, it is considered highly unlikely that intact archaeological deposits would be present. The level of archaeological potential within the proposal site (even immediately bordering reliable watercourses) is therefore considered to be low.

Eight areas in the additional assessment areas outside the proposal site were considered to have a moderate or high archaeological potential. Of these areas, five are associated with currently exposed archaeological evidence.

17.2.5 Significance assessment

The Burra Charter of Australia (Aust ICOMOS, 1987) defines cultural significance in terms of aesthetic, scientific, historic, and social values. Aboriginal cultural heritage is typically assessed according to its social and scientific significance; however other values may also be of importance. The assessment of significance provides a guideline for determining appropriate mitigation and management strategies. The relationship between levels of significance and management strategies can be summarised as follows:

- High significance – the site should be conserved and protected from the impacts of development, where possible.
- Moderate significance – the site should be protected if possible, however, if impacts to the site are unavoidable, appropriate mitigation strategies should be implemented prior to impact.
- Low significance – the site should be protected if possible, however, if impacts to the site are unavoidable, the presence of the site should not impede the proposed development.

As Aboriginal cultural significance relates to the values of a site, place or landscape to Aboriginal people, only the Aboriginal community can determine Aboriginal cultural significance.

Archaeological significance

The archaeological significance of the Aboriginal sites identified was assessed using the following criteria:

- rarity
- representativeness
- research potential
- education potential
- integrity.

The archaeological significance of the three listed sites that could not be re-identified (35-6-0062, 35-6-0063, 35-6-0065) was also considered. These sites were assessed as having low archaeological significance.

The archaeological significance of identified Aboriginal sites is provided in Table 17.1. The nature of archaeological deposits in these areas (should any exist) can only be confirmed following further investigation.

Table 17.1 Assessment of archaeological significance for areas of moderate or high archaeological potential

Site reference	Landform	Archaeological potential rating		Archaeological significance (based on potential only)	
		Within proposal site	Outside proposal site[1]	Within proposal site	Outside proposal site[1]
43-3-0111	Ridgey Creek Tributary 3	Low	Moderate	Low	Moderate
None	Burrill Creek North	Low	Moderate on north side of creek	Low within proposal site and south side of creek	Moderate on north side of creek
None	Ten Mile Creek (creek banks)	Low	Moderate to high	Low	Moderate to high

Site reference	Landform	Archaeological potential rating		Archaeological significance (based on potential only)	
35-6-0163	Ten Mile Creek (access road)	Low	Moderate to high	Low	Moderate to high at specified coordinates
None	Lower slope bordering unnamed drainage (5th order)	Low	Moderate on the southern side	Low	Moderate on the southern side
35-3-0208, 35-3-0207	Backwater Cowal (north)	Low	Moderate to high	Low	High
35-3-0206	Backwater Cowal (south)	Low	Moderate to high	Low within corridor	High
35-3-0206 (cont.)	Lower slopes bordering Backwater Cowal	Low within surfaced road	Moderate to high	Low within surfaced road	Moderate outside corridor on southern side

Note 1: The archaeological significance of these areas would be subject to review following further investigation if the detailed design identifies the need for surface disturbance within these areas.

17.3 Impact assessment

17.3.1 Risk assessment

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential risks of the proposal on Aboriginal heritage. The assessed risk level for Aboriginal heritage was given a high rating due to the potential disturbance of known or unidentified items or places of Aboriginal heritage significance.

17.3.2 How potential impacts have been avoided

The route for Inland Rail has been designed to minimise the amount of ground disturbance required, with the majority of the rail line using existing infrastructure. However, some disturbance would still be required. The potential significance of this risk needs to be assessed in the context of the amount of ground disturbance required and areas of moderate to high archaeological significance.

Potential impacts on heritage would continue to be avoided by:

- designing, constructing and operating the proposal to minimise the potential for impacts on Aboriginal heritage
- locating ancillary infrastructure including temporary construction compounds to avoid listed AHIMS sites and areas identified as having moderate to high archaeological potential
- managing the potential impacts on Aboriginal heritage in accordance with relevant legislative requirements, as outlined in section 17.1.2, and the findings of the Aboriginal cultural heritage and archaeological assessment
- implementing the mitigation measures provided in section 17.4.2.

17.3.3 Construction impacts

The main risks relating to Aboriginal heritage would occur during construction of the proposal. Works within the proposal site have the potential to directly or indirectly disturb identified Aboriginal sites and areas of archaeological potential. The impact assessment summarised in this section focuses on the potential impacts of the proposal on Aboriginal heritage in the proposal site (as defined in chapter 2).

Proposal site impacts

No areas of moderate or high archaeological potential were identified within the proposal site. The majority of works would be undertaken within the previously disturbed rail corridor where the archaeological potential is low.

The three listed sites mapped as occurring within the proposal site but not re-identified during the field survey (sites 35-6-0062, 35-6-0063, 35-6-0065) have the potential to be impacted if they have not been previously disturbed/salvaged. These sites have been assessed as having low archaeological significance.

Construction may directly or indirectly disturb:

- the two artefacts in the proposal site associated with site 35-3-0206
- site 43-3-0111 (the single silcrete flake)
- site 35-3-0207 (the scarred tree), located adjacent to the proposal site
- site 35-3-0208 (a scatter of 29 artefacts), located across an access track bordering the existing corridor.

Mitigation measures to minimise the potential for impacts to these sites are provided in section 17.4.

Impacts in the additional assessment areas

The need for any works to be undertaken in the additional assessment areas would be determined once the detailed design of the culverts and level crossings have been finalised. The design of any works in these areas would minimise, as far as practicable, the potential for impacts on identified Aboriginal heritage. Prior to finalising the detailed design of any works located in these areas, additional assessment would be undertaken in accordance with the recommendations of Technical Report 8, and the process for design refinements described in section 27.2.3 would be followed.

17.3.4 Operation impacts

Access to the rail corridor would be required during routine maintenance and repairs. As these areas would have been previously assessed and disturbed during construction, further impacts on Aboriginal heritage are considered unlikely.

17.4 Mitigation and management

17.4.1 Approach to mitigation and management

ARTC is committed to minimising the environmental impact of the proposal and is investigating opportunities to reduce actual impact areas where practicable. The area that would be directly impacted by construction activities would depend on factors such as presence of significant vegetation, constructability, construction management and safety considerations, land form, slopes and anticipated sub-soil structures. Direct impacts would be reduced as far as practicable.

There are two options to mitigate the potential impacts on artefact scatters of low archaeological significance in the proposal site. The first option is to avoid the site. Where this is not practicable, the second option is to salvage artefacts from the site prior to construction. In this instance, the collected items would be stored at an appropriate keeping place identified in consultation with Aboriginal parties and/or OEH.

For significant archaeological sites located in the vicinity of the proposal site, the extent of the site would be identified with high visibility fencing, and construction impacts avoided. The sites should also be clearly marked on all mapping and plans used by contractors working on the project.

If impacts to Aboriginal objects are unavoidable, additional assessment may be required to clarify the nature, extent and significance of the sites in consultation with relevant Aboriginal stakeholder representatives.

17.4.2 Summary of mitigation measures

To mitigate the potential for Aboriginal heritage impacts, the following mitigation measures would be implemented.

Table 17.2 Aboriginal heritage mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Avoiding impacts to Aboriginal heritage	Detailed design and construction planning would avoid direct impacts to the identified items/sites of Aboriginal heritage significance where practicable.
	Impacts outside the proposal site	Any works outside the proposal site would be subject to further review and assessment to avoid impacts on Aboriginal items.
Pre-construction/ construction	General construction impacts	A construction heritage management plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for impacts, manage heritage, and procedures for any unexpected finds. With respect to the management of Aboriginal heritage, the plan would be prepared in consultation with registered Aboriginal parties, incorporate the recommendations of the Aboriginal Cultural Heritage Assessment, and take into account the outcomes of further investigations following detailed design.
	Impact to listed Aboriginal sites	Impacts to AHIMS listed sites 35-3-0206 and 43-3-0111 would be avoided where possible. These sites would be fenced prior to construction and their locations marked on all plans. A buffer of 10 metres around the sites would be applied to all fencing. If sites 35-3-0206 and 43-3-0111 cannot be avoided, salvage of artefacts would be undertaken prior to construction in accordance with the procedures detailed in Technical Report 8. Impacts to the scarred tree at 35-3-0207 and the artefact scatter at 35-3-0208 would be avoided. The sites would be fenced prior to construction and marked on all plans.

Stage	Impact	Mitigation measures
Construction	Unexpected finds	If potential Aboriginal items are uncovered, works within 10 metres of the item would cease. The item would then be assessed and managed by a suitability qualified person in accordance with the unexpected finds procedure in the Aboriginal cultural heritage management plan. During pre-work briefings, employees would be made aware of the unexpected finds procedures and obligations under the NPW Act.
	Human skeleton material	In the event that a potential burial site or potential human skeletal material is exposed during construction, the mitigation measure provided in Table 18.2 would be implemented.

18. Non-Aboriginal heritage

This chapter provides a summary of the non-Aboriginal heritage impact assessment of the proposal undertaken by Umwelt. It describes the existing environment in terms of non-Aboriginal/historic heritage, assesses the potential impacts of the proposal, and provides recommended mitigation measures. The full report is Technical Report 9.

18.1 Assessment approach

18.1.1 Methodology

The assessment involved:

- reviewing the following heritage databases to identify whether any listed heritage items are located in the vicinity of the proposal site:
  - Australian Heritage Database (including Commonwealth and National heritage lists)
  - Australian Heritage Places Inventory
  - NSW State Heritage Inventory (including the State Heritage register)
  - ARTC's section 170 heritage register
  - Parkes Local Environmental Plan 2012
  - Narromine Local Environmental Plan 2011.
- historical research including a literature review
- reviewing the proposal description and plans
- a site survey (see below) and photographic inventory
- assessing the potential impacts of the proposal, and preparing the historical heritage impact statement, in accordance with the guidelines listed in 18.1.2.

Site survey

A targeted site survey was conducted from 10 to 14 September 2014. The aim of survey was to inspect and record the location, nature, and current condition of any listed sites identified during the database and literature review; and to identify any additional sites/items with potential heritage significance. The survey also involved a broad scale evaluation of the landscape of the study area with respect to potential cultural heritage considerations.

An additional targeted one-day field inspection, focusing on the sites of the former rail stations, was undertaken on 23 May 2016.

18.1.2 Legislative and policy context to the assessment

The main legislation relevant to non-Aboriginal heritage in NSW is the *Heritage Act 1977*. This Act includes provisions to conserve the State's environmental heritage. It provides for the identification, registration and protection of items of State heritage significance, constitutes the Heritage Council of NSW, and confers on it functions relating to the State's heritage.

As described in section 3.4, some approvals under the Heritage Act (that is, approvals under Part 4 and Division 8 of Part 6, and excavation permits under section 139) are not required for approved State significant infrastructure.

The EP&A Act establishes the framework for heritage values to be formally assessed in land use planning and local development consent processes. Under this Act, the definition of 'environment' includes cultural heritage. The Heritage Act defines 'environmental heritage' as places, buildings, works, relics, movable objects or precincts considered significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values.

Items and places of national heritage significance, as well as heritage places owned by the Australian Government, are managed under the EPBC Act. The EPBC Act provides for the identification, registration, and protection of items of national heritage significance. National heritage is one of the nine matters of national environmental significance protected by the EPBC Act.

The assessment of non-Aboriginal heritage for the proposal has been undertaken in accordance with the *NSW Heritage Manual 1996* (Heritage Office and Department of Urban Affairs and Planning, 1996) ('the NSW Heritage Manual') and relevant guidelines, including *Assessing Heritage Significance* (Heritage Office, 2001), and *Statements of Heritage Impact* (Heritage Office, 2002).

The assessment has also taken into consideration the principles contained in *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Australia ICOMOS, 2013) ('the Burra Charter') and the *Historical Archaeology Code of Practice* (Heritage Office, 2006).

18.2 Existing environment

18.2.1 Heritage context

A summary of the historic and heritage context for the assessment is provided below. Further information is provided in Technical Report 9.

Grazing/agriculture

The Lachlan River region was first discovered in 1815. In 1817, John Oxley (Surveyor General of NSW from 1812) further explored the Lachlan River plains, including the areas of Forbes, Bogan Gate, Parkes, and Peak Hill. In 1835 and 1836, Thomas Mitchell (Surveyor General from 1828), explored the region and mapped the Bogan and Lachlan rivers. Mitchell's expedition route became the basic supply route for squatting activity in the region (which includes the study area for the proposal).

Pastoralists began bringing their cattle in western NSW following John Oxley's explorations. The expanding market for meat due to population growth in NSW, and the demand for grazing land to meet the needs of the developing sheep industry, provided impetus for increased squatting activity during the 1830s. The first squatter in the Parkes area followed the expedition tracks of Mitchell, establishing a station on Goobang Creek in 1835.

Following initial squatting activity, large pastoral runs varying from 11,000 to 25,000 hectares were opened between 1835 and 1858.

In 1865, the first crop of wheat was successfully grown in the Parkes area, about 3.5 kilometres north of Parkes. The growth of the wheat industry was assisted by the gold rush (described below) and construction of the inland rail lines (described below), as well has the invention of machinery allowing for large scale harvesting.

The 1884 Land Act encouraged smaller leases of mixed farming, and the 1895 Homestead Selection Act encouraged wheat cultivation. This caused a shift in production to wheat, wool and lambs. Soldier settlement after the First World War, and private subdivision of land, allowed wheat to become a key crop.

Bulk handling of wheat grain was first phased in during the 1920s. This meant that grain did not need to be bagged before being stored and shipped, leading to substantial savings of time and money, as well as protection from pests. The first country grain silo in NSW was built at Peak Hill in 1918. By 1933, over one-third of the region around Parkes was cleared for agriculture.

Mining

The discovery of gold in the region signalled a new period of history. The majority of towns in the Lachlan River plains area, including Forbes, Parkes, Peak Hill, Wyalong, West Wyalong, and Lake Cargelligo, were established mainly as a result of gold. The earliest gold rush in the area was at Forbes in 1861. The first gold discovery in the Peak Hill area was at Tomingley in 1881. Mines at Currajong, north of Parkes, opened in 1863 and 1864. Gold was discovered at Peak Hill in 1889. A town promptly appeared in Peak Hill, a thousand miners arrived by 1890, and five mines were opened.

Urban areas

Settlement and growth came to the region in the later part of the nineteenth century. As noted above, the towns of Parkes and Peak Hill were created and grew as a result of the discovery of gold. The construction of rail lines in the region was a very significant development in the late nineteenth century, leading to the establishment and survival of a number of villages and towns. The prosperity and growth of villages and towns depended on whether a rail line linked the settlement with wider NSW.

Parkes was originally known as Currajong and Bushmans. Bushmans was officially renamed Parkes in 1873. Peak Hill developed as a town in 1889, and the village of Narromine was laid out in 1883.

Rail lines

In NSW, rail lines were historically built to two main standards: main lines, and branch/pioneer lines. As noted in chapter 2, Parkes is located on the Broken Hill line, and Narromine is located on the Main Western line. Both these lines were constructed as main lines. Parkes Station (to the east of the proposal site) was opened in 1893. Narromine Station (to the north of the proposal site), which opened in 1882, is now closed to passenger services.

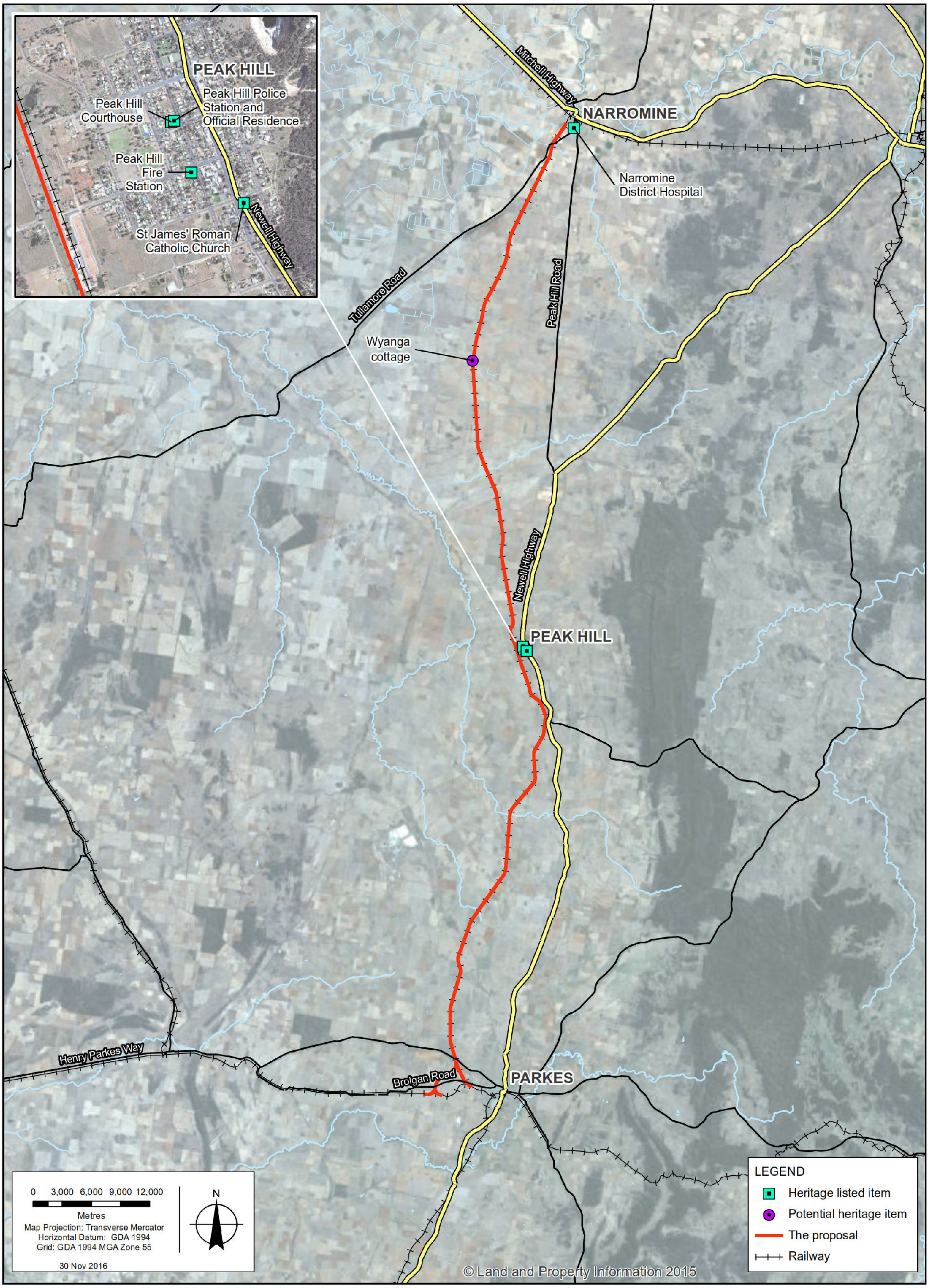
The economic depression of 1889 to 1894 dramatically slowed rail construction in NSW. When expansion of the rail system resumed, it was under a new era of austerity. The change involved the introduction of ‘pioneer lines’, constructed mainly between 1910 to 1930 on routes serving agricultural areas. To minimise the need to construct expensive bridges, these routes were selected to be located, where possible, beside or between the major inland rivers. Pioneer rail lines were constructed using light rails and low-quality sleepers with no ballast. Rail traffic was minimal, except for the heavy seasonal demand dictated by agricultural industries.

The Parkes to Narromine line, which opened in 1910 as a single track rail line, was constructed as a pioneer line. Rail stations along the line opened progressively from 1910. Rail passenger services along the line were discontinued in 1974. All stations, except Goobang Junction, closed between 1974 and 1976.

Further information on the rail lines and rail services in the study area is provided in chapter 2.

18.2.2 Heritage listed items

No heritage listed items are located within or in the immediate vicinity of the proposal site. Listed items within one kilometre of the proposal site are shown in Figure 18.1 and listed in Table 18.1. All listed items are locally significant.



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, DTDB, 2012. OEH, Heritage, 2016.

Figure 18.1
Heritage item

Table 18.1 Heritage listed items within one kilometre of the proposal site

Item name	Location	Listing	Distance from the proposal site
Narromine District Hospital	Bounded by Dandaloo, Cathundral and Temain streets, Narromine	Department of Health's section 170 register	900 metres to the east
Peak Hill Courthouse	Derribong Street	Department of Justice's section 170 register	775 metres to the east
Peak Hill Fire Station	130 Caswell Street	Fire & Rescue NSW's section 170 register	975 metres to the east
Peak Hill Police Station and Official Residence	80 Derribong Street	NSW Police Force's section 170 register	750 metres to east
St. James Roman Catholic Church	Narra Street	Parkes LEP	950 metres to east

18.2.3 Potential heritage items and resources

The potential heritage resource of the study area generally reflects the documented history of the region (summarised in section 18.2.1), and the remaining rail alignment and infrastructure associated with the original Parkes to Narromine line. With the exception of the rail line and its associated structures, evidence of stations and other infrastructure, the proposal site itself is unlikely to contain significant historical heritage or archaeological remains associated with the history of the study area.

Ongoing works and maintenance activities along the Parkes to Narromine line have, for the most part, removed all evidence of stations and associated platforms and station officer's houses. It is also considered unlikely for any substantial intact archaeological remains to be present within the proposal site.

The potential heritage resource in the proposal site, and likely absence of any archaeological resource, is considered to be typical of a rail line. It includes the rail formation itself, with culverts of varying construction materials and age, evidence of the former stations, and other rail related structures and infrastructure.

All potential heritage items located within/adjoining the proposal site are rail related. A summary of potential heritage items is provided below. Further detail is available in Technical Report 9.

Rail related items with potential heritage significance

The potential historical heritage resource in the proposal site includes the rail line and formation itself, with culverts of varying construction materials and age, evidence of the former stations, and other rail related structures and infrastructure.

Rail line and culverts

The rail line itself (including culverts/under bridges and associated rail infrastructure), has historical association with the expansion of the NSW rail network through the region, and its role in encouraging agricultural and pastoral development.

Culverts and underbridges can provide examples of the different techniques used to raise a rail line over watercourses. There are a number of underbridges (that is, small bridges spanning an opening under the rail line) surviving along the proposal site which still have timber components in addition to early concrete modifications, or are entirely constructed of timber. Some examples of these are shown in Plate 18.1 and Plate 18.2, with others provided in Technical Report 9. These are likely to be representative of the earlier types of underbridges constructed along the rail line.

Plate 18.1 Goobang Junction underbridge

Plate 18.2 Goonumbla underbridge

Former stations

There are 10 former rail station sites and one former rail loop (Myroo) located along the proposal site, and a station and a junction located within the vicinity of the proposal site (Goobang Junction and Narromine Station). In general, there is limited remaining evidence of the former rail stations, with the exception of raised earthen embankments indicating former station platforms or rail siding loading banks.

Other rail related structures and infrastructure

The grain rail sidings and landmark grain silos dominate the landscape immediately adjacent to the proposal site (examples shown in Plate 18.3 and Plate 18.4).

Plate 18.3 Grain rail sidings and silos at Tomingley West

Plate 18.4 Grain rail sidings and silos at Wyanga

Two old cottages are located in close proximity to the rail corridor – one at Wyanga adjacent to the rail corridor, and one at Tomingley West on private land about 100 metres from the rail corridor. The cottage at Tomingley West was not considered further given its distance from the corridor.

The cottage at Wyanga (referred to as 'Wyanga cottage' for the purpose of the assessment and shown in Plate 18.5) is located between the rail line and Peak Hill Railway Road, about 25 kilometres south-west of Narromine. It comprises a derelict weatherboard cottage with brick chimneys, in a serious state of disrepair. The cottage is located about 15 metres to the west of the existing tracks and south of the former station location, and is outside the boundary of the rail corridor. The cottage is likely to have been related to the original rail line, and may comprise a former Rail Officer's House.

Plate 18.5 Derelict cottage at Wyanga

No other potentially significant rail or grain siding related structures or items were identified within, or in close proximity to, the proposal site.

Summary statement of significance for potential heritage items

An assessment of significance was undertaken of the potential heritage items along the proposal site. The assessment concluded that, for items not currently subject to a heritage listing:

- The existing rail line comprises a former pioneer rail line, constructed to provide access to wheat and wool growing areas in regional NSW. As such, the proposal site demonstrates and contributes to the history of settlement in the region.
- The existing rail line is considered to be generally of local significance as a result of its:
  - relationship with the construction of pioneer rail lines in rural NSW at the beginning of the twentieth century
  - role in encouraging settlement and agricultural development in the study area
  - surviving elements, such as the timber constructed culverts/underbridges, and remnant evidence of former stations.
- Wyanga cottage is considered to be of local significance as a result of its potential association with the original rail line, and possible use as a Station Officer's house.

18.3 Impact assessment

18.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential risks of the proposal on environmental heritage. The assessed risk level for the majority of potential heritage risks was medium. Risks with an assessed level of medium or above included:

- impacts on the heritage significance of any nearby heritage items as a result of altered arrangements and access; impacts to visual amenity, landscape and vistas, and curtilage, and any impacts as a result of noise mitigation measures
- damage to heritage items from vibration during construction or operation
- disturbance of known or unidentified items or places of non-Aboriginal heritage significance.

How potential impacts have been avoided

The option development and assessment process for Inland Rail as a whole is summarised in chapter 6. As noted in chapter 6, the shortlist of route options was subject to a detailed assessment, and the proposed alignment was refined based on evaluation of key considerations, including environmental impacts. The majority of Inland Rail would be located on upgraded track in existing rail corridors, minimising as far as practicable the potential for impacts to heritage located outside the rail corridor. However, the proposal would impact on existing rail infrastructure within the rail corridor.

Potential impacts on heritage outside the rail corridor would continue to be avoided by:

- designing, constructing and operating the proposal to minimise the potential for impacts outside the rail corridor
- managing the potential impacts on non-Aboriginal heritage in accordance with relevant legislative, as outlined in section 18.1.2, and the findings of the historic heritage assessment
- implementing the heritage mitigation measures provided in section 18.4.3.

18.3.2 Construction impacts

Direct impacts can occur during construction as a result of the physical loss of part or all of a heritage item or place, and/or changes to its setting. Potential indirect impacts include:

- potential for vibration impacts to buildings/items located close the proposal site as a result of construction works and the movement of plant, vehicles and machinery
- inadvertent damage as a result of the movement of machinery and equipment
- altered historical arrangements and access
- impacts to visual amenity, landscape and vistas associated with the item
- impacts to the curtilage of an item.

Impacts on listed heritage items

No sites/items with a statutory heritage listing, with the potential to be directly or indirectly impacted by the proposal, were identified within or close to the proposal site.

Impacts on items with potential significance

Potential for direct impacts

The proposal would result in the removal of the existing rail line and associated infrastructure, and the construction of a new rail line within the same corridor. Retaining all evidence of the existing rail line is not feasible, as significant upgrades to the formation are required for it to comply with the Inland Rail performance specifications. The corridor would be retained for rail usage.

The majority of the former stations have been previously removed, with only occasional earthen embankments or loading banks remaining as evidence of their former locations. Any remaining evidence could be impacted as a result of the proposal.

The rail line itself has been continually upgraded since its construction, and no original features (with the possible exception of some of the timber components of a number of the culverts/underbridges) have been identified or are expected to be found.

The measures listed in section 18.4 (including interpretation and a photographic/archival recording) would be implemented prior to construction to minimise the potential significance of direct impacts.

There are no expected impacts to the setting of the grain silos and their landmark silos as a result of the proposal.

Wyanga cottage would not be directly impacted by the proposal. The proposal comprises the construction of a new rail line within the same rail corridor. As such, the associations, setting, and curtilage of Wyanga Cottage in relation to the rail line would essentially remain the same and would not be impacted.

Potential for indirect impacts

The main potential for indirect impacts as a result of the proposal relates to vibration generated by construction. The potential for structural vibration impacts was considered by the noise and vibration assessment (described in chapter 12). The assessment concludes that existing heritage listed items are located a sufficient distance from the proposal site such that no impacts are predicted.

With respect to potential heritage items, Wyanga cottage is located adjacent to the proposal site. The cottage is in a state of disrepair and may be impacted by vibration. The vibration assessment concluded that the cottage is located within the buffer distance where vibration levels from construction activities may cause impacts, therefore mitigation measures are recommended to minimise the potential for any impacts. The management of vibration in the vicinity of the cottage would be undertaken in accordance with the approach defined by the *Inland Rail NSW Construction Noise and Vibration Management Framework*. Potential management actions could include a dilapidation survey and careful selection of construction techniques in the vicinity of the cottage. Further information on the framework with respect to the management of vibration is provided in section 12.5.

Although the potential for indirect impacts on the cottage would be minimised as far as practicable, given the dilapidated state of the cottage, there remains the risk that it could collapse. As such, the heritage mitigation measures listed in section 18.4 (including interpretation and a photographic/archival recording) would be implemented prior to construction.

18.3.3 Operation impacts

Operation of the proposal would not directly impact on any listed or potential heritage items. The main potential for indirect impacts relates to vibration generated by the movement of trains, and a change in the visual setting and/or character associated with the presence of new infrastructure.

The potential for structural vibration impacts was considered by the noise and vibration assessment (described in chapter 12). No operational impacts on listed or potential heritage items were predicted.

The potential for visual impacts was considered by the landscape and visual impact assessment (described in chapter 19). The assessment concluded that the overall visual impact of the proposal would be low, as the majority of the proposal involves minor works to existing infrastructure. Measures are provided in section 19.4 to mitigate the potential for visual impacts.

18.4 Mitigation and management

18.4.1 Approach to mitigation and management

A photographic/archival recording of certain elements of the proposal site and items with potential heritage significance is proposed (culverts/underbridges with timber components, former rail station, and Wyanga cottage). This is to ensure that a full understanding and accurate record of these items would be available for future generations.

In addition to recording, an interpretation strategy would be developed, in consultation with relevant stakeholders, to provide a concept and framework for interpretation of the original rail line and rail infrastructure to be removed. This would ensure information regarding this infrastructure is accessible and available for the community to understand.

Potential vibration impacts would be managed in accordance with the Inland Rail Construction Noise and Vibration Management Framework, described in section 12.5.

18.4.2 Consideration of the interactions between mitigation measures

Measures to minimise the potential for vibration impacts (provided in chapter 12) and visual impacts (chapter 20) would minimise the potential for indirect impacts as a result of the proposal.

18.4.3 Summary of mitigation measures

To mitigate the potential for non-Aboriginal heritage impacts, the following mitigation measures would be implemented.

Table 18.2 Non-Aboriginal heritage mitigation measures

Stage	Impact	Mitigation measures
Detailed design/pre-construction	Heritage interpretation	An interpretation strategy would be developed for the proposal to provide a concept and framework for interpretation of the original rail line and associated infrastructure and structures.
	Impacts to potential heritage items	A photographic/archival recording would be undertaken of culverts/underbridges with timber components, former rail station sites, and Wyanga cottage, in accordance with *Photographic Recording of Heritage Items Using Film or Digital Capture* (Heritage Division, 2006). The photographic recording would include contextual photographs showing the relationships between the rail line, station sites, Wyanga cottage, and associated grain rail sidings and silos.
	Wyanga cottage	The detailed design of the proposal would minimise the potential for direct impacts to Wyanga cottage. The management of potential vibration impacts at the cottage would be undertaken in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework.
	Accidental impacts at Wyanga cottage	Direct impacts to the cottage would be avoided by the installation of temporary fencing, and marking the cottage as a ‘no go’ area on plans.

Stage	Impact	Mitigation measures
Construction	Unexpected finds	In the event that unexpected archaeological remains, relics, or potential heritage items are discovered during construction, all works in the immediate area would cease, and the remains and potential items would be assessed by a qualified archaeologist or heritage consultant. If necessary, the Heritage Division of OEH would be notified in accordance with the requirements of section 146 of the *Heritage Act 1977*.
	Human skeleton material	In the event that a potential burial site or potential human skeletal material is exposed during construction, the procedure recommended by the historic heritage impact assessment would be followed in accordance with the *Policy Directive – Exhumation of Human Remains* (NSW Department of Health, 2008), *Skeletal Remains – Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977* (NSW Heritage Office, 1998) and the *Aboriginal Cultural Heritage Standards and Guidelines Kit* (NPWS, 1997).

19. Landscape and visual

This chapter provides a summary of the landscape and visual impact assessment of the proposal. It describes the existing landscape and visual environment, assesses the impacts of construction and operation, and provides recommended mitigation measures. The full assessment report is provided as Technical Report 10.

19.1 Assessment approach

19.1.1 Methodology

A qualitative assessment of the landscape and visual impacts of the proposal was undertaken. The assessment involved:

- desktop analysis
- site visit and analysis
- landscape character assessment
- determining the ability of the landscape to absorb the proposal (the absorptive capacity)
- identifying potentially sensitive visual receptors
- assessing the potential for landscape and visual impacts (see below)
- developing mitigation measures to minimise the potential for negative impacts and enhance the potential for positive impacts.

Sensitive visual receivers typically include:

- occupiers of residences with views of a proposal site
- communities with a landscape setting or views valued by the community and/or visitors
- users of outdoor recreation areas whose attention or interest may be focused on the landscape
- motorists/pedestrians travelling along scenic roads/routes.

The potential sensitivity of receivers to change was determined and rated (from very low to high). Sensitivity depends on the location of receivers, the importance of their view, land uses, and the extent of existing screening.

Landscape character impacts refer to the relative capacity of the landscape to accommodate changes to the physical landscape through the introduction of new features or loss/modification of existing features. Impacts were assessed from representative viewpoints and rated (from very low to high).

The significance of potential visual impacts was determined by assessing the magnitude of impacts in combination with the sensitivity of the receiver. Potential impacts were rated according to their significance (severity), as shown in Figure 19.1.

Technical Report 10 provides further information on how the impact, sensitivity, and level of significance were assigned.

Sensitivity of feature / Magnitude of impacts	High	Moderate	Low	Very low
High	High	High to moderate	Moderate	Very low
Medium	High to moderate	Moderate	Moderate to low	Very low
Low	Moderate	Moderate to low	Low	Very low
Very low	Very low	Very low	Very low	Very low

Figure 19.1 Impact significance rating matrix

19.1.2 Policy context to the assessment

The landscape and visual impact assessment was undertaken with reference to the following guidelines, policies, and standards:

- *Environmental Impact Assessment Guidance Note – Guidelines for landscape character and visual impact assessment* 3rd edition (Roads and Maritime, 2013)
- *AS4282-1997 Control of the obtrusive effects of outdoor lighting*
- *Beyond the Pavement: urban design policy, procedures and design principles* (Roads and Maritime, 2014)
- *Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW* (Roads and Maritime, 2012)
- *NSW Sustainable Design Guidelines Version 3.0* (Transport for NSW, 2013)
- *Technical guideline for Urban Green Cover in NSW* (OEH, 2015)
- *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring* (Department of Planning and Environment, 2016).

Further information is provided in Technical Report 10.

19.2 Existing environment

The landscape and visual environment of the proposal site is characterised by its generally rural/agricultural nature, with areas of more concentrated urban development located in towns and villages.

For much of the proposal site, the existing rail track and associated rail infrastructure forms the main visual feature in the landscape (shown in Plate 19.1).

Features contributing to the visual appearance of the rural/agricultural areas include open rural land interspersed with scattered development, dwellings, buildings and sheds; small stands of native vegetation and scattered trees; watercourses (mainly ephemeral); road and rail infrastructure; and agricultural infrastructure such as grain silos. Features contributing to the visual environment of the urban areas include a mix of older commercial and residential buildings among new developments, and general urban infrastructure.

Further information on the proposal site and surrounding land uses is provided in chapters 2 and 20.

Plate 19.1 Existing rail track

19.2.1 Visual sensitivity

The majority of the proposal site passes through open rural land with sparsely scattered dwellings. There are a limited number of sensitive receivers with potential views of the proposal site.

Within the extent of visual influence of the proposal site (that is, the area from within which views to the proposal site are available), visual receivers are generally limited to users of rail and road infrastructure facilities. The number of potential receivers increases closer to the towns/villages.

The area surrounding the proposal site for the Parkes north west connection is considered to be the most visually sensitive, as the proposal would be located in a greenfield area (shown in Plate 19.2). In this area, there are a few residences whose existing views are dominated by surrounding rural land.

Areas with a low to very low visual sensitivity occur where the proposal site passes through predominantly rural land with an absence of residences and major roads, or where roads occur only in the regional setting. Main roads in the study area are often lined with canopy trees offering visual protection to properties in the agricultural landscape.

Plate 19.2 Indicative view of location for the Parkes north west connection

19.2.2 Landscape character zones

For the purposes of the assessment, four landscape character zones were identified. These are areas with similar landscape and physical qualities. The character zones consist of two main landscape character types (settlement and agricultural landscape), with two sub-types in each.

The absorptive capability relates to the ability of a landscape character zone to absorb a proposal within the existing landscape setting. The overall landscape and features within a landscape character zone with a high absorptive capability would not be markedly changed by a proposal. A low absorptive capability means that a landscape is less able to absorb the impacts of a proposal, and therefore there is more potential for impacts to landscape character.

The landscape character zones are described in Table 19.1 and are shown in Figure 19.2.

Table 19.1 Landscape character zones

Character zone	Description	Absorptive capability
Settlement – township	The proposal site is located to the west of Parkes, and is surrounded by open land and scattered development, road and rail infrastructure. Approaching the town, the Parkes Golf Club is located to the east of the proposal site, whilst rail infrastructure facilities and general industrial activity occur to the west. Overall, the finger-like settlement pattern dictates the character of the zone, with recreational and open reserves predominately located on the outer edges of the town.	**High** The flat topography, built form, and scattered trees provide opportunities for changes to be absorbed in the existing landscape setting.

Character zone	Description	Absorptive capability
Settlement – village	The proposal site traverses the western edge of Peak Hill, and is surrounded by rail infrastructure and rural land. A grid-like pattern of residential development, consisting of large lots, is located further to the east of the proposal site. Overall, the settlement pattern dictates the character of the zone and does not provide for any distinguishable landscape features.	**High** The flat topography, built form, and scattered trees provide opportunities for changes to be absorbed in the existing landscape setting.
Agriculture – Goonumbla rolling countryside	This character zone is located between Parkes and Peak Hill. This zone has an open, rolling character. The southern extent of the zone towards Parkes comprises rounded low hills. Rural residences and structures are dispersed across the landscape, as are historical rail infrastructure and large grain silos and storage facilities. Vegetation ranges from scatterings and small clusters of trees to lineal distributions along main roads and paddock edges. A distinct feature in the landscape is the dense lining of trees along Burill Creek between Goonumbla and Mickibri.	**Moderate to high** This landscape is low lying with open grassland plains and minimal canopy coverage. Changes in the existing landscape setting are less easily absorbed.
Agriculture – Bogan marshland plains	This character zone is located between Peak Hill and Narromine. It is typical of the landscape of the Darling Riverine Plains, having a relatively flat landform with river channel and floodplain features dominating the landscape. The northern extent of the zone passes through the Narromine Hills landscape which is shaped by low rounded hills standing above the alluvial plain. Rural residences and structures are dispersed across the landscape. The zone is characterised by extensively cleared land, although there are some locations where trees line main roads, shelter belts traverse paddocks, and scattered trees line watercourses such as Bulldog and Burrabadine creeks. An exception to this is Tomingley Creek, where a distinct corridor of vegetation and trees line the banks.	**Moderate to high** This landscape is low lying with open plains and minimal canopy coverage. Changes in the existing landscape setting are less easily absorbed.

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Data source: Commonwealth of Australia (Geoscience Australia). 250K Topographic Data Series 3, 2006. LPI, DTDB, 2012.

Figure 19.2

Landscape character zones

19.3 Impact assessment

19.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential risks associated with changes to the landscape and visual environment. The assessed risk level for the majority of potential risks was between low and medium. Risks with an assessed level of medium or above include:

- adverse impacts on landscape character during construction, particularly in greenfield areas
- impacts on visual amenity due to the introduction of new built elements, and the removal of vegetation.

How potential impacts have been and would be avoided

The option development and assessment process for Inland Rail and the proposal is described in chapter 6. As noted in chapter 6, the shortlist of route options was subject to a detailed assessment, and the proposed alignment was refined based on evaluation of key considerations, including environmental impacts. The majority of Inland Rail would be located on upgraded track in existing rail corridors, minimising as far as practicable the potential for impacts outside the rail corridor. However, the proposal would impact on the existing rail infrastructure within the rail corridor. For works outside the corridor, impacts to communities and landscape were included in the selection criteria used for the assessment of options.

Potential impacts on landscape character and visual environment would continue to be avoided by:

- designing, constructing and operating the proposal to minimise the potential for impacts outside the rail corridor
- managing the potential impacts on the visual setting of non-Aboriginal heritage as described in chapter 18
- designing, constructing, and operating the proposal to minimise the potential for visual amenity impacts, including implementing the mitigation measures listed in section 19.4.

19.3.2 Construction impacts

During construction, positioning plant and equipment within view of properties and existing road users would result in temporary visual impacts. Earthworks would also expose subsoil. The exposed soil would form a visible element in the landscape for a limited period.

Where roads are close to the proposal site, construction work and cleared areas would be visible to motorists. However, visual impacts would be temporary and fleeting in nature. The existing rail line already forms a visual feature in the landscape, meaning that visual modification would generally be low level and difficult to perceive from the wider road network.

The proposal would require removal of some vegetation within the boundaries of the proposal site. This would include trimming and/or clearing of vegetation. Some of this vegetation contributes to the amenity and character of the local area and/or screens views from properties surrounding the proposal site. The removal of this vegetation would have the potential to reduce some screening between residential dwellings and the rail corridor.

The use of lighting for works outside standard working hours may result in light spill impacting neighbouring properties and residents. Light generated during construction would be designed so it complies with *Australian Standard AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting*, and considers the good lighting design principles documented in the *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring* (Department of Planning and Environment, 2016). Generally, lighting would be designed to minimise off-site light spill.

Potential visual impacts during construction would be minimised through implementation of the mitigation measures provided in section 19.4.

