

DEPARTMENT OF PLANNING, INDUSTRY
AND ENVIRONMENT

APRIL 2021

WAGGA WAGGA SAP STRUCTURE PLAN REPORT

BIODIVERSITY, HERITAGE,
CONTAMINATION AND
HYDROGEOLOGY

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Wagga Wagga SAP Structure Plan Report Biodiversity, Heritage, Contamination and Hydrogeology




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ABBREVIATIONS

ACHCRs	<i>Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010</i> (Department of Environment, Climate Change and Water 2010)
ACHHHA	Aboriginal Cultural Heritage and Historic Heritage Assessment
AEI	areas of environmental interest
AHIMS	Aboriginal Heritage Information Management System
BAM	Biodiversity Assessment Method 2017
BAR	Biodiversity Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCD	Biodiversity and Conservation Division
BOM	Bureau of Meteorology
BPLM	Bushfire Prone Land Map
Code of Practice	<i>Code of Practice for the Investigation of Aboriginal Objects in New South Wales</i> (DECCW 2010)
DPC	NSW Department of Premier and Cabinet
DPIE	NSW Department of Planning, Industry and Environment
EPA	Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GDE	groundwater dependent ecosystems
LEP, the	<i>Wagga Wagga Local Environmental Plan 2010</i>
LGA	local government area
mAHD	metres relative to Australian Height Datum
MDB	Murray-Darling Basin
MNES	Matters of National Environmental Significance
NSW	New South Wales
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyl
PCT	Plant Community Type
PSI	Preliminary Site Investigation
RAPs	Registered Aboriginal Parties
the Regional Plan	<i>Riverina Murray Regional Plan 2036</i> (DPE, 2017)
this report	<i>Wagga Wagga SAP Baseline Analysis Summary Report</i>

RWCC	Riverina Water County Council
SAII	Serious and Irreversible Impact
SAP	Special Activation Precinct
SWOT	strengths, weaknesses, opportunities and threats
TRH	total recoverable hydrocarbons
WALs	water access licences

1 INTRODUCTION

1.1 OVERVIEW

The NSW Department of Planning, Industry and Environment (DPIE) has commissioned WSP to prepare a Structure Plan Report (this report) for the Wagga Wagga Special Activation Precinct (Wagga Wagga SAP) within Wagga Wagga, NSW.

1.1.1 BACKGROUND TO WAGGA WAGGA SAP

The establishment of Special Activation Precincts (SAPs) is a joint Government Agency initiative announced by NSW Government as part of its *20-Year Economic Vision for Regional NSW* (NSW Government, 2018). SAPs are a new way of planning and delivering infrastructure projects in strategic regional locations in NSW to ‘activate’ State or regionally significant economic development and jobs creation. A SAP contains five core components (shown in Figure 1.1), which would lead to government led jobs creation and economic development. The NSW Department of Premier and Cabinet (DPC) and DPIE are leading the creation of the Wagga Wagga SAP.

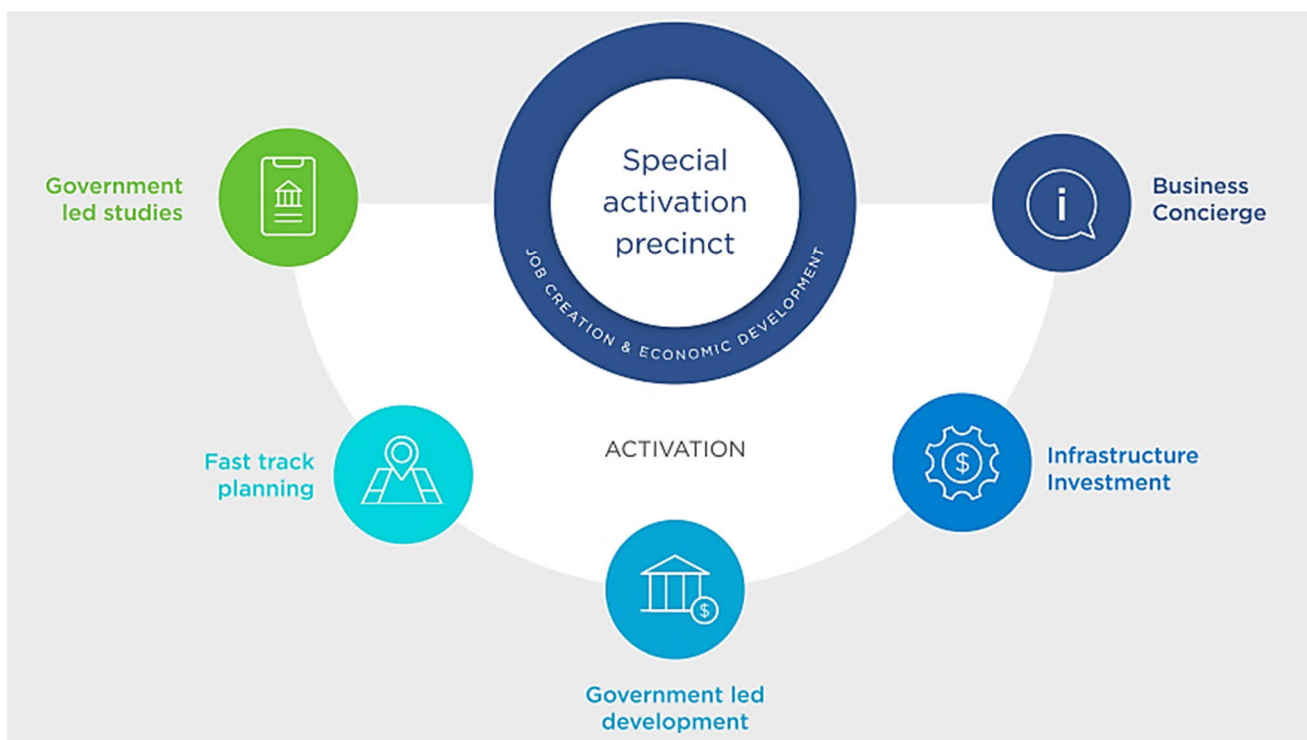


Figure 1.1 The five core components of a SAP (NSW Government, 2019)

Wagga Wagga was chosen to be a SAP because of its existing rail and road connections with Australia’s major cities (shown on Figure 1.2), and unique opportunity to build on several existing and already-planned private and government investments focusing on freight and logistics, advanced manufacturing, agribusiness, recycling and renewable energy. These existing investments include the Inland Rail project, Riverina Intermodal Freight and Logistics (RiFL) Hub and Bomen Business Park.