19.3.3 Operational impacts

The proposal would result in the introduction of infrastructure in what is currently mainly a rural area. This would result in a change in the character of those properties that are directly impacted by the proposal, and a change in views from those viewpoints and properties with views to the proposal. Potential landscape character and visual impacts are considered below.

Main visual features of the proposal

The main features of the proposal with the potential for landscape and visual impacts are:

- replacing the existing track and formation with new materials, including height increases of 0.3 metres to one metre
- new sections of track at crossing loops
- new fencing and rail infrastructure in certain areas, including signage and signals
- spoil mounds (up to two metres high) within the rail corridor along the proposal site
- larger trains operating through the study area – trains would be double stacked, with a height of 6.5 metres (an example of a double stacked train is shown in Plate 19.3) and up to 1,800 metres in length
- Parkes north west connection

  Brolgan Road overbridge.

Plate 19.3 Example of a double stacked train

Landscape character impact

The impact on the landscape would vary along the length of the proposal site. The potential impacts on each landscape character zone are summarised in Table 19.2.

Impacts on landscape character generally occur where the ability to absorb change is lowest. For the proposal, this occurs in the areas where the proposal requires the removal of trees and is located in a greenfield area (for the Parkes north west connection). For other areas, the magnitude of impacts is lower, as the landscape is better able to absorb the proposal.

Table 19.2 Summary of landscape character impact ratings

Character zone (described in Table 19.1)	Main works in zone	Impact summary	Magnitude of impacts	Impact rating
Settlement – township	Track works Ancillary works including level crossing upgrades, communications, fencing and utilities	As most of the proposal occurs in the existing rail corridor it would have a relatively low impact on the surrounding landscape for this zone as a whole. In some cases, trees lining the roads (such as Henry-Parkes Way) screens views of the proposal site.	Low	Low
Settlement – village	Track works and ancillary works	The proposal would not impact on the character of this zone. The rail line already forms a key visual feature in the zone, and the proposal would involve minor changes to the appearance of the line. The proposal would involve generally low levels of visual modification. The proposed height increases (as a result of the track raising and larger trains) would be difficult to perceive in the wider landscape, or would be perceived as a small component within the wider landscape.	Low	Low
Agriculture – Goonumbla rolling countryside and Bogan marshland plains	Track works and ancillary works Crossing loops Parkes north west connection Brolgan Road overbridge	The proposal would have minimal impacts to the character of these zones overall. Similar to the village zone, the proposal involves minor changes to existing infrastructure which already forms a key visual feature of these zones. The main potential landscape impact would be in the Goonumbla rolling countryside zone, as a result of the Parkes north west connection. Due to the flat topography of the area, views would be available of elevated structures (the overbridge), and the infrastructure would present as new features in this landscape, impacting on the typical character of this area.	Low to moderate	Low to moderate

Visual impact

Given the low profile and horizontal form of most of the proposal, the level of visual modification would be confined to a distance relatively close to the area subject to change. The effect of distance on modification levels was incorporated into the assessment by applying different modification ratings to foreground (0 to 0.35 kilometres), middle ground (0.35 to 0.7 kilometres) and background (0.7 to one kilometres) views. The visual modification rating would be highest in the foreground, except where foreground vegetation screens the proposal.

Within the existing rail corridor, the proposal is generally considered to result in a low level of visual modification as it involves upgrading existing infrastructure. For the Parkes north west connection and the Brolgan Road overbridge, moderate to high levels of visual modification are associated with the construction of new infrastructure outside the existing rail corridor.

Once detailed design for the Parkes north west connection and the Brolgan Road overbridge have advanced to a sufficient level of detail, artist impressions would be prepared and used to support ongoing community consultation. However, in the meantime, Plate 19.4 to Plate 19.6 provide an indication of what these items would like, as they are of a similar section of rail line and similar road over rail bridge in a rural setting.

Plate 19.4 Example of similar infrastructure to the Parkes north west connection and the Brolgan Road overbridge – a new section of rail line with road overbridge

Plate 19.5 Example of similar infrastructure to the Brolgan Road overbridge – road overbridge pavement view

Plate 19.6 Example of similar infrastructure to the Parkes north west connection and the Brolgan Road overbridge – road overbridge side view

Whilst most of the proposal would be undertaken where rail infrastructure already exists, minor visual impacts would result from:

- the slight increase in the elevation of the tracks and formation
- a change from old and weathered infrastructure to new rail infrastructure
- larger trains using the rail line.

Visual modification ratings were generally assessed as being low to very low, other than in locations where the most visually sensitive viewpoint is in the background.

The proposed spoil mounds would provide some screening of the tracks and trains. At the maximum height of two metres, a spoil mound would provide visual screening of the proposed elements at the perpendicular view. Whilst cess drains and spoil mounds would run adjacent to long expanses of the proposal, there would be gaps to allow water to drain away from the rail formation. Additionally, spoil mounds would range in height, would not necessarily be located on both sides of the corridor, and would not extend throughout the corridor.

The assessment concluded that the crossing loops would result in a moderate level of visual impacts, as a new parallel track would be constructed. However, in the case of the crossing loop near Alectown, a very low level of visual impacts is estimated as the most sensitive viewpoint is a single dwelling located about one kilometre from the proposal site.

The visual impacts of the Parkes north west connection are considered to be medium to high, as it would result in vegetation removal and the presence of new infrastructure (including an elevated structure) in existing rural paddocks near residences (nine are located within one kilometre). Despite the high visual impact rating only one residence, located about 500 metres east of the Brolgan Road overbridge, would have a direct view of the Brolgan Road overbridge. The majority of residences are located near the northern part of the Parkes north west connection and would be unlikely to have a clear view of the infrastructure given the height and distance to the proposed rail line, and their location in an undulating landscape. The remaining residences would likely only see either the top of the double stacked trains or a view of Brolgan Road overbridge at a distance.

19.4 Mitigation and management

19.4.1 Summary of mitigation measures

To mitigate the potential landscape and visual impacts of the proposal, the following measures would be implemented.

Table 19.3 Landscape and visual mitigation measures

Stage	Impact	Mitigation measures
Detailed design/pre-construction	Landscape character and visual impacts	Detailed design would be undertaken according to the design vision, objectives and principles which underpin the concept design, and would take into account the guidelines listed in section 19.1.2.
	Artist impressions	Following completion of detailed design of the Parkes north west connection and Brolgan Road overbridge, artist impressions and perspective drawings would be developed for consultation purposes.
Construction	Light spill	Temporary lighting would be designed and sited to avoid light spill into residential properties and identified sensitive receivers. Temporary and any permanent lighting would be designed and sited so it complies with: - *Australian Standard AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting* - *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring* (Department of Planning and Environment, 2016).
	Spoil mounds	Spoil mounds would be shaped to reduce their angular profile and ensure that they are integrated within the landscape. Sharp transition angles in the surface profile would be avoided, and rounded profiles would be used to provide a more natural form. Grass cover would be established over the surface area in accordance with the rehabilitation strategy.

20. Land use and property

This chapter provides the land use and property impact assessment of the proposal. It describes the existing environment, assesses the impacts of construction and operation on land use, including property, agriculture uses, biosecurity, and land use in general, and provides recommended mitigation measures.

20.1 Assessment approach

20.1.1 Methodology

The assessment involved:

- reviewing the regulatory framework for land use and management, including relevant State, regional and local planning legislation, environmental planning instruments, policies, strategies and guidelines
- reviewing, identifying, and mapping existing land uses within the study area based on a desktop review of GIS spatial data and aerial photography, including:
  - land use zoning under the *Parkes Local Environmental Plan 2012* (the Parkes LEP) and the *Narromine Local Environmental Plan 2011* (the Narromine LEP)
  - significant properties and/or landholdings
  - agricultural uses, including any areas of regionally significant farmland; areas used for cropping, grazing and horticulture; travelling stock reserves; and agricultural infrastructure
  - Crown land
  - conservation and forest reserves
  - mineral resources and mining leases.
- assessing the potential for impacts on agricultural land uses during construction and operation, including undertaking a land use conflict risk assessment in accordance with the *Land use conflict risk assessment guide* (Department of Primary Industries, 2011)
- consideration of the potential for impacts on other land uses during construction and operation
- providing measures to mitigate and manage the impacts identified.

20.1.2 Legislative and policy context to the assessment

Relevant legislation and planning instruments are summarised in chapter 3. Land use planning strategies relevant to the study area and proposal are summarised in chapter 5.

The main guideline relevant to the assessment is *Infrastructure proposals on rural land* (Department of Primary Industries, 2013). This guideline provides the potential impacts to be considered by consent authorities' relation to infrastructure proposals, including:

- resource use and fragmentation
- impacts on farming operations and livestock
- increased weed, biosecurity and bushfire risks
- site rehabilitation.

These potential issues were considered as part of the assessment of potential impacts on agricultural land.

20.2 Existing environment

20.2.1 General land use description

An overview of general land use in the study area is provided in chapter 2. The proposal key features and land uses in the study area (based on the land use zoning from the LEPs) are shown in Figure 20.1. Other specific land uses considered by this chapter are shown in Figure 20.2.

The majority of land within the study area is held in freehold title. This includes properties held in freehold by private owners and various State Government departments. The study area also comprises areas identified as Crown land, including reserves, waterways and public roads.

Table 20.1 provides a summary of the main land uses in the Narromine and Parkes LGAs calculated based on mapping data provided by OEH. This data indicates that agricultural land uses (grazing and cropping) account for 90 per cent of the total land area within the two LGAs.

Table 20.1 Land use by LGA

Land use	Parkes (ha)	Narromine (ha)	Total land area (ha)	Per cent
Grazing	316,240	250,114	566,354	51
Cropping	205,856	228,551	434,408	39
Conservation area	33,645	11,632	45,277	4
Tree and shrub cover	26,078	10,818	36,896	3
Transport and other corridors	5,828	6,376	12,204	1
River and drainage system	2,490	8,247	10,737	0.96
Urban	2,820	5,556	8,376	0.75
Special category	598	2,120	2,718	0.24
Mining and quarrying	1,639	169	1,808	0.16
Wetland	64	1,471	1,535	0.14
Horticulture	30	721	751	0.07
Intensive animal production	18	97	114	0.01
Power generation	6	0	6	

Land use within the proposal site

Existing rail corridor

The majority of the proposal site is located within the existing rail corridor, which is used for infrastructure (transport – rail and supporting infrastructure) purposes. The zoning of the rail corridor is either SP1 – Special Activities (Freight Transport Facility) or SP2 – Infrastructure (Rail Infrastructure).

The rail corridor is subject to active use for rail transport. Existing operations along the corridor are described in chapter 2.

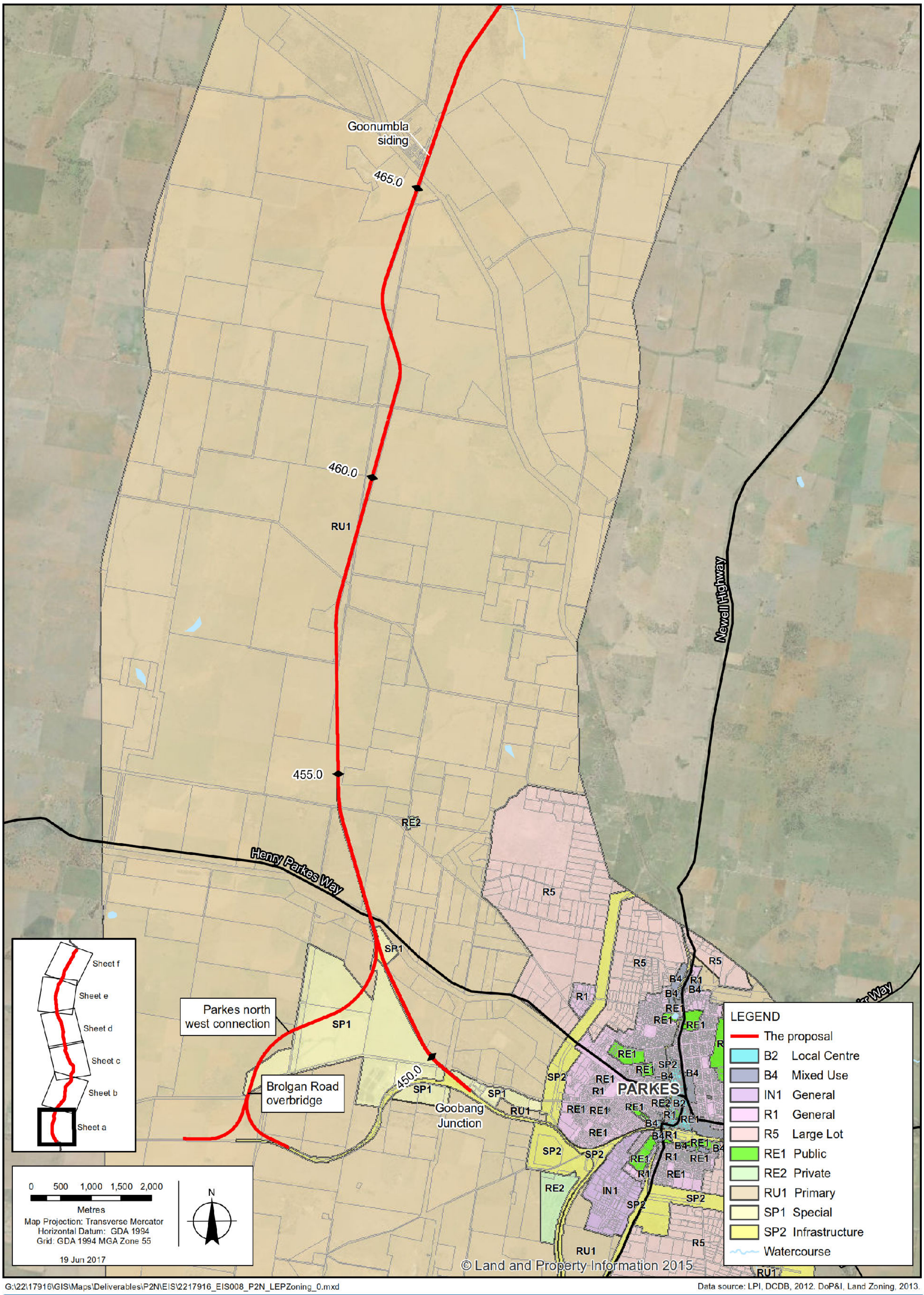
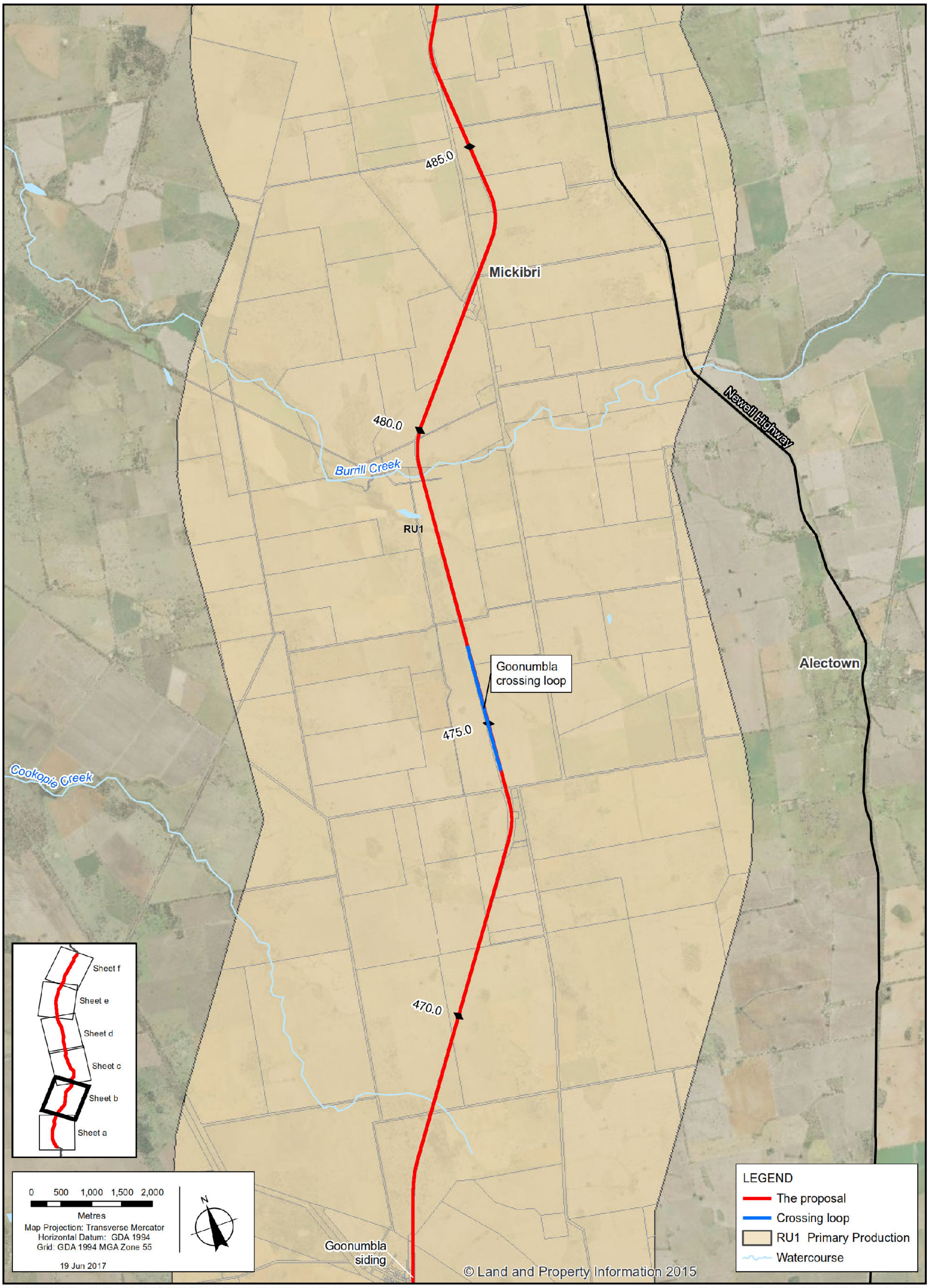


Figure 20.1a
Land use zoning



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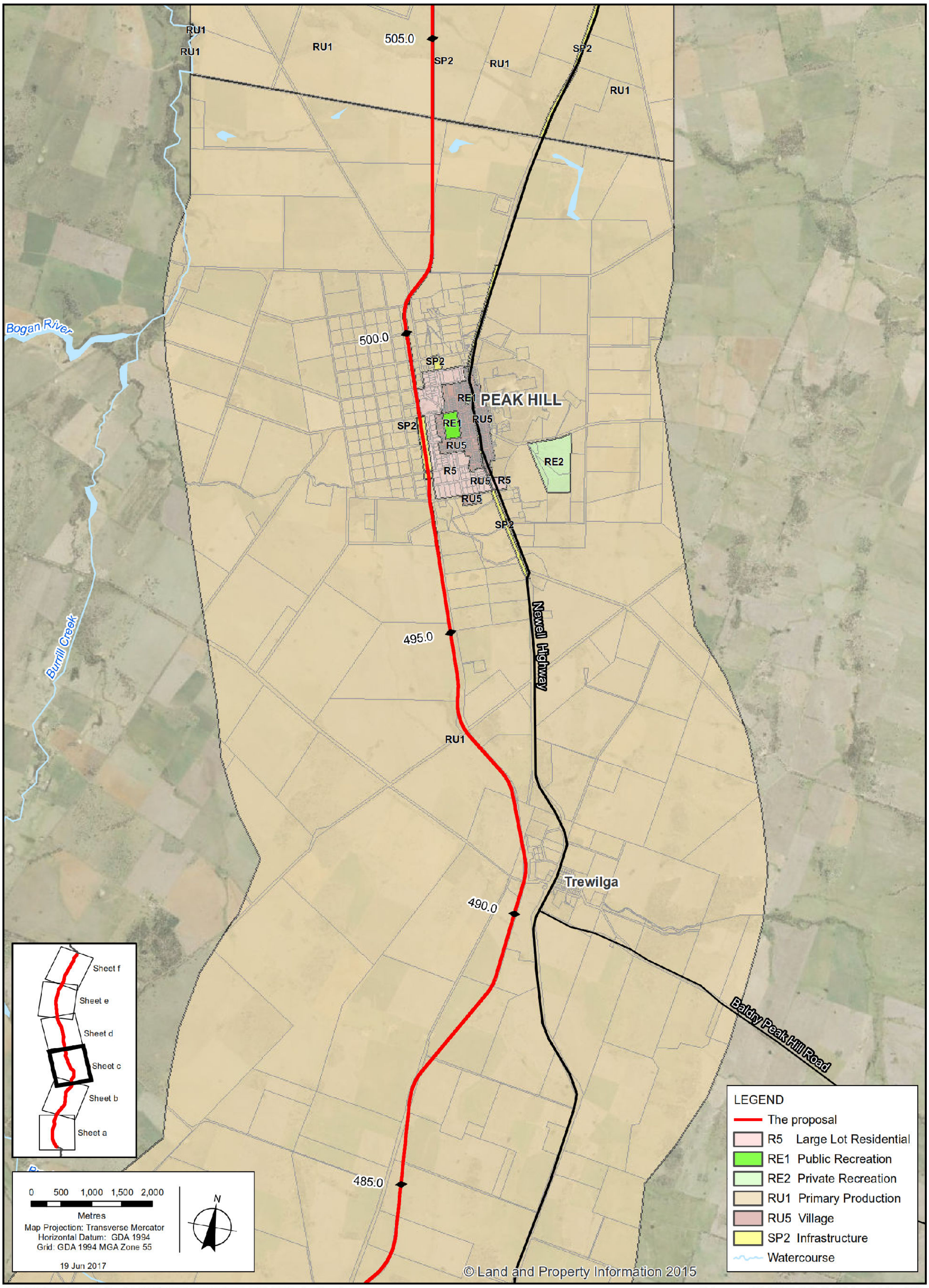
Data source: LPI, DCDB, 2012. DoP&I, Land Zoning, 2013.

Figure 20.1b
Land use zoning



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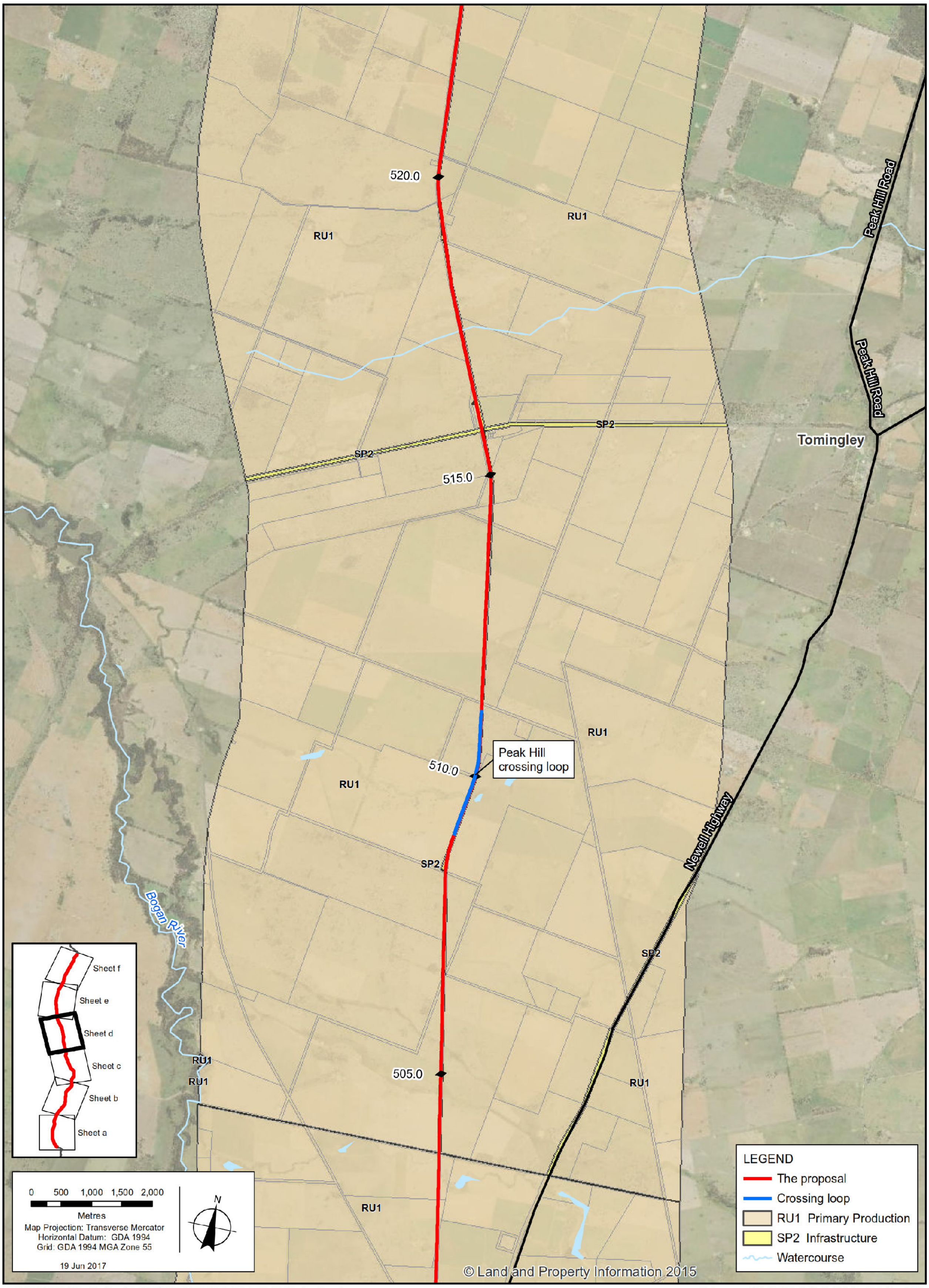
Data source: LPI, DCDB, 2012. DoP&I, Land Zoning, 2013.

Figure 20.1c
Land use zoning



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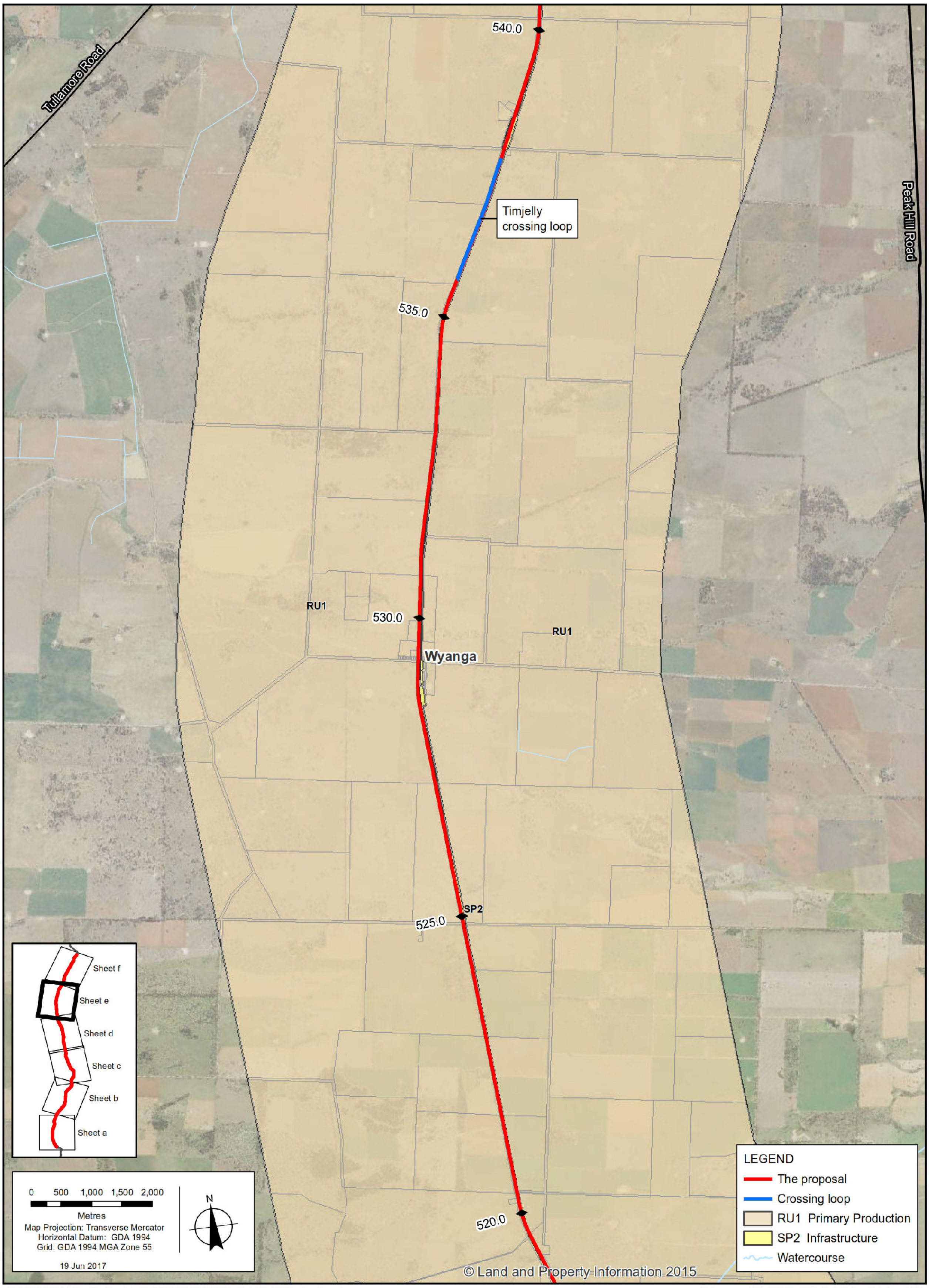
Data source: LPI, DCDB, 2012. DoP&I, Land Zoning, 2013.

Figure 20.1d
Land use zoning



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Data source: LPI, DCDB, 2012. DoP&I, Land Zoning, 2013.

Figure 20.1e
Land use zoning

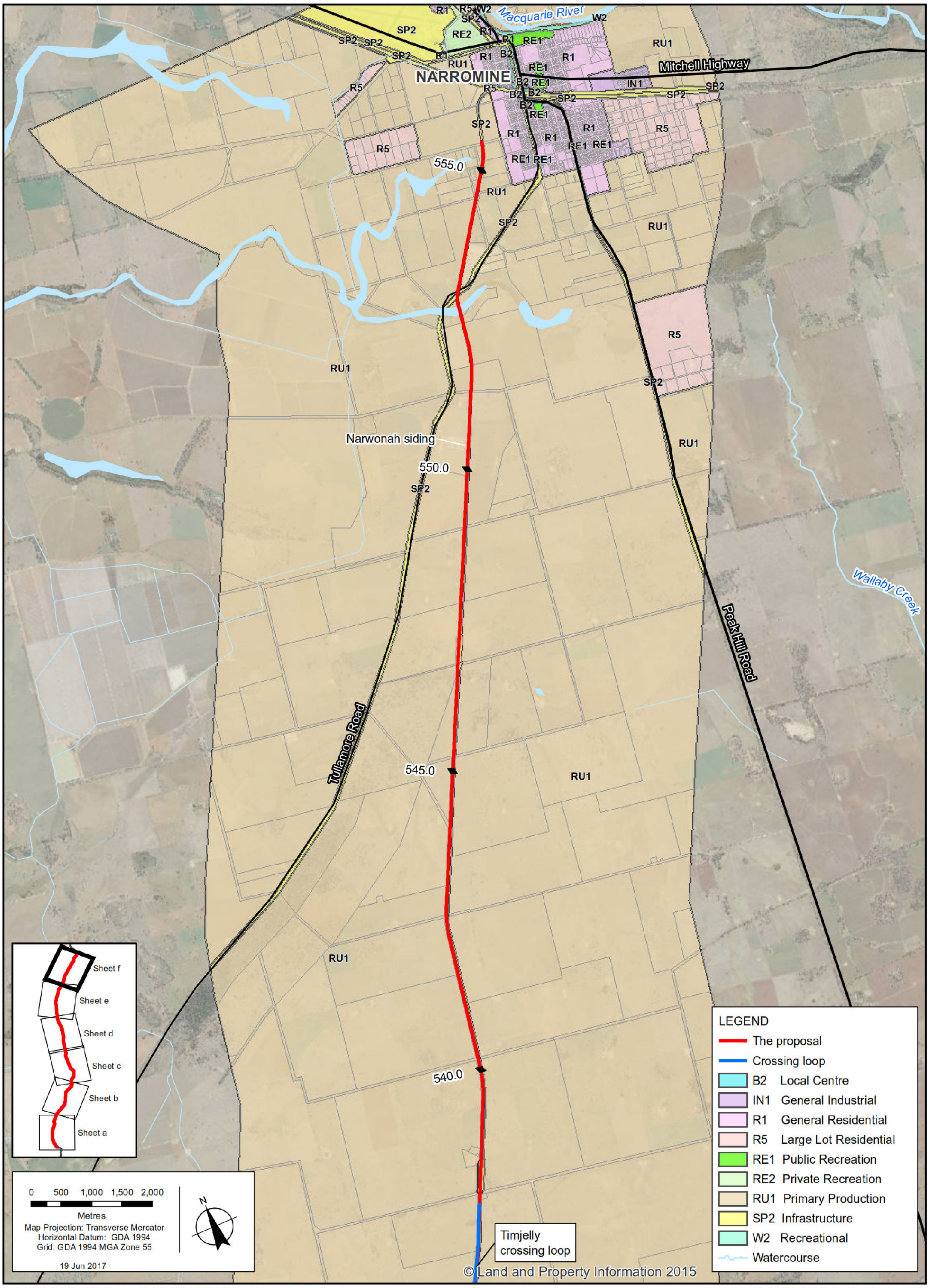
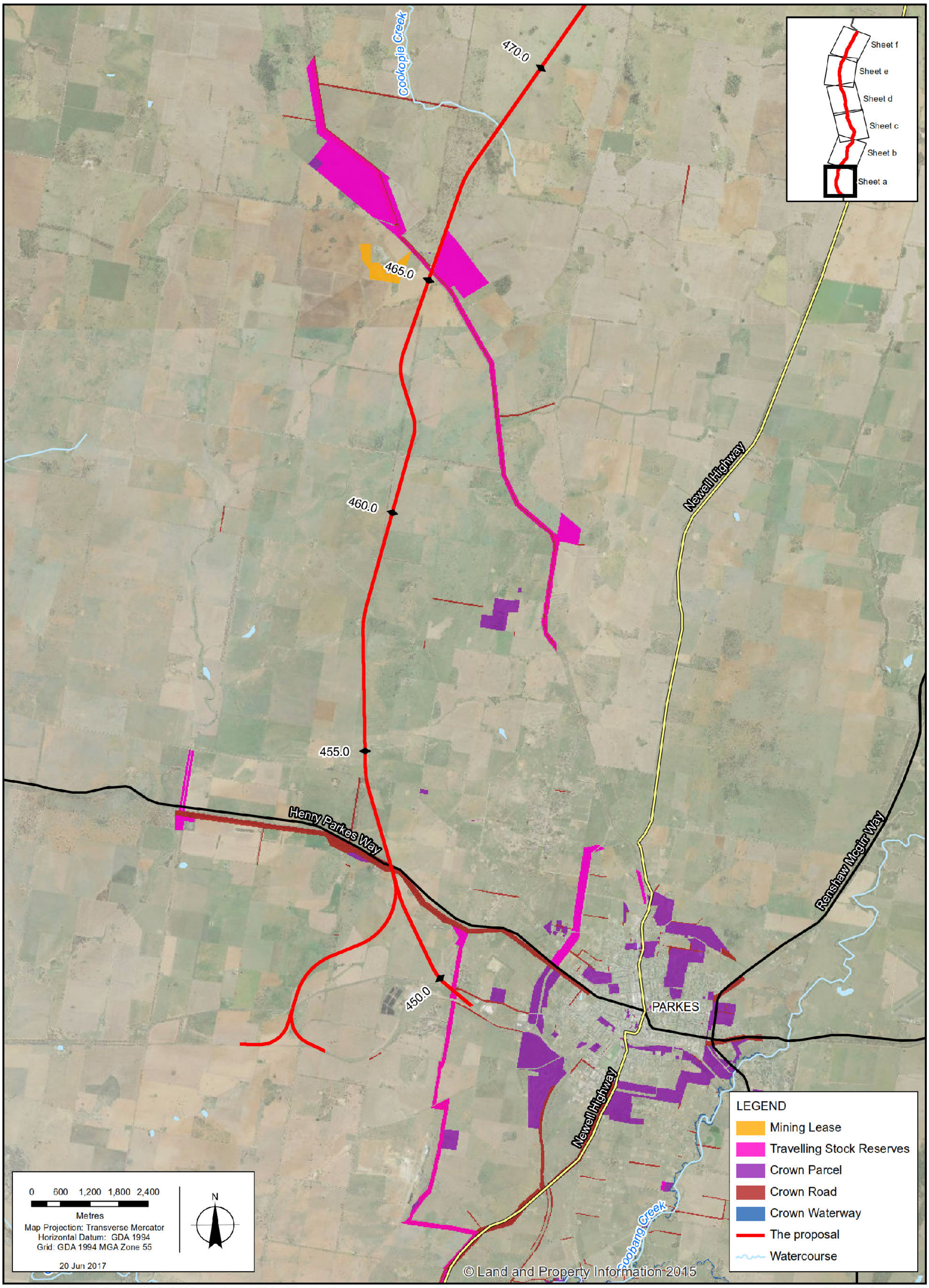


Figure 20.1f
Land use zoning



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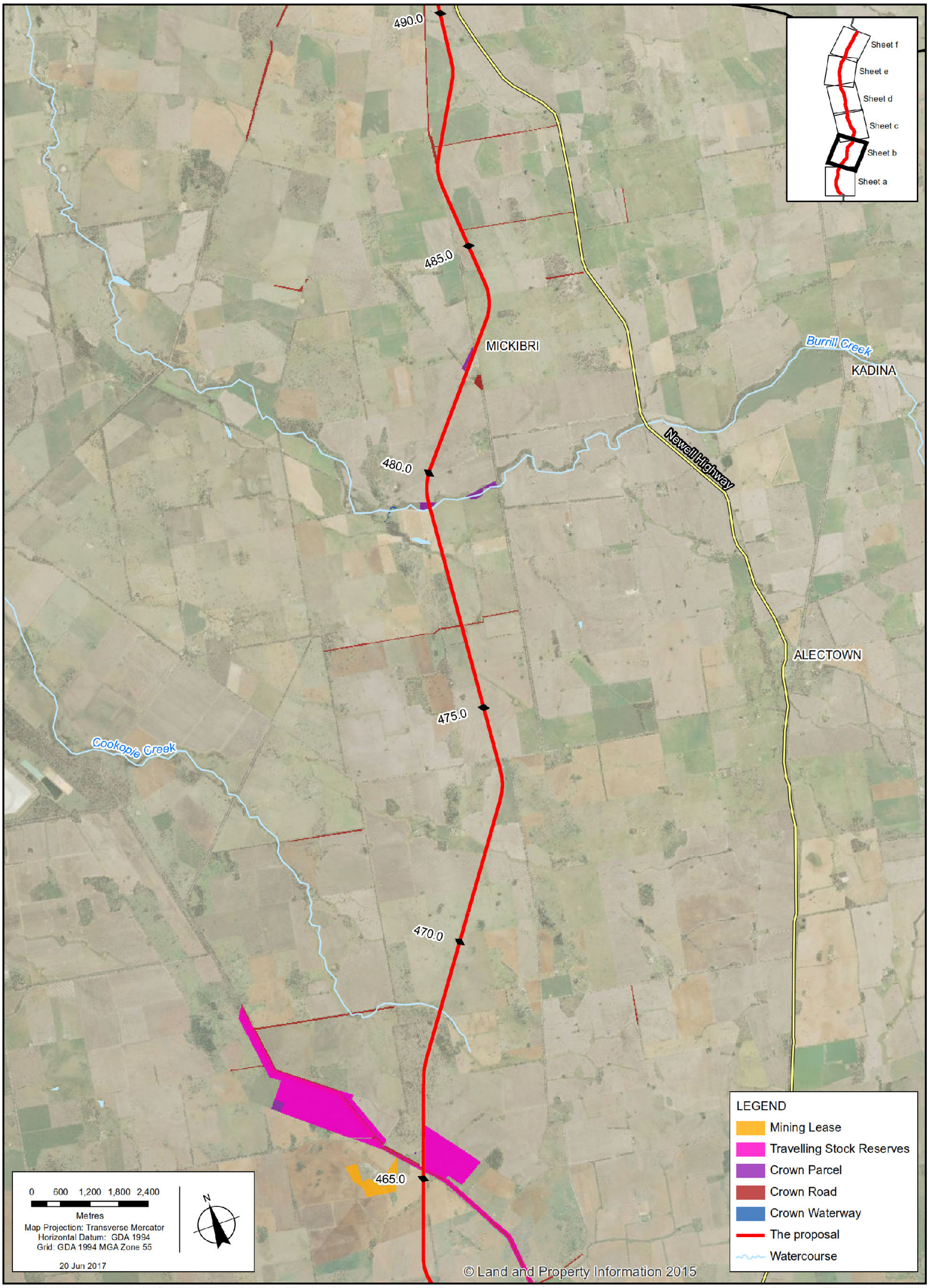
Data source: LPI, DCDB, Imagery, 2012

Figure 20.2a
Specific land uses



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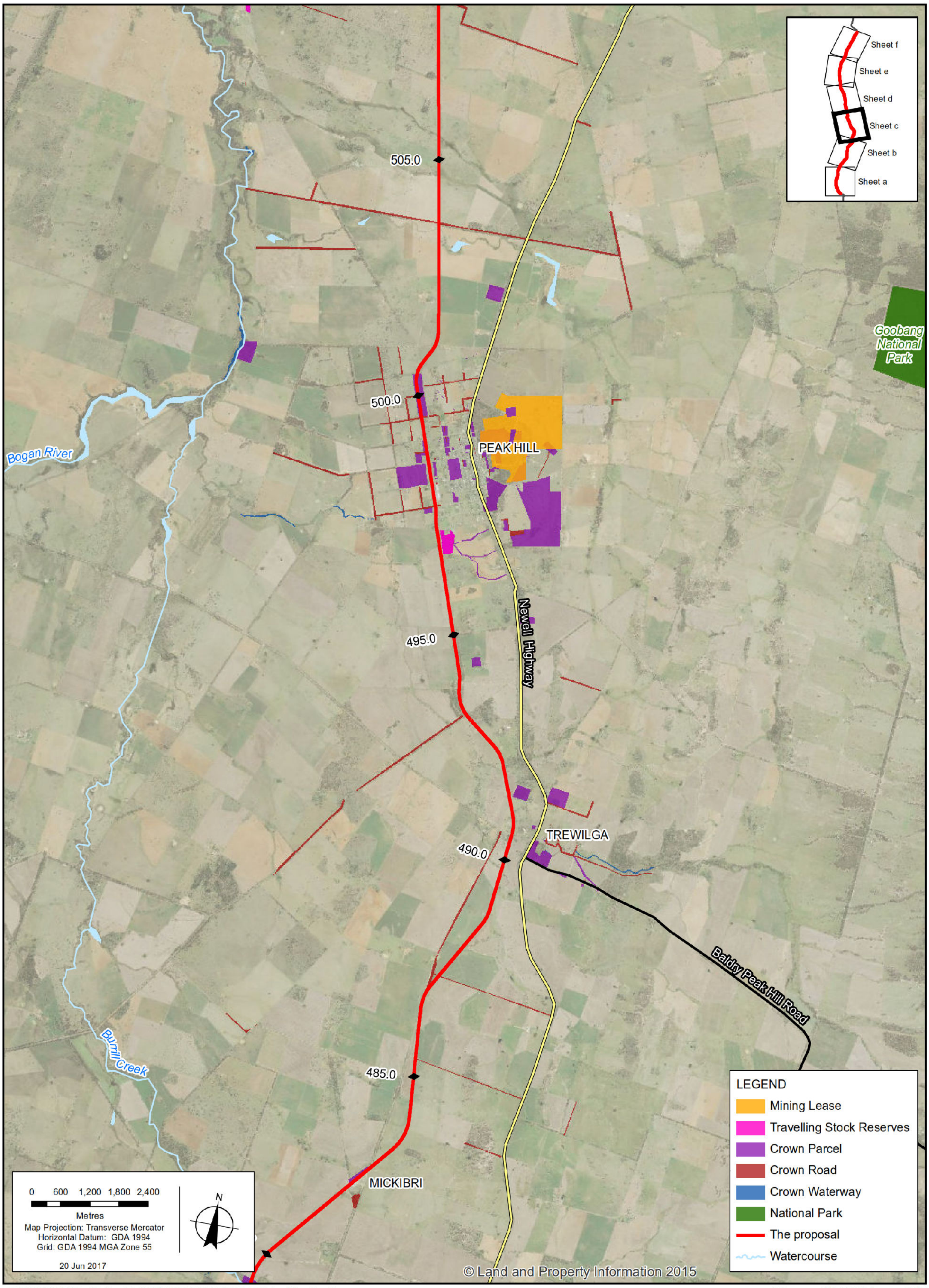
Data source: LPI, DCDB, Imagery, 2012

Figure 20.2b

Specific land uses



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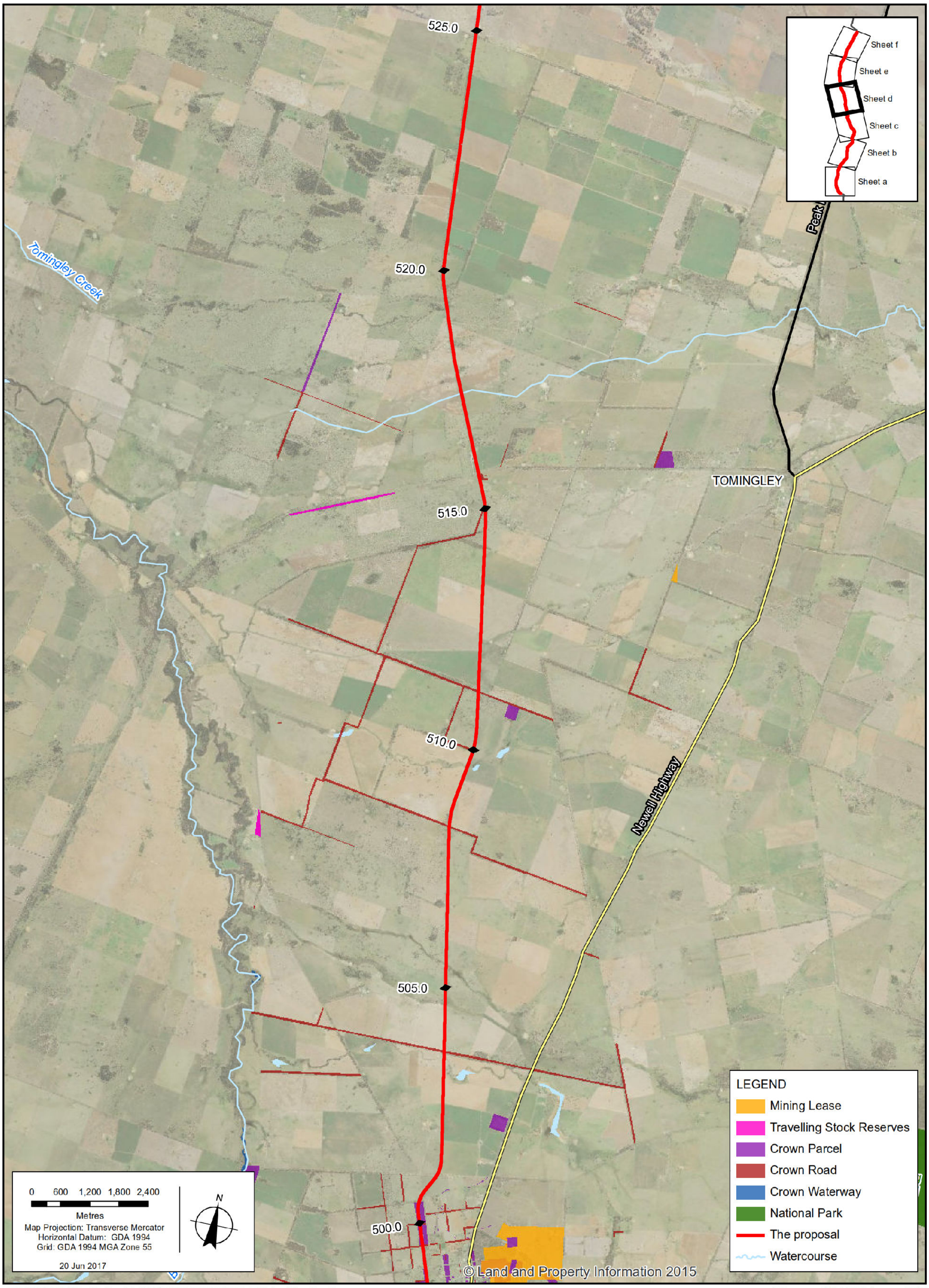
Data source: LPI, DCDB, Imagery, 2012

Figure 20.2c
Specific land uses



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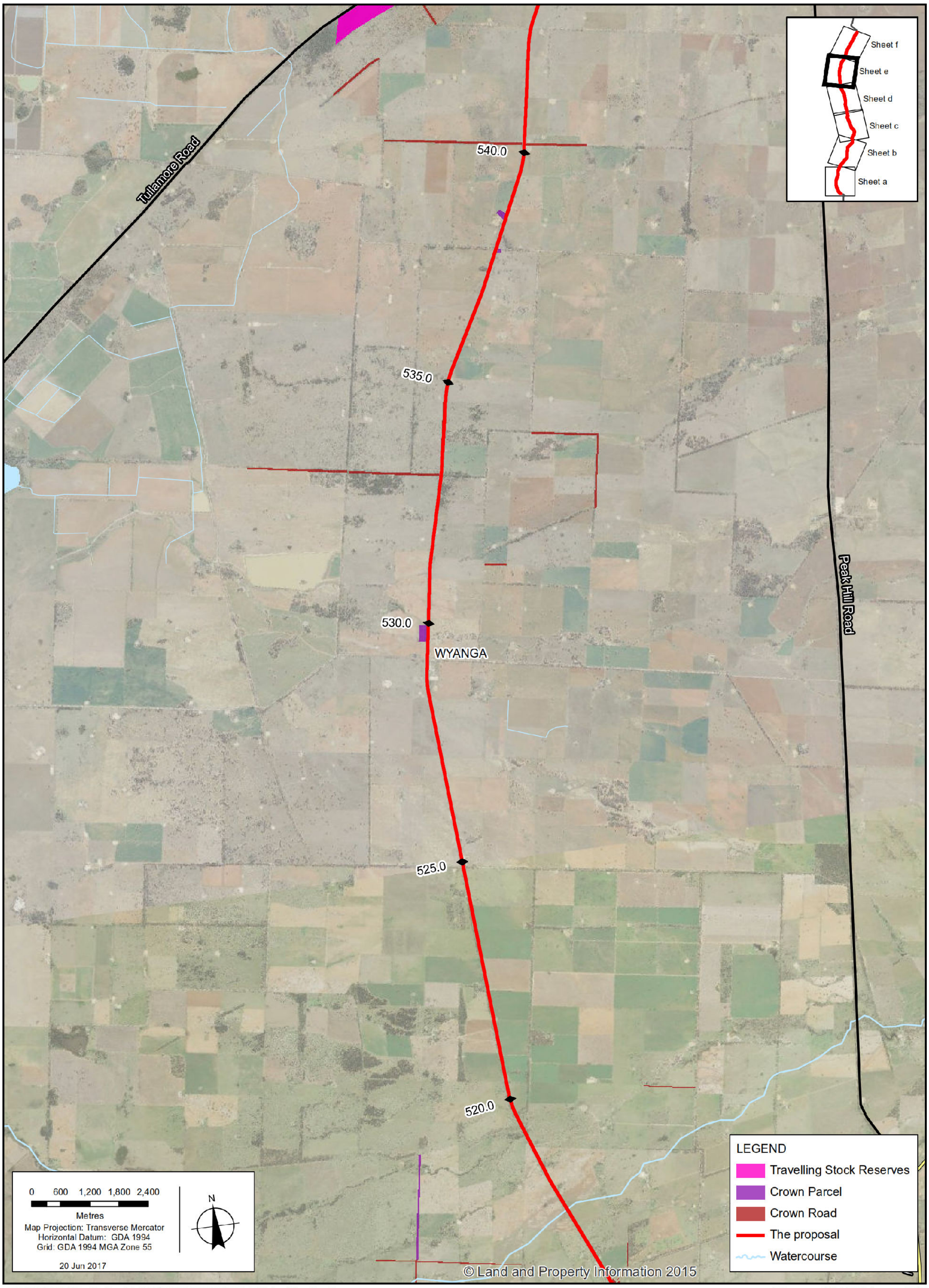
Data source: LPI, DCDB, Imagery, 2012

Figure 20.2d
Specific land uses



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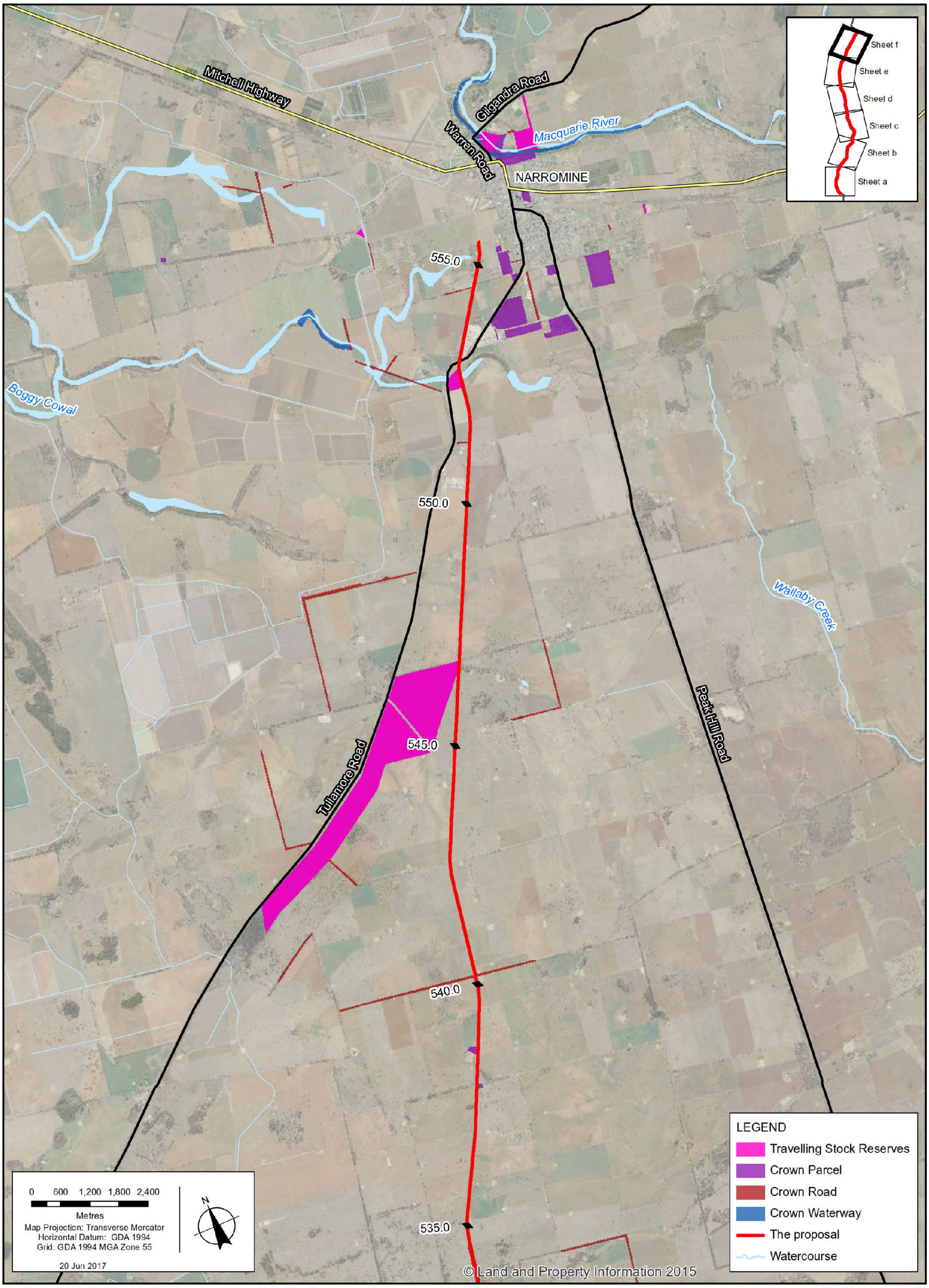
Data source: LPI, DCDB, Imagery, 2012

Figure 20.2e
Specific land uses



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Data source: LPI, DCDB, Imagery, 2012

Figure 20.2f

Specific land uses

Outside the existing rail corridor

Outside the existing rail corridor, the existing land use is predominantly rural/agricultural. Land in the proposal site outside the existing rail corridor is zoned RU1 – Primary Production, with the exception of the Parkes north west connection site, which is generally zoned either SP1 – Special Activities (Freight Transport Facility) or SP2 – Infrastructure (Rail Infrastructure).

Adjoining/surrounding land uses

Land surrounding the majority of the proposal site is used for rural/agricultural purposes (mainly zoned RU1 Primary Production). Properties include open grazing land, land used for cropping, scattered vegetation, residences and other farm buildings. Further information on agricultural land uses is provided in section 20.2.2.

Other land use zones adjoining the proposal site include:

- land zoned as General Residential (R1) and Large Lot Residential (R5) where the proposal site runs through Parkes, Peak Hill and Narromine
- land zoned as Infrastructure (SP2) and used for classified roads (such as the Newell Highway). Further information on the road network in the study area is provided in chapter 9
- land zoned as Special Activities (SP1) adjoining the proposal site north west of Parkes. This zoning allows for uses including freight transport facilities, heavy industrial storage establishments, high technology industries, rural industries, transport depots and truck depots.

20.2.2 Agricultural uses and activities

The climate in the study area is generally suited to rain watered winter crop production (cereals and oilseeds) as well as pasture production for grazing livestock, although the variability in rainfall introduces significant production risks which may be alleviated by irrigation, depending on water allocations. The main crops grown in the study area are listed in Table 20.2. Livestock numbers for grazing land are listed in Table 20.3.

Table 20.2 Major crops grown

Crop variety	Parkes (ha)	Narromine (ha)	Total (ha)	Per cent
Wheat	114,280	145,138	259,418	67.4
Barley	45,628	13,857	59,485	15.5
Canola	16,001	22,634	38,635	10
Chickpeas	2,328	14,745	17,073	4.5
Cotton	864	9,655	10,519	2.7
Sorghum	273	5	278	0.08
Mung beans	189	59	248	0.07
Fava beans	0	33	33	0.02
Totals	**179,563**	**206,126**	**385,689**	**100**

Source: ABS (2012) Agricultural Commodities Small Area Data, Australia, 2010-11, Cat. No. 7121.0

Table 20.3 Livestock numbers

Livestock	Parkes	Narromine	Total
Sheep	594,110	324,097	918,207
Lambs	279,615	152,365	431,980
Cattle (beef)	20,620	35,584	56,204

Source: ABS (2012) Agricultural Commodities Small Area Data, Australia, 2010-11, Cat. No. 7121.0

Land and soil capability

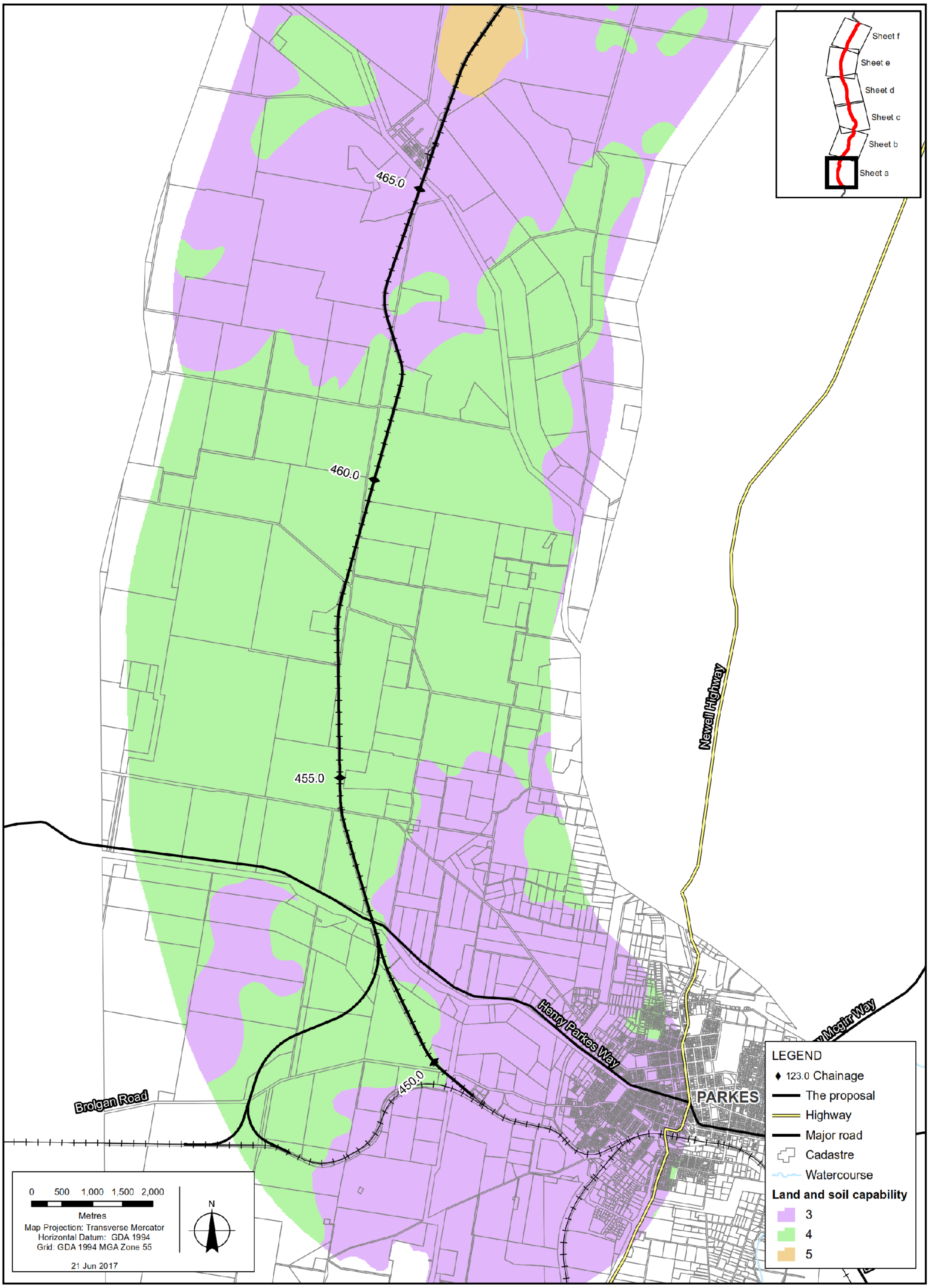
Rural lands in NSW are currently being mapped according to two different land classification systems. The first of these classifies land into eight classes known as Land Capability Classes and was developed by the former NSW Soil Conservation Services, while the second system classifies land into five classes known as Agricultural Suitability Classes. The aim of the Land Capability classification is to delineate the various classes of rural land on the basis of the land to remain stable under particular land uses. The Agricultural Suitability classification also uses land capability as a basis but then incorporates other factors such as closeness to markets, availability of water etc. Because the Land Capability system classifies land in terms of inherent physical characteristics or constraints, it consider the optimum use of land rather than the maximum use and in general will not change over time, while the Agricultural Suitability may. Given this, the Land Capability system was consider better to assess how the proposal may have an impact on agricultural land use on the area through physical changes to the landscape such as flooding.

The eight-class classification is shown in Table 20.4 while Figure 20.3 shows the land capability classes in proximity to the proposal site. Land near the proposal site predominantly comprises Class 3 and Class 4 land. In the northern half of the proposal land is capable of being regularly cultivated while in the south the land is suitable for grazing with occasional cultivation as per the definition in Table 20.4. This is consistent with the land uses described in section 20.2.1 which identified cropping and grazing as the predominant land uses near the proposal site.

Table 20.4 Land and soil capability

Broad category	Class	Description
Land capable of being regularly cultivated (Slope < 10%)	Class 1	No special soil conservation works or practices necessary
	Class 2	Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation.
	Class 3	Structural soil conservation works such as diversion banks, graded banks and waterways, together with soil conservation practices as in Class 2.
Land not capable of being regularly cultivated but suitable for grazing with occasional cultivation (Slope 10% - 25%)	Class 4	Soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or reestablishment of permanent pastures.
	Class 5	Structural soil conservation works such as absorption banks, diversion banks and contour ripping, together with the practices as in Class 4.
Land not capable of being cultivated but suitable for grazing (Slope > 25%)	Class 6	Soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. This class may require some structural works.
Other lands	Class 7	Land best protected by green timber
	Class 8	Cliffs, lakes or swamps and other land incapable of sustaining agricultural or pastoral production.

Source: Cunningham et al 1988, Systems used to classify rural lands in New South Wales.



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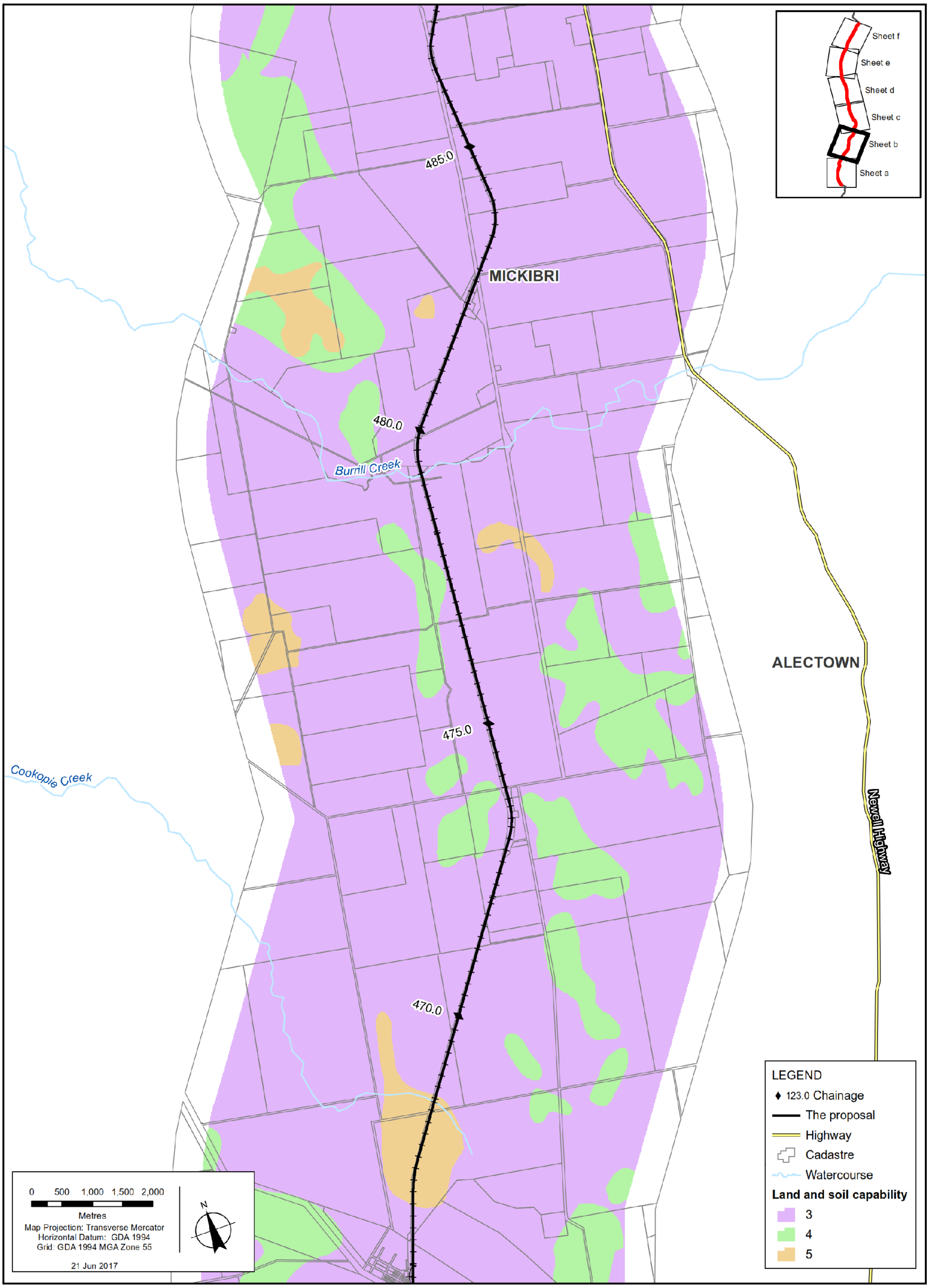
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.3a
Land and soil capabilities



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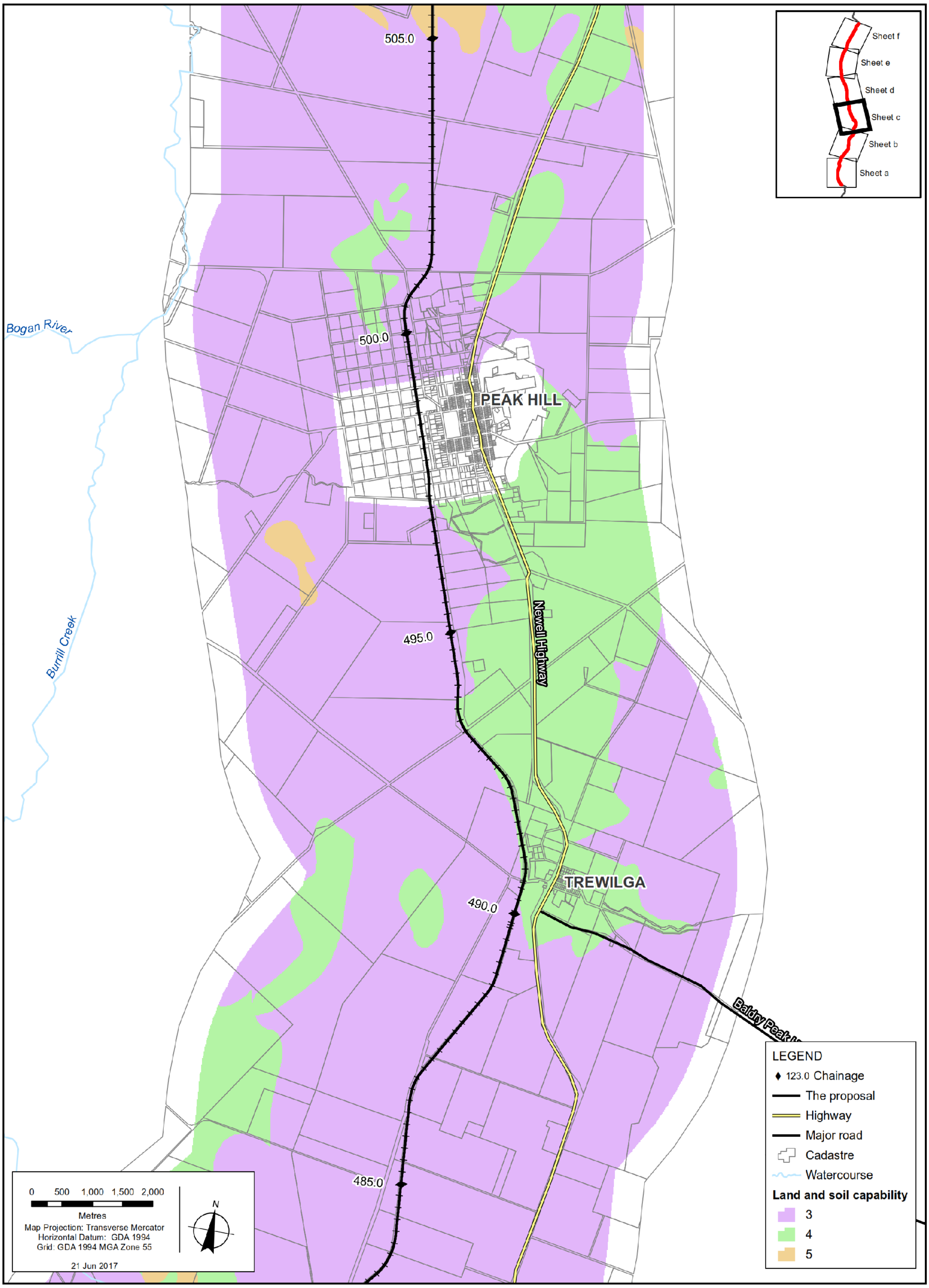
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.3b
Land and soil capabilities



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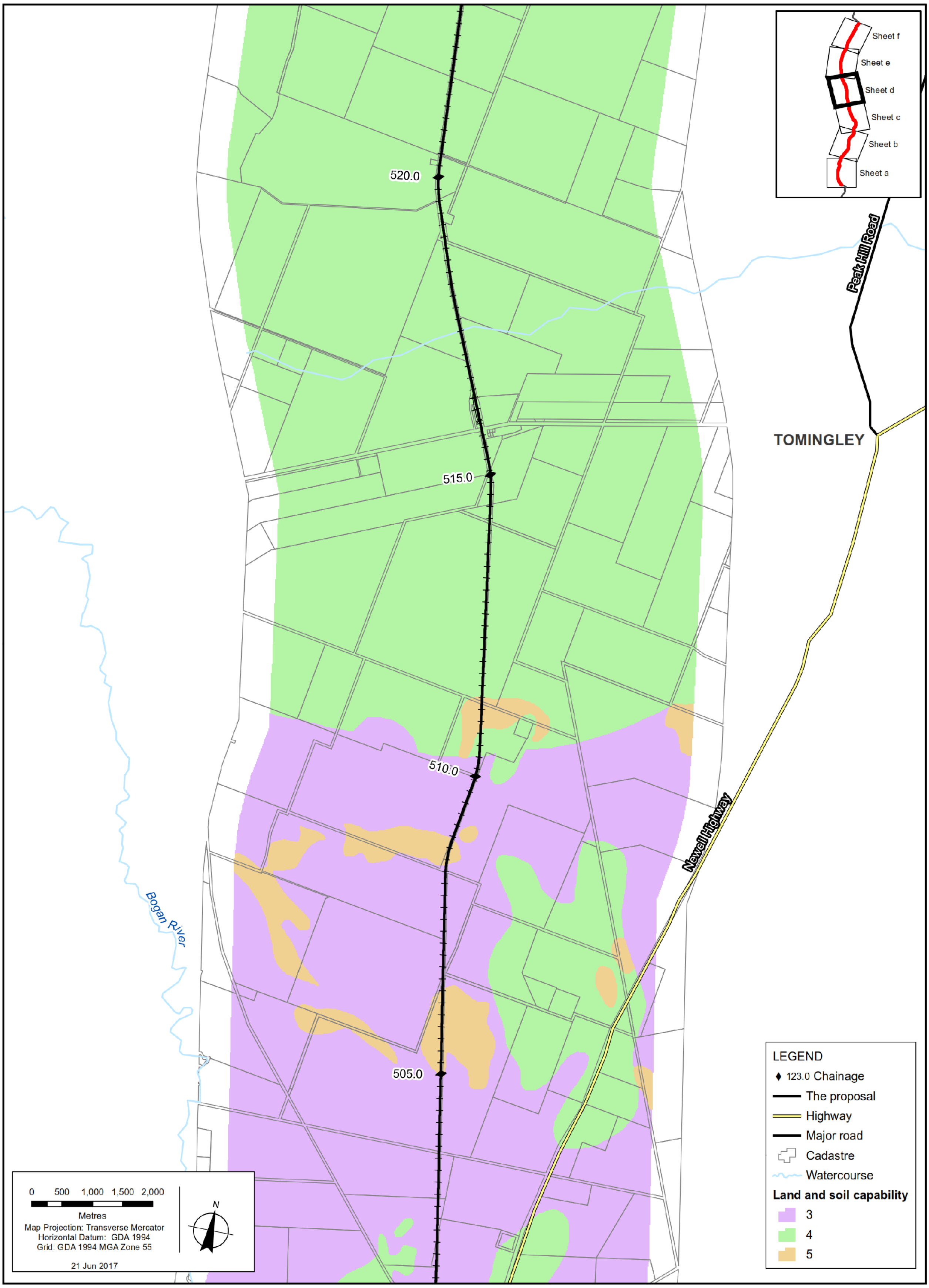
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.3c
Land and soil capabilities



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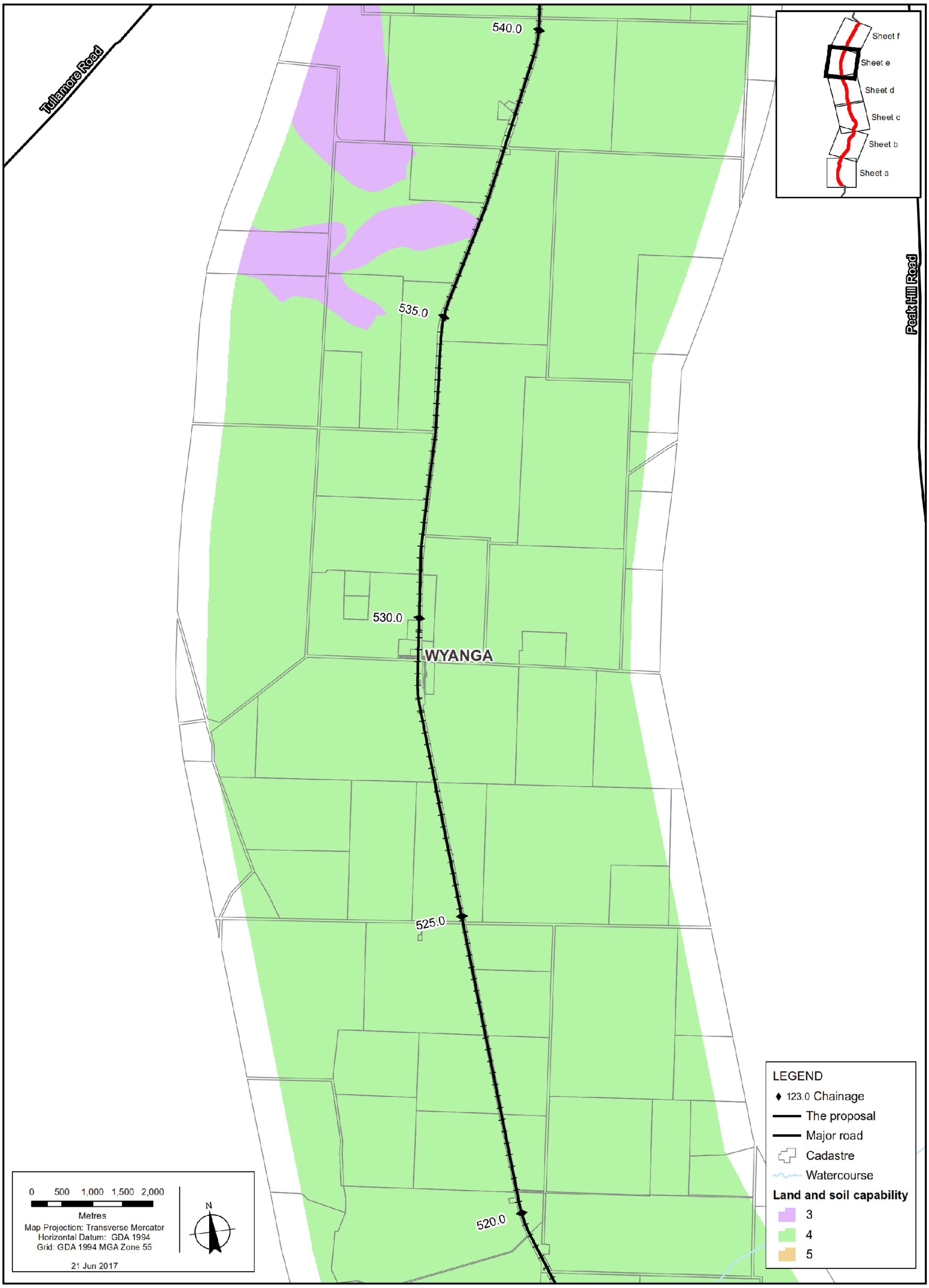
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.3d
Land and soil capabilities



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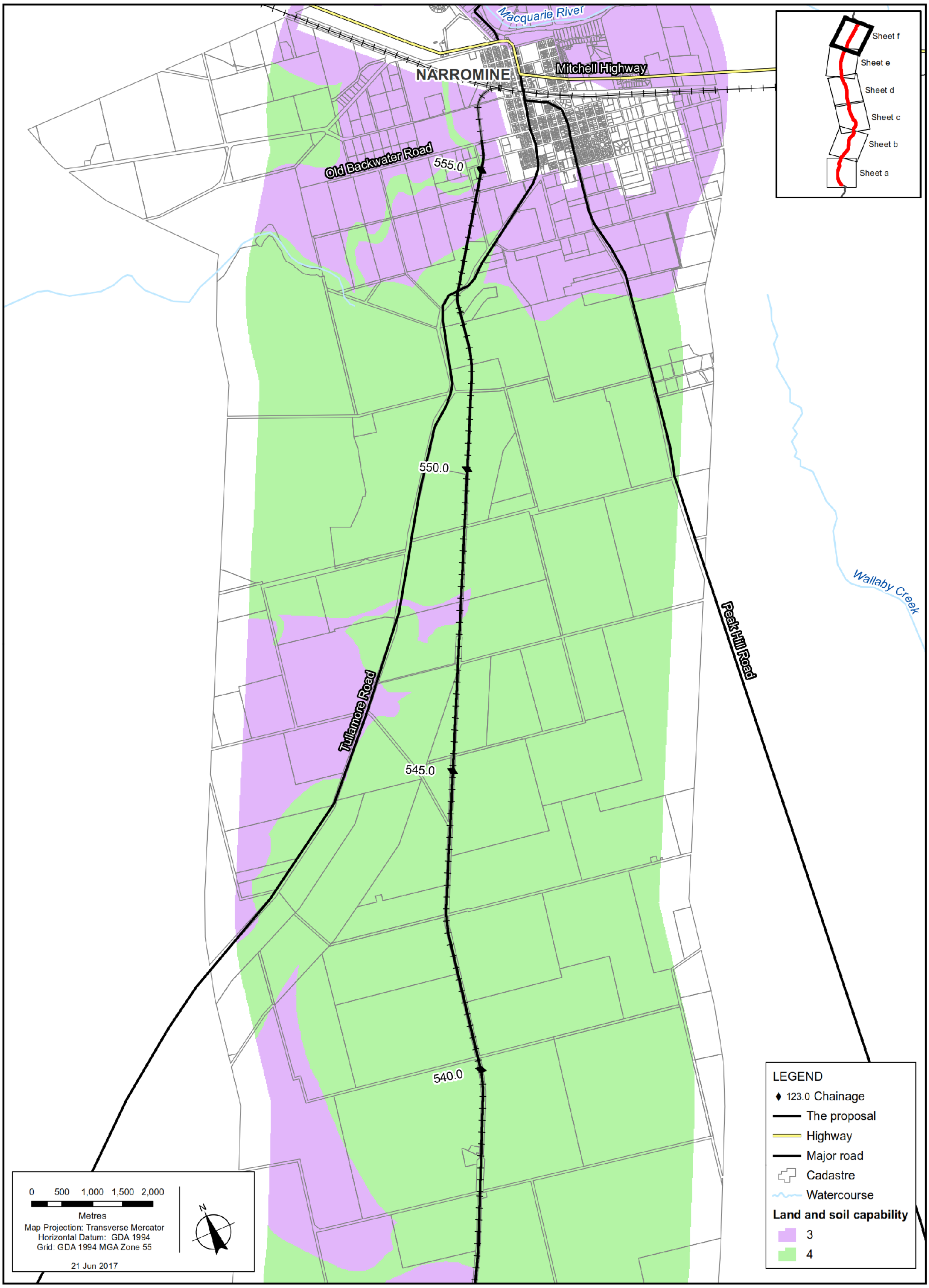
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.3e
Land and soil capabilities



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.3f
Land and soil capabilities

20.2.3 Reserves

There are no reserves close to the proposal site. The nearest reserve is Goobang National Park, which is located about nine kilometres to the east of the proposal site at the nearest point.