The Inland Rail project has received \$9.3 billion in funding from the Commonwealth Government to support the upgrade of the existing freight network from Brisbane the Melbourne. It is projected that the first train will run between the two capital cities in 2025. Wagga Wagga is an important connection for the Inland Rail project, due to the strategic location of the planned RiFL Hub. The Inland Rail project would work in conjunction with the RiFL Hub to facilitate the transfer

of freight containers between road and rail and create faster and easier access to global markets, create jobs and attract investors and developers.

The *Riverina Murray Regional Plan 2036* (the Regional Plan; DPE, 2017) identifies Bomen Business Park as a significant contributor to jobs and economic growth in the region. The Bomen Business Park supports a variety of existing businesses focused around freight and logistics and agribusiness. This includes food manufacturing industries, an abattoir, chemical manufacturing, a canola crushing and oil refinery, manufacturing industries, equipment, lead and battery recycling, and Council's Livestock Marketing Centre. Wagga Wagga also features an emerging solar industry, with the Bomen Solar Farm located north-east of Bomen Business Park and covering around 250 hectares.

Furthermore, the Regional Plan identifies that Wagga Wagga and its surrounds is:

- a major freight and logistics hub, with identified growth potential linked to its strategic location between major ports in Sydney and Melbourne and increased agricultural production capacity
- a provider of services to the wider region of 185,000 people through its hospital and education institutes, including Charles Sturt University and Riverina TAFE
- an identified location for the establishment of a business environment that is conducive to innovation and advances in technology.

Wagga Wagga SAP's strategic location provides the opportunity to capitalise on these existing industries, along with the potential to expand into warehousing, advanced manufacturing and renewable energy. It will also lead to investment in common-use infrastructure and utilities, including roads, water, electricity, telecommunication, gas systems and services, high speed internet and data connections and facilities, and other possible infrastructure or services. As a result, the Wagga Wagga SAP has the ability to create a world-class business precinct with a focus on freight and logistics, advanced manufacturing, recycling and renewable energy.

1.1.2 LOCATION OF WAGGA WAGGA SAP

The Wagga Wagga local government area (LGA) is located approximately 455 kilometres south west of Sydney, in the Riverina Murray Region. The City of Wagga Wagga is the largest inland regional city in NSW and the major centre in the Region with other key centres including Albury and Griffith. The main townships and settlements in the LGA include Gundagai, Tumut, Hay, Temora, Narrandera, Junee and Deniliquin. As of the 2016 census, the City of Wagga Wagga had approximately 62,500 people (ABS, 2016), which is forecast to grow to a population of 100,000 people by 2038.

The Wagga Wagga SAP investigation area (shown on Figure 1.3) is located 10 kilometres north-east of Wagga Wagga Central Business District (CBD) and covers approximately 4,506 hectares, with approximately 300 to 400 hectares already in the Bomen Business Park.

The Wagga Wagga SAP investigation area is serviced by the Main Southern Railway and several major roads, including the Olympic Highway which connects the area to Brisbane and Melbourne. Wagga Wagga Regional Airport is located approximately nine kilometres south east of the investigation area. Figure 1.2 shows the main transportation connections from Wagga Wagga to other major cities.



Figure 1.2 Existing major road, rail and air connections to Wagga Wagga (DPE, 2019)