20.2.4 Mining leases

Active mines and areas subject to mining leases are listed in Table 20.5 and shown in Figure 20.2.

Table 20.5 Mining leases in the study area

Operator of mining lease	Size (ha)	Type of lease	Approx. distance from proposal site at the nearest point
Jandew Pty Ltd	32.2	Mineral (Agricultural Lime, Copper, Dimension Stone, Gold, Lead, Limestone, Silver, Zinc)	0.3 km to the west
Alkane Resources	163	Mineral (Alumina, Barite, Bismuth, Cadmium, Chlorite, Copper, Corundum, Feldspathic Materials, Gold, Kaolin, Mica, Phosphates, Pyrophyllite, Reef Quartz, Sele)	1.0 km to the east

20.2.5 Crown land and travelling stock reserves

Crown land within 100 metres of the proposal site comprises 51 Crown roads, which is inclusive of 16 shared Crown and council owned roads. Of these, 20 roads either cross or end at the proposal site. In addition, 18 parcels of Crown land are located directly adjacent to the proposal site.

Travelling stock reserves are parcels of Crown land reserved under legislation for use by travelling stock. They provide pasture reserves for travelling or grazing stock. Travelling stock reserves within 100 metres of the proposal site (shown in Figure 20.2) comprise:

- eight Crown roads (comprising three Crown and five shared Crown and council roads), six of which cross the proposal site
- six parcels of Crown land, of which three are directly adjacent to the proposal site.

The above summary and the Crown land shown on Figure 20.2 differentiates between Crown land that is travelling stock reserves and other Crown land.

No Native Title Claims or Indigenous Land Use Agreements have been registered or notified by the National Native Title Tribunal for Crown land in the study area. Additionally the Office of the Registrar and the National Native Title Tribunal did not identify any Registered Aboriginal Owners or Native Title parties that should be contacted regarding the proposal.

20.2.6 Land ownership/tenure

Land within the rail corridor is owned by various government agencies. Ownership of land within other areas of the proposal site comprises various government agencies, the Crown, and a number of private owners. Land ownership for land proposed for acquisition is listed in Appendix G.

20.3 Impact assessment

20.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential issues and risks associated with land use and property. The assessed risk level for the majority of potential land uses risks was medium to high. Risks with an assessed level of medium or above include:

- temporary impacts on land use during construction
- impacts on agricultural practices during construction activities as a result of changes to access, noise, and air pollution
- impacts on land use as a result of property acquisition.

How potential impacts have been avoided

The approach to avoiding land use and property impacts is similar to that for landscape and visual impacts, as described in section 19.3. For the proposal section in particular, the proposal minimises 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 Parkes north west connection), land use and property impacts were included in the list of selection criteria used for the analysis of options.

Potential impacts on land use and property would continue to be avoided by:

- designing, constructing, and operating the proposal to minimise the potential for land take outside the rail corridor
- implementing the mitigation measures provided in section 20.4.

20.3.2 Land acquisition and leasing

As noted in section 7.5, a limited amount of property acquisition would be required to construct the proposal. Initial and indicative land acquisition requirements are provided in Appendix G. At this stage of the design process, it is estimated that land acquisition would partially affect a total of 10 privately owned lots. All acquisitions of privately owned land would be undertaken in consultation with landowners and in accordance with the requirements of the *Land Acquisition (Just Terms Compensation)* Act 1991.

The land use for those areas acquired outside the existing rail corridor, such as for the Parkes north west connection, would change from the existing land use (the existing zoning is defined in Appendix G) to an active transport (rail) use. The total area of the privately owned lots that would be subject to acquisition for the Parkes north west connection is about 692 hectares, of which about 349 hectares is zoned RU1 (primary production). The exact area of the lots that would need to be acquired would be confirmed during detailed design. It is expected that acquisition would mainly affect land zoned for special activities/infrastructure (SP1 and SP2), with a lesser area of RU1 zoned land likely to be required (refer to Figure 20.1). Construction and operation of the Parkes north west connection is consistent with the objectives of the SP1 and SP2 zones as per the Parkes LEP, which are to provide suitable land for a national multi-modal freight and transport interchange, and provide for infrastructure and related uses.

Any land required for construction (for the location of construction compounds and site accesses) would be leased from landholders. Leasing requirements are unknown at this stage. Consultation regarding agreements would be undertaken with landowners prior to construction commencing.

Impacts to Crown land

At this stage of the design process, it is estimated that land acquisition would affect three parcels of Crown land (roads). All acquisition of Crown land would be undertaken in consultation with the Department of Primary Industries, and in accordance with the requirements of the *Crown Lands Act 1989* and the *Land Acquisition (Just Terms Compensation) Act 1991*.

20.3.3 Construction impacts

Land use

General land use impacts

During construction, temporary changes to the use of some land would occur. Impacts to the use of the land would be mainly related to a temporary change from the land uses summarised in section 20.2.1 to an active construction site.

For the majority of the rail corridor, the impacts would be temporary and short term as construction activities would move along the corridor progressively. This would minimise the impacts on existing land uses at any one point to a relatively short period of time.

Impacts to agricultural land uses and land capability

Potential impacts to agricultural land uses would also include the general property impacts described below. Construction activities that may involve temporary change in use of land outside the rail corridor would include access tracks and compounds. As the land surrounding the majority of the proposal site is subject to agricultural land uses, the main potential impact would be to land used for grazing or cropping purposes. It is expected that these would be short term in duration, and any removal of agricultural production would have a negligible effect on the overall value of agriculture within the region. It would be necessary to ensure that during construction phase a tailored, risk based framework approach to biosecurity is considered for each property.

Travelling stock reserves

As described in section 20.2.5, three travelling stock reserves cross the proposal site and five are located directly adjacent to the proposal site. Construction activities may temporarily impact access to/along travelling stock reserves at locations where the reserves cross the proposal site, as the proposal site would need to be fenced during construction and access restricted. The construction of infrastructure and placement of compounds could also affect access and use of reserves directly adjacent to the proposal site. ARTC has commenced discussions with Local Land Services to understand how and when the reserves with the potential to be impacted are used, and how impacts could be avoided. Alternative access arrangements would be made as required.

Reserves

The proposal would not impact any conservation or recreation reserves.

Mining leases

The proposal would not impact land subject to active mining leases.

Services and utilities

As noted in section 8.7, construction has the potential to impact on existing utilities and services, including underground services such as electricity, gas, and telecommunications; and overhead power lines. Impacts may include temporary disruption as a result of services relocation/upgrade (for example, power outages) or accidental damage. These impacts are considered to be minimal as the disruptions would be short-term, and affected residents and/or business owners would be notified in advance of any disruptions.

Utility and service provides would continue to be consulted during the detailed design process to identify possible interactions and develop procedures to be implemented to minimise the potential for service interruptions, which have the potential to impact on existing land uses.

Property impacts

Potential property impacts during construction are considered in Table 20.6.

Table 20.6 Potential property impacts during construction

Potential impacts	Comment
Damage to stock and property	Construction on or immediately adjacent to private properties has the potential to damage or injure property, stock and/or crops if the movement of vehicles occurs on private property, or if stock were to cross the proposal site. Any property/stock disturbance or injury could have social and/or financial impacts, for example, by causing extra time to be expended doing additional tasks, moving stock etc.
Land rehabilitation	Landowners would expect that construction sites are adequately restored to their original condition.
Biosecurity risks, including the spread of weeds and disease	There is the potential for weeds and disease to be transferred from one property to another via construction vehicles or machinery, or construction crew clothing and footwear. This potential impact is considered further below.
Disruption of services or utilities to individual properties	Impacts may include temporary disruption as a result of services relocation/upgrade (for example, power outages) or accidental damage. These impacts are considered to be minimal as the disruptions would be short-term, and affected residents and/or business owners would be notified in advance of any disruptions.
Change to property access	Construction activities may temporarily block access to land. This could include paddocks being temporarily severed with the effect that grazing by livestock is temporarily constrained e.g. due to the unavailability of drinking water. Further information on the potential for access impacts is provided in chapter 9.
Interrupted management	Construction and operation could cause a delay to land owners completing various crop and livestock husbandry operations (e.g. weed spraying, harvesting, animal health treatments etc).
Dust and noise	Construction has the potential to generate dust and noise impacts. Dust could settle on crops and pastures, and noise could affect grazing patterns of livestock. Dust suppression would reduce the risk of dust settling on crops and pasture. Also, any dust accretions would be removed at each rainfall event resulting in negligible impact. Livestock generally become habituated to noise. Although grazing patterns may be altered, productivity is unlikely to be impacted. Further information on the potential for air quality and noise impacts is provided in chapters 11, 12 and 13.

Increased in biosecurity risks – pests, diseases and weeds

The proposal would result in the increased movement of vehicles and people to, around and within the proposal site during construction. The main biosecurity risk relates to the spread of weeds that may result from the increased movement of vehicles. Weed seeds could be transported through and within the site on clothing and via vehicle wheels and undercarriages.

If a new pest or disease becomes established, it can affect agricultural properties through increased costs (for monitoring, production practices, additional chemical use and labour), reduced productivity (in yield and/or quality) or loss of markets.

Existing weed species, and mitigation measures to manage the potential spread are weeds, are described in chapter 10.

The construction compounds would include waste bins which could attract pest animals. This risk would be minimised by fencing compounds and appropriate management of waste as outlined in chapter 24.

20.3.4 Operation impacts

Land use

General land use impacts

For land within the existing rail corridor, the general land use would remain the same however use of the rail line would intensify once Inland Rail is operational, as described in section 7.6. Potential impacts associated with the increase in train movements, including safety, access and amenity impacts, are considered in chapters 9, 11 and 21, respectively.

Outside the existing rail corridor, acquisition of land for the Parkes north west connection would change the land use from the existing rural uses to an active transport (rail) use. As described in section 20.3.2, the majority of land to be acquired is zoned for a use which is consistent with the proposed transport use. Therefore, the impacts on existing land use would be minimal, and limited to land zoned for agricultural purposes (that is, RU1). The potential impacts to agricultural land use are described further below.

Future use and development potential

The acquisition of land for the proposal would potentially result in the reconfiguration of some partially impacted properties. In these cases, there may be potential impacts on future property development due to a reduction in the property size and amount of developable area on each property. This would be taken into account during the acquisition process.

The proposal would not directly impact any local urban release areas identified for future residential or employment land.

Agricultural impacts

As described in section 20.3.2 about 50 per cent of the lots that would affected by acquisition for the Parkes north west connection are currently zoned RU1. Of this land, approximately 66 per cent is used for cropping and 34 per cent is used for grazing (refer to Figure 20.4). This is consistent with the agricultural land class of the majority of the land in this area (Class 4 – refer to Figure 20.3). If all of this land were to be acquired (which is considered unlikely) then this would relate to less than 0.001 per cent of the total land used in Parkes LGA for cropping and grazing, respectively. Therefore, any removal of agricultural production would have a negligible effect on the overall value of agriculture within the region.

No operational impacts to surrounding agricultural land uses are predicted. Potential impacts associated with the increase in train movements, including safety, access and amenity impacts, are considered in chapters 9, 11 and 21, respectively.

Travelling stock reserves

The proposal would have minimal impacts on travelling stock reserves, as access would be maintained during operation.

Flooding impacts on land use

As described in chapter 15, the hydrology and flooding assessment identifies that there would be some changes in flood levels upstream of the proposal site. These changes would largely be a result of the lifting of the level of the rail formation, with this in part being counteracted by the provision of culverts under the rail formation.

An assessment of land use impacts as a result of the predicted change in flooding has been undertaken. Figure 20.4 shows the changes in the one per cent AEP flood event extents due to the proposal and impacts on existing land use. Table 20.7 lists the areas of land uses affected by existing and predicted flood events.

Table 20.7 Land use impact by flood extents under existing and design conditions

Land use	Existing area impacted by a 1% AEP flood event (ha)	Area that would be impacted with the proposal (ha)	Increase/ decrease (ha)	Increase/ decrease (%)
Conservation area	1.3	1.3		
Cropping	288	332.4	44.4	15
Grazing	485	538.9	53.9	11
Mining and quarrying	1.6	1.6	0	0
River and drainage system	58	56	-2	-3
Special category	7.3	2.3	-5	-68
Transport	92.9	97	4.1	4
Urban	3.9	7	3.1	79
Total	**938**	**1036.5**	**98.5**	**10**

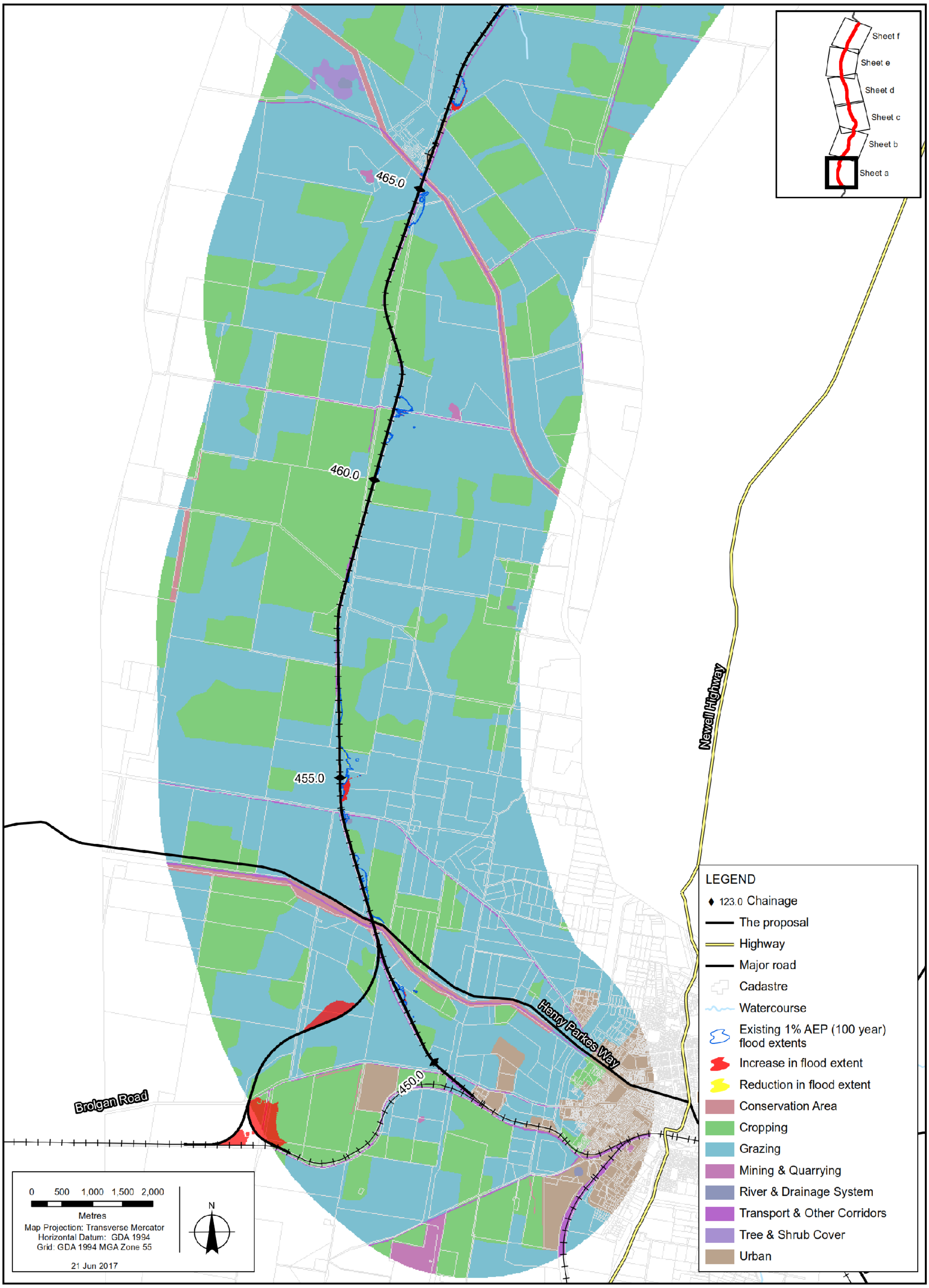
As shown in Table 20.7, the proposal would increase the impact of localised flooding in the study area by about 100 hectares, with increases in inundation mainly impacting (in terms of total area) cropping and grazing land uses. However, the duration of flooding in these additional areas under most flood events is likely to be in the order of a few hours, which would be insufficient to determintally affect crops, and flooding would generally only impact properties already affected by flooding (refer to Figure 20.4). The increased extent of flooding equates to about 0.01 per cent of the total land currently used for cropping and grazing in the Parkes and Narromine LGAs. As a result, the temporary removal of agricultural production in these areas, although considered unlikely to occur, would have a negligible effect on the overall value of agriculture within the region.

The increase in flood extent may temporarily affect access within the affected properties. Additional discussions would be undertaken with the landowners of the affected properties to determine the consequences of the expected impacts and, where necessary, further refine mitigation measures to reduce the impacts.

Further information on the potential for flooding impacts during operation is provided in chapter 15.

Property impacts

The proposal would not result in direct impacts to properties during operation. Potential impacts associated with the increase in train movements, including safety, access and amenity impacts, are considered in chapters 9, 11 and 21, respectively.



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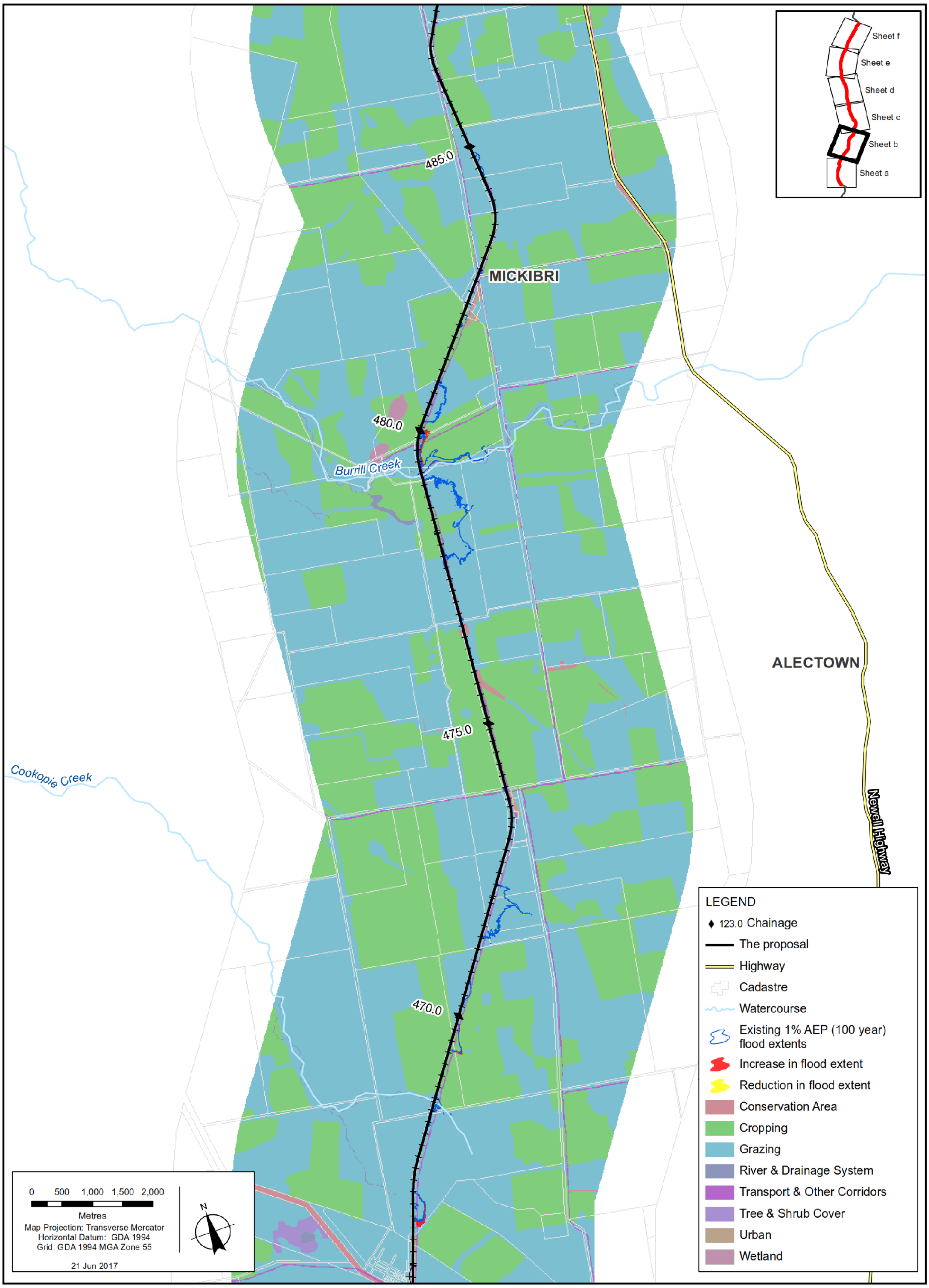
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.4a
Change in flood extents - land uses



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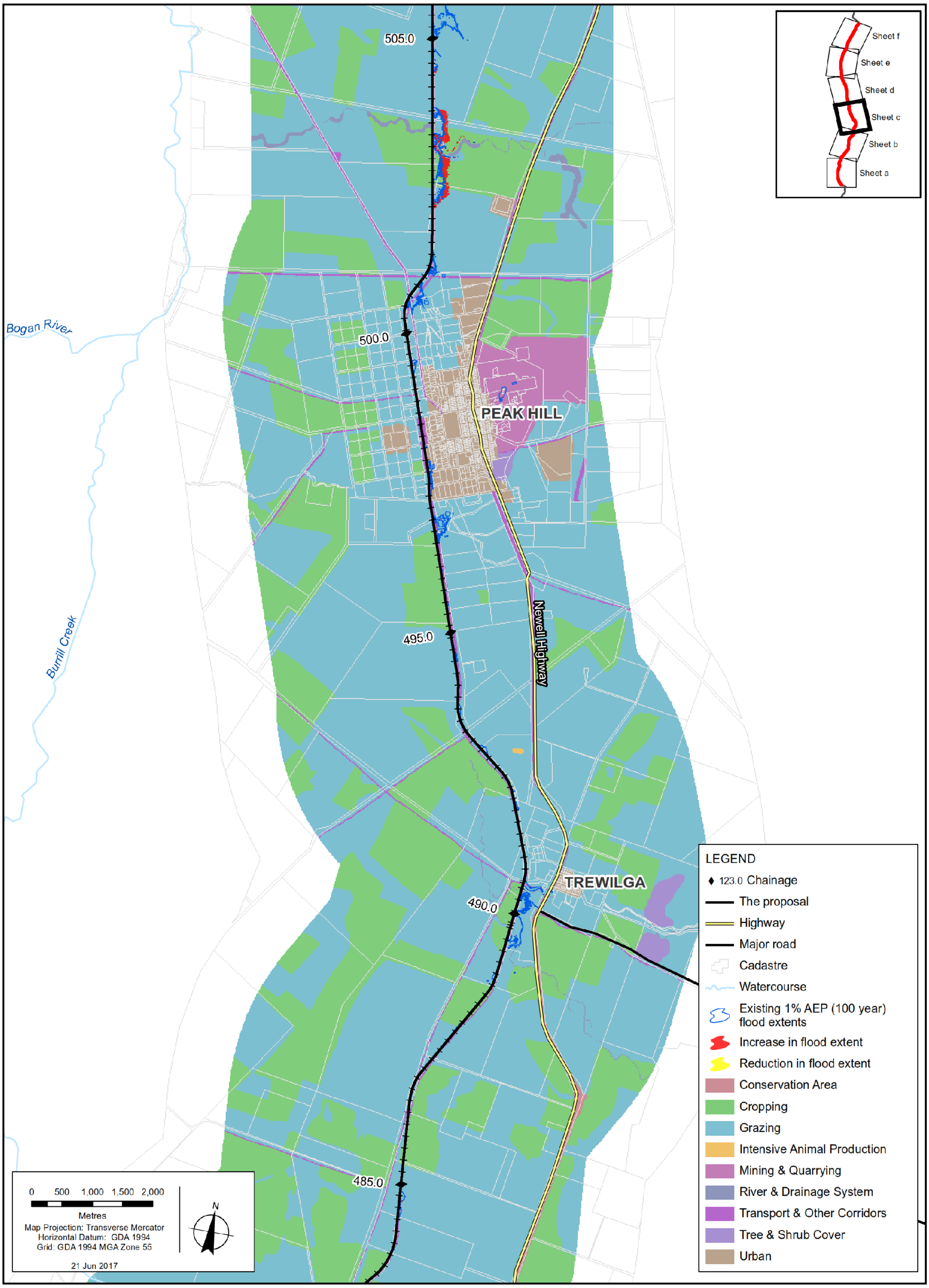
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.4b
Change in flood extents - land uses



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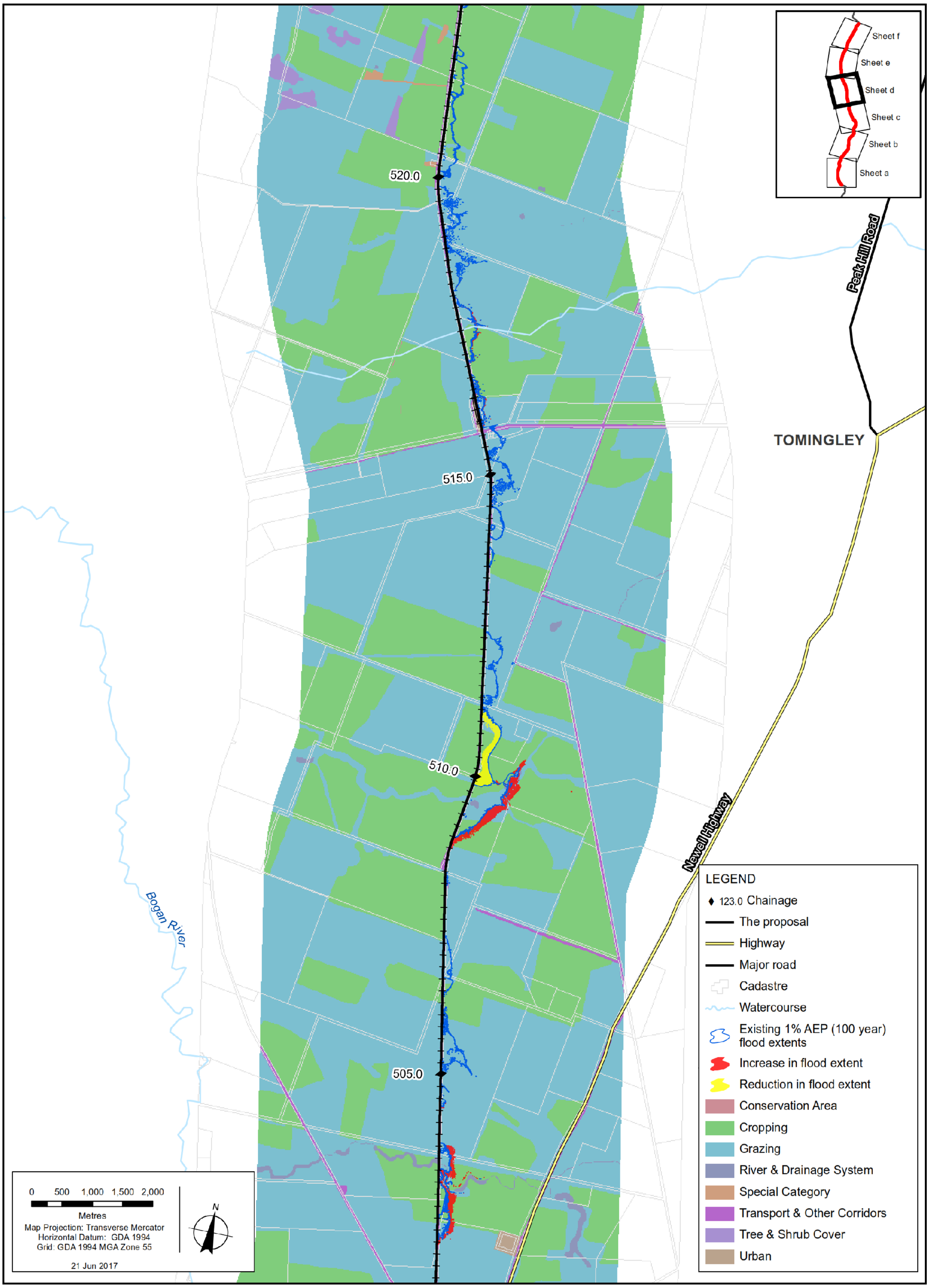
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.4c
Change in flood extents - land uses



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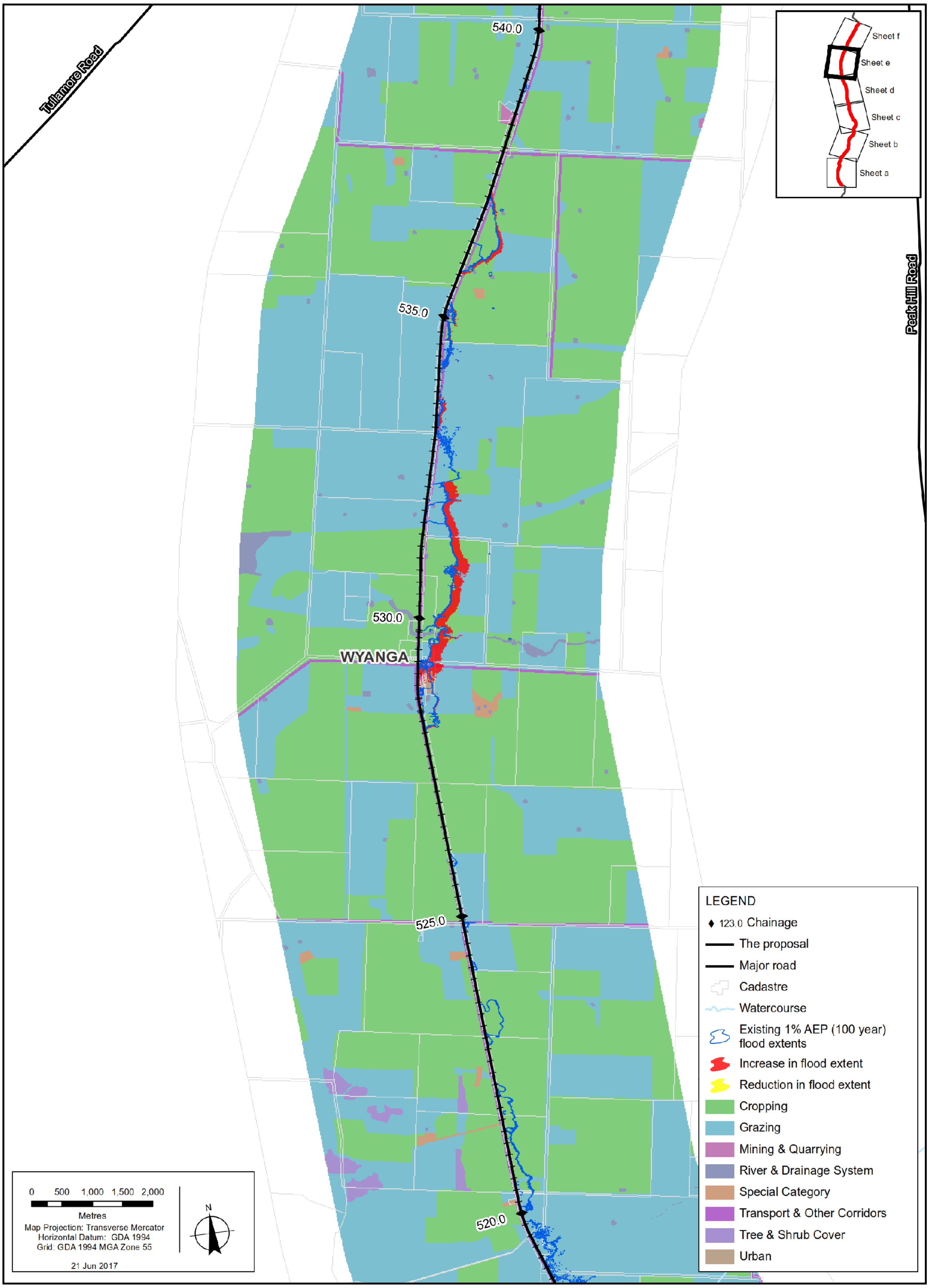
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.4d
Change in flood extents - land uses



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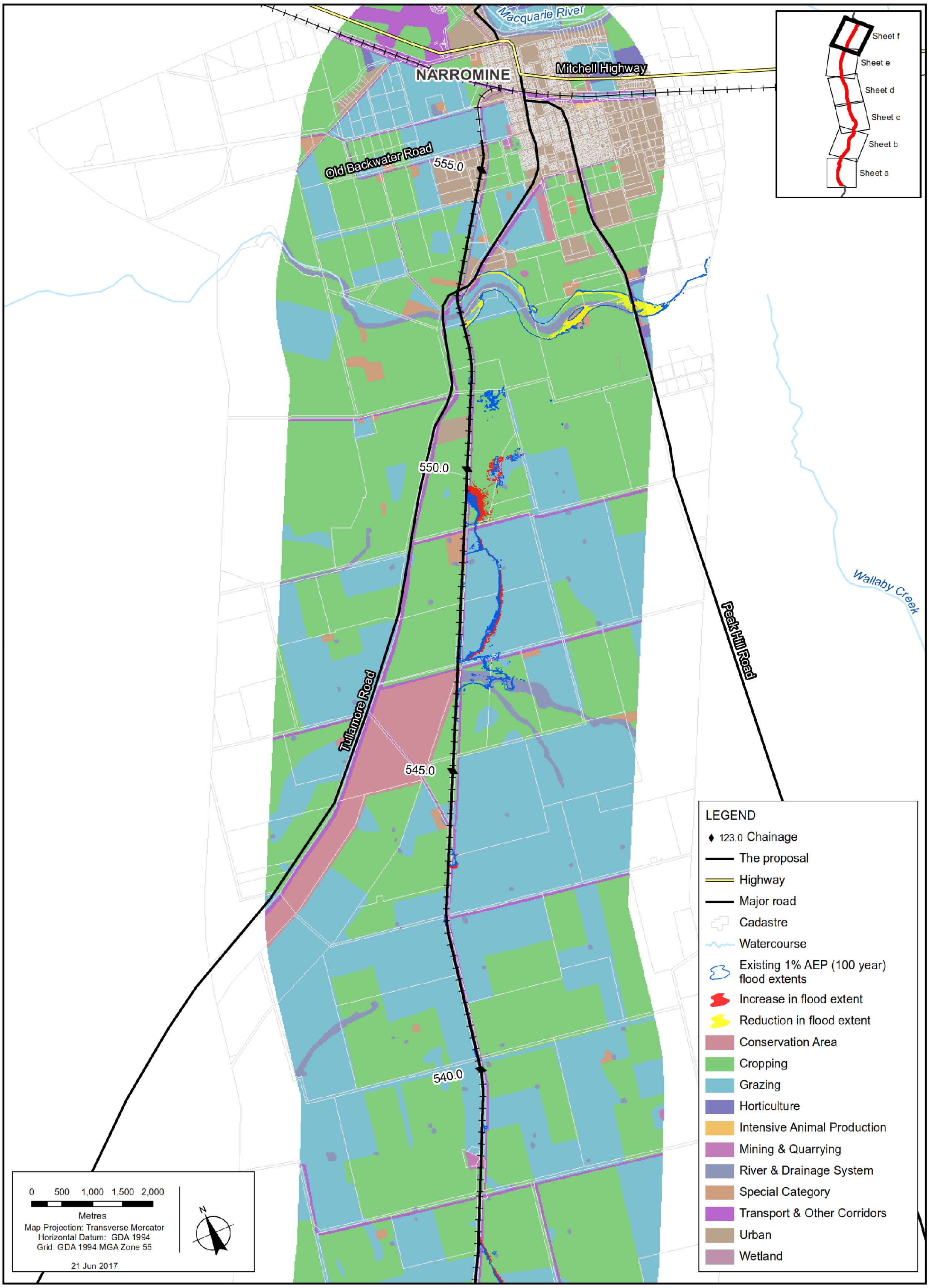
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.4e
Change in flood extents - land uses



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006. LPI, Imgery, 2015

Figure 20.4f
Change in flood extents - land uses

20.4 Mitigation and management

20.4.1 Approach to mitigation and management

Overall, the majority of potential construction related impacts would be short term and temporary in nature. The potential for these impacts would be significantly reduced by:

- effective construction design and planning
- implementation of the mitigation measures provided below
- minimising the need for local road and access closures
- providing alternative access arrangements in the event that closures are necessary
- consultation with individual landowners to identify individual concerns, and develop and document strategies to address these concerns
- ongoing communication.

Key mitigation measures to minimise the potential for land use impacts during construction would be the rehabilitation strategy (included as a mitigation measure in chapter 10) and individual property management agreements. Areas disturbed during construction would be rehabilitated progressively in accordance with the rehabilitation plan.

Individual property management agreements would be developed in consultation with landowners/lessees who would be directly impacted during construction. These would define ARTC's commitments as to how construction would be managed as it impacts individual properties.

20.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to manage the potential for air quality, noise, dust, socio-economic, waste, and health and safety impacts would also assist in minimising the potential for land use and property impacts.

The rehabilitation strategy would also assist in mitigating potential biodiversity, and landscape and visual impacts.

20.4.3 Summary of mitigation measures

To mitigate the potential impacts to land use and property, the following measures would be implemented.

Table 20.8 Land use and property mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Property impacts	Individual property management agreements would be developed in consultation with landowners/occupants, with respect to the management of construction on or immediately adjacent to private properties. These would detail any required adjustments to fencing, access, farm infrastructure, and relocation of any impacted structures, as required.
	Acquisitions	All acquisitions/adjustments would be undertaken in consultation with landowners and in accordance with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991*.

Stage	Impact	Mitigation measures
	Access	Access to properties would be maintained and managed in accordance with the mitigation measures listed in section 9.4.
	Travelling stock reserves	Local Land Services would continue to be consulted during detailed design to understand how impacts to travelling reserves routes can be avoided during construction and operation. Alternative access arrangements would be made as required.
Detailed design/ pre-construction and construction	Impacts to services and utilities	Utility and service providers would continue to be consulted during detailed design to identify possible interactions and develop procedures to minimise the potential for service interruptions and impacts on existing land uses.
	Consultation and communication	Property owners/occupants would be consulted during the design and construction phases, in accordance with the communication plan for the proposal (described in chapter 4), to ensure that owners/occupants are informed about the timing and scope of activities in their area; and any potential property impacts/changes, particularly in relation to potential impacts to access, services, or farm operational arrangements. The results of consultation would be incorporated in the individual property management agreements as appropriate. Consultation would be undertaken with landowners affected by level crossing changes and agreement obtained, where required.
	Biosecurity risks	The weed management plan included in the CEMP would detail measures to minimise the potential for biosecurity risks during construction.
Construction	Rehabilitation	The rehabilitation strategy would include measures to restore disturbed sites as close as possible to the pre-construction condition or better, or to the satisfaction of landowners. Rehabilitation of disturbed areas would be undertaken progressively, consistent with the rehabilitation strategy and Individual property management agreements (where relevant).

21. Socio-economic assessment

This chapter provides a summary of the socio-economic impact assessment of the proposal. It describes the existing socio-economic environment, assesses the potential impacts of the proposal, and provides recommended mitigation measures. The full assessment report is provided as Technical Report 11.

21.1 Assessment approach

21.1.1 Methodology

The assessment involved:

- reviewing background information on the proposal and the socio-economic environment of the study area
- analysis of available community survey data, including data and reports from the Australian Bureau of Statistics (ABS) *Census 2011*, NSW Bureau of Crime Statistics and Research, Bureau of Transport Statistics, and the local councils
- preparing a profile of the existing community that may be impacted by the proposal
- discussions with representatives of the Parkes and Narromine councils
- analysis of the outcomes of community consultation as summarised in chapter 4
- a desktop analysis of the potential impacts and benefits of the proposal, including the potential for both direct and indirect impacts on the community and businesses, in accordance with the principles and guidelines listed in 21.1.2
- identifying measures to mitigate and manage the impacts identified.

Further information on the methodology is provided in Technical Report 11.

21.1.2 Legislative and policy context to the assessment

Relevant legislation/guidelines

The EP&A Act establishes the framework for socio-economic impacts to be formally assessed in land use planning and development assessment processes. Under section 4 of the EP&A Act, the definition of 'environment' is 'all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings'.

The assessment of socio-economic impacts has been undertaken with reference to:

- *International Principles for Social Impact Assessment 2003* (Vanclay, 2003)
- *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects* (Vanclay F, et al, 2015)
- *Environmental Impact Assessment Practice Note - Socio-economic assessment* (Roads and Maritime, 2013).

Economic policy context

The study area is covered by two regional development plans prepared by Regional Development Australia: *Central West Regional Plan 2013 – 2016* (RDA Central West, 2013) and the *Orana Regional Plan 2013 – 2016* (RDA Orana, 2015). The Central West Regional Plan is also supported by the NSW Central West Freight Study (RDA Central West, 2014).

The NSW Government's *Economic Development Strategy for Regional NSW* (NSW Department of Trade and Investment, 2015) also applies to the study area.

At a local level, economic development is considered within the community strategic plans prepared by Parkes and Narromine councils.

Community planning context

The context for local community planning is provided by the *Parkes Community Strategic Plan 2022* (Parkes Shire Council, 2012) and the *Narromine Community Strategic Plan* (Narromine Shire Council, 2013).

21.2 Existing environment

A general description of the proposal site and surrounds is provided in chapter 2. The proposal site traverses the outskirts of the towns of Parkes, Peak Hill, and Narromine. The main area of business/employment located near the proposal site is the Parkes National Logistics Hub (the Parkes Hub) site, which adjoins the proposal site at its southern end. Development of the Parkes Hub is being facilitated by Parkes Shire Council. Further information is provided in chapter 2.