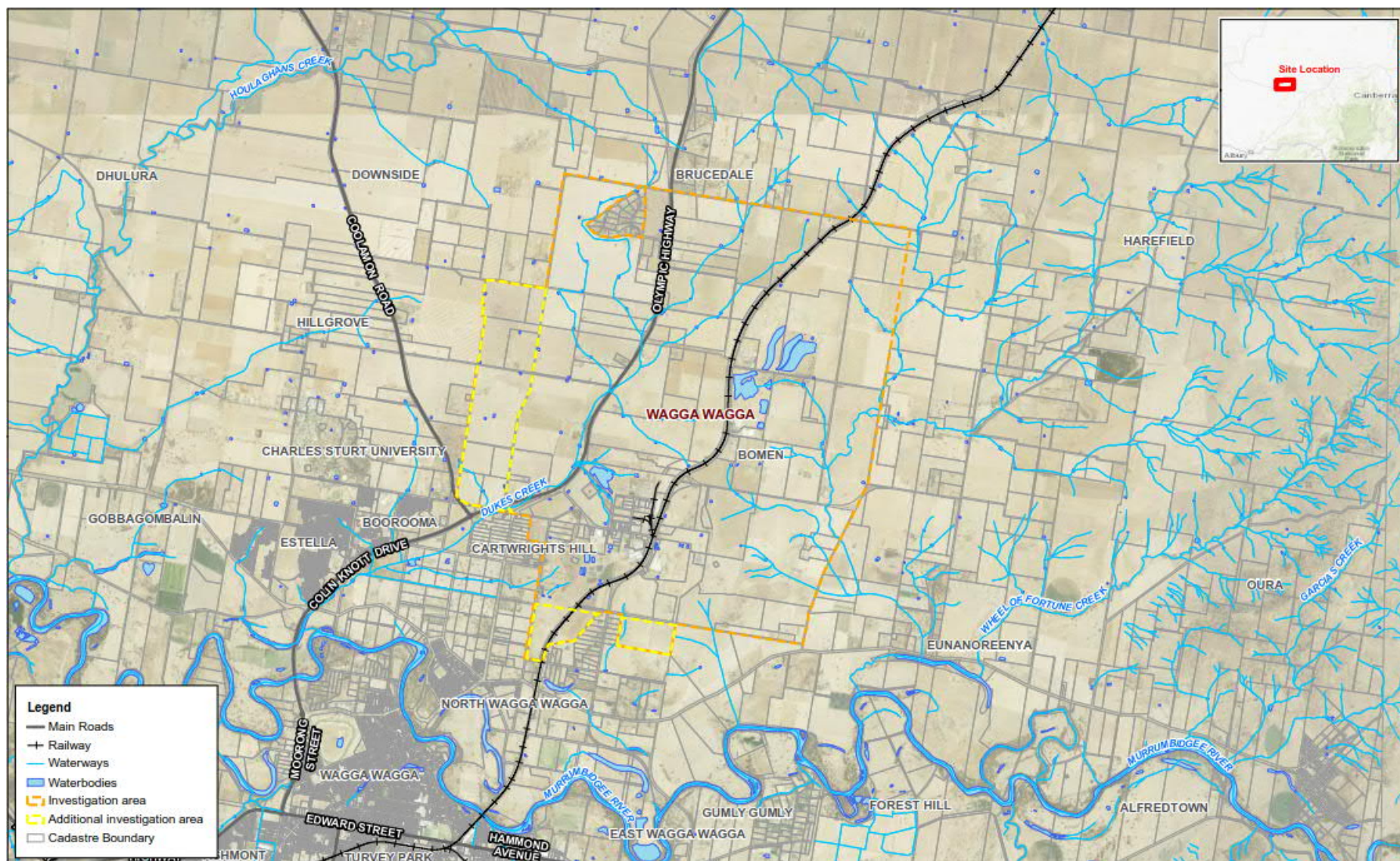


Figure 1.3 Investigation area of Wagga Wagga SAP

1.1.3 PLANNING FRAMEWORK

Currently under the *Wagga Wagga Local Environmental Plan 2010* (the LEP), the Wagga Wagga SAP Investigation Area is zoned for a variety of land uses including (shown on Figure 1.4):

- IN1 – General Industrial
- IN2 – Light Industrial
- SP2 – Infrastructure
- RU1 – Primary Production
- RU6 – Transition
- R5 – Large Lot Residential
- E2 – Environmental Conservation
- RE1 – Public Recreation.

This SAP process will involve a review of the current zoning as part of the development of the SAP Structure Plan.

1.1.3.1 WAGGA WAGGA BIODIVERSITY CERTIFICATION

An existing Biodiversity Certification for the Wagga Wagga Local Environment Plan 2008 covers much of the investigation area. This biodiversity certification was established under the *Threatened Species Conservation Act 1995* and applies to land zoned IN1, IN2, R5 and SP2 under the Wagga Wagga Local Environmental Plan 2010. Part 7 of the *Biodiversity Conservation Act 2016* (BC Act) does not apply to zones within the investigation area that are biodiversity certified.

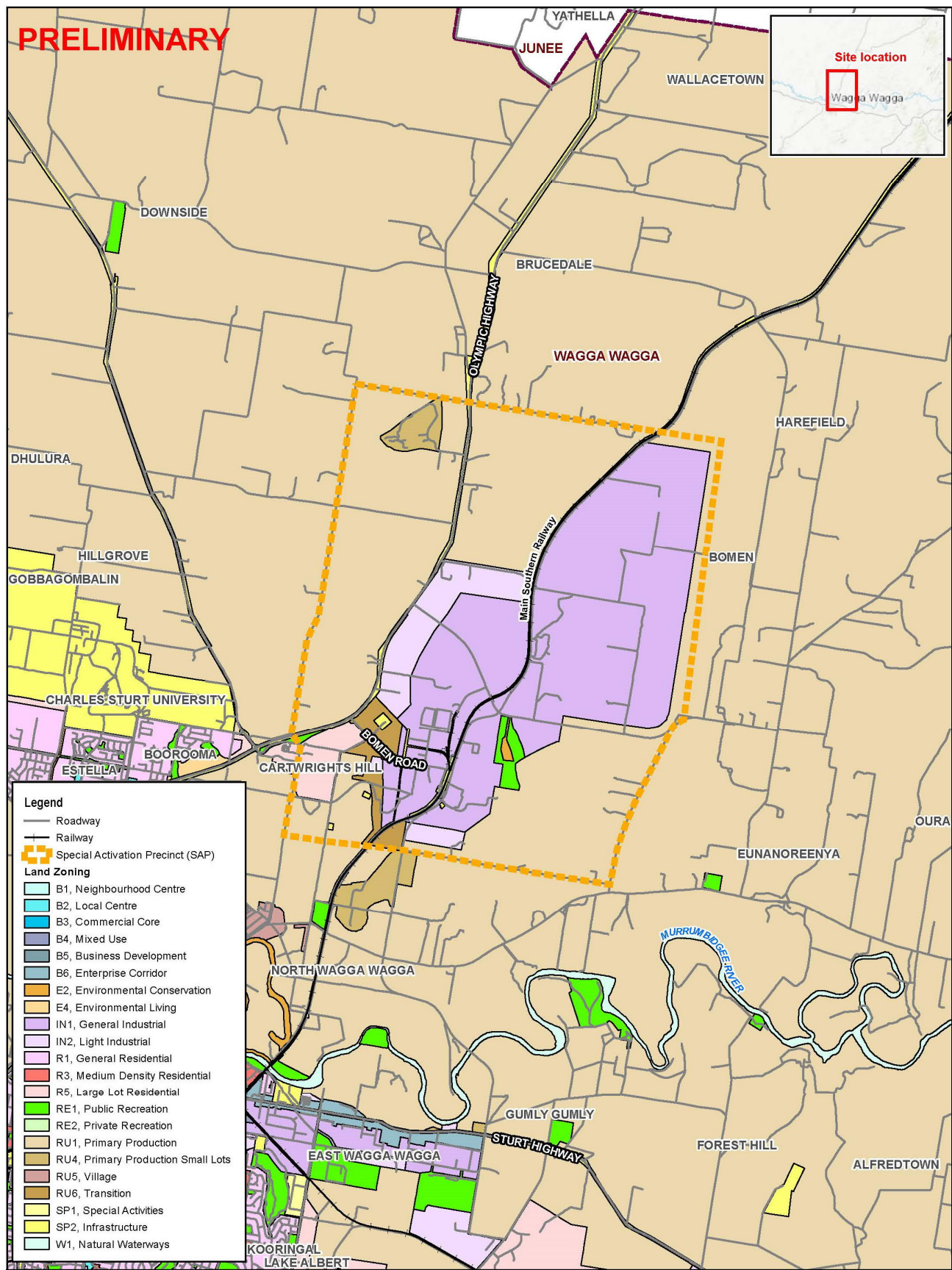


Figure 1.4 Current zoning of the Wagga Wagga SAP investigation area

1.2 PURPOSE OF THIS REPORT

This report provides a summary of the concept precinct scenario options testing and master plan conclusions for the following specialist areas:

- biodiversity and bushfire
- Aboriginal and non-Aboriginal heritage
- geology, soils and contamination
- hydrogeology.

1.2.1 RELATIONSHIP TO THE SAP PROCESS

This report is part of a wider strategic, statutory and regulatory process to achieve planning outcomes for the Wagga Wagga SAP project. Figure 1.5 below displays where this report plays a role in the broader Wagga Wagga SAP project, and the next steps the assessment will feed into.

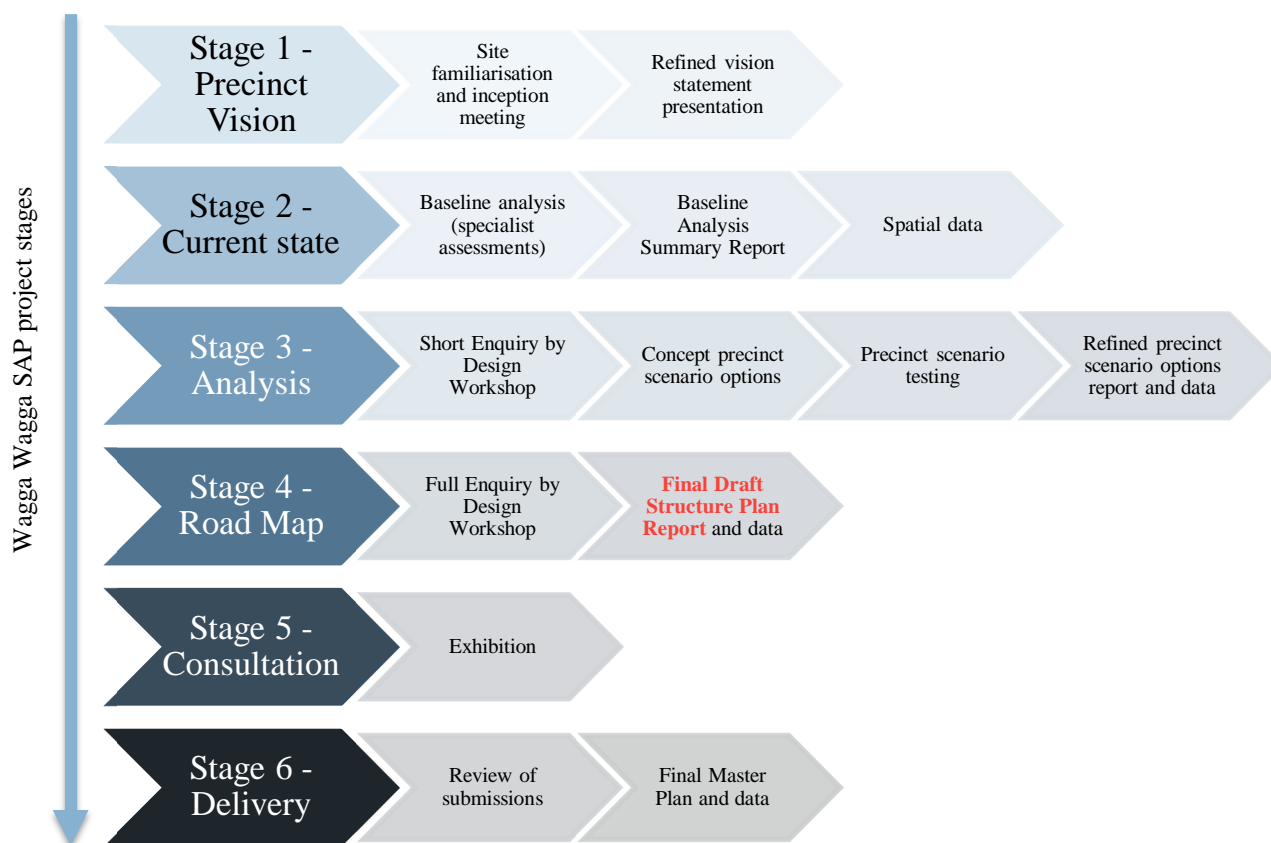


Figure 1.5 Flowchart of Wagga Wagga SAP process, with this report noted in **bold**

2 METHODOLOGY AND EXISTING ENVIRONMENT

2.1 OVERVIEW

2.1.1 TECHNICAL STUDIES UNDERTAKEN

Five technical studies were undertaken to inform this report:

- Biodiversity Assessment Report – Stage 1
- Bushfire Constraints & Opportunities Report
- Aboriginal Cultural Heritage and Historic Heritage Assessment report
- Preliminary Site Investigation
- Desktop Hydrology Assessment.

The key findings of these technical studies are summarised in Chapters 2 and 3, and provided as Appendices to this report.

2.1.2 INVESTIGATION AREA

The SAP investigation area identified in Figure 1.3 was composed for the purpose of the technical reports, as a basis for the specialist assessments. It is acknowledged that the final Wagga Wagga SAP boundary is likely to be refined and different to the current investigation area.

2.2 BIODIVERSITY AND BUSHFIRE

This section summarises the methodology and existing environment for the Biodiversity Assessment Report – Stage 1 and Bushfire Constraints and Opportunities Report that was prepared for the Wagga Wagga SAP and are provided in Appendix A and Appendix B respectively.