Key socio-economic indicators (mainly from 2011 ABS census data) are summarised below. Further information on the socio-economic characteristics of the study area is provided in Technical Report 11.

21.2.1 Key socio-economic characteristics

Parkes local government area

The Parkes LGA has an estimated resident population (during the 2011 census) of 14,592 people, which increased to 15,337 in 2015. The town of Parkes had a population of 10,026 people during the 2011 census, which comprised 69 per cent of the LGA's population. Between 2001 and 2015, the population of the LGA grew by 4.9 per cent. In 2011, the population of Peak Hill was 755, comprising 5.2 per cent of the LGA's population.

Both the LGA and the town of Parkes have a similar age profile. Analysis of the age structure showed that the median age for the LGA was 39 years.

The most common occupations within the LGA are managers, technicians and trades workers, and professionals (17.7, 14.8 and 13.5 per cent of the workforce respectively).

There is a full time labour force participation of 56.1 per cent across the LGA. The most common employment industries in the LGA are retail trade, health care and social assistance, and agriculture, forestry and fishing, making up 12.7, 12 and 11.5 per cent respectively of the workforce. Of the workforce employed in agricultural industries, 10.9 per cent are employed in sheep, beef cattle, and grain farming.

The median average income of the LGA is $456 per week. 19.8 per cent of the population have a tertiary qualification.

Other economic indicators for the Parkes LGA include (for 2014/15):

- domestic exports – $255.4M
- international exports - $255.52M
- local sales - $852.60M
- worker productivity - $101,925 per worker.

Parkes is the main town within the Parkes LGA. It is a commercial centre with its major industries including agriculture, transport, mining, and tourism (Parkes Shire Council, 2016a). The CSIRO Parkes Radio Telescope is a key tourist attraction, as is the Parkes Elvis Festival, which attracts about 20,000 visitors each year.

A range of accommodation facilities are located in Parkes, including four caravan or cabin parks (providing a total of 86 cabins/units plus caravan and camping sites), seven hotels, 15 motels and five bed and breakfasts, with about 1500 bed spaces. Preliminary consultation with operators of some of these facilities indicates that frequent and/or longer term cabin/unit rental is common with workers of nearby mines and of the current Newell Highway upgrading project. Operators also indicated that demand for temporary accommodation is currently exceeding supply, with over half of this demand from mining workers.

The town has a range of community facilities and services, including education (schools and the TAFE Western Institute campus), childcare, parks and recreation facilities, emergency services, shops, and medical services (including the newly built Parkes Hospital).

As the main town within the LGA, people from surrounding areas and villages, such as Peak Hill, would travel to Parkes to access local facilities, including shopping, administrative services, the hospital, and the Parkes Community Health Centre.

Parkes Shire Council noted the following during consultation:

- mining is the largest contributor to the Parkes economy, and provides a skilled workforce base to the town
- existing accommodation in town should have the capacity to cater for the construction workforce for the proposal
- there is a positive view of the proposal throughout the community.

Narromine local government area

The Narromine LGA has an estimated resident population (during the 2011 census) of 6,585 people, which increased to 6,822 in 2015. The town of Narromine had a population of 3,789 people during the 2011 census, which comprised 57.5 per cent of the LGA's population. Between 2015 and 2001, the population of the LGA decreased by 3.4 per cent.

Both the LGA and the town of Narromine have a similar age profile. Analysis of the age structure showed that the median age for the LGA is 39 years.

There is a full time labour force participation of 65 per cent across the LGA. The most common employment industries in the LGA are agriculture, forestry and fishing; retail trade; and health care and social assistance, making up 25.4, 11 and 9.2 per cent of the workforce respectively. The most common occupations within the LGA are managers; professionals; and labourers (24.1, 13 and 12.6 per cent of the workforce respectively).

The median average income of the LGA is $492 per week. 18.6 per cent of the population have a tertiary qualification.

The town of Narromine has a population of 3,789 people and is the biggest town in the Narromine LGA. With respect to employment, agriculture is the biggest employer of local residents (25.4 per cent). Other employers major include healthcare (11 per cent), retail (9.2 per cent), education and training (8.7 per cent), construction, and transport, postal and warehousing (both 5.8 per cent).

A range of accommodation facilities are located in Narromine, including the Narromine Tourist Park (11 cabins and 36 powered sites), three hotels, two motor inns, a bed and breakfast, and a farm stay.

A range of local community facilities and services are located in the town, including education and childcare, parks and recreation facilities, library, emergency services, shops, and medical/health services (including the Narromine hospital and community health centre).

People from Narromine may also access regional facilities in Dubbo, such as Dubbo Base Hospital, Lourdes Hospital, Dubbo Community Health Centre, and Macquarie Regional Library.

Narromine Shire Council noted the following during consultation:

- the residents are very community minded
- opportunities for the LGA associated with the proposal include future development, increased production in Narromine, and the removal of heavy vehicles from the road network.

21.3 Impact assessment

21.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential socio-economic risks. The assessed risk level for the majority of potential socio-economic risks was between medium and high. Risks with an assessed level of medium or above include:

- impacts to local amenity during operation due to increased frequency of trains
- impacts on community facilities during construction
- increased demand for accommodation during construction
- impacts on access to community facilities during construction.

How potential impacts have been avoided

The option development and assessment process for the Inland Rail location/route options is summarised in chapter 6. As noted in chapter 6, the shortlist of route options was subject to a detailed assessment, and the proposed alignment was refined based on evaluation of key considerations, including community impacts.

Potential socio-economic impacts would continue to be avoided by:

- designing, constructing and operating the proposal to minimise the potential for amenity impacts arising from traffic, noise and vibration, air quality, and visual amenity, including the implementation of mitigation measures in chapters 9, 11, 13 and 19
- minimising the potential for safety issues by implementing the mitigation measures in chapter 25
- implementing the socio-economic management and mitigation measures provided in section 21.4
- communicating with local residents and other relevant stakeholders (including Parkes and Narromine councils) to provide advance notice of construction activities and associated impacts, and provide information on the operation of the proposal.

21.3.2 Construction impacts

The key potential socio-economic impacts of the proposal during construction include:

- impacts to the local community and/or individual landowner/occupants resulting from changes to traffic, transport, and access arrangements
- community amenity and safety impacts
- access to accommodation and services
- economic impacts and benefits during construction, including employment generation.

Socio-economic impacts due to property impacts

During construction, some landholders would experience some impacts resulting from changes to infrastructure and utilities within the property, establishment of compound sites and the need to gain access to private properties.

Frequent access to properties can disrupt private landholders through impacts to agricultural activities and lifestyles.

Potential land use and property impacts during construction are described in chapter 20.

Community access impacts

As described in chapter 9, construction of the proposal would result in short term impacts to traffic and access within the study area, and an increase in both heavy and light vehicle movements on the local road network. The traffic assessment concludes that the anticipated maximum hourly volume on potential access roads is within the level of service threshold for these roads, and no significant community impacts are predicted.

Changes to the movement of traffic and access arrangements as a result of the construction of the Parkes north west connection (including the Brolgan Road overbridge) could result in a temporary increase in the distance travelled and delays for some residents in this area. This impact would be limited to the duration of the construction period.

The proposal would not directly impact on access to local businesses and social infrastructure. Access to individual properties would be maintained, and any potential impacts would be managed by the implementation of measures provided in chapters 9 and 20. In summary, no significant socio-economic impacts have been identified as a result of the predicted traffic, transport and access impacts.

Community amenity impacts

Construction of the proposal may result in the following amenity impacts experienced by members of the local community:

- increase in noise for residents located around the proposal site due to the operation of plant and equipment, and construction traffic
- increase in traffic and associated noise for residents located around the proposal site and construction access routes
- increase in dust generated during construction, which may impact on local amenity
- visual impacts.

These issues have been addressed in other sections of this EIS, as follows:

- traffic (chapter 9)
- noise and vibration (chapters 11 and 12)
- air quality (chapter 13)
- visual impacts (chapter 19).

Amenity impacts would be temporary and appropriately managed with the mitigation measures provided in these chapters.

Potential safety issues and impacts are considered in chapter 25.

Accommodation

An average of 150 workers would be required to construct the proposal. Preference would be given to locally/regionally based workers where practicable, with local workers likely to be sourced from the Parkes, Narromine, and Dubbo LGAs. Some workers would also need to be sourced from outside of the local area, dependant on the availability and skill of local workers and the proposal timeframes. Workers from outside the local area would require temporary accommodation. Workers would need to be accommodated such that potential impacts on the availability and affordability of rental accommodation are minimised. Housing and accommodation for future workers would be identified prior to construction to reduce any impact to local housing affordability and availability within the study area. Maximising the employment of local residents would reduce the demand for accommodation.

The non-resident workforce has the potential to increase demand for local services. Assuming that a larger proportion of the workforce would be residents from the area, consultation with both Narromine and Parkes Shire Councils confirmed that the existing community support and health services have the capacity to accommodate the increase in demand from the non-resident workforce.

Economic impacts and benefits during construction

Construction of the proposal would generate employment, with the estimated workforce numbers provided in chapter 8. This would benefit the local community and businesses. The workforce is likely to include a mix of local residents, and people from outside the area who would need to be accommodated within the local area, potentially in the towns/villages of Parkes, Forbes, Peak Hill, Narromine, Dubbo and/or Gilgandra.

New employment opportunities would also provide the opportunity for training and the development of new skills, which, for local residents, would benefit the local areas/region.

Construction activities, requirements and the needs of the workforce would have the potential to result in increased trade for local businesses, including:

- accommodation
- food services
- retail trade
- bus and coach drivers
- finance
- education and training
- health care
- recreation services.

21.3.3 Operation impacts

The key potential socio-economic impacts of the proposal during operation include:

- community amenity impacts and safety impacts
- access and connectivity impacts, including delays associated with a higher train frequency
- economic impacts, including potential local and regional benefits, and the benefits of Inland Rail as a whole.

Potential land use and property impacts during operation are described in chapter 20.

Community amenity impacts

The main potential for community amenity impacts relates to the increase in train movements along the proposal site.

Changes to access, noise levels, air pollution, and visual changes from the presence of the proposal may impact on the amenity for the surrounding community. These impacts and mitigation measures are addressed in other chapters of the EIS, as noted above.

Potential community health and safety impacts are considered in chapter 25. Impacts to land use due to flooding are discussed in chapter 20. Social impacts associated with train delays are discussed below.

Community access impacts

The main potential traffic impact of the proposal would be impacts to travel time for road users as a result of increased train activity at level crossings. Given the local nature of most affected roads, this impact is only expected to affect a small number of community members.

A very small number of community members may experience changed access to Parkes due to the realignment of Coopers Road and Millers Lookout Road. Further consultation would be undertaken with relevant stakeholders regarding the need for road alignment at Millers Lookout Road and Coopers Road.

Regional bus services may experience a small increase in delays at level crossings due to the increased frequency of trains. Delays would be minor when considered in the context of the distances travelled. Emergency vehicles may also experience delays at level crossings. Given that the level crossings are mainly located on local roads outside the towns, overall emergency response times are not expected to be significantly impacted. Consultation with local emergency services during detailed design would ensure emergency service providers are aware of accessible routes during operation, particularly alternate routes in the case of level crossing delays.

An increase in the number of trains may impact on community safety, as there would be an increase in the potential for a pedestrian or cyclist to encounter a train, and drivers may take additional risks to avoid being delayed.

There is the potential for some drivers, observing a train approaching, to take additional risks to avoid being delayed. Risks include speeding or ignoring warning controls at level crossings.

Changes to property access roads and the local road network may be required in some locations as a result of the rationalisation of level crossings. The closure of some level crossings may result in changes to how landholders and livestock move around their property, which in turn might impact agricultural activities and the operation of agricultural businesses.

Consultation with potentially affected landowners would continue during detailed design, and closures would only be undertaken following agreement with the owner.

Economic and wider community benefits

Local benefits

During consultation on the proposal, representatives of local councils expressed their strong support for the proposal, noting that Inland Rail offers significant potential benefits for the regions productivity and economic development opportunities. The study area is well positioned to leverage economically from Inland Rail as a result of the location of the Parkes Hub. The proposed Parkes north west connection would facilitate connections between Inland Rail and the Broken Hill rail line. To take advantage of this, Parkes Shire Council is facilitating development of the Parkes intermodal facility (Parkes Hub).

It is noted that no stop facilities form part of the proposal at this stage. The stopping patterns for Inland Rail trains continue to be firmed up, and would be finalised in consultation with regional stakeholders, included Parkes Shire Council.

The *Business Case for Inland Rail* (ARTC, 2015) notes that Inland Rail will enable farmers to move agriculture products more efficiently for domestic use and for export, as it will pass through some of Australia's most productive farming country. The Business Case also recognises further benefits to supply chain efficiencies for commercial freight, and benefits to consumers and regional areas.

Wider benefits

As part of the overall Inland Rail project, the proposal has the potential to contribute to wider economic and community benefits, including the following (ARTC, 2015):

- Strong benefit cost ratio – it is estimated that Inland Rail will have an economic benefit cost ratio of 2.62.
- Boost the Australian economy – Inland Rail is expected to increase Australia's gross domestic product by $16 billion during its construction and first 50 years of operation.
- Create jobs – it is estimated that an average of 700 additional jobs would be created during operation.
- Improve connections within the national freight network – Inland Rail enhances the National Land Transport Network by creating a rail linkage between Parkes and Brisbane, providing a connection between Queensland and the southern and western States.
- Provide better access to and from regional markets – Inland Rail will make it easier for freight to move from farms, mines and ports to national and overseas markets. It is estimated that two million tonnes of agricultural freight will switch from road to rail.
- Reduce costs – Transport costs for freight travelling between Melbourne and Brisbane will reduce by $10 per tonne.
- Increased capacity of the transport network – Inland Rail will increase capacity for freight and passenger services by reducing congestion along the busy coastal route and allow for growth in passenger services particularly in the Sydney region.
- Improve road safety – It is estimated that each year, Inland Rail will remove 200,000 truck movements from roads and reduce truck volumes in 20 regional towns; and reduce the number of serious crashes, avoiding fatalities and serious injuries.

As noted by the *Australian Infrastructure Audit Report* (Infrastructure Australia, 2015) 'Rail offers … societal benefits in terms of lower emissions, reduced road congestion and increased safety per tonne kilometre, particularly over longer distances or when carrying heavy goods.'

21.4 Mitigation and management

To mitigate the potential for socio-economic impacts, and enhance the benefits of the proposal, the following measures would be implemented.

Table 21.1 Socio-economic mitigation measures

Stage	Impact/issue	Mitigation measures
Detailed design/ pre-construction, construction	Communication	Key stakeholders (including local councils, emergency service providers, public transport providers, the general community and surrounding land owners/occupants) would continue to be consulted regarding the proposal in accordance with the communication plan described in chapter 4.
	Local access to Inland Rail	ARTC would continue to work with relevant stakeholders, including Parkes Shire Council, to identify opportunities to facilitate local access to Inland Rail via the Parkes intermodal facility.

Stage	Impact/issue	Mitigation measures
	Accommodation	A temporary workforce housing and accommodation plan would be developed and implemented during construction. This would include a requirement for consultation to be undertaken with local accommodation providers and councils regarding the availability of accommodation, and the need to maintain some availability for non-workforce accommodation.
Construction	Communication	A communication management sub-plan would be prepared as part of the CEMP including a detailed list of the measures that would be implemented during construction to communicate with and respond to community concerns. The plan would include, as a minimum: - requirements to provide details and timing of proposed activities to affected residents, the local community and businesses, and local bus operators - consultation actions in relation to access arrangements and servicing requirements - complaints handling procedure - procedure to notify adjacent land users for any changed conditions during the construction period such as traffic, pedestrian or driveway access.
		Local residents, businesses and other stakeholders would be notified before work starts, and would be regularly informed of construction activities.
	Access	Access to individual residences, services and businesses would be maintained during construction. Where alternative access arrangements need to be made, these would be developed in consultation with affected property owners/occupants.
	Workforce	Where practicable, the workforce would include workers sourced locally, and opportunities for training potential local employees would be provided. This would include exploring opportunities for local Indigenous participation in consultation with local Indigenous service providers. A zero tolerance policy relating to anti-social behaviour would be adopted for work sites.
	Demands for goods and services	Local suppliers would be identified and approached for procurement of goods and services where practicable in line with a local business and industry procurement plan.
Operation	Community safety	A safety awareness program would be developed and implemented to educate the community regarding safety around trains. This would focus on community and rural property operators who cross the rail corridor to access their properties.

22. Sustainability

This chapter provides the sustainability assessment of the proposal. It describes the overall approach to sustainability, and the specific objectives and initiatives that would be incorporated into the proposal's design, construction and operation.

22.1 Assessment approach

22.1.1 What is sustainability?

Sustainability, or sustainable development, has many different definitions, depending on the application and context. In 1987, the Brundtland Commission defined sustainable development 'as development that meets the needs of the present, without compromising the ability of future generations to meet their own needs' (WCED, 1987).

In 1992, ecologically sustainable development (ESD) was defined by the Ecologically Sustainable Development Steering Committee as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends are maintained, and the total quality of life, now and in the future can be increased' (Commonwealth of Australia, 1992).

In NSW, the concept of ESD was introduced into planning and development legislation by the EP&A Act. One of the objectives of the EP&A Act is '(vii) to encourage ecologically sustainability development'. In accordance with part 3 of schedule 2 of the Regulation, an EIS is required to include '(f) the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to the principles of ecologically sustainable development set out in subclause (4).' Section 6(2) of the *Protection of the Environment Administration Act 1991* states that ESD can be achieved through the implementation of:

- the precautionary principle
- intergenerational equity
- conservation of biological diversity and ecological integrity
- improved valuation, pricing and incentive mechanisms.

For infrastructure projects, 'infrastructure sustainability' is defined by the Infrastructure Sustainability Council of Australia (ISCA) as 'infrastructure that is designed, constructed and operated to optimise environmental, social and economic outcomes of the long term'. ISCA states that 'Infrastructure sustainability provides an opportunity to go beyond business as usual, or simply mitigating environmental and social impacts. It provides the opportunity to drive and measure performance towards enhanced liveability and productivity and better economic outcomes, in a strategic and holistic fashion' (ISCA, 2016).

Using a tool such as ISCA's infrastructure sustainability rating tool (the 'IS rating tool'), an assessment of the sustainability performance of an infrastructure proposal can be undertaken.

22.1.2 Sustainability context for Inland Rail

ARTC is committed to ensuring that its projects are implemented in a manner that is consistent with the principles of ESD. ARTC has applied, and will continue to apply, the principles of ESD throughout the development and assessment of Inland Rail and the proposal. ARTC has developed a Sustainability Implementation Framework for Inland Rail.

The implementation framework identifies that the following themes underpin the sustainability objectives for the delivery and operation of Inland Rail:

- safety
- community
- workforce

- procurement
- materials/waste
- ecology
- greenhouse gas and emissions
- governance.

The implementation framework outlines key recommendations and requirements for embedding sustainability across each of the above themes. It also outlines how monitoring and review of sustainability objectives for Inland Rail would occur.

A sustainability policy for Inland Rail has been developed as part of the implementation framework, underpinned by the following key commitments:

- put safety at heart of everything we do
- minimise our environmental footprint
- engage early and meaningfully with all stakeholders, including Aboriginal parties in accordance with established practices
- make decisions based on a strong understanding of technical, economic, environmental and social issues
- future-proof Inland Rail so it is efficient and effective in the long term
- promote economic benefits within regional communities
- regularly review and audit processes and performance.

22.1.3 Methodology

The assessment summarised in this chapter considers the application of sustainability principles to the proposal, and the opportunities to achieve sustainability targets and outcomes that are aligned with best practice infrastructure projects. The assessment was undertaken using the IS rating tool, and with consideration of the *NSW Sustainable Design Guidelines* (Transport for NSW, 2014).

By considering the results of the sustainability assessment, the proposal would continue to be designed, constructed, and operated to minimise potential sustainability risks, whilst also optimising environmental, social and economic outcomes.

ISCA's infrastructure sustainability rating tool

The IS rating tool can be applied to many different infrastructure projects, including rail projects. Ratings can be undertaken on a design, as built drawings, and operation of a project. An infrastructure project is assessed in terms of how it performs in each of 15 categories that are grouped into six themes in infrastructure sustainability. These include:

- management and governance
- using resources
- emissions, pollution and waste
- ecology
- people and place
- innovation.

Depending on the initiatives and performance of a project across each theme, it will achieve a score from one to 100 corresponding to a rating level of commended, excellent or leading.

An assessment was undertaken for Inland Rail using the IS rating tool. The following approach was used:

- the rating that would apply to the proposal under a business as usual approach was determined
- initiatives that could be implemented to provide additional value ('credits') to the proposal were identified
- the rating that could be achieved with the implementation of these initiatives was determined.

Further information on the application of the IS rating tool to the proposal is provided in Appendix I.

NSW Sustainable Design Guidelines

The approach to sustainability detailed in the *NSW Sustainable Design Guidelines* (Transport for NSW, 2014) is underpinned by a series of themes and objectives, which define the approach to the delivery of sustainable assets. The *NSW Sustainable Design Guidelines* are divided into seven sustainability themes (with several sub-themes), and include compulsory and discretionary initiatives in relation to:

- energy and greenhouse gases
- climate resilience
- materials and waste
- biodiversity and heritage
- water
- pollution control
- community benefit.

Compulsory initiatives may relate to a corporate target or are considered to be fundamental to the delivery of sustainable assets. If a compulsory initiative is considered to apply, then it must be completed. A discretionary initiative may not be practical for a particular project or may not be the most appropriate initiative to meet a sustainability outcome. Written justification must be provided if a discretionary initiative has not been selected for implementation.

Projects can achieve a score of bronze, silver, gold, or platinum based on their selection of discretionary sustainable initiatives.

22.1.4 Legislative and policy context to the assessment

Sustainability considerations have been imbedded in a number of legislative and policy mechanisms, particularly in relation to resource use, waste, and energy efficiency. These include:

- *Waste Avoidance and Resource Recovery Act 2001* (the WARR Act)
- *National Greenhouse and Energy Reporting Act 2007*
- *National Strategy for Ecologically Sustainable Development* (Ecologically Sustainable Development Steering Committee, 1992)
- *National Waste Policy: Less Waste, More Resources* (Australian Government, 2009)
- *Sustainable Procurement Guide* (Australian Government, 2013)
- *NSW Sustainable Design Guidelines* (Transport for NSW, 2014)
- *NSW Government Resource Efficiency Policy* (OEH, 2014)
- *Infrastructure Sustainability Planning Guidelines* (ISCA, 2016)

The proposal is considered according to the principles of ESD in chapter 28.

22.2 Assessment results

22.2.1 IS rating tool

The process and results of the assessment undertaken using the IS rating tool are provided in Appendix I. Under a business as usual approach, the proposal would achieve a 'commended' rating. However, with the implementation of relevant sustainability opportunities that add value to the proposal, an 'excellent' rating could be achieved. Key opportunities include minimising:

- water usage during construction
- electricity usage during construction and operation
- greenhouse gas emissions from the consumption and burning of fossil fuels
- demand on local and regional resources
- the carbon footprint of construction materials (type, quality, quantity, location, end product)
- waste production.

The sustainability assessment using the IS rating tool would be updated as the development of the proposal progresses.

22.2.2 Sustainability objectives and initiatives

The next stage of the assessment involved translating the Inland Rail IS rating tool results and opportunities into objectives and initiatives that could be potentially implemented during design, construction, and operation of the proposal.

The sustainability objectives and supporting potential initiatives identified for the proposal are listed in Table 22.1. The objectives and initiatiatives are consistent with those identified as part of the IS rating tool assessment, required to achieve an 'excellent' rating. The outcomes and initiatives align with those outlined in the *NSW Sustainable Design Guidelines* and other relevant guidelines.

The potential initiatives outlined in Table 22.1 would be reviewed and refined during the design process and, where practicable, used to develop targets which would be included in contract documents for all detailed design, construction and operation contracts. Contractors would be required to clearly identify how they would ensure that specific initiatives and targets are met.

Implementation of the final sustainability initiatives and targets would be monitored and audited in line with the requirements of Inland Rail's Sustainability Implementation Framework.

Table 22.1 Proposal sustainability objectives, outcomes and potential initiatives

Theme	Objectives	Desired outcomes	Potential sustainability initiatives for the proposal
Governance and management of the process	To integrate sustainability into management systems and approach. To demonstrate leadership by embedding sustainability objectives into decision making. To establish governance arrangements which support resource efficiency, and continuous improvement of sustainability performance. To achieve an 'excellent' rating using the IS rating tool.	Policies, targets, and objectives are integrated in proposal documentation and commitments. The proposal demonstrates a high level of performance against objectives and appropriate benchmarks. A lessons learnt process is implemented to cover the broad project benefits and values, with consideration to all stakeholders. Sustainability audits of the management systems are conducted. Senior management participate in review of audits.	Ensure the proposal decision making framework includes sustainability criteria which consider the environment and community. Develop a sustainability management plan for the proposal that incorporates performance targets across all sustainability themes, based on best practice benchmarking and response to policy and regulatory context. Develop an assurance framework and reporting system to assist ARTC and contractors to report against sustainability performance. Monitor sustainability performance and report results at all levels of the ARTC corporate structure. Couple sustainability risk and opportunities with overall project risk processes to drive consistency and improve project outcomes.
Procurement and purchasing	To integrate sustainability into procurement systems. To reduce the adverse environmental, social and economic impacts of purchased products and services throughout their life. To influence contractors, subcontractors and materials suppliers to adopt procurement objectives in their works and procurement.	Transport-related costs such as fuel, vehicle maintenance and road congestion are reduced. The proposal reduces the NSW Government's operating costs and ensures the effective and efficient use of resources (SEARs performance outcome).	Partner with local suppliers where economically and reasonably feasible. Develop and implement a sustainable procurement policy in accordance with the principles and concepts outlined in the *Sustainable Procurement Guide* (2013), to apply to contractors, subcontractors and suppliers.

Theme	Objectives	Desired outcomes	Potential sustainability initiatives for the proposal
Climate change adaptation	To assess climate change risks and requirement for climate change adaptation measures. To design infrastructure and operations to be resilient to the impacts of climate change.	Flood impacts on the proposal would be reduced, leading to a reduction on time and cost to restore track operations during a wash out event. Heat stress on rail segments would be reduced. Asset durability is improved with cascading improvements to service reliability and maintenance schedules.	Further refine the climate change risk assessment (undertaken as part of the climate change impact assessment – chapter 23) as the design of the proposal progresses. Incorporate into the design adaption measures as per those provided in chapter 23 to mitigate extreme and high level climate change risks, and address medium level climate change risks on the proposal.
Energy and carbon	To understand the potential for minimising energy use from non-renewable sources and greenhouse gas emissions across the infrastructure life cycle. To use energy sources more efficiently and reduce greenhouse gas emissions.	Energy use during construction and operation is reduced. Cost-effective and innovative approaches to energy efficiency, energy procurement and low-carbon/renewable sources are supported. There is a shift to lower carbon transport.	Establish energy efficiency targets for the proposal. Monitor and track carbon emissions from construction and operation and reduce emissions through operating practices and design refinements. Target a reduction in materials haulage through more efficient procurement. Utilise and incorporate energy efficient construction plant and equipment, methods and practices. Use local sources of materials, where feasible.
Water conservation	To understand the potential for minimising water use from potable sources across the infrastructure life cycle. To reduce water usage during construction and operation.	Potable water usage is minimised. Opportunities for rainwater, groundwater, greywater and blackwater harvesting and reuse are maximised.	Implement design and construction initiatives to minimise potable water consumption. Undertake a water balance study to inform feasibility for reuse efficiencies.

Theme	Objectives	Desired outcomes	Potential sustainability initiatives for the proposal
Resource use and materials	To identify the life cycle environmental impacts of materials throughout the infrastructure asset life cycle. To reduce the construction materials footprint by optimising the use of socially and environmentally responsible materials.	Conservation of natural resources is maximised. *(SEARs performance outcome)*. The proposal reduces the NSW Government's operating costs and ensures the effective and efficient use of resources. *(SEARs performance outcome)*.	Establish targets to maximise the reuse of existing materials. Optimise the design to minimise volumes of excavation, steel and imported materials. Specify materials that reduce the need for virgin material supply. Source materials from sustainable suppliers.
Discharges to air, land and water	To identify impacts to local receiving water quality, noise, vibration, air quality and light across the proposal's life cycle. To minimise air, land and water pollution from the proposal's construction and operation.	Potential sources of pollution are reduced. Control at the source of the pollution is optimised to avoid environmental harm.	Ensure an Environmental Management System and Construction Environmental Management Plan are in place prior to construction. Avoid the use of dangerous goods and hazardous materials, where possible. Monitor implementation of noise, air, soil and water quality mitigation measures. Target zero major pollution incidents.
Land	To identify land that has previously been developed and where it can be reused. To identify contamination risks and perform sustainable remediation. To identify risks from flooding.	Remediation of any contaminated sites is undertaken where required. Land use planning and minimisation of impact on critical land resources is considered.	Reduce clearing of vegetation where possible. Optimise the design to minimise volumes of excavation and maximise reuse of topsoil where appropriate. Apply soil management practices to protect and maintain land values, where possible. Undertake appropriate flood design to minimise risk to the proposal resulting from flood risk and impacts on line outages.

Theme	Objectives	Desired outcomes	Potential sustainability initiatives for the proposal
Waste	To identify the potential for sustainable waste management plans and practices. To minimise waste throughout the proposal's lifecycle.	The amount of waste disposed to landfill is minimised. The amount of material reused during construction and operation is maximised.	Provide facilities in all construction compounds to allow for segregation of waste types to facilitate recycling. Adopt waste recycling targets to maximise recycling of construction waste. Balance site works to avoid excess or import of spoil. Reuse ballast and structural fill either during construction or in the formation of spoil mounds. Use prefabricated civil components where possible to reduce construction waste, material usage, pollution risks and travel. Plan for final disposal of operational assets.
Ecology	To identify impacts to local ecological value and habitat connectivity. To enhance environmental outcomes and improve stakeholder/community relations.	Biodiversity would be protected and enhanced through appropriate planning and management.	Prepare and implement a biodiversity management plan as part of construction. Establish and achieve targets for biodiversity conservation and enhancement, where practicable.
Heritage	To enhance heritage outcomes and improve stakeholder/community relations.	Heritage would be protected and enhanced through appropriate planning and management.	Prepare and implement Heritage Management Plans for ongoing management and monitoring of heritage items, where relevant. Develop partnerships with relevant stakeholders to utilise heritage places to promote local heritage values, where practicable.

Theme	Objectives	Desired outcomes	Potential sustainability initiatives for the proposal
Community amenity and benefit	To make a positive contribution to community health and well-being. To assess the impact to design and practice in response to the likelihood of crime.	Landholders and community groups are engaged throughout the proposal's construction and operation. Zero harm to the workforce and community is achieved.	Engage with the impacted community when selecting noise attenuation treatments. Engage with landholders and affected communities throughout the proposal in order to reduce future safety incidents. Listen to and act on community concerns.
		Inland Rail is integrated with surrounding land uses. Crime prevention is implemented to maximise safety during construction and operation.	Implement appropriate design practices in public interaction zones to minimise likelihood of crime.
Stakeholder participation	To assess the level of risk attributed to the engagement, and consideration of stakeholders and their concerns, in the context of the proposal's operation and maintenance. To build a shared understanding of Inland Rail and effective working relationships.	Community believe their issues are being heard and addressed. Local businesses are involved during construction and operation.	Provide design information to assist stakeholder consultation and engage the community and stakeholders during design. Involve local business in the sustainable procurement strategy for the proposal.
Urban & landscape design	To identify the potential for adoption of best practice urban design principles.	Visual amenity of the proposal is improved.	Urban design principles are incorporated into aspects of design, where relevant.

22.3 Mitigation and management

22.3.1 Approach to mitigation and management

A Sustainability Implementation Framework has been developed for Inland Rail to guide how Inland Rail would achieve consistency with an 'excellent' rating, based on the IS rating tool. The implementation framework underpins the sustainability objectives and targets for Inland Rail. A sustainability management plan would be developed for the proposal to incorporate the proposal specific objectives and outcomes required to achieve an 'excellent' rating, including those listed in Table 22.1.

22.3.2 Consideration of the interactions between mitigation measures

The sustainability management plan would be considered during development of the proposal's CEMP and OEMP (described in chapter 27) to ensure consistency with regards to sustainability.

Climate change risk adaptation measures described in chapter 23 would be incorporated into the sustainability management plan.

22.3.3 Summary of mitigation measures

To optimise the environmental, social and economic performance of the proposal, the following measures would be implemented.

Table 22.2 Sustainability mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Sustainability management plan	The potential sustainability initiatives identified for the proposal would be reviewed and updated during the detailed design stage. A sustainability management plan would be developed to guide the design, construction and operation of the proposal to ensure that an 'excellent' rating (according to the ISCA infrastructure sustainability rating tool) is achieved. The sustainability management plan would incorporate the updated sustainability initiatives, and the review and reporting requirements necessary to demonstrate how sustainability has been incorporated into the proposal during design, construction and operation.
Construction	Procurement	Procurement would be undertaken in accordance with the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Reporting	Sustainability reporting (and corrective action where required) would be undertaken during construction in accordance with the sustainability management plan.
Operation	Sustainability management plan	Prior to operation commencing, the sustainability management plan would be reviewed and updated, and relevant initiatives would be implemented during operation.

23. Climate change risk

This chapter provides the climate change risk assessment of the proposal. It assesses the impacts of climate change on the proposal, and provides recommended adaptation and mitigation measures.

23.1 Assessment approach

23.1.1 About climate change

Climate change has the potential to alter the frequency, intensity and distribution of extreme weather related natural hazards, including more intense and frequent heat waves, droughts, floods and storm surges. The risk of climate change impacts on rail infrastructure need to be considered as part of the design process, as structures need to be designed to last for many years, and therefore need to be resilient to climate change.

Climate change adaptation planning and risk management is an evolving field. Responses to reduce the risks of climate change broadly fall into two categories: mitigation and adaptation. Using the definitions of the *Inter-governmental Panel on Climate Change* (IPCC, 2007), mitigation aims to reduce human effects on the climate system by strategies to reduce greenhouse gas sources and emissions, and to enhance greenhouse gas sinks. Adaptation refers to adjustments in response to actual or anticipated climate changes or their effects, to moderate harm or to exploit beneficial opportunities. Infrastructure design and planning needs to incorporate adaptation measures, based on the assessed risk of climate change to a proposal.

23.1.2 Methodology

The purpose of the climate change risk assessment for the proposal is to:

- identify and assess the risks that climate change poses to the proposal
- prioritise risks that require further action as a basis for decision-making and planning.

The overall approach to the assessment involved modelling two potential climate change scenarios for the study area using the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) 'Australian Climate Futures' climate change modelling tool, and assessing the potential risks for the proposal based on these scenarios.

The assessment involved:

- reviewing climate data
- developing projections of the future climate in the study area and determining the climate projection scenarios for the assessment
- undertaking a detailed climate change risk assessment and determining risk ratings
- identifying potential adaptation measures and/or design strategies based on the identified risks and potential impacts.

The longitudinal nature of climate change assessment makes it difficult to pinpoint potential impacts within a relatively short construction timeframe. Changes to climate over this timeframe would be associated with changes in weather and climate variability, which refers to the 'normal' monthly to decadal variability in the components of climate. As this chapter focuses on the assessment of climate change over the life of the proposal, any potential impacts during the construction phase are considered more appropriate for assessment in a shorter timescale. These impacts are therefore not considered further in this assessment and the chapter focuses on potential operational impacts.

As described in chapter 25 an emergency response plan would be prepared during detailed design and would include measures to mitigate potential impacts from emergency situations, including those potentially associated with climate change such as bushfires and extreme weather.

Further information on the methodology for the climate change risk assessment and the detailed results are provided in Appendix J. A summary of the results is provided in the following sections.

23.1.3 Legislative and policy context to the assessment

Relevant legislation, policies, guidelines and standards include:

- *National Greenhouse and Energy Reporting Act 2007*
- *AS 5334:2013 Climate change adaptation for settlements and infrastructure – a risk based approach*
- *AS/NZS ISO 31000:2009 (AS/NZS 2009) Risk management – principles and guidelines*
- *Climate Change Impacts and Risk Management – A Guide for Business and Government* (Australian Greenhouse Office, 2006)
- *Guide to Climate Change Risk Assessment for NSW Local Government* (OEH, 2011)
- *National Climate Resilience and Adaptation Strategy* (Department of the Environment, 2015)
- *Climate Change in Australia - Central Slopes Cluster Report* (CSIRO and BoM, 2015)
- *Checklist for best practice adaptation planning and implementation* (OEH, undated).

23.2 Assessment results

Key areas that may be at risk for the proposal include:

- track infrastructure
- critical supply infrastructure
- drainage systems, culverts and embankments
- bridges and structures
- electronics and signage
- safe operation of the network.

The key climate variables that may increase risk of impact from climate change are mainly:

- increase in average temperatures and extreme heat events
- changes to rainfall intensity and frequency of rainfall events
- changes to storm intensity and impacts from increased wind.

Potential risks rated high or medium are considered on the following page.

Potential risks

Increasing average and extreme temperatures

Temperatures have increased steadily and climate projections indicate there will be both an increase in average temperatures and extreme temperatures. With climate projections forecasting a potential increase in average daily temperatures of three degrees Celsius by 2070, this is likely to result in increasing heat stress on infrastructure assets and the need to respond with increased temperature ranges used in design to address this increased stress. Common areas which may be impacted by increasing average and extreme temperatures in rail infrastructure include:

- increased derailment from heat stress and buckling of rail lines
- failure of power supply and electronic equipment
- increased frequency of interruptions to mains power supply
- damage or deterioration of external surfaces
- failure of equipment such as ventilation or air conditioning units

- sagging of overhead lines
- failure of signalling and communications equipment.

Increased rainfall intensity

As temperatures increase the water cycle intensifies with more evaporation resulting in more intense rainfall events. This has a very specific impact on rail infrastructure by causing:

- increased water flows through drainage systems and culverts causing potential flooding or inundation
- structural scouring
- wash out of foundations or ballast
- inundation of buildings, electrical equipment and damage from flooding
- hail damage to external surfaces.

Reduced average rainfall/drought

Recent climate data and future projections show longer periods with little rainfall and conversely more intense rainfall events. This leads to more wetting and drying of soils leading to greater ground instability. Impacts on transport infrastructure can include:

- cracking and movement of concrete track form and failure of embankments
- sub-surface soil stability for prolonged periods of heating and drying
- instability and cracking of structural barriers
- cracking and wear of support structures
- increased maintenance and management of landscaped areas.

Storm impact from wind/changes to wind speed

Severe storms have the potential to cause damage not only from rainfall but also high winds and hail which can cause significant disruption and damage to infrastructure. Impacts may include:

- windblown debris (eg trees) contacting tracks or overhead equipment causing safety risks, disruption and potential power outages
- increased wind loading potentially causing damage to structures or derailment of double stacked trains
- direct wind or hail damage to electronics and signalling equipment.

Other risks

The following potential risks were identified, but are not considered to be relevant to the proposal:

- humidity: unlikely to impact upon proposal materially
- time in drought: unlikely to impact upon proposal materially
- solar radiation: unlikely to impact upon proposal materially
- sea level rise: not directly impacting the proposal due to its distance from the coast.

23.3 Mitigation and management

23.3.1 Approach to mitigation and management

The outcome of the climate change risk assessment is a priority list of risks for which a range of possible adaptation responses can be developed. Some identified risks may require immediate practical adaptation response or modifications to design, while others may require further investigation. The suggested adaptation measures for the proposal, developed as an outcome of the climate change risk assessment, are listed in Appendix J.

The sustainability management plan for the proposal (described in chapter 22) would include the adaption measures actions relevant to the proposal.

These measures would be reviewed as part of the detailed design process, and incorporated into the design and operating procedures as far as practicable.

23.3.2 Summary of mitigation measures

To mitigate the potential impacts to climate change, the following measures would be implemented.

Table 23.1 Climate change mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Climate change risk management	The climate change risk assessment would continue to be refined as the design of the proposal progresses. The adaptation measures identified for the proposal would be reviewed, and final measures would be incorporated into the design where practicable.
Operation	Climate change risk management	The recommended adaptation measures would be reviewed, and a final list of adaptation measures for implementation during operation would be confirmed and implemented. Operational management and maintenance procedures would include measures relating to potential climate change risks, as listed in section 23.2. Emerging opportunities to manage potential climate change impacts on the proposal would continue to be monitored.

24. Waste

This chapter provides the waste impact assessment of the proposal. It assesses the impacts of construction and operation, and provides recommended mitigation measures.

24.1 Assessment approach

24.1.1 Methodology

The assessment involved:

- reviewing the regulatory framework for waste management
- identifying potential waste generating activities
- identifying the likely classification of waste generated by the proposal in accordance with relevant legislation and guidelines
- estimating quantities of waste, where feasible
- identifying available waste management options
- developing a conceptual waste management plan for construction and operation.

It is noted that the waste types and quantities estimated as an outcome of this assessment are indicative, and have been identified for the purpose of determining potential waste impacts and waste management options. Although the quantities of waste actually generated by the proposal may differ from the estimates made, the identified waste management options are variable and would be appropriate to the final waste quantities.

24.1.2 Legislative and policy context to the assessment

The main legislation relevant to the management of waste are the POEO Act, the *Protection of the Environment Operations (Waste) Regulation 2014* (the Waste Regulation) made under the POEO Act, and the WARR Act.

The POEO Act establishes the procedures for environmental control, and for issuing environmental protection licences regarding matters such as waste, air, water and noise. The Waste Regulation regulates matters such as the obligations of consignors (producers and agents), transporters, and receivers of waste in relation to waste transport licensing and tracking requirements.

The WARR Act aims to ensure that waste management options are considered against the following waste management hierarchy:

1. avoidance of unnecessary resource consumption
2. resource recovery (including reuse, reprocessing, recycling and energy recovery)
3. disposal.