2.2.1 AIMS AND OBJECTIVES

The draft Biodiversity Assessment Report (BAR) has been prepared to address Stage 1 of the Biodiversity Assessment Method 2017 (BAM) and provides an assessment of the biodiversity values of the investigation area. Whilst the primary purpose of this report is to provide an assessment of the biodiversity values of the investigation area in the context of the *Biodiversity Conservation Act 2016* (BC Act) it also assesses ‘Matters of National Environmental Significance’ (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The purpose of this Stage 1 report is to provide an understanding of the baseline biodiversity values of the investigation area to inform the development of the Wagga Wagga SAP Structure Plan and identify any existing data gaps.

The objectives of the bushfire assessment are to identify relevant bushfire planning considerations and outline Bushfire Protection Measures that may be applicable to the future Wagga Wagga SAP, to assist development of the Wagga Wagga SAP Structure Plan.

2.2.2 METHODOLOGY

The Biodiversity Assessment Report – Stage 1 was prepared in accordance with the BAM 2017, which involved:

- undertaking a desktop review including:
 - Atlas of Living Australia
 - Bionet Atlas of NSW Wildlife
 - NSW Department of Primary Industries Critical Habitat register
 - NSW Office of Environment and Heritage Critical Habitat register
 - PlantNet Spatial Search
 - Protected Matters Search Tool
- reviewing previous ecological surveys including:
 - Wagga Wagga Planning Study: Environmental/Biodiversity report for Bomen (2008)
 - Proposed Biodiversity Certification for the Wagga Wagga LEP 2008.

Field surveys were carried out between the 8–12, 15–19 July, 2–4 October 2019, 20–21 November and 3 December 2019. This involved vegetation surveys including Vegetation Integrity Plots, Paddock Tree Assessments, threatened flora and fauna species targeted surveys in accordance with the BAM 2017 and relevant guidelines outlined further in the Biodiversity Assessment Report. The threatened species subject to targeted surveys and survey effort are outlined in Section 2.6 in Appendix A.

The Bushfire Constraints and Opportunities Report involved undertaking a site walkover, desktop assessment of the investigation area and a review of relevant bushfire planning considerations, legislation and guidelines in accordance with *Planning for Bush Fire Protection* (NSW Rural Fire Services, 2018).

2.2.3 EXISTING ENVIRONMENT

Much of the investigation area occurs as cleared land that is used for agricultural, industrial and residential purposes. Within this highly modified landscape, patches of remnant native vegetation and planted native trees occur and most of these areas are within an existing Biodiversity Certification for the Wagga Wagga Local Environment Plan 2008. This certification area provided landscape scale linkages particularly along the Olympic Highway corridor and protection to several native vegetation patches. This biodiversity certification was established under the *Threatened Species Conservation Act 1995* and is due to expire in 2020. It is likely that the Wagga Wagga SAP would provide an updated certification under the BC Act that covers the entire investigation area. Any consideration of biocertification must be prepared in consultation with the Biodiversity and Conservation directorate of the Department of Planning, Industry and Environment.

2.2.3.1 VEGETATION TYPES

Native vegetation was mapped as occurring over a total of 120.33 hectares of the 4170.5 hectares (2.9%) of the investigation area. A total of five native vegetation plant community types (PCTs) were recorded including (Figure 2.1):

- PCT 9 River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone mainly in the Riverina Bioregion (Moderate condition).
- PCT 267 White Box – White Cypress Pine – Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion (Moderate condition).
- PCT 277 Blakely's Red Gum – Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion (in two condition classes: moderate condition and scattered trees).
- PCT 312 Yellow Box grassy tall woodland on valley flats in the upper slopes of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion (Moderate condition).
- PCT 346 White Box – Blakely's Red Gum – White Cypress Pine shrubby woodland on metamorphic hills in the Wagga Wagga – Cootamundra region of the NSW South Western Slopes Bioregion (Scattered Trees).