It is an offence under the Waste Regulation to transport waste generated in NSW more than 150 kilometres from the place of generation for disposal, unless the waste is transported to one of the two lawful disposal facilities nearest to the place of generation.

The movement of controlled waste is also regulated by the *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998*, made under the *National Environment Protection Council Act 1994*.

The *Australian Dangerous Goods Code* (National Transport Commission, 2015) defines a set of requirements for the transport of dangerous goods defined in the code. In NSW, the *Dangerous Goods (Road and Rail Transport) Regulation 2009* gives effect to the Australian Dangerous Goods Code.

Definition of waste

Schedule 5 of the POEO Act defines waste as:

(a) *any substance (whether solid, liquid or gaseous) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment*

(b) *any discarded, rejected, unwanted, surplus or abandoned substance*

(c) *any otherwise discarded, rejected, unwanted, surplus or abandoned substance intended for sale or for recycling, processing, recovery or purification by a separate operation from that which produced the substance*

(d) *any processed, recycled, reused or recovered substance produced wholly or partly from waste that is applied to land, or used as fuel, but only in the circumstances prescribed by the regulations*

(e) *any substance prescribed by the regulations to be waste.*

Waste classification

The classifications that apply to waste in NSW and the descriptions of each are provided by the POEO Act, the Waste Regulation and supporting guidelines, including the *Waste Classification Guidelines* (EPA, 2014a). Many waste types are pre-classified under the POEO Act and do not require testing. However, if a waste is not pre-classified, it may need to be tested to determine its classification.

Other

Consideration was given to the *NSW Waste Avoidance and Resource Recovery Strategy 2014 – 21* (EPA, 2014b). The primary goal of this strategy is to enable NSW to improve environment and community well-being by reducing the environmental impact of waste and using resources more efficiently. This strategy is informed and driven by the waste hierarchy defined in the WARR Act. It is supported by various regulations and policies including the POEO Act and Waste Regulation. To support the primary goal of the strategy, the proposal would be constructed and operated with consideration to the waste hierarchy. Additionally, any waste generated from the proposal would be disposed of in accordance with regulatory requirements.

The *NSW Sustainable Design Guidelines* (Transport for NSW, 2014) were also considered as the guideline includes compulsory and discretionary initiatives in relation to materials and waste. Further discussion regarding these guidelines and the associated initiatives is provided in chapter 22.

24.2 Impact assessment

24.2.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential waste risks.

The assessed risk level for the potential risks was low. This is because the proposal is unlikely to result in significant amounts of waste being generated, with the exception of construction related waste.

How potential impacts would be avoided

In general, with respect to waste, potential impacts would be avoided by:

- managing wastes in accordance with relevant legislative and policy requirements, as outlined in section 24.1.2
- designing, constructing and operating the proposal so that wastes are managed according to the waste minimisation hierarchy:
  - avoidance, where possible
  - treated as required, and reused on-site
  - recycled, either within the process or off-site
  - where other alternatives are not possible, wastes would be disposed of at appropriately licensed waste management facilities.
- implementing the waste management and mitigation measures provided in section 24.3
- implementing the air quality measures provided in chapter 13
- managing hazardous wastes in accordance with the mitigation measures provided in chapter 25.

24.2.2 Construction impacts

Waste generation

The following waste generating activities would occur during construction:

- site preparation works
  - clearing and grubbing
  - topsoil stripping
  - site compound establishment
  - haul roads, access roads and laydown construction
  - fencing (temporary and or permanent).
- cut and fill earthworks
- drainage structure demolition, replacement or construction
- culvert replacement or construction
- welding
- ballasting and tamping
- level crossing closure, removal or upgrading
- site compound operation
- plant and equipment operation.

Waste from site preparation may include vegetation, roots, tree stumps, and general rubbish and debris.

Local accommodation at various towns would be used for construction staff. No construction camps are proposed, however site compounds would be established – some with office facilities and temporary amenities. The establishment of these site compounds may generate some minor quantities of construction material waste such as metals, wood, concrete etc.

Wastewater generated by site compound operations would include grey water and sewage from site amenities, and wash-down water used for vehicles and equipment.

Food waste, waste paper and cardboard, plastic, metal (including aluminium cans), glass and electrical waste would be generated by construction staff, as well as any office facilities at the site compounds. Maintenance fluids generated by the operation of construction plant and equipment would include paints, solvents, lubricants, and oils. Hydrocarbon and water mixtures or emulsions would be generated in plant and equipment wash-down areas within site compounds.

Waste generated during construction would include packaging waste, such as pallets, plastic film wrap, cable reels, and metal straps/bands.

Table 24.1 lists the predicted construction waste types, likely classifications, and estimated quantities.

Table 24.1 Waste estimates and classification - construction

Activity	Waste	Classification	Estimated quantity (tonnes unless indicated)
Clearing and grubbing	Green waste	General solid waste (non-putrescible)	Zero off-site - stockpiled in bottom layer spoil mounds
	Rubbish and debris	General solid waste (non-putrescible)	200
Topsoil stripping	Topsoil	General solid waste (non-putrescible) or virgin excavated natural material	Zero off-site - placed over top of stockpiled spoil mounds
Rail formation	Sleepers, tracks	General solid waste (non-putrescible)	Rail 106 km x 2 and sleepers (106,000/0.6) mix timber steel
Site compound establishment	Waste concrete (for hardstand areas)	General solid waste (non-putrescible)	100
	Waste metal	General solid waste (non-putrescible)	10
	Waste wood	General solid waste (non-putrescible)	20
	Waste glass	General solid waste (non-putrescible)	< 1
	Waste plastic	General solid waste (non-putrescible)	< 1
Fencing (temporary and permanent)	Waste metal / timber posts	General solid waste (non-putrescible)	20 km
Cut and fill earthworks	Contaminated spoil	Special waste	<1 based on existing contamination assessment results (see chapter 14)
Drainage structures and culvert construction/ replacement	Waste wood and concrete	General solid waste (non-putrescible)	2,775
	Waste metal	General solid waste (non-putrescible)	< 1

Activity	Waste	Classification	Estimated quantity (tonnes unless indicated)
Welding	Waste metal	General solid waste (non-putrescible)	Rail off cut kept, other minimal (<1)
Ballasting and tamping	Waste ballast	General solid waste (non-putrescible)	Zero off-site - all ballast used, unsuitable stockpiled into spoil mounds
Site compound operation	Food waste	General solid waste (putrescible)	<1
	Wastewater	Liquid waste	To be confirmed
	Waste paper	General solid waste (non-putrescible)	1
	Waste cardboard	General solid waste (non-putrescible)	2
	Waste plastic and glass	General solid waste (non-putrescible)	<1
	Waste metal	General solid waste (non-putrescible)	10
	Electrical waste	General solid waste (non-putrescible)	2
	Waste from vehicle/plant equipment maintenance	General solid waste (non-putrescible) - drained oil filters (mechanically crushed), rags and oily rags only if they contain non-volatile petroleum hydrocarbons and no free liquids. Hazardous waste - containers holding oil, grease and lubricants if residues have not been removed by washing (see Appendix 2 of the *Waste Classification Guidelines Part 1: Classifying Waste* (EPA, 2014a))	<1

Approximate waste volumes and the potential classification would be estimated and/or confirmed following finalisation of the detailed design and incorporated into the CEMP prepared for the proposal.

Noise and dust impacts associated with the excavation, handling, storage on-site and transport of waste (where required) are considered as part of the construction scope of works assessed in chapters 11, 13 and 14. Sediment and leachate impacts associated with the stockpiling of spoil are considered in chapter 16.

Spoil generation and management

Spoil generation and quantities

Spoil is soil, rock or dirt excavated and removed from its original location. It is estimated that a total of 801,857 cubic metres of spoil would be generated during construction. All spoil is expected to be reused either for track formation/construction or used to create spoil mounds (as described in chapters 7 and 8).

Only some minor quantities of contaminated spoil may be generated. This spoil would not be reused on site and would be disposed of off-site at an appropriately licenced facility.

The estimated quantities of spoil that would be generated and reused are listed in Table 24.2.

The majority of spoil would be generated during excavation required for the construction of cess drains. Relatively smaller quantities would be generated during site preparation activities, and from other earthworks such as for the formation treatment.

Table 24.2 Preliminary estimate of potential spoil generation

Location/source (start chainage)	Spoil generation estimate (m^3)	Spoil to be reused in track works (m^3)	Spoil to be used on site in spoil mounds (m^3)
449.5	27,128	4,900	22,228
453.0	23,228	6,300	16,928
457.5	24,723	6,300	18,423
462.0	27,979	6,300	21,679
466.5	44,401	6,300	38,101
471.0	17,211	6,300	10,911
475.5	15,222	6,300	8,922
480.0	15,404	6,300	9,104
484.5	27,247	6,300	20,947
489.0	24,518	6,300	18,218
493.5	25,333	6,300	19,033
498.0	48,073	6,300	41,773
502.5	42,092	6,300	35,792
507.0	31,921	6,300	25,621
511.5	45,981	6,300	39,681
516.0	43,912	6,300	37,612
520.5	44,185	6,300	37,885
525.0	43,594	6,300	37,294
529.5	36,517	6,300	30,217
534.0	27,337	6,300	21,037
538.5	42,001	6,300	35,701

Location/source (start chainage)	Spoil generation estimate (m^3)	Spoil to be reused in track works (m^3)	Spoil to be used on site in spoil mounds (m^3)
543.0	39,418	6,300	33,118
547.5	43,351	6,300	37,051
552.0	41,085	10,550	30,535
TOTAL	**801,857**	**154,050**	**647,807**

As listed in Table 24.2, it is estimated that about 19.2 per cent of the spoil generated (154,050 cubic metres) could be reused in track works, with the remainder being used in spoil mounds. This would continue to be refined during detailed design. Consistent with the waste minimisation hierarchy, the approach to spoil management would follow the hierarchy of options listed in Table 24.3.

Table 24.3 Spoil management hierarchy for the proposal

Priority	Reuse options	Approach
1	Avoid	The detailed design would be optimised to minimise spoil generation.
2	Re-use for construction of the proposal	Spoil generated during construction would be reused for the proposal, including reuse spoil for fill, embankments and mounds within a short haulage distance of the source.
3	Reuse on other projects	Reuse spoil for fill, embankments and mounds on other projects within a financially feasible transport distance of the proposal site.
4	Disposal	Excess spoil would be disposed of in accordance with the waste management plan prepared as part of the CEMP (refer section 24.3).

Waste handling and management

Approach to waste minimisation and reuse

Waste management measures have been developed for the identified types of waste in accordance with the waste management hierarchy (refer Table 24.6). Although the waste management hierarchy has been considered for each waste type, not all waste management options are applicable to a given waste type. For example, some types of waste are non-recyclable. As such, only the applicable waste management options are applied.

Recycling and disposal

The following waste management facilities are located in the study area:

- Parkes Waste Depot (Broglan Road, Parkes)
- Parkes Shire rural waste depots – Peak Hill, Alectown, Bogan Gate, Trundle, Tullamore and Gunningbland
- Narromine Waste Management Facility (Gainsborough Road, Narromine)
- Trangie Waste Management Facility (Trangie Tip Road, Trangie)
- Tomingley Waste Transfer Station (Gundong Road, Tomingley).

The majority of rural landfills or transfer stations are operated by local councils for use by residents. However, the larger landfills and transfer stations are able to accept commercial waste. Arrangements would be made with landfill/transfer station operators to ensure that the waste types and quantities could be accepted.

The approach to waste management during construction is described in section 24.3. The waste management measures proposed to align with the waste management hierarchy are listed in Table 24.6. This table also outlines the contingency measures (disposal) for wastes that cannot be avoided, reused, recycled or treated. Measures to facilitate segregation and prevent cross contamination are also provided.

24.2.3 Operation impacts

Operation waste generating activities

The main waste generating activity during operation would be track maintenance. Small quantities of green waste may be generated during maintenance activities as a result of vegetation control, herbicide use, and maintenance of the entire rail corridor. Other general debris and litter are also expected to be collected during maintenance. These activities already occur under existing operational conditions.

Maintenance of plant and vehicles would be undertaken back at ARTC's existing provisioning centres therefore waste from maintenance of plant and vehicles during operation has not been considered further.

Classification and estimates/details of the quantity of each classification of waste to be generated

The anticipated waste types, likely classifications, and estimated quantities during operation are listed in Table 24.4.

Table 24.4 Waste estimates and classification - operation

Activity	Waste	Classification	Quantity (tonnes per year)
Track maintenance	Green waste	General solid waste (non-putrescible)	<1
	Rubbish and debris	General solid waste (non-putrescible)	200

Waste handling and management

The approach to waste management during operation is provided in section 24.3. The waste management measures proposed to align with the waste management hierarchy are listed in Table 24.8. This table also outlines the contingency measures (disposal) for wastes that cannot be avoided, reused, recycled or treated. Measures to facilitate segregation and prevent cross contamination are also provided.

Due to the minimal amounts of waste likely to be generated during operation, the potential for significant environmental impacts associated with the excavation, handling, on-site storage and transport waste would be low. Any impacts would be minimised by implementing existing ARTC procedures and complying with the operational EPL.

24.3 Mitigation and management

24.3.1 Approach to mitigation and management

The waste management strategy for the proposal would continue to be developed and refined during detailed design, and would include:

- the procurement plan
- construction waste management plan
- consideration of waste in operational environmental management procedures
- waste auditing and monitoring.

A construction waste management plan would be developed for the proposal as part of the CEMP. Operational procedures would continue to consider waste management in accordance with regulatory requirements. Waste management during construction and/or operation would also be undertaken in accordance with ARTC's existing procedures and EPL. Implementation of these measures would ensure that waste is managed in an environmentally sound manner, and in accordance with legislative requirements for waste disposal and waste tracking.

In addition, waste auditing and monitoring would be undertaken to ensure that the waste management plan for construction are scaled with actual waste volumes. The proposed approach to environmental management during construction and operation is described in chapter 27.

24.3.2 Consideration of the interactions between mitigation measures

All mitigation measures would be consolidated and described in the environmental management plans for construction and operation. The plans would identify measures that are common between waste types and or impact categories. Common impacts and common mitigation measures would be consolidated to ensure consistency.

24.3.3 Summary of mitigation measures

To manage and mitigate the potential for waste impacts, the following mitigation measures would be implemented.

Table 24.5 Waste mitigation measures

Stage	Impact	Mitigation measures
Detailed design	Excess waste generation	Detailed design would include measures to minimise excess spoil generation. This would include a focus on optimising the design to minimise spoil volumes, and the reuse of material on-site.
Pre-construction/ construction	Amenity and general environmental impacts	A waste management plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for impacts on the local community and environment. The waste management measures to be incorporated are listed in Table 24.6.
Construction	Waste management	Waste segregation bins would be located at site compounds to facilitate segregation and prevent cross contamination.
Operation	Waste management	The waste management measures listed in Table 24.8 would be implemented where practicable during operation.

Table 24.6 Construction waste management measures

Waste	Hierarchy	Management
Green waste	Avoid	Clearing would be minimised by placing temporary infrastructure in areas that have been previously cleared, degraded or have naturally lower above ground biomass.
	Reduce	Areas to be cleared would be marked to reduce incidental clearing.
	Reuse	As far as practicable, cleared material would be chipped, mulched and stockpiled for reuse during finishing works. Materials with special habitat value, such as hollow bearing logs or trees, would be selectively removed for reuse, or placed in nearby bushland.
	Dispose	Noxious weeds would be disposed of in accordance with relevant guidelines/requirements.
Rubbish and debris	Recycle	Where recycling is considered feasible, rubbish and debris would be stored for collection by an authorised contractor for offsite recycling.
	Dispose	Where rubbish and debris is not recyclable, the waste would be removed to a storage location for collection by an authorised contractor for offsite disposal.
Food waste	Disposal	Putrescible waste would be stored at allocated bins at each site compound, for collection by an authorised contractor, and disposed of offsite.
Wastewater	Dispose	Wastewater/sewage from site compound amenities/ablutions would be removed by an authorised contractor for disposal in accordance with regulatory requirements.
Spoil	Reduce	The proposal is designed to adhere to the natural ground profile, where practicable, in order to reduce earthworks.
	Reuse	All spoil is expected to be reused either for track formation/construction or used to create spoil mounds.
	Recycle	Surplus material that cannot be reused would be stockpiled on site. Options to recycle spoil would be investigated where practicable.
	Dispose	Only minor quantities of contaminated spoil will require offsite disposal at an appropriately licenced facility.
Topsoil	Reuse	Topsoil would be stockpiled for reuse during rehabilitation. Stockpiles would be managed to maintain soil structure and fertility.
	Treat	Low quality topsoil would be treated with ameliorants to improve structure and fertility.
	Dispose	Surplus or unusable topsoil would be disposed at locations within the rail corridor.
Waste concrete	Avoid	Procurement of surplus concrete powder would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Reuse	Sleepers would be reused where appropriate.
	Recycle	Waste concrete would be crushed and recycled where practicable.

Waste	Hierarchy	Management
	Dispose	Waste concrete that cannot be recycled would be collected and stored in designated storage areas for offsite disposal by an authorised contractor.
Waste ballast	Avoid	Procurement of surplus ballast would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Disposal	All unusable ballast would be placed into spoil mounds.
Waste metal	Avoid	Procurement of surplus metal, including rail, would be avoided by adhering to the procurement plan.
	Reduce	Waste metal would be reduce by limiting offcuts.
	Recycle	Suitable rail offcuts or scrap metal (including metal bands from packaging of construction materials and hot waste from welding) would be stored for collection by an authorised contractor and recycled offsite. Market demand for this recyclable waste would also be considered.
Waste wood	Avoid	Procurement of surplus wood would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Reuse	Waste wood would be stored on site for reuse, where practicable.
	Recycle	Waste wood that cannot be reused on site (including cable reels from packaging) would be collected in designated recycling containers for offsite disposal by an authorised contractor, where recycling is considered feasible. Market demand for this recyclable waste would be considered.
Waste glass	Recycle	Waste glass would be stored at recycling bins at each site compound, for collection by an authorised contractor and recycled offsite, where feasible.
	Dispose	Where recycling is not considered feasible, the waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal.
Waste plastic	Avoid	Procurement of surplus plastic would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Recycle	Waste plastic would be stored at recycling bins at each site compound, for collection by an authorised contractor and recycled offsite.
	Dispose	Where recycling is not considered feasible, the waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal.
Waste rubber	Avoid	Procurement of surplus rubber (e.g. gloves, earplugs, tyres) would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Recycle	Waste rubber would be stored at recycling bins for collection by an authorised contractor and recycled offsite.

Waste	Hierarchy	Management
	Dispose	Where recycling is not considered feasible, or is contaminated, waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal.
Waste paper	Avoid	Procurement of surplus paper would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Reduce	Waste paper from office/administration facilities would be minimised by enabling 'secure print' feature on all printers and by encouraging double-sided printing.
	Recycle	Waste paper would be stored at recycling bins at each site compound, for collection by an authorised contractor, and recycled offsite, where feasible.
	Dispose	Where recycling is not considered feasible, the waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal.
Waste cardboard	Avoid	Procurement of surplus cardboard would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Recycle	Waste cardboard would be stored at recycling bins at each site compound, for collection by an authorised contractor, and recycled offsite, where feasible.
	Dispose	Where recycling is not considered feasible, the waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal.
Waste aluminium cans	Recycle	Waste aluminium would be stored at recycling bins at each site compound, for collection by an authorised contractor, clubs or charities, and recycled offsite.
Electrical waste	Avoid	Procurement of surplus appliances and cabling would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Reuse	Product stewardship arrangements would be sought, with a view to some electrical appliances being reused under return to supplier arrangements.
	Recycle	Electrical waste would be stored at recycling bins at each site compound, for collection by an authorised contractor, and recycled offsite, where feasible. Market demand for this recyclable waste would also be considered.
	Dispose	Where recycling is not considered feasible, the waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal.
Waste oil, grease, lubricants,	Avoid	Procurement of surplus appliances and cabling would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).

Waste	Hierarchy	Management
oily rags and filters	Recycle	Only waste oil and oil filters to be recycled through storage in recycling bins at each site compound, collection by an authorised contractor, and recycling offsite, where feasible.
	Dispose	The waste would be collected and stored in designated waste storage areas for collection by an authorised contractor for offsite disposal. Where feasible, containers holding oil, grease and lubricants would be washed prior to disposal or stored separately for disposal as hazardous waste.
Waste pallets	Avoid	Procurement of surplus pallets would be avoided by adhering to the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
	Reduce	Delivery of material on pallets would be limited wherever possible. If materials have to be delivered to site on pallets, ensure that pallets are returned to the supplier at time of delivery, where practicable.
	Reuse	Product stewardship arrangements would be sought, with a view to pallets being reused under the stewardship of the supplier.
	Recover	Options to recover wood from pallets by chipping, for reuse as mulch, would be pursued where practicable.

Table 24.7 Colour-coding scheme for waste segregation bins

Waste type	Colour
General waste	RED
Paper, cardboard, cans, bottles	BLUE
Metal	GREY
Plastics	ORANGE
Green waste, organics	GREEN

Table 24.8 Operation waste management measures

Waste	Hierarchy	Management
Green waste	Reuse	As far as practicable, green waste generated from maintenance activities would be chipped, mulched and reused for vegetation management, or collected by an authorised contractor and recycled offsite.
	Dispose	Noxious weeds would be disposed of in accordance with relevant guidelines/requirements.
Rubbish and debris	Recycle	Wastes would be would be collected by an authorised contractor and recycled offsite, where recycling is considered feasible.
	Dispose	Where waste is not recyclable, it would be collected by an authorised contractor and disposed offsite at a suitably licenced facility.
Waste metal	Avoid	Procurement of surplus metal, including rail, would be avoided by adhering to the procurement plan.

Waste	Hierarchy	Management
	Reduce	Waste metal would be reduced by limiting offcuts.
	Recycle	Suitable rail offcuts or scrap metal (including metal bands from packaging of materials for maintenance and hot waste from welding) would be collected by an authorised contractor and recycled offsite. Market demand for this recyclable waste would also be considered.

25. Health and safety (including hazardous materials)

This chapter provides an assessment of the potential health and safety impacts of the proposal on the surrounding community and the environment. It assesses the potential impacts of construction and operation, and provides recommended mitigation measures.

25.1 Assessment approach

25.1.1 Methodology

A desktop level assessment was undertaken to identify potential impacts to the health and safety of the surrounding community and environment as a result of the construction and operation of the proposal. The assessment involved:

- reviewing the relevant regulatory framework and applicable guidelines
- identifying construction and operational activities with the potential to cause health and safety impacts to off-site receivers
- considering the potential impacts associated with hazardous materials, as defined by the guidelines to *State Environmental Planning Policy No 33 – Hazardous and Offensive Development* (SEPP 33)
- reviewing bushfire prone land maps for the proposal site, where available
- qualitatively assessing potential impacts to public health and safety
- providing mitigation measures for implementation during construction and operation.

The assessment focuses on those construction and operational activities with the potential to result in health and safety impacts on surrounding communities, land uses, and the environment (also known as 'off-site receivers'). The assessment does not take into account potential health and safety risks to on-site workers associated with normal construction operations, as these are regulated by workplace health and safety legislation (including the *Work Health and Safety Act 2011*), and are not relevant to approval of the proposal under Part 5.1 of the EP&A Act. Site management would be the responsibility of the construction contractor, who would be required (under the Work Health and Safety Act) to manage the site in accordance with relevant regulatory requirements.

25.1.2 Legislative and policy context to the assessment

The assessment gave consideration to the following relevant legislation, policies and guidelines:

- Rural Fires Act 1997
- Dangerous Goods (Road and Rail Transport) Regulation 2009
- Planning for bush fire protection (NSW Rural Fire Service, 2006)
- Australian Code for the Transport of Dangerous Goods by Road & Rail Dangerous Goods Code (National Transport Commission, 2016) ('the Dangerous Goods Code')
- Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Department of Planning, 2011) ('Applying SEPP 33').

Dangerous goods and hazardous materials

Hazardous materials are classified based on their health effects, while dangerous goods are classified according to their physical or chemical effects, such as fire, explosion, corrosion and poisoning, affecting property, the environment or people.

As the proposal is State significant infrastructure, SEPP 33 does not apply to the proposal (refer to section 25.4.3). However, Applying SEPP 33 provide a process of identifying a potentially hazardous development by identifying storage and transport screening thresholds. The thresholds in Applying SEPP 33 represent the maximum quantities of hazardous materials that can be stored or transported without causing a significant off-site risk.

Hazardous materials are defined by Applying SEPP 33 as substances falling within the classification of the Dangerous Goods Code. Dangerous goods are substances that, because of their physical, chemical (physicochemical) or acute toxicity properties, present a risk to people, property or the environment. Types of substances classified as dangerous goods include explosives, flammable liquids and gases, corrosives, chemically reactive or acutely (highly) toxic substances. Dangerous goods are defined by the Dangerous Goods Code.

25.2 Existing environment

25.2.1 Sensitive receivers

The proposal would generally be located more than 200 metres from most sensitive receivers. Sensitive receivers and land uses close to the proposal site are described in chapters 11 and 20.

25.2.2 Existing goods transport arrangements

Existing operations along the rail lines in the study area are described in chapter 2.

25.2.3 Bushfire

Bushfire presents a threat to public safety and environmental (biodiversity) values. According to the *Bush Fire Risk Management Plan* (Parkes Bush Fire Management Committee, 2002) the major ignition sources in the Parkes LGA are:

- farm and road maintenance machinery
- road traffic
- lightening
- railways.

The risk of bushfire can be considered in terms of environmental factors that increase the risk of fire (fuel quantity and type, weather patterns and topography), as well as specific activities or infrastructure components that can exacerbate ignition risks. Environmental factors are considered in this section while potential ignition sources which may be generated by the proposal are described sections 25.3.2 and 25.3.3.

Existing risk

Bushfire prone areas are those areas which can support a bushfire or are likely to be subject to bushfire attack. Bushfire prone land maps have been prepared by most local councils across NSW and certified by the Commissioner of the NSW Rural Fire Service. These maps identify bushfire hazards and associated buffer zones within a local government area.

No bushfire prone land maps are publically available from Parkes or Narromine councils. However, a number of fire alerts during the summer months have been issued for locations surrounding the proposal site, and the presence of long grass in many areas would exacerbate the potential for grass fires near the proposal site, particularly during times of drought.

According to the *Bush Fire Risk Management Plan*, between 1951 and 1987 there were five major fires in areas that are now part of Goobang National Park. The *Bush Fire Risk Management Plan* also noted that every five to 10 years a major fire occurs in the eastern range of the Parkes LGA.

Vegetation

The majority of the proposal site has been modified by uses and activities associated with rail transport and surrounding agricultural land uses. Vegetation within and in the vicinity of the proposal site is described in chapter 10.

Topography

The slope of a site can also influence the rate of fire spread, with a doubling of the rate of spread for every slope increase of 10 degrees. As a consequence, a bushfire hazard downslope of a site would pose a greater risk, as the bushfire would travel upwards, with a corresponding increase in flame height and intensity. The proposal site crosses flat to undulating rises along the lower western slopes of a north–south trending range.

Climate

The overall climate of the proposal site is temperate. The fire season within the Parkes Shire Bush Fire District generally runs from November through to March, and temperatures can range from the high 20s to the low 40s (degrees Celsius). The weather generally consists of hot dry summers with hot dry winds which come from the north-west, and cooler dry winds which come from the south-west. These cooler winds can be accompanied by electrical activity and occasional heavy thunderstorms.

25.3 Impact assessment

25.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential health and safety risks. The assessed risk level for the majority of potential risks to health and safety was between medium and high. Risks with an assessed level of medium or above are as follows:

- impacts from the transport, storage and use of hazardous substances and dangerous goods
- emissions from vehicles or plant during construction
- reduced safety for road users and pedestrians during construction
- health impacts from noise and air pollution during construction and operation
- potential for the proposal to exacerbate bushfire risk (as a result of the storage of dangerous goods, and construction site issues such as smoking or hot works)
- impacts from spills or accidents during the transport, storage, and use of hazardous substances and dangerous goods
- potential for train strike for pedestrians and vehicles crossing the rail corridor.

How potential impacts would be avoided

In general, potential health and safety impacts would be avoided by:

- managing construction and operation in accordance with relevant legislative and policy requirements, as listed in section 25.1.2
- designing, constructing and operating the proposal to minimise risks to health and safety
- implementing the management and mitigation measures described in section 25.4.3.

25.3.2 Construction impacts

Storage, handling and transport of dangerous goods and hazardous materials

The storage and handling of dangerous goods and hazardous materials have the potential to impact the surrounding community and environment if leaks and spills occur, resulting in the potential contamination of air, soils, surface water and/or groundwater.

Dangerous goods that may be used during construction are listed in Table 25.1. These are compared to the storage and transport thresholds in Applying SEPP 33. These thresholds represent the maximum amounts of dangerous goods that can be stored or transported to and from a proposal site without causing a significant risk to off-site receptors.

In general, low volumes of dangerous goods would be stored in construction compounds adjacent to the rail corridor. The quantity of goods stored would be commensurate with the demand for those goods so that excess goods are not sitting idle.

Table 25.1 Dangerous goods volumes and thresholds

Dangerous good	Australian Dangerous Good Code Class	Storage method	SEPP 33 thresholds		
			Storage volume (in tonnes unless indicated)	Minimum storage distance from sensitive receptors (m)	Transport (weekly)
Petrol	C11; 3 PG III2	20 litre drums	Greater than 5 if stored with other Class 3 flammable liquids	5	n/a if not transported with Class 3 dangerous goods
Diesel	C11; 3 PG III2	20 litre drums	Greater than 5 if stored with other Class 3 flammable liquids	5	n/a if not transported with Class 3 dangerous goods
Lubricating and hydraulic oils and greases	C2	20 litre drums	n/a	n/a	n/a if not transported with Class 3 dangerous goods
Cement	n/a	Bags or pallets	n/a	n/a	Not subject to thresholds
Acetylene	2.1	Cylinders (up to 55 kg)	Greater than 100 kg	15	2 tonnes/30 times per week
Epoxy glue	3 PG III	Small containers	Greater than 5	5	10 tonnes/60 times per week
Premix concrete	n/a	Bags or pallets	n/a	n/a	Not subject to thresholds
Shotcrete accelerator	3 PG III	1,000 lt intermediate bulk containers (IBCs)	Greater than 5	5	3 tonnes/45 times per week

Dangerous good	Australian Dangerous Good Code Class	Storage method	SEPP 33 thresholds		
			Storage volume (in tonnes unless indicated)	Minimum storage distance from sensitive receptors (m)	Transport (weekly)
Acids	8 PG II	1,000 lt IBCs	Greater than 25	n/a	2 tonnes/30 times per week
Bases	8 PG II	1,000 lt IBCs	Greater than 25	n/a	2 tonnes/30 times per week
Disinfectant	8 PG II	500 lt IBCs	Greater than 50	n/a	2 tonnes/30 times per week

Notes 1: Classified as C1 if not stored with other Class 3 flammable liquids
2: Classified as 3PGIII if stored with other Class 3 flammable liquids

Bushfire

Potential ignition sources during construction include cigarettes and domestic rubbish (such as glass bottles), and the generation of sparks through hot works such as welding or the excavator bucket making contact with rock or the rail track.

Fuel leaks and spills from plant and machinery, and the storage of dangerous goods during construction, could also provide a fuel source for bushfires.

Underground and aboveground utilities

The potential rupture of underground utilities during excavation or collision of plant and equipment with aboveground services could pose risks to public safety. Rupture or contact with services during works could also result in short term outages, as could relocation of utilities and services.

Health and safety impacts associated with encountering utilities would be minimised by undertaking utilities investigations, including intrusive investigations, and consultation with service providers as part of the detailed design phase.

Potential contamination

Contaminants of potential concern that could potentially be exposed during excavation include hydrocarbons and asbestos. Exposure to these contaminants could cause health and safety impacts to the community through inhalation and/or direct contact, or impacts to the environment due to contamination of land.

Health and safety impacts associated with potential exposure to contaminated and hazardous materials would be minimised through implementation of an unexpected finds protocol and waste management plan that would be prepared as part of the CEMP.

Further information on contamination and associated mitigation measures is provided in chapter 14.

Risk of subsidence

As described in chapter 15, the potential for dewatering during construction is low, due to the shallow depth of excavation and the low potential for groundwater to be encountered in significant volumes at these depths. The proposal would also not involve the excavation of any tunnels or other sub-surface cavities. Based on the nature of the works being undertaken and the existing environment, the risk of subsidence as a result of construction is considered negligible.

Emergency vehicle movements

As described in chapter 9, construction of the proposal would result in temporary impacts to traffic and access within the proposal area, and an increase in both heavy and light vehicle movements on the local road network. The proposed works on level crossings may also result in disruptions to local traffic. This could cause delays and/or potential access restrictions to emergency vehicle movement in the proposal area. However, the traffic impact assessment concluded that the road network performance would not decline as a result of construction. Therefore, any delays would likely be minor.

Impacts from delays and potential access restrictions would be managed through the implementation of a traffic management plan and appropriate traffic controls, which would consider emergency vehicle access and movements. Ongoing liaison with local councils, Roads and Maritime Services, and emergency services organisations would be undertaken as part of the detailed design phase to confirm any additional measures to mitigate potential impacts to emergency vehicle movements.

Other health and safety risks

A number of other construction activities could result in impacts to the health and safety of site workers, users, visitors, and the local community if improperly managed. These include:

- working within an operating rail environment
- the operation of vehicles and construction equipment on site
- the transportation of equipment, excavated spoil and material to and from site
- construction failures or incidents resulting in flooding, inundation or excavation collapse.

In addition to the above, there is the potential for risks to pedestrian/public safety resulting from unauthorised access to construction work areas.

The potential for the above activities to cause health and safety impacts is considered to be minimal, based on the remote nature of the majority of the proposal site.

NSW workplace safety laws require construction sites to have adequate site security, which includes appropriate fencing. All construction work would be isolated from the general public. The construction contractor would need to ensure that construction sites are secure at all times, and take all possible actions to prevent entry by unauthorised persons.

Health and safety risks during construction would be managed by the implementation of standard workplace health and safety requirements.

A work health and safety management plan and safe work method statements would be developed in accordance with regulatory requirements.

25.3.3 Operation impacts

Storage, handling and transport of dangerous goods and hazardous materials

The amount of hazardous materials and dangerous goods that would be used during maintenance activities would be much smaller than the volumes required during construction. Hazardous materials and dangerous goods required during maintenance would be similar to those listed in Table 25.1, and would be transported in vehicles/trucks to areas requiring maintenance.

Transport of hazardous materials and dangerous goods via rail during freight operations has the potential to cause impacts to the surrounding community and the environment through leaks and spills. The transport of hazardous materials and dangerous goods would be the responsibility of the freight operator/s and would be undertaken in accordance with relevant standards and regulatory requirements (including the *Australian Dangerous Goods Code* (National Transport Commission, 2015) and ARTC's standard operating procedures).

Bushfire

The potential for bushfire during operation would be similar to that during construction, although the likelihood of a bushfire occurring during operation would be less than construction.

Operation has the potential to cause ignition sources through littering and the mechanical failure of infrastructure components that can exacerbate ignition risks. This could include failure of metal components at high speeds.

Emergency vehicle movements

As described in chapter 15, the proposal may increase the extent or duration of flooding of public roads at some locations, which could lead to road closures and restrict movement of emergency vehicles. However, flooding would only occur at the same public road locations as that where it is currently occurring. No additional public roads would be closed due to flooding. Therefore, there would be no additional impacts to emergency vehicle movements as a result of the proposal.

Other health and safety risks

Potential impacts to the health and safety of the local community include:

- risks to pedestrians and road vehicles as a result of collisions with trains at stops and level crossings
- other safety risks, such as security risks, unauthorised access etc
- general worker health and safety issues for drivers and maintenance staff.

These potential impacts would be managed by undertaking the design with an appropriate emphasis on safety according to relevant design standards and requirements.

Targeted community education programs would be implemented prior to and during operation to provide information about Inland Rail operation and safety, particularly at level crossings (refer to chapter 21).

Works within the rail corridor would be undertaken in accordance with ARTC's standard operating procedures, thereby reducing the potential for impacts to the health and safety of workers, visitors and users.

25.4 Mitigation and management

25.4.1 Approach to mitigation and management

Bushfire and emergency response

An emergency response plan would be developed as part of the CEMP in consultation with state and regional emergency service providers. The plan would include protocols and procedures to be followed during emergency situations associated with construction (including bushfires, explosions, vehicle and rail collisions, spillage or flooding events) in addition to:

- roles and responsibilities
- traffic management/control systems in the case of emergency
- training programs to ensure that all staff are familiar with the plan
- design and management measures to address the potential environmental impacts of an emergency situation.

Response to bushfire and other emergencies during operation would be undertaken in accordance with ARTC's existing Safety Management System (SMS) and associated procedures.

Storage, handling and transport of dangerous goods and hazardous materials

The CEMP and operational procedures for Inland Rail as a whole would include requirements for the storage, handling and transport of dangerous goods and hazardous materials in accordance with relevant regulatory requirements and ARTC's standards.

A spill response procedure would also be developed as part of the CEMP and would include notification and clean-up requirements in the event of a spill.

Community safety

As discussed in section 21.4, a safety awareness program would be developed and implemented to educate the community regarding safety around trains. This would focus on community and rural property operators who cross the rail corridor to access their properties.

25.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to control impacts to health and safety of workers, visitors and the public may replicate mitigation measures proposed for the control of impacts associated with noise, air quality, water quality, traffic and access and waste management.

All mitigation measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

25.4.3 Summary of mitigation measures

To mitigate the potential health and safety risks, the following measures would be implemented.

Table 25.2 Health and safety mitigation measures

Stage	Impact	Mitigation measures
Detailed design/ pre-construction	Public safety	A hazard analysis would be undertaken during the detailed design stage to identify risks to public safety from the proposal, and how these can be mitigated through safety in design.
	Services and utilities	The location of utilities, services, and other infrastructure would be identified prior to construction to determine requirements for access to, diversion, protection and/or support.
Pre-construction/ construction	Public safety from bushfires, fires, explosions, flooding and inundation	An emergency response sub-plan would be developed and implemented as part of the CEMP in consultation with relevant stakeholders. It would include measures to minimise the potential for health and safety impacts on the local community and environment.

Stage	Impact	Mitigation measures
Construction	Storage and handling of dangerous goods	Hazardous materials and dangerous goods would be stored, handled and transported in accordance with relevant regulatory requirements and relevant Australian Standards, including SEPP 33 thresholds. This would include a requirement to provide a minimum bund volume of 110% of the largest single stored volume within the bund. A risk management strategy would be developed to manage the potential for risks in situations where the minimum distance from sensitive receivers cannot be achieved, or the quantity of hazardous materials exceed SEPP 33 threshold levels.
Operation	Bushfire, storage and handling of dangerous goods, other health and safety risks	Operation would be undertaken in accordance with ARTC's standard operating procedures.

26. Cumulative and residual impacts

This chapter provides an assessment of the potential cumulative impacts of the proposal. It describes other projects in the study area, and identifies where there is the potential for cumulative impacts to occur. It also provides an assessment of the potential for residual impacts following implementation of the mitigation measures provided in chapters 9 to 25.

26.1 Overview

For an EIS, cumulative impacts can be defined as the successive, incremental, and combined effect of multiple impacts, which may in themselves be minor, but could become significant when considered together.

The SEARs for the proposal requires (item 2.1(n)):

> *'an assessment of the 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'.*

The assessment of potential cumulative impacts has been undertaken in accordance with the SEARs, and considers the potential for impacts taking into account other projects in the study area. The assessment draws on the findings of chapters 9 to 25, and environmental impact assessments of other projects. The cumulative impact assessment is provided in section 26.2.

The SEARs also require an assessment of the potential for residual impacts, including consideration of how these would be managed or offset. For the purpose of the EIS, residual impacts are considered to be the impacts of the proposal that may remain in the medium to long term, even after the implementation of the mitigation measures provided in chapters 9 to 25. The residual impact assessment is provided in section 26.3.

26.2 Cumulative impact assessment

26.2.1 Methodology

The following tasks were undertaken to assess the potential for cumulative impacts:

- identifying existing or proposed projects in the study area (either proposed or approved) based on information available in the public domain
- screening identified projects for their potential to interact with the proposal
- identifying and assessing the significance of potential cumulative impacts.

The study area for the cumulative impact assessment was the Parkes, Narromine, and Dubbo LGAs. Projects in the study area were identified based on a search of the following data sources, undertaken in December 2016:

- the Department of Planning and Environment's online major projects database
- proponent websites
- local council websites/DA tracking databases
- the public register under the POEO Act 1997.

The projects identified were screened in relation to their potential for cumulative impacts with the proposal, based on their nature, size, and proximity to the proposal site.