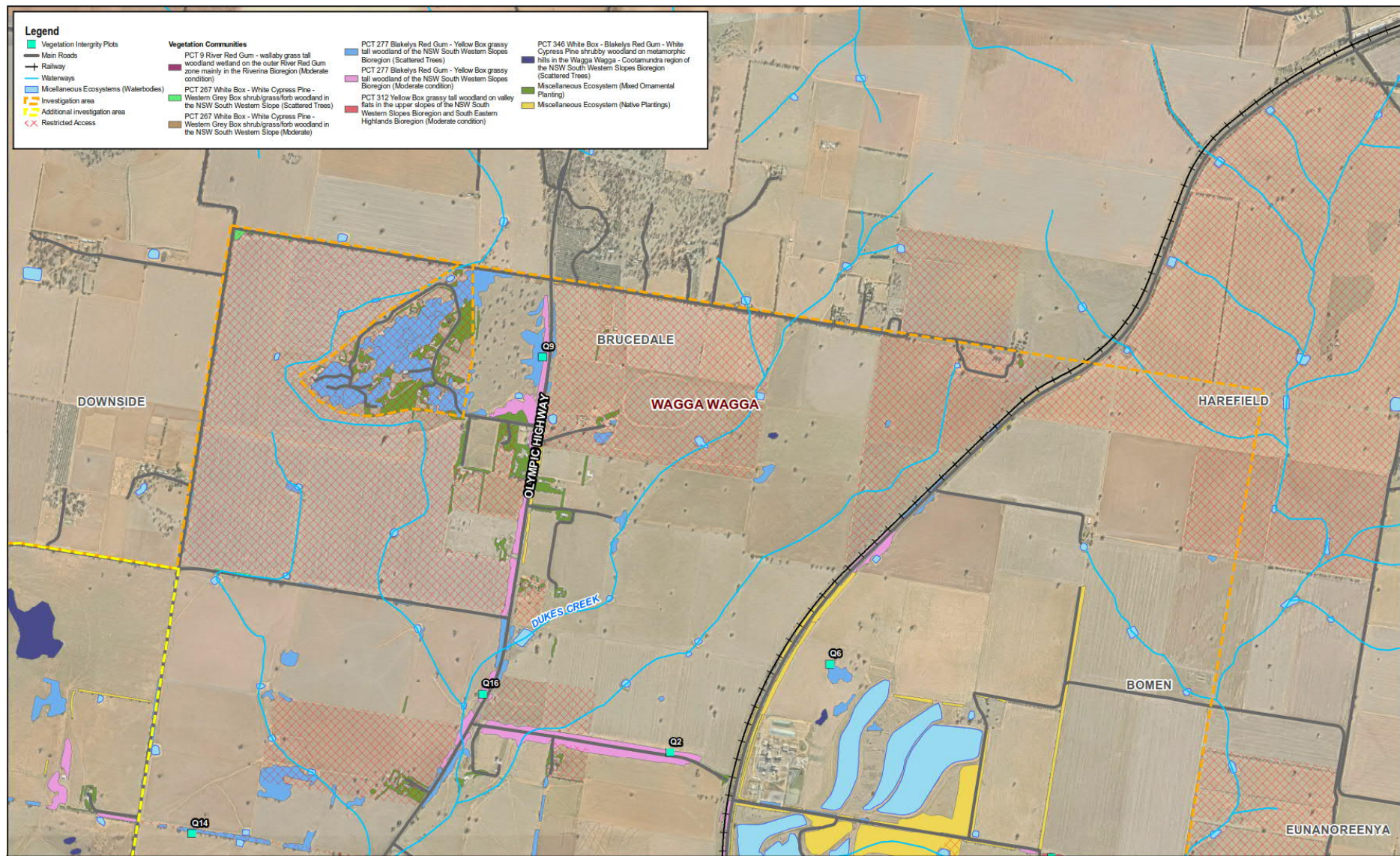


Figure 2.1 Vegetation types and conditions (Page 1 of 3)

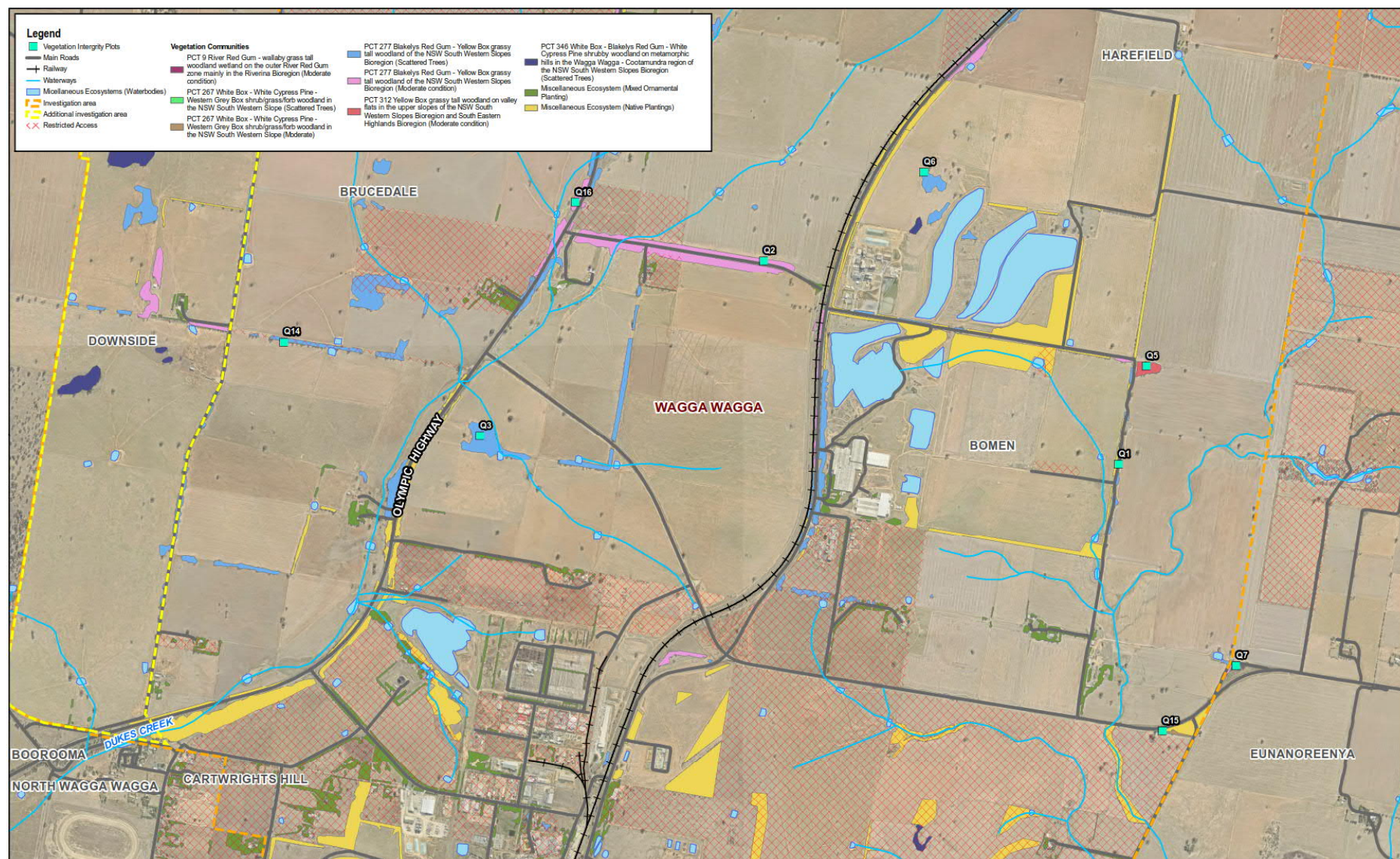


Figure 2.2 Vegetation types and conditions (Page 2 of 3)