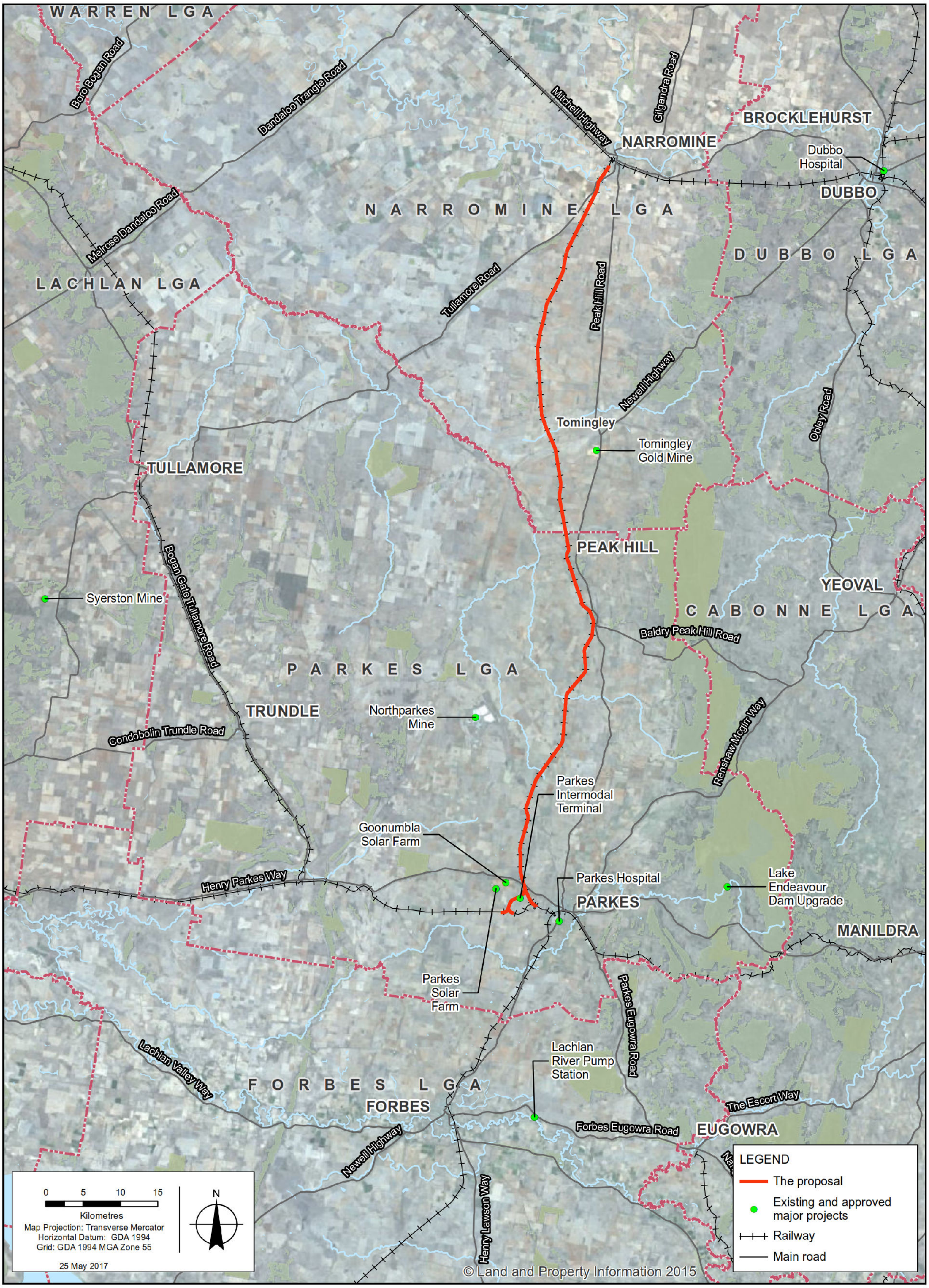
Screening of potential cumulative impacts was undertaken by comparing the extent and duration of impacts, and their potential to occur in the same place at the same time as that for the proposal. The significance of these cumulative impacts was then assessed, with consideration of the extent, magnitude, and duration of the impact and the sensitivity of the environment.

26.2.2 Other projects in the study area

Existing or proposed projects in the study area considered to have the potential for cumulative impacts with the proposal are listed in Table 26.1 and are shown in Figure 26.1. Further information on these projects on the following pages.

Table 26.1 Existing or proposed projects

Project	Proponent	Type	Status	LGA	Approx. distance from the proposal site (km)
Existing projects					
Syerston Mine	Black Range Minerals	Mineral extraction	Operational	Parkes	40
Northparkes Mine	Rio Tinto, Sumitomo Metal Oceania Pty Ltd and Sumitomo Corporation	Metal mining	Operational with approval to expand	Parkes	10
Parkes Hospital	Health infrastructure	Hospital	Operational	Parkes	1.5
Lachlan River Pump Station	Parkes Shire Council	Water infrastructure	Operational	Parkes	17
Lake Endeavour Dam Upgrade	Parkes Shire Council	Water infrastructure	Operational	Parkes	28
Tomingley Gold Mine	Alkane Resources Ltd	Metal mining	Operational with approval to expand	Narromine	4
Proposed and approved projects					
Goonumbla Solar Farm	Smardi Enterprises	Power generation	Approved	Parkes	2
Parkes Solar Farm	Neon Australia	Electricity generation	Approved	Parkes	4
Parkes Intermodal Terminal	Asciano Ltd	Rail and related transport	Approved	Parkes	Adjoins
Dubbo Hospital Redevelopment Stages 3 and 4	Health Infrastructure	Hospital	Proposed	Dubbo	30



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 26.1
Projects in the study area

Existing projects

Syerston Mine

The Syerston nickel cobalt mine is located near the township of Trundle, about 40 kilometres west of the proposal site. The initial proposal was approved in 2001, with three subsequent applications submitted to modify the operation of the mine. In 2005, an application was submitted to allow for an increase in the run-of-mine processing rate, limestone quarry extraction rate, and adjustments to ore procession operations. In 2006, another application was submitted to allow for reconfiguration of the water supply bore field. Most recently, an application was submitted to adjust mining and processing operations to initially focus on scandium oxide production. The assessment of the latest application is in progress, awaiting further information from the applicant.

Northparkes Mine

The Northparkes gold and copper mine has been operating since 1993, with approval granted in 2007 to allow for ongoing operation of the previously approved facilities and extension of the underground block cave mining. In October 2009, two further modifications were granted; one for a mine and mill upgrade to increase production and extend the mine life, the other being for the development of a warehouse.

The site is also subject to three Mining Leases, three Exploration Licences, one Environmental Protection Licence, a Limestone State Forest Occupation Permit and local council approval for road train access on Bogan Road (Umwelt, 2011).

In July 2014, the Minister for Planning granted approval with conditions for development of further mining operations, including depth extensions. This project will also allow for the increase in maximum production and major upgrades to associated mining infrastructure.

Parkes Hospital

The redevelopment of Parkes Hospital includes site preparation works, bulk earthworks, construction of a new two storey hospital building, and associated site infrastructure works. The works were approved in July 2014, with the new hospital officially opened in January 2016.

Lachlan River Pump Station

The Lachlan River Pump Station was completed in May 2016. The project, undertaken by Parkes Shire Council, included replacing the river intake pump at the Lachlan River, refurbishing infrastructure and commissioning Bore 8 to increase of water security for the Parkes/Peak Hill area.

Lake Endeavour Dam Upgrade

The Lake Endeavour Dam Upgrade was undertaken by Parkes Shire Council. The project involved strengthening the Dam to ensure the long term stability and integrity of the structure. The project also involved enhancing the Dam for increased flood security. Lake Endeavour Dam is also available for use for passive recreation activities, with a permit (Parkes Shire Council, 2016).

Tomingley Gold Mine

The Tomingley Gold Mine project, which was approved in July 2012, included:

- construction, operation and rehabilitation of an open cut and underground gold mine and associated infrastructure
- extraction and process of up to 1.5 million tonnes of gold ore per year for up to 10 years
- transportation the processed ore from the site via road.

Construction of the project commenced in February 2013, mining began in November 2013 and the plant was commissioned in February 2014.

Approval of subsequent modifications to the original consent occurred in November 2013, July 2014 and July 2016. The first modification was to adjust a range of commitments made during the original application which were no longer appropriate. The second was to permit enhancement of the approved and constructed amenity bund, and cut back one of the approved open cut mines. The third, and most recent modification, was for a further cut back, establishment of an additional open cut mine, and underground workings. Decommissioning activities are to occur progressively, with complete rehabilitation proposed by 2021.

Proposed and approved projects

Parkes Solar Farm

The Parkes Solar Farm was approved in July 2016. The proposal comprises the construction, operation, and eventual decommissioning of the Parkes Solar Farm. The proposal provides for construction and operation of about 215,000 solar panels on a 210 hectare site, internal access tracks, staff amenities, and a vegetation buffer. The Parkes Solar Farm would have the capacity to generate 50 megawatts per year.

Goonumbla Solar Farm

The Goonumbla Solar Farm project is proposed for a site adjacent to the Parkes Solar Farm site. The Goonumbla Solar Farm would include more than 200,000 solar panels, and have capacity to generate up to 150 megawatts of electricity.The project was granted approval in December 2016, subject to conditions.

Parkes Intermodal Terminal

The Parkes Intermodal Terminal (also known as the Parkes National Logistics Hub or the Parkes Hub) is located adjacent to the proposal site (for the Parkes north west connection) and the Broken Hill line. Approval was granted in March 2007 for the construction and operation of a facility providing for the large scale transport and storage of freight, and the transfer of freight containers between trucks and trains. The Parkes Intermodal Terminal occupies a 516 hectare site, and is intended to operate 24 hours, seven days per week. Asciano and SCT Logistics own land at the site.

In January 2012, approval was granted to modify the original consent. This approval extended the previously lapsed approval for five years. While the land has been re-zoned, development is yet to commence. The intent is to develop the site to maximise the opportunities resulting from Inland Rail.

Dubbo Hospital Redevelopment Stages 3 and 4

In February 2013 consent was granted for Stages 1 and 2 of the Dubbo Hospital redevelopment. These stages comprised of a new building, internal linkages, plant and equipment as well as refurbishment of existing buildings, demolition of old buildings and new landscaping. These works are almost complete.

In June 2016 Health Infrastructure requested SEARs for Stages 3 and 4 of the hospital redevelopment. Stages 3 and 4 consist of:

- construction of a new three store building
- demolition of existing buildings
- construction of a new car park, ambulance driveway and hospital entry.

Timing and details of construction and operation are not yet publicly available.

26.2.3 Cumulative impacts

The potential for cumulative impacts between the proposal and the projects listed in section 26.2.2 is considered below, according to the key environmental issues listed by the SEARs.

Traffic and transport

The greatest potential for cumulative traffic impacts are associated with construction traffic in the vicinity of Parkes. The proposal site adjoins the site for the Parkes Intermodal Terminal. Timing for the construction of the terminal is unknown, as construction has not commenced and the approval expires in February 2017. As such, it is not possible to assess the potential for cumulative impacts between the proposal and the terminal.

Two other projects are located in the vicinity of the Parkes north west connection – the Goonumbla Solar Farm and Parkes Solar Farm. Based on the construction timing proposed in the EISs for these projects, it is unlikely that construction of the proposal would overlap with construction of the Parkes Solar Farm. However, construction of the proposal could overlap with construction of the Goonumbla Solar Farm (between May and September 2018).

Construction traffic for Goonumbla Solar Farm is estimated to be a maximum of about 140 vehicles per day. Vehicle movements during construction of the proposal are estimated to be 400 per day. If construction of these projects overlap, there is sufficient capacity on the Newell Highway to accommodate the combined increase in traffic movements. Construction of the solar farm would use Henry Parkes Way for access, and it is not anticipated that this road would be impacted by construction of the proposal. As such, there is no anticipated significant cumulative traffic impacts.

There are no anticipated operational impacts due to the very low traffic numbers associated with both the proposal and the solar farms.

Biodiversity

The existing rail corridor and surrounding lands have been subject to a range of historic disturbances from land clearing, agriculture, and rail infrastructure development. The history of disturbance has resulted in an incremental loss of vegetation and fauna habitat across the broader Parkes to Narromine area. This cumulative loss of habitat has placed further pressure on local threatened flora and fauna species and ecological communities.

The proposal would further increase fragmentation in an already fragmented landscape for those vegetation communities and habitats within the proposal site that would be directly impacted by the proposal. However, the proposal would not significantly change the overall connectivity of habitats in the region, as the vast majority of the proposal site is located in an existing rail corridor. Fragmentation and connectivity considerations have been taken into account as part of the biodiversity assessment and the biodiversity offsets calculations.

Noise and vibration

As noted above, construction of the proposal could overlap with construction of the Goonumbla Solar Farm. There are two sensitive receivers located on Millers Lookout Road that could be impacted from construction noise from both projects. The predicated noise at these receivers from construction of the Goonumbla Solar Farm would be about 27 dB(A), compared with about 43 dB(A) from construction of the proposal. As construction noise from the proposal would be significantly greater than that of the solar farm, there would be no cumulative increase in noise impacts.

No cumulative noise impacts are likely to be associated with operation of the solar farms and the proposal. There is the potential for cumulative noise impacts with the Parkes Intermodal Terminal, however there is insufficient information currently available to determine to what extent and when.

Air quality

Air quality impacts from the proposal are predominately associated with construction dust. The assessment found that the predicted particulate levels from construction of the proposal would be unlikely to extend farther than 150 metres from work areas, and would have insignificant cumulative impacts with other projects. Predicted particulate increments from construction would be localised to within a few hundred metres of construction works, and would be unlikely to impact on regional air quality. The Parkes Intermodal Terminal is the only project located close enough to the proposal site to potentially result in cumulative air quality impacts. The construction timing of the terminal is unknown. If construction overlaps, coordination with the terminal proponent may be required.

Operational air quality impacts are not expected at distances greater than 20 metres from the proposal site. There are no identified significant sources of air pollutants, namely nitrogen oxides and particulates, within 20 metres of the proposal site, and cumulative impacts are not expected. The Parkes Intermodal Terminal is the only project located within 20 metres of the proposal. Air emissions from the terminal would be associated with emissions from trains and vehicles, and no cumulative impacts are predicted.

Soils

The potential for erosion and sedimentation as a result of the proposal is mainly associated with construction. These potential impacts would be readily managed with the implementation of standard erosion and sedimentation control measures. As such, it is not expected that the proposal would have a material impact on erosion and sedimentation at a scale such that cumulative impacts could occur.

The overall risk of encountering or generating land contamination is low, and the proposal would be unlikely to generate impacts at a scale that would interact with other projects.

Hydrology and flooding

It is predicted that the proposal would result in a small increase in the area and duration of flooding in the immediate vicinity of the proposal site, and that impacts are highly localised. None of the existing or proposed projects will have a significant influence on hydrology and flooding. As such, no cumulative impacts are expected to occur.

Water quality

Water quality impacts from the proposal would be associated with construction and would be highly localised. There are no anticipated cumulative impacts.

Aboriginal heritage

A small number of Aboriginal heritage sites may be impacted by the proposal. While some of the existing and proposed projects may also impact Aboriginal heritage items, due to the relatively low density of development in the region there are no anticipated cumulative impacts.

Non-Aboriginal heritage

No sites/items with a statutory heritage listing, with the potential to be directly or indirectly impacted by the proposal, were identified within or in the immediate vicinity of the proposal site. However, a number of items with potential heritage significance were identified.

While some of the existing and proposed projects may also impact heritage items, they will not impact rail heritage items or items immediately adjacent to the existing rail corridor. As such, no cumulative impacts are expected to occur.

Landscape and visual impacts

Given the low profile and horizontal form of most of the proposal, the level of visual modification would be confined to a distance relatively close to the area subject to change. The magnitude of the impacts for the proposal are low, as the visibility of the proposal is reduced by the typical flat topography and lack of sensitive receivers.

The combination of the proposal with the other projects proposed near the Parkes north west connection would result in a change in the visual landscape if the other projects proceed.

Land use and property

As the proposal would be undertaken mainly within the existing rail corridor, land use impacts are generally limited. There would be a relatively small area of additional land required for the Parkes north west connection.

In the vicinity of the Parkes north west connection, with the proposal and other projects, land use will change from rural residential/agricultural to other uses, including an intermodal facility, solar farms, and power generation. These changes are permissible under the current land use zonings.

Socio-economic

The project has the potential to compete with other projects and industries (including mining related) for employees, due to similar skill requirements – particularly during the peak construction period. Projects that are under construction would generate higher volumes of demand for labour and accommodation facilities than operational projects. These impacts are most likely to occur when construction of the southern end of the proposal is being undertaken, depending on the timing of construction for the other projects.

As noted above, construction of the proposal could overlap with construction of the Goonumbla Solar Farm. It is estimated that construction of this project would require a maximum of 100 staff.

The non-residential workforce has the potential to increase the demand for temporary in Parkes, Narromine, Peak Hill and Dubbo. This may reduce the availability and affordability of housing and accommodation for the duration of construction. There is insufficient information to determine the likelihood and extent of this potential impact, as it would depend on the timing of other projects. A review of accommodation would be undertaken prior to construction, and a workforce housing and accommodation plan would be implemented by ARTC for Inland Rail as a whole.

Waste

The generation of waste as a result of the construction would be minimised by implementing a waste management plan. Only licensed facilities would be used for waste disposal. The following waste management facilities are located in the study area:

- Parkes Waste Depot (Broglan Road, Parkes)
- Parkes Shire rural waste depots – Peak Hill, Alectown, Bogan Gate, Trundle, Tullamore and Gunningbland
- Narromine Waste Management Facility (Gainsborough Road, Narromine)
- Trangie Waste Management Facility (Trangie Tip Road, Trangie)
- Tomingley Waste Transfer Station (Gundong Road, Tomingley).

There are few projects in the vicinity of the proposal site that are likely to generate construction waste in the foreseeable future. Based on current information, construction of the proposal may overlap with the Goonumbla Solar Farm. No significant cumulative impacts as a result of waste generation are anticipated.

The existing mines in the study area have waste management plans in place, and while expansions are being undertaken, significant waste generation requiring off-site disposal is not anticipated.

Other issues

The potential for cumulative impacts for the other issues listed in the SEARs are considered in Table 26.2.

Table 26.2 Cumulative impacts – other issues

Key Issue	Cumulative impact assessment
Protected and sensitive lands	The proposal would not impact protected lands as defined by the SEARs. There would be limited impacts to waterfront land during construction, mainly as a result of the replacement of culverts. Due to the minimal impact as a result of the proposal, the potential for cumulative impacts to protected and sensitive lands is negligible.
Biosecurity	Biosecurity risks associated with other projects are relatively low, as the projects are confined to discrete sites. The greatest risks would occur during construction, but even this is considered to be very low. As such, no cumulative impacts to biosecurity are predicted.
Sustainability and climate change	Cumulative sustainability and climate change assessments are not relevant to the proposal. The sustainability assessment required by the SEARs is for an assessment of the sustainability of the proposal using the Infrastructure Sustainability Rating Tool and current guidelines and targets. This cannot be applied to a cumulative assessment. In relation to climate change, the SEARs requires an assessment of the impacts of climate change on the proposal, not an assessment of the proposal on climate change.
Health and safety	Potential health and safety impacts associated with other approved and proposed projects are not anticipated to increase the risks to public safety when combined with the proposal.

26.2.4 Summary of results

The potential for cumulative impacts between the proposal and other existing or proposed projects is low. Despite the extent of the area included in this cumulative impact assessment, a relatively small number of major projects were identified for inclusion in the assessment. The assessment considered all existing projects as part of the baseline assessment, and proposed changes to these projects were also considered.

The assessment concludes that the impacts from the proposal, combined with other existing and proposed projects in the study area, would not result in significant cumulative impacts.

26.3 Residual Impacts

A summary of the potential residual impacts for the proposal is provided in Table 26.3, together with a description of how these potential residual impacts would be managed.

Table 26.3 Residual impact assessment

Potential residual impacts	Comment	Approach to mitigation and management
Traffic and transport		
There is the potential for permanent impacts with the changes to level crossings and changes to roads in the vicinity of the Parkes north west connection.	The extent of impact would be determined during detailed design and through a process of consultation in regards to potential level crossing and road closures. There would be no forced closure of level crossings.	Consultation would be undertaken with relevant stakeholders prior to changes to access or level crossings in accordance with ARTC's processes. The operation of level crossings that have been subject to change would be reviewed after the proposal

Potential residual impacts	Comment	Approach to mitigation and management
		commences to ensure appropriate protection is provided, that they are appropriate for the traffic conditions, and whether any additional queuing capacity is required.
Biodiversity		
The proposal would involve the permanent removal of native vegetation and fauna habitat during construction, including removal of threatened ecological communities and habitats for threatened species.	Construction of the proposal would involve: - removal of about 76 hectares of native vegetation - removal of about 63 hectares of listed threatened ecological communities under the TSC Act and/or EPBC Act (as part of the total native vegetation clearance). *It is noted that the estimate of potential clearing would continue to be refined as the design of the project progresses, with the aim of reducing the potential clearing required.*	These potential impacts would be mitigated by the proposed mitigation measures, including: - implementation of a biodiversity offset strategy to offset permanent removal of native vegetation - detailed design and construction planning would minimise direct impacts to vegetation mapped as threatened ecological communities as far as practicable - implementation of the flora and fauna management sub-plan (as part of the CEMP), including weed control, fauna habitat management and monitoring
		- pre-clearance surveys would be undertaken, and a tree felling procedure would be implemented to avoid injury and mortality of native fauna during construction - native vegetation temporarily disturbed during construction would be rehabilitated.
Noise		
It is anticipated that, without mitigation, noise levels during operation would exceed relevant criteria at about 28 sensitive receivers.	During detailed design the noise modelling would be updated and further assessment undertaken to identify reasonable and feasible noise mitigation measures to achieve appropriate noise levels.	A range of potential design and mitigation measures would be considered and assessed during the detailed design process, including: - rail dampers - noise barriers - architectural treatment. Post construction noise monitoring would be undertaken

Potential residual impacts	Comment	Approach to mitigation and management
		at representative locations to verify the effectiveness of the applied mitigation measures with respect to the determined trigger levels.
Hydrology and flooding		
A reduction in inundation for events up to the two per cent AEP event is anticipated, together with an increase in the extent of inundation for flood events exceeding the two per cent AEP.	The potential impacts are not considered significant, as no houses or other structures would be impacted by the changes in flooding. Impacts are anticipated to be localised.	During detailed design the potential impacts to flooding and hydrology would be further assessed and the design amended as appropriate to minimise impacts. Flood modelling to support detailed design would be ongoing. Consultation would be undertaken with local councils and emergency services to ensure that the flood-related outcomes of the proposal are consistent with local planning and any future floodplain risk management plans.
Aboriginal heritage		
Construction of the proposal may result in the disturbance/ destruction of identified and unidentified Aboriginal archaeological sites.	Works within the proposal site have the potential to directly or indirectly disturb identified Aboriginal sites and areas of archaeological potential. Two listed sites were identified within the proposal site, and two sites are located adjacent to the proposal site. The proposal may directly or indirectly disturb these sites during construction. These sites have been assessed as having low archaeological significance.	These potential impacts would be mitigated by the proposed mitigation measures, including: ▸ detailed design and construction planning would minimise direct impacts to items/sites of Aboriginal heritage significance ▸ listed sites would be avoided where practicable ▸ implementation of the Aboriginal cultural heritage management plan ▸ sites within the proposal site would be avoided where practicable ▸ collection of artefacts according to recommended protocols if the sites cannot be avoided.

Potential residual impacts	Comment	Approach to mitigation and management
Visual amenity		
Presence of new structures in the landscape for the Parkes north west connection, including a new section of rail line and the Brolgan Road overbridge.	Operational impacts of the proposal would occur as a result of the introduction of new structures in the rural/natural landscape. The significance of these impacts is mitigated by the lack of receivers and relatively flat environment. The visual amenity in the vicinity of the Parkes north west connection is anticipated to change, as adjoining land has been re-zoned as Special Activities (SP1). This zoning allows for uses including freight transport facilities, heavy industrial storage establishments, high technology industries, rural industries, transport depots and truck depots.	Detailed design would involve consideration of building materials and treatments to minimise the potential visibility of the project. Landscaping, vegetation rehabilitation and replanting would be undertaken in accordance with the CEMP.
Land use		
Some property would be acquired to construct the proposal. Currently it is anticipated that 10 privately owned properties may be impacted.	Property acquisition is required for construction of the Parkes north west connection and potentially in some areas adjacent to the existing corridor (to be determined during detailed design).	All acquisitions/adjustments would be undertaken in consultation with landowners and in accordance with the requirements of the Land Acquisition *(Just Terms Compensation) Act 1991*.
Socio-economic		
Potential for community amenity and safety impacts as a result of the increase in train movements along the proposal site.	Changes to noise levels, air pollution, and visual changes from the presence of the proposal may impact on the amenity for the surrounding community. These have been discussed above where appropriate.	An operation communication and education plan would be designed and implemented prior to the commencement of operation to provide information about Inland Rail operation and safety, particularly at level crossings.

PART D: EIS Synthesis and Conclusion

27. Approach to environmental management and mitigation

This chapter, together with chapter 28, provides a synthesis of the environmental impact statement. This chapter compiles the key potential impacts that have not been avoided, and the measures proposed to avoid, minimise, manage or offset the impacts identified in Part C. The chapter also provides the outcomes the proponent is seeking to achieve through the implementation of the mitigation measures.

27.1 Compilation of impacts

Part C of the EIS provides an assessment of the potential impacts of the proposal during construction and operation. The key potential impacts requiring mitigation and management are summarised in Table 27.1 and Table 27.2. The approach to mitigating and managing potential impacts is described in section 27.2. Further information on these impacts is provided in chapters 9 to 25.

Table 27.1 Summary of key potential construction impacts

Issue	Key potential construction impacts
Traffic, transport and access	- Temporary impacts to traffic and access, and an increase in both heavy and light vehicle movements on the local road network, particularly in the vicinity of the Parkes north west connection - Works on level crossings may result in local traffic disruptions and short term access restrictions - New temporary access tracks may be required in some locations - Construction activities would result in temporary impacts on existing rail operations - Localised minor impacts on Brolgan Road traffic, including access to Coopers Road, during construction of the Brolgan Road overbridge
Biodiversity	- Permanent removal or modification (clearing) of about 75.8 hectares of native vegetation, and temporary disturbance of about 35.3 hectares of native vegetation, which includes threatened ecological communities listed under the TSC Act and/or the EPBC Act - Impacts on aquatic ecological systems as a result of works to culverts and access across watercourses
Noise and vibration	- Potential for construction noise to exceed the relevant criteria at various receivers along the proposal site
Air quality	- Generation of dust from construction works and the movement of equipment and machinery
Soils and contamination	- Erosion and sedimentation during construction could result in the contamination of soils and surface waters - The main contaminants that could be exposed during excavation are hydrocarbons and asbestos - Contamination associated with any leaks and spills
Hydrology and flooding	- Potential for inundation during flood events - Changes in flows as a result of construction activities

Issue	Key potential construction impacts
Water quality	▸ Erosion and the generation of sediment, particularly during watercourse crossings and the construction of new culverts ▸ Impacts on downstream water quality if management measures are not implemented, monitored, and maintained
Aboriginal heritage	▸ Potential to impact four listed Aboriginal heritage sites ▸ Impacts on any unexpected finds
Non-Aboriginal heritage	▸ Impacts on the existing Parkes to Narromine line, a potential heritage item considered to be generally of local significance ▸ Potential for vibration impacts on a dilapidated cottage (referred to as 'Wyanga cottage'), which is considered to be of local heritage significance ▸ Impacts on any unexpected finds
Visual and landscape	▸ Visual impacts during construction as a result of the presence of construction works, plant, and disturbance
Land use and property	▸ Temporary disturbance to land use along the proposal site ▸ Temporary impacts to agricultural/farming practices ▸ Limited acquisition of privately owned land (mainly for the Parkes north west connection), with resultant changes in land use
Socio-economics	▸ Beneficial impacts during construction including employment (an estimated average workforce of 150 people), training opportunities, and flow on local and regional economic benefits ▸ Impacts on the local community and/or individual landowners/occupants resulting from changes to traffic, transport and access arrangements ▸ Impacts on the amenity of the local community, and impacts associated with the inflow of the workforce into the local area, including a requirement for temporary accommodation
Sustainability and climate change	▸ Material consumption and associated carbon footprint ▸ Emissions of greenhouse gases ▸ Discharge to surrounding environment including waste production ▸ Clearing and land excavations ▸ Demand for fuel (diesel), water, sand, and aggregate
Waste	▸ Indicatively, the proposal would generate about 647,807 cubic metres of spoil which would be re-used in track formation/construction (about 19 per cent) and for spoil mounds ▸ Other waste material would include green waste, sleepers, rail tracks, formation material, fencing, and general soil waste

Issue	Key potential construction impacts
Health and safety	▸ Introduction of potential ignition sources and fuel sources could increase bushfire risks ▸ If inadequately managed, the storage and handling of dangerous goods and hazardous materials could cause leaks and spills, with resultant contamination and health impacts ▸ Potential rupture of underground utilities during excavation or collision of plant and equipment with aboveground services ▸ Public health and safety risks during construction

Table 27.2 Summary of key potential operation impacts

Issue	Key potential operation impacts
Traffic, transport and access	▸ Impacts on travel time as a result of increased train activity at level crossings ▸ The Parkes north west connection and the Brolgan Road overbridge would impact on Millers Lookout Road and Coopers Road, and would create a short 'bypassed' section of Brolgan Road
Biodiversity	▸ Increase in train strikes on fauna species
Noise and vibration	▸ Noise levels at a number of residential receivers have the potential to exceed the redeveloped rail line criteria for operational rail noise by the year 2040
Air quality	▸ Increase in the number of diesel freight trains has the potential to increase levels of pollutants such as nitrogen oxides and particulate matter ▸ Decreasing the number of heavy vehicles using major transport routes such as the Newell Highway would have a positive impact on air quality for receivers along these routes
Soils and contamination	▸ If inadequately managed, maintenance could result in erosion of soils ▸ Contamination of soils as a result of any accidental spills
Water quality	▸ Surface runoff, which may contain sediment, traces of fuel, dissolved metals, and other contaminants deposited in the corridor from operation activities, could impact water quality ▸ Impacts on water quality as a result of any accidental spills

Issue	Key potential operation impacts
Hydrology and flooding	‣ Raising the height of the rail formation would impact surface water flows across the floodplain, changing the upstream flooding regime, and resulting in more concentrated flows through culverts that discharge to downstream waterways ‣ Flood modelling predicts that the proposal would: • reduce the length of overtopping of the existing rail corridor in the proposal site during a one per cent AEP, from about 7,175 metres to 406 metres • reduce the area of upstream flooding for flood events up to the two per cent event • reduce the area subject to flooding for smaller flood events • increase the extent of flooding in a one per cent AEP event by about 10 per cent
Visual and landscape	‣ Introduction of new structures in the landscape, mainly associated with the Parkes north west connection and the Brolgan Road overbridge
Land use and property	‣ Use of the rail line would intensify once Inland Rail is operational ‣ Flood modelling predicts that the proposal would result in an increase in the area of land subject to temporary inundation, mainly affecting land subject to cropping and grazing uses
Socio-economics	‣ Beneficial impacts would include better access to and from regional markets (including via the Parkes intermodal facility), enabler for regional economic development along the Inland Rail corridor, and safety and amenity benefits as a result of the reduction of freight transport on major road corridors
Sustainability and climate change	‣ Potential risk of asset damage or failure in extreme weather events ‣ Emissions of greenhouse gases from operational energy use and embodied energy in materials ‣ Reduction in greenhouse gas emissions from transfer of freight from trucks to rail ‣ Demand for fuel (diesel) and water
Waste	‣ Small quantities of green waste, general debris, and litter may be generated during maintenance
Health and safety	‣ Introduction of potential ignition sources could increase bushfire risks ‣ If inadequately managed, transport of hazardous materials and dangerous goods via rail has the potential to impact the surrounding community and the environment through leaks and spills ‣ Public health and safety risks including risks to pedestrians and road vehicles as a result of collisions with trains at level crossings, and other safety risks, such as security risks and unauthorised access

27.2 Approach to environmental management

The approach to environmental mitigation and management for the proposal involves:

- Project design – as described in section 7.1, the proposal incorporates measures to avoid and minimise impacts.
- Mitigation measures – mitigation measures provided in chapters 9 to 25 are identified as an outcome of the environmental impact assessment, and are consolidated in section 27.3.
- ARTC's Environmental Management System – would be used to manage the construction and operation of Inland Rail, including the proposal. The management system would provide the framework for implementing the construction and operation environmental management plans described below, and any conditions of other approvals, licences, or permits.
- Inland Rail NSW Construction Noise and Vibration Management Framework – describes how ARTC proposes to manage construction noise and vibration for Inland Rail in NSW as a whole, including management measures, processes, and the approach to additional assessment where required. A copy of the framework is provided in Appendix H.
- Proposal specific CEMP and OEMP – prepared to guide the approach to environmental management during construction and operation, as described in sections 27.2.1 and 27.2.2. The CEMP and OEMP would:
  - outline the environmental management practices and procedures to be followed
  - document processes for demonstrating compliance with the commitments made in this EIS, the submissions report (to be prepared), and relevant approval conditions
  - be prepared in consultation with relevant agencies and in accordance with the *Guideline for the Preparation of Environmental Management Plans* (DIPNR, 2004).
- Environmental performance outcomes – establishes the intended outcomes to be achieved by the project. The environmental performance outcomes are provided in 27.4.

27.2.1 CEMP

The CEMP would include:

- ARTC's environmental policy, objectives, and performance targets for construction
- reference to all relevant statutory and other obligations, including consents, licenses, approvals, and voluntary agreements required
- management policies, procedures, and review processes to assess the implementation of environmental management practices and the environmental performance of the proposal against the objective and targets
- requirements and guidelines for management in accordance with:
  - the conditions of approval for the proposal
  - the mitigation measures specified in this EIS
  - relevant construction management guidelines (including those listed in Appendix K).
- requirements in relation to incorporating environmental protection measures and instructions in all relevant standard operating procedures and emergency response procedures
- roles and responsibilities of all personnel and contractors to be employed on site
- incident and contingency management procedures
- procedures for complaints handling and ongoing communication with the community
- a monitoring and auditing program, as defined by this EIS and the conditions of the approval

An outline of the CEMP, including the required sub-plans and a guide to the general construction management measures required in each, is provided in Appendix K.

27.2.2 OEMP

The OEMP would include:

- a description of activities to be undertaken during operation
- an environmental risk analysis to identify the key environmental performance issues associated with the operation phase
- statutory and other obligations that the proponent is required to fulfil during operation, including approvals, consultations and agreements required from authorities and other stakeholders under key legislation and policies
- a description of the links with ARTC's Environmental Management System, and the environment protection licence relevant to the proposal
- overall environmental policies, guidelines and principles to be applied to operation
- roles and responsibilities for relevant employees involved in operation, including relevant environmental training and induction requirements
- incident and contingency management procedures
- details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions would be taken to address identified potential adverse environmental impacts.

27.2.3 Approach to design refinements

The design of the proposal as described in the EIS would be subject to ongoing refinements during the detailed design phase. Refinements may be made to:

- avoid ground conditions or services that present significant construction difficulties in terms of logistics, time and/or cost
- reduce the construction timeframe
- avoid areas of environmental sensitivity identified following approval
- reduce impacts on local residents
- improve the operation of the project without increasing the potential environmental impacts.

Such refinements may include, for example:

- minor changes to the location of construction compounds and construction site access routes
- minor changes to access roads as a result of changes to level crossings within the assessment area described in chapter 2
- changes to culvert upgrade proposals within the assessment area described in chapter 2
- changes to the level crossing upgrade proposals
- minor changes to the location of key infrastructure, refinement or reorientation of site boundaries
- minor changes in technology or the features of key proposal components.

Refinements would not include significant changes to the proposal.

For design refinements a consistency review would be undertaken to consider whether the refinement:

- would result in any of the conditions of approval not being met
- be consistent with the objectives and operation of the proposal as described in the environmental assessment
- result in a significant change to the approved project
- would trigger the requirement for additional Aboriginal heritage surveys and mitigation measures as described in Technical Report 7
- would result in any potential environmental or social impacts of a greater scale or different nature than that considered by the EIS.

A refinement that does not meet these criteria would be considered a design modification. Approval would be sought from the Minister for Planning for any such modifications in accordance with the requirements of Part 5.1 of the EP&A Act.

27.3 Compilation of mitigation measures

Table 27.3 to Table 27.5 provide a compilation of the measures proposed to mitigate and manage the potential impacts of the proposal, as detailed in Part C. The measures listed may be revised in response to submissions raised during public exhibition of the EIS and/or any design changes made following exhibition. The final list of mitigation measures would be provided in the submissions/preferred infrastructure report. If the proposal is approved, the conditions of approval, which would include reference to the finalised mitigation measures, would guide subsequent phases of the proposal. The works would be undertaken in accordance with the conditions of approval and the final list of mitigation measures.

Table 27.3 Compilation of proposal specific mitigation measures for detailed design/pre-construction

No.	Issue	Detailed design/pre-construction mitigation measures
D1	**Environmental management**	
D1.1	*CEMP*	▸ A CEMP would be prepared to detail the approach to environmental management during construction, as described in section 27.2.1 and in accordance with the conditions of approval.
D2	**Traffic, transport and access**	
D2.1	*Traffic, transport and access*	▸ The detailed design of the proposal would minimise the potential for impacts to the surrounding road and transport network, property accesses, and access for emergency vehicles. ▸ Where any legal access to a property is permanently affected and a property has no other legal means of access, alternative access to and from a public road would be provided to an equivalent standard where feasible and practicable. Where an alternative access is not feasible or practicable, and a property is left with no access to a public road, negotiations would be undertaken with the relevant property owner for acquisition of the property in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991.*
D2.2	*Consultation*	▸ Input would be sought from relevant stakeholders (including Parkes Shire Council, Narromine Shire Council, and Roads and Maritime Services) prior to finalising the detailed design of those aspects of the proposal that impact on the operation of road infrastructure under the management of these stakeholders. ▸ The traffic, transport and access management sub-plan would be developed in consultation with (where relevant) Parkes Shire Council, Narromine Shire Council, Roads and Maritime Services, and local public transport/bus operators.
D2.3	*Level crossings*	▸ Level crossings would be provided with warning signage, line marking and other relevant controls; in accordance with the relevant national and ARTC standards.
D3	**Biodiversity**	
D3.1	*Biodiversity offset strategy*	▸ The biodiversity offset strategy (phase 1) for the proposal would be finalised, in accordance with the requirements of the *Framework for Biodiversity Assessment* (OEH, 2014a) and the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014c).

No.	Issue	Detailed design/pre-construction mitigation measures
		▸ The offset strategy would be approved by the Department of Planning and Environment prior to the commencement of construction work that would result in the disturbance of relevant ecological communities, threatened species, or their habitat, unless otherwise agreed.
D3.2	*Direct impacts to biodiversity*	▸ Detailed design and construction planning would minimise the construction footprint and avoid impacts to native vegetation as far as practicable.
D3.3	*Riparian vegetation*	▸ Compounds and stockpile sites would be located an appropriate distance from riparian vegetation to avoid impacts on aquatic habitat. This includes (for the proposal site) a minimum of 50 metres for type 2, classes 2 and 3 watercourses (Burrill Creek), and 10 to 50 metres for type 3, classes 2 to 4 watercourses (other watercourses). ▸ Direct impacts to in-stream vegetation and native vegetation on the banks of watercourses would be avoided as far as practicable.
D3.4	*Fish passage*	▸ Detailed design and construction planning would minimise the potential for impacts to fish passage. To ensure that fish passage is maintained, watercourse crossing structures would be designed in accordance with the guideline *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003) and the minimum design requirements specified in Table 4.1 of Technical Report 3.
D3.5	*Rehabilitation strategy*	▸ A rehabilitation strategy would be prepared to guide the approach to rehabilitation of disturbed areas following the completion of construction. The strategy would include: • clear objectives and timeframes for rehabilitation works (including the biodiversity outcomes to be achieved) • details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives • identification of flora species and sources • procedures for monitoring the success of rehabilitation • corrective actions should the outcomes of rehabilitation not conform to the objectives adopted.
D3.6	*Pre-clearing surveys*	▸ Pre-clearing surveys and inspections would be undertaken prior to construction. The surveys and inspections, and any subsequent relocation of species, would be undertaken and in accordance with the biodiversity management sub-plan in the CEMP.
D4	**Noise and vibration**	
D4.1	*Noise and vibration control*	▸ The proposal would be designed with the aim of achieving the operational noise and vibration criteria identified by the noise and vibration assessment. ▸ Track features such as crossovers, turnouts, and rail joints would be avoided near vibration sensitive structures where practicable.

No.	Issue	Detailed design/pre-construction mitigation measures
D4.2	*Construction vibration*	▸ Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and vibration monitoring would be carried out in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework, to ensure vibration levels remain below appropriate limits for that structure.
D4.3	*Operational noise and vibration review*	▸ An operational noise and vibration review would be undertaken as described in section 11.5 to guide the approach to identifying feasible and reasonable mitigation measures to incorporate in the detailed design.
D5	**Soils and contamination**	
D5.1	*Structural integrity*	▸ Foundation and batter design would include engineering measures to minimise operational risks from shrink swell, dispersive, and/or low strength soils.
D5.2	*Dilapidated building near site TP33*	▸ Prior to removal of this building (if required), the presence of asbestos would be confirmed, and any removal required would be undertaken in accordance with *How to Safely Remove Asbestos Code of Practice* (Safe Work Australia, 2016).
D6	**Hydrology and flooding**	
D6.1	*Flooding*	▸ The design features listed in section 15.3.1 would continue to be refined to not worsen existing flooding characteristics, where feasible and reasonable, up to and including the one per cent AEP event. Detailed flood modelling would consider potential changes to: • upstream flood extents • level crossing and road flood levels and extent • overland flow paths and storage effects due to spoil mounds and other proposal infrastructure • flood evacuation routes. ▸ Flood modelling to support detailed design would be carried out in accordance with the guidelines listed in section 15.1.2. ▸ Flood modelling and mitigation would consider future floodplain risk management plans, and would be undertaken in consultation with the relevant local council, the Office of Environment and Heritage, and State Emergency Services.
D6.2	*Emergency routes*	▸ Where feasible, facilities and routes identified as being critical to emergency response operations would be protected from the probable maximum flood level.
D6.3	*Downstream watercourse stability*	▸ Further modelling would be undertaken during detailed design to confirm the locations downstream of culverts that require erosion protection, and the extent and type of protection required.