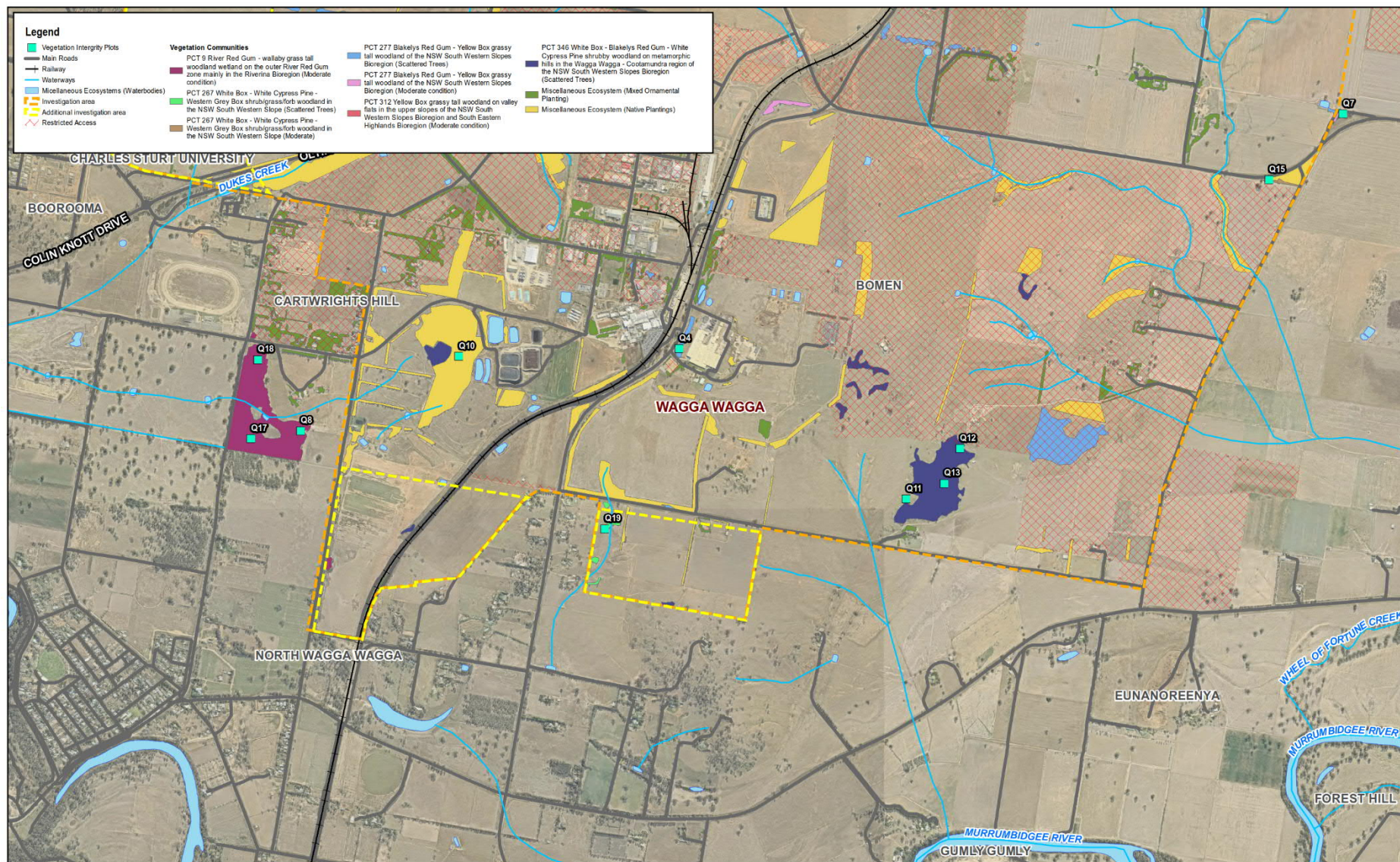


Figure 2.3 Vegetation types and conditions (Page 3 of 3)

In addition, two non-native vegetation types were recorded:

- Miscellaneous ecosystem – Native Plantings
- Miscellaneous ecosystem – Mixed Ornamental Plantings.

Of these, three plant community types PCT 267, PCT 277 and PCT 312 corresponded to a threatened ecological community being White Box Yellow Box Blakely's Red Gum Woodland (see Section 2.2.3.2).

2.2.3.2 THREATENED ECOLOGICAL COMMUNITIES

White Box Yellow Box Blakely's Red Gum Woodland is listed as Endangered under the BC Act and Critically Endangered under the EPBC Act. Within the study area, 23.64 ha aligned to White Box Yellow Box Blakely's Red Gum Woodland listed under the BC Act, and 10.55 ha of this was also commensurate with listing under the EPBC Act.

2.2.3.3 THREATENED FLORA

A total of 11 threatened flora species were identified by the BAM calculator and during desktop assessment for assessment. Field surveys identified potential habitat for one threatened flora species – Small Scurf-pea (*Cullen parvum*). This species is considered most reliably detected between December and January. However, this species is likely to be affected pending targeted seasonal surveys.

2.2.3.4 AQUATIC HABITAT

Within the investigation area aquatic habitat occurs in the form of freshwater streams and creeks that either have the potential contain mapped key fish habitats or are connected to mapped key fish habitat. Majority of the aquatic habitat within the investigation area is predominately ephemeral in nature with some more permanent water bodies associated with agricultural dams.

The investigation area has one tributary, Dukes Creek, that is mapped as key fish habitat. No endangered species under the *Fisheries Management Act 1994* (FM Act) have mapped habitat within the investigation area. Despite the ephemeral nature of the mapped water bodies, these habitats do still provide marginal habitat for aquatic species, and due to their connection to important mapped aquatic habitat associated with the Murrumbidgee River should be considered important in maintaining their ecological integrity.

The Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Murray River (Lowland Catchment of the Murray River) is listed as an Endangered ecological community under the FM Act. All mapped streams and tributaries within the investigation area are upstream of the Lowland Catchment of the Murray River and directly flow into this aquatic ecological community.

2.2.3.5 THREATENED FAUNA

In accordance with BAM, threatened fauna are considered as either (or both) predicted or ecosystem credit species and candidate or species credit species based on associated vegetation and micro habitat features.