No.	Issue	Detailed design/pre-construction mitigation measures
D6.4	*Water usage (private bores and surface water)*	▶ Detailed design and construction planning would aim to minimise the use of potable water during construction. ▶ Appropriate sources for construction water would be determined prior to construction in consultation with relevant stakeholders, and appropriate approvals and agreements would be sought for the extraction of water.
D7	**Water quality**	
D7.1	*Water quality*	▶ The design features listed in section 16.3.1 would continue to be refined and implemented to minimise the potential impacts of the proposal on water quality.
D7.2	*Surface water monitoring framework*	▶ A surface water monitoring framework would be developed as part of the soil and water management sub-plan in the CEMP. It would identify monitoring locations at discharge points, and selected locations in watercourses where works are being undertaken. ▶ The monitoring framework would include the relevant water quality objectives, parameters, and criteria from Technical Report 7, and specific monitoring locations which have been identified based on the hydrological attributes of the receiving watercourse, in consultation with DPI (Water) and the EPA.
D8	**Heritage**	
D8.1	*Avoiding impacts to Aboriginal heritage*	▶ Detailed design and construction planning would avoid direct impacts to the identified items/sites of Aboriginal heritage significance where practicable.
D8.2	*Impacts to Aboriginal heritage outside the proposal site*	▶ Any works outside the proposal site would be subject to further review and assessment to avoid impacts on Aboriginal items.
D8.3	*Non-Aboriginal heritage interpretation*	▶ An interpretation strategy would be developed for the proposal to provide a concept and framework for interpretation of the original rail line and rail infrastructure.
D8.4	*Impacts to Aboriginal sites*	▶ Impacts to AHIMS listed sites 35-3-0206 and 45-3-0111 would be avoided where possible. These sites would be fenced prior to construction and their locations marked on all plans. A buffer of 10 metres around the sites would be applied to all fencing. ▶ If these sites cannot be avoided, salvage of artefacts would be undertaken prior to construction in accordance with the procedures detailed in Technical Report 8. ▶ Impacts to the scarred tree at 35-3-0207 and the artefact scatter at 35-3-0208 would be avoided. The sites would be fenced prior to construction and marked on all plans.
D8.5	*Impacts to potential heritage items*	▶ The detailed design of the proposal would minimise the potential for direct impacts to Wyanga cottage. ▶ The management of potential vibration impacts at the cottage would be undertaken in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework.

No.	Issue	Detailed design/pre-construction mitigation measures
		▸ Direct impacts to Wyanga cottage would be avoided by the installation of temporary fencing, and marking the cottage as a 'no go' area on plans. ▸ A photographic/archival recording would be undertaken of culverts/underbridges with timber components, former rail station sites (as described in sections 6.4.1 and 6.4.2 of Technical Report 8), and Wyanga cottage, in accordance with *Photographic Recording of Heritage Items Using Film or Digital Capture* (Heritage Division, 2006). ▸ The photographic recording would include contextual photographs showing the relationships between the rail line, station sites, and associated grain rail sidings and silos.
D9	**Landscape and visual**	
D9.1	*Landscape character and visual impacts*	▸ Detailed design would be undertaken in accordance with the design vision, objectives, and principles which underpin the concept design, and would take into account the guidelines listed in section 19.1.
D9.2	*Artist impressions*	▸ Following completion of detailed design of the Parkes north west connection and Brolgan Road overbridge, artist impressions and perspective drawings would be developed for consultation purposes.
D10	**Land use and property**	
D10.1	*Property impacts*	▸ Individual property management agreements would be developed in consultation with landowners/occupants, with respect to the management of construction on or immediately adjacent to private properties. These would detail any required adjustments to fencing, access, farm infrastructure, and relocation of any impacted structures, as required.
D10.2	*Acquisitions*	▸ All acquisitions/adjustments would be undertaken in consultation with landowners and in accordance with the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991*.
D10.3	*Access to properties*	▸ Access to properties would be maintained and managed in accordance with the mitigation measures listed under item D2 above.
D10.4	*Travelling stock reserves*	▸ Local Land Services would continue to be consulted during detailed design to understand how impacts to travelling reserves routes can be avoided during construction and operation. Alternative access arrangements would be made as required.
D10.5	*Impacts to services and utilities*	▸ Utility and service providers would continue to be consulted during detailed design to identify possible interactions and develop procedures to minimise the potential for service interruptions and impacts on existing land uses.
D10.6	*Consultation and communication*	▸ Property owners and occupants would be consulted in accordance with the communication plan for the proposal (described in chapter 4), to ensure that owners/occupants are informed about the timing and scope of activities in their area; and any potential property impacts/changes, particularly in relation to potential impacts to access, services, or farm operational arrangements.

No.	Issue	Detailed design/pre-construction mitigation measures
		▸ The results of consultation would be incorporated in the individual property management agreements as appropriate. ▸ Consultation would be undertaken with landowners affected by level crossing changes and agreement obtained, where required.
D10.7	*Biosecurity risks*	▸ The weed management plan included in the CEMP would detail measures to minimise the potential for biosecurity risks during construction.
D11	**Socio-economics**	
D11.1	*Communication*	▸ Key stakeholders (including local councils, emergency service providers, public transport providers, the general community, and surrounding land owners/occupants) would continue to be consulted regarding the proposal in accordance with the communication plan described in chapter 4.
D11.2	*Local access to Inland Rail*	▸ ARTC would continue to work with relevant stakeholders, including Parkes Shire Council, to identify opportunities to facilitate local access to Inland Rail via the Parkes intermodal facility.
D11.3	*Accommodation*	▸ A temporary workforce housing and accommodation plan would be developed and implemented during construction. This would include a requirement for consultation to be undertaken with local accommodation providers and councils regarding the availability of accommodation, and the need to maintain some availability for non-workforce accommodation.
D12	**Sustainability**	
D12.1	*Sustainability management plan*	▸ The potential sustainability initiatives identified for the proposal would be reviewed and updated during the detailed design stage. ▸ A sustainability management plan would be developed to guide the design, construction, and operation of the proposal, to achieve an ‘excellent’ rating according to the ISCA infrastructure sustainability rating tool. ▸ The sustainability management plan would incorporate the updated sustainability initiatives, and the review and reporting requirements necessary to demonstrate how sustainability has been incorporated into the proposal during design, construction, and operation.
D13	**Climate change**	
D13.1	*Climate change impacts*	▸ The climate change risk assessment would continue to be refined as the design of the proposal progresses. ▸ The adaptation measures identified for the proposal would be reviewed and final measures would be incorporated into the design where practicable.
D14	**Waste**	
D14.1	*Waste management*	▸ Detailed design would include measures to minimise excess spoil generation. This would include a focus on optimising the design to minimise spoil volumes, and the reuse of material on-site.

No.	Issue	Detailed design/pre-construction mitigation measures
D15	**Health and safety**	
D15.1	*Public safety*	▸ A hazard analysis would be undertaken during detailed design to identify risks to public safety from the proposal, and how these can be mitigated through safety in design.
D15.2	*Services and utilities*	▸ The location of utilities, services and other infrastructure would be identified prior to construction to determine requirements for access to, diversion, protection and/or support.

Table 27.4 Compilation of proposal specific mitigation measures for construction

No.	Issue	Construction mitigation measures
C1	**Environmental management**	
C1.1	*CEMP*	▸ Construction of the proposal would be undertaken in accordance with the approved CEMP.
C2	**Traffic, transport and access**	
C2.1	*Access to properties*	▸ Property access would be maintained throughout the construction period, with suitable alternative access arrangements provided where required.
C2.2	*Emergency vehicle access*	▸ Access for emergency vehicles would be maintained along key emergency access routes throughout the construction period, with suitable alternative access arrangements provided where required.
C2.3	*Rail traffic diversions*	▸ Diversions of existing rail traffic would be undertaken in consultation with relevant stakeholders, and alternative arrangements would be provided.
C2.4	*Consultation*	▸ Consultation with relevant stakeholders would be undertaken regularly to facilitate the efficient delivery of the proposal and to minimise congestion and inconvenience to road users. Stakeholders would include the relevant local council, bus operators, Roads and Maritime Services, emergency services, and affected property owners/occupants. ▸ The community would be notified in advance of any proposed road and pedestrian network changes through signage, the local media, and other appropriate forms of communication. ▸ Where changes to access arrangements are required, ARTC would advise property owners/occupants and consult with them in advance regarding alternative access arrangements.
C3	**Biodiversity**	
C3.1	*Avoidance of impacts*	▸ Areas of biodiversity value outside the proposal site would be marked on plans, and fenced or signposted where practicable, to prevent unnecessary disturbance.
C3.2	*Weed management*	▸ Noxious weeds would be managed in accordance with the *Noxious Weeds Act 1993*. Weeds of national environmental significance would be managed in accordance with the *Weeds of National Significance Weed Management Guide*.

No.	Issue	Construction mitigation measures
C3.3	*Rehabilitation*	▶ Rehabilitation of disturbed areas would be undertaken progressively and in accordance with the rehabilitation strategy.
C4	**Noise and vibration**	
C4.1	*Noise and vibration management*	▶ The Inland Rail NSW Construction Noise and Vibration Management Framework would be implemented, and the proposal would be constructed, with the aim of achieving the construction noise management levels and vibration criteria identified by the noise and vibration assessment. ▶ All feasible and reasonable noise and vibration mitigation measures would be implemented. ▶ Any activities that could exceed the construction noise management levels and vibration criteria would be identified and managed in accordance with the Inland Rail NSW Construction Noise and Vibration Management Framework and the CEMP. ▶ Notification of impacts would be undertaken in accordance with the consultation plan for the proposal.
C4.2	*Work outside primary proposal construction working hours*	▶ An out-of-hours work protocol would be developed to guide the assessment and management of works outside primary proposal construction hours.
C5	**Air quality**	
C5.1	*Construction activities and earthworks that may cause dust impacts*	▶ Where sensitive receivers are located within 150 metres of construction works, or visible dust is generated from vehicles using access roads, road watering would be implemented.
C6	**Hydrology and Flooding**	
C6.1	*Flooding*	▶ Construction planning and the layout of construction work sites and compounds would be carried out with consideration of overland flow paths and flood risk, avoiding flood liable land and flood events where possible.
C6.2	*Water usage*	▶ Monitoring would be undertaken during extraction to ensure volumes stipulated by license requirements and/or private landholder agreements are not exceeded.
C7	**Water quality**	
C7.1	*Monitoring*	▶ Water quality would be monitored during construction in accordance with the surface water monitoring framework.
C7,2	*Discharge to surface water*	▶ Discharge to surface water would be undertaken in accordance with the construction EPL, and would consider the hydrological attributes of the receiving watercourse.
C8	**Heritage**	
C8.1	*Unexpected finds*	▶ In the event that unexpected archaeological remains, relics, or potential heritage items are discovered during construction, all works in the immediate area would cease, and the remains and potential items would be assessed by a qualified archaeologist or

No.	Issue	Construction mitigation measures
		heritage consultant. If necessary, the Heritage Division of OEH would be notified in accordance with the requirements of section 146 of the *Heritage Act 1977*. ▸ If potential Aboriginal items are uncovered, works within 10 metres of the item would cease. The item would then be assessed and managed by a suitability qualified person in accordance with the unexpected finds procedure in the construction heritage management plan. ▸ During pre-work briefings, employees would be made aware of the unexpected finds procedures and obligations under the NPW Act.
C8.2	*Human skeleton material*	▸ In the event that a potential burial site or potential human skeletal material is exposed during construction, the procedure recommended by the historic heritage impact assessment would be followed in accordance with the *Policy Directive – Exhumation of Human Remains* (NSW Department of Health, 2008), *Skeletal Remains – Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977* (NSW Heritage Office, 1998), and the *Aboriginal Cultural Heritage Standards and Guidelines Kit* (NPWS, 1997).
C9	**Landscape and visual**	
C9.1	*Light spill*	▸ Temporary lighting would be designed and sited to avoid light spill into residential properties and identified sensitive receivers. ▸ Temporary and any permanent lighting would designed and sited to comply with: • *AS 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting* • *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring* (Department of Planning and Environment, 2016).
C9.2	*Spoil mounds*	▸ Spoil mounds would be shaped to reduce their angular profile and ensure that they are integrated within the landscape. Sharp transition angles in the surface profile would be avoided, and rounded profiles would be used to provide a more natural form. Grass cover would be established over the surface area in accordance with the rehabilitation strategy.
C10	**Land use and property**	
C10.1	*Communication*	▸ Property owners/occupants would continue to be consulted during construction, in accordance with the requirements of item D10.6.
C10.2	*Rehabilitation*	▸ The rehabilitation strategy (item D3.5) would include measures to restore disturbed sites as close as possible to the pre-construction condition or better, or to the satisfaction of landowners. ▸ Rehabilitation of disturbed areas would be undertaken progressively, consistent with the rehabilitation strategy and Individual property management agreements (where relevant).

No.	Issue	Construction mitigation measures
C11	**Socio-economics**	
C11.1	*Communication*	- Local residents, businesses and other stakeholders would be notified before work starts in accordance with the communication plan, and would be regularly informed of construction activities.
C11.2	*Access*	- Access to individual residences, services and businesses would be maintained during construction. Where alternative access arrangements need to be made, these would be developed in consultation with affected property owners/occupants.
C11.3	*Workforce*	- Where practicable, the workforce would include workers sourced locally, and opportunities for training potential local employees would be provided. This would include exploring opportunities for local Indigenous participation in consultation with local Indigenous service providers. - A zero tolerance policy relating to anti-social behaviour would be adopted for work sites.
C11.4	*Demands for goods and services*	- Local suppliers would be identified and approached for procurement of goods and services where practicable.
C12	**Sustainability**	
C12.1	*Procurement*	- Procurement would be undertaken in accordance with the *Sustainable Procurement Guide* (Australian Government, 2013) and the *NSW Government Resource Efficiency Policy* (OEH, 2014).
C12.2	*Reporting*	- Sustainability reporting (and corrective action where required) would be undertaken during construction in accordance with the sustainability management plan.
C13	**Waste**	
C13.1	*Waste management*	- Waste segregation bins (colour coded as listed in Table 24.7) would be located at key construction compounds where practicable, to facilitate segregation and prevent cross contamination.
C14	**Health and safety**	
C14.1	*Storage and handling of dangerous goods*	- Hazardous materials and dangerous goods would be stored, handled, and transported in accordance with relevant regulatory requirements and relevant Australian Standards, including SEPP 33 thresholds. This would include a requirement to provide a minimum bund volume of 110% of the largest single stored volume within the bund. - A risk management strategy would be developed to manage the potential for risks in situations where the minimum distance from sensitive receivers cannot be achieved, or the quantity of hazardous materials exceed SEPP 33 threshold levels.

Table 27.5 Compilation of proposal specific mitigation measures for operation

No.	Issue	Operation mitigation measures
O1	**Environmental management**	
O1.1	*OEMP*	▸ An OEMP would be prepared to detail the approach to environmental management during operation, as described in section 27.2.2 and in accordance with the conditions of approval. ▸ The proposal would be operated in accordance with the approved OEMP.
O2	**Traffic, transport and access**	
O2.1	*Level crossings*	▸ The operation of level crossings that have been subject to changes as part of the proposal would be reviewed after the proposal commences operation to confirm: • that the level of protection continues to be appropriate • that the infrastructure is appropriate for the traffic conditions.
O3	**Biodiversity**	
O3.1	*Fish passage*	▸ Culverts would be regularly inspected and maintained to ensure functionality and minimise blockage of fish passage.
O3.2	*Weed management*	▸ Annual inspections would be undertaken for weed infestations and to assess the need for control measures. ▸ Any outbreak of noxious and/or weeds of national environmental significance would be managed in accordance with the *Noxious Weeds Act 1993,* the *Weeds of National Significance Weed Management Guide*, and the requirements of relevant authorities.
O4	**Noise**	
O4.1	*Operational noise and vibration*	▸ The proposal would be operated with the aim of achieving the operational noise and vibration criteria identified by the noise and vibration assessment, the requirements of the conditions of approval, and the relevant environment protection licence.
O4.2	*Monitoring*	▸ Once Inland Rail has commenced operation, operational noise and vibration compliance monitoring would be undertaken at representative locations to compare actual noise performance against that predicted by the noise and vibration assessment. ▸ Compliance monitoring requirements would be defined as part of the operational noise and vibration review. ▸ The results of monitoring would be included in an operational noise and vibration compliance report, prepared in accordance with the conditions of approval.
O5	**Air quality**	
O5.1	*Rail vehicle emissions*	▸ The proposal would be managed in accordance with the air quality management requirements specified in the EPL.
O5.2	*Impacts during maintenance*	▸ Maintenance service vehicles and equipment would be maintained and operated in accordance with the manufacturers specifications.

No.	Issue	Operation mitigation measures
O6	**Soils and contamination**	
O6.1	*Soil erosion and sedimentation*	▶ During any maintenance work where soils are exposed, sediment and erosion control devices would be installed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
O6.2	*Contamination*	▶ ARTC's existing spill response procedures would be reviewed to determine applicability and suitability during operation. The adopted procedure would include measures to minimise the potential for impacts on the local community and the environment as a result of any leaks and spills.
O7	**Water quality**	
O7.1	*General water quality management*	▶ The proposal would be managed in accordance with the water quality management requirements specified in the EPL for ARTC and ARTC's Environmental Management System.
O8	**Socio-economics**	
O8.1	*Community safety*	▶ A safety awareness program would be developed and implemented to educate the community regarding safety around trains. This would focus on community and rural property operators who cross the rail corridor to access their properties.
O9	**Sustainability**	
O9.1	*Sustainability*	▶ Prior to operation commencing, the sustainability management plan would be reviewed and updated, and relevant initiatives would be implemented during operation.
O10	**Climate change**	
O10.1	*Climate change*	▶ The recommended adaptation measures would be reviewed, and a final list of adaptation measures for implementation during operation would be confirmed and implemented. ▶ Operational management and maintenance procedures would include measures relating to potential climate change risks, as listed in chapter 23. ▶ Emerging opportunities to manage potential climate change impacts on the proposal would continue to be monitored.
O11	**Waste**	
O11.1	*Waste management*	▶ The waste management measures listed in Table 24.8 would be implemented where practicable during operation.

No.	Issue	Operation mitigation measures
O12	**Health and safety**	
O12.1	*Bushfire, storage and handling of dangerous goods, other health and safety risks*	- Operation would be undertaken in accordance with ARTC's standard operating procedures.

27.4 Compilation of performance outcomes

The SEARs identify a number of desired performance outcomes for the proposal. These desired performance outcomes outline the broader objectives to be achieved in the design, construction, and operation of the proposal. Based on the outcomes of the environmental impact assessment summarised in Part C of the EIS, and the implementation of the mitigation measures compiled in section 27.3, environmental performance outcomes have been established for the proposal. These are listed in Table 27.6 from the SEARs, and the third column provides the proposal specific environmental performance objectives to achieve the desired outcome.

Future design development and any design changes would be considered against these environmental performance outcomes.

Table 27.6 Compilation of environmental performance outcomes

Key issue (as listed in the SEARS)	SEARS desired performance outcomes	Proposal specific environmental performance outcomes
5. Air quality	The project is designed, constructed and operated in a manner that minimises air quality impacts (including nuisance dust and odour) to minimise risks to human health and the environment to the greatest extent practicable.	The proposal is designed to minimise the potential for vegetation clearance and associated dust impacts. The proposal is constructed and operated in accordance with the requirements of the POEO Act and relevant environmental protection licences. Dust generated during construction will not exceed the relevant criteria in the *National Environment Protection (Ambient Air Quality) Measure* and the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC, 2005).
6. Biodiversity	The project design considers all feasible measures to avoid and minimise impacts on terrestrial and aquatic biodiversity. Offsets and/or supplementary measures are assured which are equivalent to any remaining impacts of project construction and operation.	The proposal is designed to minimise the surface footprint and impacts on biodiversity. Potential impacts on biodiversity are managed in accordance with relevant legislation, including the EP&A Act, TSC Act, FM Act, EPBC Act, and the *Noxious Weeds Act 1993*. The biodiversity outcome is consistent with the *Framework for Biodiversity Assessment* (OEH, 2014a). Offsets are provided in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014c).

Key issue (as listed in the SEARS)	SEARS desired performance outcomes	Proposal specific environmental performance outcomes
7. Climate change risk	The project is designed, constructed and operated to be resilient to the future impacts of climate change.	Climate change risks are considered throughout the design and development process. The proposal is designed to maximise climate change resilience while minimising costs, community, and environmental impacts. The climate change risk assessment is maintained in line with updated global climate models and regional projection data. The proposal is designed, constructed, and operated in accordance with relevant climate change legislation and guidelines.
8. Flooding	The project minimises adverse impacts on existing flooding characteristics. Construction and operation of the project avoids or minimises the risk of, and adverse impacts from, infrastructure flooding, flooding hazards, or dam failure.	Construction is undertaken in a manner that minimises the potential for adverse flooding impacts, through staging of works and the implementation of mitigation measures. The proposal makes a positive contribution to local flooding characteristics by replacing existing drainage infrastructure. Structures such as spoil mounds are designed and located such that flows are not significantly impeded. The proposal reduces the length of overtopping of the existing rail corridor. The proposal reduces or does not significantly increase the area subject to flooding.
9. Health and safety	The project avoids, to the greatest extent possible, risk to public safety.	Construction targets zero safety incidents. All dangerous goods are stored, handled and transported in accordance with relevant regulatory requirements and Australian Standards.

Key issue (as listed in the SEARS)	SEARS desired performance outcomes	Proposal specific environmental performance outcomes
10. Heritage	The design, construction and operation of the project facilitates, to the greatest extent possible, the long term protection, conservation and management of the heritage significance of items of environmental heritage and Aboriginal objects and places. The design, construction and operation of the project avoids or minimises impacts, to the greatest extent possible, on the heritage significance of environmental heritage and Aboriginal objects and places.	The proposal is designed to minimise the surface footprint. The design is sympathetic to the historic significance of the existing rail corridor and the heritage significance of surrounding listed heritage items, and where practicable, avoids and minimises impacts to heritage. Impacts on heritage are managed in accordance with relevant legislation, including the EP&A Act, the *Heritage Act 1977*, and relevant guidelines. The potential impacts identified are mitigated by photographic/archival recording.
11. Noise and vibration – amenity	Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity. Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during operation of the proposal are effectively managed to protect the amenity and well-being of the community.	The proposal minimises impacts to the local community by: - controlling noise and vibration at the source - controlling noise and vibration on the source to receiver transmission path - controlling noise and vibration at the receiver - implementing practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers.
12. Noise and vibration – structural	Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings, items including Aboriginal places and environmental heritage, and nearby road infrastructure. Increases in noise emissions and vibration affecting environmental heritage as defined in the *Heritage Act 1977* during operation of the proposal are effectively managed.	The proposal minimises impacts to structures by: - controlling vibration at the source - controlling vibration on the source to receiver transmission path - implementing practicable and reasonable measures to minimise vibration impacts of construction activities on structures.
13. Protected and sensitive lands	The project is designed, constructed and operated to avoid or minimise impacts on protected and sensitive lands.	The proposal does not impact on protected and sensitive lands as defined by the SEARs.

Key issue (as listed in the SEARS)	SEARS desired performance outcomes	Proposal specific environmental performance outcomes
14. Socio-economic, land use property, agriculture and biosecurity	The project minimises adverse social and economic impacts and capitalises on opportunities potentially available to affected communities. The project minimises impacts to property and business and achieves appropriate integration with adjoining land uses, including maintenance of appropriate access to properties and community facilities, and minimisation of displacement of existing land use activities, dwellings and infrastructure.	The proposal minimises impacts to the local community and businesses. As part of Inland Rail as a whole, the proposal provides for the development of an efficient and sustainable route for the transport of freight between Brisbane and Melbourne. The proposal provides opportunities for regional economic development, by enabling local and regional businesses to access Inland Rail via regional transport hubs. Impacts to existing land use and properties are minimised. The proposal is appropriately integrated with adjoining land uses, and access to private properties is maintained. The proposal is appropriately integrated with local and regional land use planning strategies.
15. Soils	The environmental values of land, including soils, subsoils and landforms, are protected. Risks arising from the disturbance and excavation of land and disposal of soil are minimised, including disturbance to acid sulfate soils and site contamination.	Site-specific soil, subsoil and landform characteristics are taken into consideration during detailed design and construction. Any contamination is managed in accordance with relevant regulatory requirements. Any soil waste is assessed, classified, managed and disposed of in accordance with the *Waste Classification Guidelines* (EPA, 2014).
16. Sustainability	The project reduces the NSW Government's operating costs and ensures the effective and efficient use of resources. Conservation of natural resources is maximised.	The design process targets an 'excellent' rating in accordance with the ISCA rating tool. Sustainability considerations are integrated throughout the design, construction, and operation phases of the proposal. The proposal contributes to one of the desired outcomes of Inland Rail – to have more than 750,000 fewer tonnes of carbon, one-third less fuel consumption, and reduced truck volumes in over 20 regional towns.

Key issue (as listed in the SEARS)	SEARS desired performance outcomes	Proposal specific environmental performance outcomes
17. Traffic, transport and access	Network connectivity, safety and efficiency of the transport system in the vicinity of the project are managed to minimise impacts. The safety of transport system customers is maintained. Impacts on network capacity and the level of service are effectively managed. Works are compatible with existing infrastructure and future transport corridors.	The proposal provides for more efficient and productive freight rail operations. Impacts to traffic and transport are minimised. Motorist, pedestrian and cyclist safety will be maintained or improved. The proposal contributes to one of the desired outcomes of Inland Rail – to have reduced truck volumes on the road network, improving road safety. Safe access to properties is maintained. The proposal is integrated with existing and future local and regional transport infrastructure and planning strategies.
18. Visual amenity	The project minimises adverse impacts on the visual amenity of the built and natural environment (including public open space) and capitalises on opportunities to improve visual amenity.	Vegetation providing screening to the rail corridor is retained where practicable. The proposal is designed to have regard to the surrounding landscape and visual environment. The proposal incorporates features to minimise the potential visual impacts where visual receptors are concentrated. The proposal makes a positive contribution to the quality of the visual environment in the vicinity of the Parkes north west connection. The proposal is visually integrated with its surroundings.
19. Waste	All wastes generated during the construction and operation of the proposal are effectively stored, handled, treated, reused, recycled and/or disposed of lawfully, and in a manner that protects environmental values.	Waste is managed in accordance with the POEO Act and the WARR Act. Waste is assessed, classified, managed, and disposed of in accordance with the *Waste Classification Guidelines* (EPA, 2014). Reusable spoil is beneficially reused in accordance with the project spoil reuse hierarchy.

Key issue (as listed in the SEARS)	SEARS desired performance outcomes	Proposal specific environmental performance outcomes
20. Water - hydrology	Long term impacts on surface water and groundwater hydrology (including drawdown, flow rates and volumes) are minimised. The environmental values of nearby, connected and affected water sources, groundwater and dependent ecological systems including estuarine and marine water (if applicable) are maintained (where values are achieved) or improved and maintained (where values are not achieved). Sustainable use of water resources.	The proposal avoids long term impacts to surface water. Opportunities to reuse water resources are considered during the design process. The use of water during construction is minimised.
21. Water - quality	The project is designed, constructed and operated to protect the NSW Water Quality Objectives where they are currently being achieved, and contribute towards achievement of the Water Quality Objectives over time where they are currently not being achieved, including downstream of the project to the extent of the project impact including estuarine and marine waters (if applicable).	The proposal is designed and constructed such that changes to water flows in watercourses are minimised. Water discharged does not exceed the ANZECC 2000 guidelines for protection of aquatic ecosystems or water quality trigger values. Impacts to water quality during construction and operation are minimised.

28. Conclusion

This chapter provides the conclusion to the EIS. It summarises the proposal for which approval is sought; the uncertainties that still exist and how these will be resolved; and provides the justification for the proposal, having regard to biophysical, economic and social considerations.

28.1 Summary description of the proposal for which approval is sought

This EIS considers the potential impacts of the proposal to construct and operate the Parkes to Narromine section of Inland Rail. It has been prepared to support ARTC's application for approval of the proposal in accordance with the requirements of Part 5.1 of the EP&A Act, and as a controlled action under the EPBC Act. The EIS addresses the environmental assessment requirements of the Secretary of the Department of Planning and Environment, dated 8 November 2016.

28.1.1 Proposal features

The proposal consists of 106 kilometres of upgraded track and associated facilities, and is generally located in the existing rail corridor between the towns of Parkes and Narromine, via Peak Hill. A new connection to the Broken Hill Line is also proposed outside the rail corridor at the southern end of the proposal site near Parkes.

The key features of the proposal involve:

- upgrading the existing track, track formation, and culverts within the existing rail corridor for a distance of 106 kilometres between Parkes and Narromine
- realigning the track where required within the existing rail corridor to minimise tight curves
- providing three new crossing loops within the existing rail corridor, at Goonumbla, Peak Hill, and Timjelly
- providing a new 5.3 kilometre long rail connection ('the Parkes north west connection'), including a road bridge over the new section of rail at Brolgan Road ('the Brolgan Road overbridge').

Ancillary works that would be undertaken include works to level crossings, signalling and communications, signage, fencing, and services and utilities.

Further information on the design features of the proposal is provided in chapter 7.

28.1.2 Operation

The proposal would form part of the rail network managed and maintained by ARTC. Train services would be provided by a variety of operators.

Prior to the opening of Inland Rail as a whole, the rail line would be used by existing rail traffic, which includes trains carrying grain and ore at an average rate of about four trains per day.

It is estimated that the operation of Inland Rail would involve an annual average of about 8.5 trains per day in 2025, increasing to 15 trains per day in 2040. In the proposal site, this would be additional to the existing rail traffic using the rail line.

The trains would be a mix of grain, bulk freight, and other general transport trains. Total annual freight tonnages would be about 11.8 million tonnes in 2025, increasing to about 19 million tonnes in 2040 (from the existing two million tonnes of grain per year).

Train speeds would vary according to axle loads, and range from 80 to 115 kilometres per hour (for 21 tonne trains). Trains would operate 24 hours per day. They would be up to 1,800 metres long; carry double stacked containers; and have a height of 6.5 metres.

Further information on how the proposal would be operated is provided in chapter 7.

28.1.3 Construction

Construction of the proposal would commence once all necessary approvals are obtained, and the detailed design is complete. It is anticipated that construction would take about 18 months, commencing in early to mid 2018, and concluding in late 2019.

Construction along the existing rail corridor would depend on the possession strategy. However, it is anticipated that progress would be from south to north, and involve three main stages:

- stage 1 – Parkes to Goonumbla
- stage 2 – Goonumbla to Narwonah
- stage 3 – Narwonah to Narromine.

Construction of the Parkes north west connection and the Brolgan Road overbridge would be undertaken in parallel with the above stages.

Further information on how the proposal would be constructed is provided in chapter 8.

28.2 Proposal uncertainties

The EIS is based on the feasibility design for the proposal. Given the current level of design development, there remain some uncertainties relating to technical requirements, how the proposal would be constructed, and how it would operate as part of Inland Rail overall. These details would be resolved as the design of the proposal, and Inland Rail as a whole, progresses.

A summary of the uncertainties around the design, construction and/or operational methodologies of the proposal, and how these will be resolved, is provided in Table 28.1.

Table 28.1 Proposal uncertainties

Category	Uncertainty	How uncertainties will be resolved
Design	Property acquisition – exact areas that need to be acquired	Refining the amount and location of property acquisition will involve a detailed survey of the proposal site and surrounding properties, and confirmation of the final detailed design for the proposal.
	Spoil mounds – location and design	The location, sizing and design of the spoil mounds will be determined during the detailed design phase, with consideration given to the results of hydraulic modelling.
	Final level crossing strategy	The next stage in the level crossing strategy involves reviewing the proposed arrangements for each crossing in detail, and confirming the preferred approach, taking into account input from affected land owners and stakeholders, opportunities for alternative access.
	Parkes north west connection – connections and integration with the Parkes intermodal facility	The connections will be refined during detailed design.
	Brolgan Road overbridge – access arrangements	Access and turning arrangements for local properties, and arrangements for the short 'bypassed' section of Brolgan Road, will be confirmed as part of the detailed design and in consultation with Parkes Shire Council.

Category	Uncertainty	How uncertainties will be resolved
	Utilities – impacts to utilities to be defined in detail	Site utilities investigations will be completed during detailed design to validate current assessments and confirm relocation/protection requirements.
	Existing sidings – horizontal distances, loading points and mainline impacts	A detailed survey will be completed during detailed design to assist in defining the specific locations and operational requirements of existing sidings, as well as impacts to loading infrastructure at these sidings.
Construction methodology	Haul routes – exact routes and haulage methods	A detailed haulage program will be developed based on the detailed design.
	Compound sites – location, layout and facilities	The final location and layout of compound sites will be confirmed based on the detailed design, taking into account the criteria and requirements specified in chapter 8.
Operational methodology	Stop locations between Narromine and Parkes for freight trains using Inland Rail	Train stopping patterns and associated infrastructure requirements will continue to be refined as the design of the other sections of Inland Rail progresses. Train stopping patterns will be developed in consultation with potential users of Inland Rail and key stakeholders, including the agencies responsible for major intermodal terminals along the route (such as Parkes Shire Council).

28.3 Justification of the proposal

28.3.1 Summary of proposal justification

Australia's freight task is set to experience significant growth over the coming decades. The existing freight infrastructure cannot support this projected growth, with increasing pressure on already congested roads and rail lines through Sydney, and increasing use of heavy trucks such as B-doubles and, potentially, B-triples along the Hume-Pacific and Newell highway corridors.

Inland Rail will address the growing freight task by helping to move freight off the congested road network, and moving interstate freight off the congested Sydney suburban rail network. It provides a reliable road-competitive solution to the freight task, and enables the commercial and social benefits of rail to be leveraged to meet Australia's long-term freight challenge.

Inland Rail will connect key production areas in Queensland, NSW and Victoria with export ports in Brisbane and Melbourne, and provide linkages between Melbourne, Brisbane, Sydney, Adelaide and Perth. It will reduce freight transit times, reduce congestion on rail and road networks, and enable the movement of larger freight volumes via rail, by making the movement of longer and double stacked trains possible.

Inland Rail will provide the backbone infrastructure necessary to significantly upgrade the performance of the east coast rail freight network to better serve future freight demands, while also diverting demand from the constrained road freight and rail passenger network.

In summary, as described in chapter 5, Inland Rail is needed to respond to the growth in demand for freight transport, and address existing freight capacity and infrastructure issues. The analysis of demands undertaken by ARTC indicated that there would be sufficient demand for Inland Rail.

The proposal is a critical component of Inland Rail, and has been designed to maximise use of the existing rail corridor, while still contributing to the overall efficiency of Inland Rail. Through the Parkes north west connection, the proposal would assist in connecting south-east Queensland more directly with Adelaide and Perth (via Parkes), delivering immediate interoperability with the high performance east–west trans-continental line.

28.3.2 Summary of proposal benefits

The proposal is a key component of Inland Rail, which would:

- Boost the Australian economy – Inland Rail is expected to increase Australia's gross domestic product by $16 billion during its construction and first 50 years of operation.
- Create jobs – it is estimated that construction of Inland Rail would require a workforce of up to 16,000 people at the peak of construction, and an average of 700 additional jobs per year over the construction period.
- Improve connections within the national freight network – Inland Rail will enhance the National Land Transport Network by creating a rail linkage between Parkes and Brisbane, providing a connection between Queensland and the southern and western states, and a connection to the east–west trans-continental line.
- Provide better access to and from regional markets – Inland Rail will make it easier for freight to move from farms, mines, and ports to national and overseas markets.
- Reduce costs – it is estimated that rail costs for intercapital freight travelling between Melbourne and Brisbane will reduce by $10 per tonne. Highway maintenance costs will reduce.
- Offer better transit time and reliability – Inland Rail will allow a transit time of less than 24 hours between Melbourne and Brisbane and a reliability of 98 per cent – matching current road levels.
- Increase the capacity of the transport network – Inland Rail will increase the capacity for freight and passenger services by reducing congestion along the busy coastal transport route, and allow for growth in passenger services, particularly in the Sydney region.
- Reduce distances travelled – with Inland Rail, the rail distance between Melbourne and Brisbane will reduce by 200 kilometres, and the distance between Brisbane and Perth, and Brisbane and Adelaide will reduce by 500 kilometres.
- Improve road safety – it is estimated that each year, there will be up to 15 fewer serious crashes, avoiding fatalities and serious injuries.
- Improve sustainability – carbon emissions will reduce by 750,000 tonnes.
- Improve community amenity – truck volumes and road congestion on some of Australia's busiest highways will reduce, which will also mean a reduction in trucks travelling through more than 20 regional towns. This will lead to corresponding reduction in amenity impacts associated with the movement of freight by road, including noise and air emissions.
- Provide an alternative north-south freight link – Inland Rail will provide a second link between Queensland and the southern states, making Australia's national freight rail network less vulnerable to disruptions, for example from extreme weather events.
- Promote complementary supply chain investments – Inland Rail will be a catalyst for complementary private sector investments, such as fleet upgrades, new metropolitan and regional terminals, and integrated freight precincts.

28.3.3 Consequences of not proceeding

The proposal is a section of Inland Rail as a whole, and Inland Rail cannot proceed if the proposal does not proceed. This would mean that the benefits of Inland Rail would not be realised.

28.3.4 Environmental considerations

Environmental investigations were undertaken during preparation of the EIS to assess the potential impacts of the proposal. These included specialist assessments of terrestrial and aquatic biodiversity; heritage; traffic and transport; hydrology, flooding and water quality; noise and vibration; soils; landscape and visual amenity; air quality; sustainability and climate change; socio-economics; and waste. The EIS has documented the potential environmental impacts of the proposal, considering both potential positive and negative impacts, and identifies mitigation measures to protect the environment where required.

Biophysical environment

The main potential impacts of the proposal on the biophysical environment include:

- direct impacts to biodiversity as a result of clearing of areas of native vegetation
- potential indirect flora and fauna impacts
- water quality impacts during construction
- geomorphological impacts to watercourses as a result of the construction of new culverts
- an increase the extent of flooding in a one in 100 year event by about 10 per cent.

Cultural

The main potential impacts of the proposal on the cultural environment (including land use, heritage, and socio-economics) include:

- minor changes to access arrangements as a result of the proposed consolidation of some level crossings
- disturbance of items with potential heritage significance
- visual impacts as a result of the introduction of new permanent structures in the landscape
- amenity related impacts during construction and operation (for example, noise, dust, traffic)
- acquisition of land
- minor impacts to surrounding agricultural land uses
- employment and associated economic benefits during construction
- contribution to the benefits of Inland Rail, as summarised in section 28.3.2
- local and regional benefits via the opportunities presented by the Parkes intermodal facility.

Addressing the potential impacts

As described in chapters 7, 8 and 27, the proposal would incorporate environmental management and design features to ensure that potential impacts are managed and mitigated as far as practicable. The majority of the potential construction related impacts would be effectively mitigated by the implementation of best practice construction management, including the implementation of the environmental management approaches described in section 27.2.

The biodiversity offset strategy would be finalised and implemented to address the residual impacts of the proposal on biodiversity values, according to the requirements for Part 5.1 projects under the EP&A Act, and to offset impacts on EPBC Act matters.

28.3.5 Ecologically sustainable development

The EP&A Act adopts the definition of ecologically sustainable development contained in the POEO Act 1991. An assessment of the proposal against the principles of ecologically sustainable development as per clause 7(4) of Schedule 2 of the Regulation 2000 is provided below.

Precautionary principle

A range of environmental investigations, as described in Part C of the EIS, have been undertaken during the development of the proposal and the environmental assessment process, to ensure that potential impacts are understood with a high degree of certainty. The assessment of the potential impacts of the proposal is considered to be consistent with the precautionary principle. The assessments undertaken are consistent with accepted scientific and assessment methodologies, and have taken into account relevant statutory and agency requirements. The assessments have applied a conservative approach with regard to construction and operational arrangements, and the modelling used.

The proposal has evolved to avoid impacts where possible and to reflect the findings of the studies undertaken. The route for the proposal has been selected to minimise the potential environmental impacts, particularly the amount of vegetation clearing that would be required, by maximising the use of existing rail corridors.

A number of safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the project. No safeguards have been postponed as a result of lack of scientific certainty.

Principle of inter-generational equity

Construction of a long linear infrastructure project such as the proposal has the potential for some degree of environmental and social disturbance. These disturbances include the clearing of vegetation; some disturbance to private properties during construction; potential disturbance of some heritage sites; and localised impacts. However, the potential for environmental and social disturbance as a result of construction has to be balanced against the long term benefits of the Inland Rail overall.

Should the proposal not proceed, the principle of intergenerational equity may be compromised, as future generations would experience the increased environmental and safety impacts associated with the transport of large volumes of freight via the Newell Highway. The strategic planning studies summarised in chapter 5 have identified a strong need and justification for Inland Rail. The proposal would, as part of Inland Rail, benefit future generations by providing a safer, more efficient, means of freight transport.

Conservation of biological diversity and ecological integrity

Ecological studies have been undertaken to identify potential adverse impacts on biodiversity. Where potential impacts cannot be avoided, mitigation measures would be implemented to reduce the impact as far as possible.

The proposal would result in the clearing of some vegetation associated with threatened plant communities. Mitigation measures are proposed to minimise and manage the significance of the impact on native vegetation and flora and fauna. Biodiversity offsets would be implemented to address the impacts that cannot be avoided.

Improved valuation and pricing of environmental resources

The assessment has identified the environmental and other consequences of the proposal, and identified mitigation measures where appropriate to manage potential impacts. If approved, the construction and operation of the proposal would be in accordance with relevant legislation, the conditions of approval, and the construction and operation environmental management plans. These requirements would result in an economic cost to the proponent. The implementation of mitigation measures would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

The concept design for the proposal has been developed with an objective of minimising potential impacts on the surrounding environment. This indicates that the concept design has been developed with an environmental objective in mind.

28.4 Concluding statement

The proposal involves upgrading the existing rail line and associated works between Parkes and Narromine, and operating the new/upgraded section of rail line as part of Inland Rail. The proposal is needed to support the development of Inland Rail, and to provide a connection between Inland Rail and the east-west trans-continental rail line via the Broken Hill Line.

Potential impacts resulting from the proposal are considered manageable through the implementation of the proposed mitigation measures.

The detailed design for the proposal would be developed with the objective of minimising potential impacts on the local and regional environment, and the local community. The design and construction methodology would continue to be developed with this overriding objective in mind, taking into account the input of stakeholders.

To manage the potential impacts identified by the EIS, and in some cases remove them completely, the assessment chapters outline a range of mitigation measures that would be implemented during construction and operation of the project. Chapter 27 summarises the mitigation measures that would be implemented. The environmental performance of the project would be managed by the implementation of the CEMP and OEMP. These plans would also ensure compliance with relevant legislation and any conditions of approval.

With the implementation of the proposed mitigation and management measures the potential environmental impacts of the proposal would be adequately managed.

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