PREDICTED THREATENED FAUNA – ECOSYSTEM CREDIT SPECIES

Database searches identified 55 threatened fauna species as potentially utilising the habitats found within the investigation area. Likelihood of occurrence assessments (Appendix D of Appendix A), identified 12 threatened fauna species as considered predicted under the BAM based on habitat associated with recorded vegetation types. Predicted species do not require detailed targeted survey as they are considered ecosystem credit offsets based on potential available foraging habitat characteristics within associated vegetation types. All BAM predicted species considered to have a moderate or higher likelihood of occurrence are outlined in Table 2.1.

Table 2.1 BAM predicted threatened fauna species (ecosystem credit species)

COMMON NAME	SCIENTIFIC NAME	BC ACT	LIKELIHOOD OF OCCURRENCE AND ASSOCIATED VEGETATION TYPE(S)
Birds			
Black Falcon	<i>Falco subniger</i>	V	Moderate – An open country species for which habitat is not optimum but may occur within the investigation area on an intermittent basis. Associated vegetation types: PCT 9, PCT 267, PCT 277, PCT 312 and PCT 346.
Flame Robin	<i>Petroica phoenicea</i>	V	Recorded – The species was recorded within open understorey vegetation within the investigation area. Foraging habitat for the species is present within the investigation area. Associated vegetation types: PCT 267, PCT 277, PCT 312 and PCT 346.
Freckled Duck	<i>Stictonetta naevosa</i>	V	Moderate – The species may occur in local dams and wetlands on an intermittent basis. Associated vegetation types: PCT 9 and PCT 267.
Grey-crowned Babbler (eastern subspecies)	<i>Pomatostomus temporalis</i>	V	Moderate – There are previous records and suitable habitat available within the study area. Additionally, two nests that were likely once utilised by the species were identified within the study area, however, they appeared to be unused at the time of survey. Associated vegetation types: PCT 267, PCT 277 and PCT 312.
Little Lorikeet	<i>Glossopsitta pusilla</i>	V	Moderate – The species has been recorded locally at low densities, but due to its mobility and suitable habitat within the investigation area it is likely to occur on at least an intermittent basis. Associated vegetation types: PCT 267, PCT 277, PCT 312 and PCT 346.
Spotted Harrier	<i>Circus assimilis</i>	V	Recorded – A single individual was recorded in the study area during onsite avifauna surveys. Associated vegetation types: PCT 9, PCT 267, PCT 277, PCT 312 and PCT 346.
Varied Sittella	<i>Daphoenositta chrysoptera</i>	V	Moderate – The species may occur intermittently in the canopies of larger woodland patches within the investigation area. Associated vegetation types: PCT 9, PCT 267, PCT 277, PCT 312 and PCT 346.

COMMON NAME	SCIENTIFIC NAME	BC ACT	LIKELIHOOD OF OCCURRENCE AND ASSOCIATED VEGETATION TYPE(S)
Mammals			
Eastern Bentwing-bat, Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i> (previously <i>Miniopterus schreibersii oceanensis</i>)	V	Moderate – No preferred roosting habitat (cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding) were identified within the investigation area but due to its mobility, seasonal occurrences may occur on an intermittent basis. Associated vegetation types: PCT 9, PCT 267, PCT 277, PCT 312 and PCT 346.
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	Moderate – The species has been recorded locally and there is suitable foraging habitat within the investigation area. A Flying-fox camp is located to the south of the investigation area along the Murrumbidgee River (last surveyed in 2015) (Department of the Environment, 2019). No breeding camps were recorded within the investigation area during field surveys. Associated vegetation types: PCT 267 and PCT 277.
Inland Forest Bat	<i>Vespadelus baverstocki</i>	V	Moderate – Suitable roosting and foraging habitat is present within the investigation area and due to the species mobility, it may occur seasonally on an intermittent basis. Associated vegetation types: PCT 9, PCT 267, PCT 277, PCT 312 and PCT 346.
Little Pied Bat	<i>Chalinolobus picatus</i>	V	Moderate – No records of the species occur within the locality, with the closest records near Leeton and Bowning in NSW. Some suitable roosting and foraging habitat occurs within the study area and due to its mobility, seasonal occurrences may occur on an intermittent basis. Associated vegetation types: PCT 9, PCT 267, PCT 277, PCT 312 and PCT 346.
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	V	Moderate – suitable roosting and foraging habitat is present within the investigation area and due to the species mobility, seasonal occurrences may occur on an intermittent basis. Associated vegetation types: PCT 9, PCT 277, PCT 312 and PCT 346.

(1) Listed under the BC Act - E= Endangered, V= Vulnerable

THREATENED FAUNA CANDIDATE SPECIES – SPECIES CREDIT SPECIES

Database searches identified 54 threatened fauna species as potentially utilising the habitats found within the investigation area. Of these, 12 species were identified within the BAM credit calculator to be candidate species based on the associated recorded vegetation types. Of these candidate species, a total of four have either been recorded or assessed as having a moderate or higher likelihood of occurrence and are considered affected species within the investigation area.

Affected species have been assigned species polygons in accordance with section 6.4 of the BAM where habitat attributes occur within associated vegetation zones.

Table 2.2 BAM predicted threatened fauna species (species credit species)

COMMON NAME	SCIENTIFIC NAME	BC ACT STATUS ¹	SPECIES PRESENCE	JUSTIFICATION	AFFECTED SPECIES?
Birds					
Glossy Black-cockatoo	<i>Calyptrorhynchus lathami</i>	V	No (surveyed)	Low – No preferred feed tree species which would form foraging habitat were identified within the study area. Given this it can be assumed that breeding habitat within the study area (living or dead tree with hollows greater than 15 cm diameter and greater than 5 m above ground) is unlikely to be utilised by this species.	No – Given the limited foraging resources available within the study area (i.e. preferred Allocasuarina and Casuarina species) it is considered unlikely this species would utilise the study area as breeding habitat. This species is not considered further.
Little Eagle	<i>Hieraaetus morphnoides</i>	V	Yes (surveyed)	Recorded – The investigation area occurs within the home range of local individuals. One individual was recorded within the investigation area in during field surveys. No breeding habitat in the form of large old trees within suitable vegetation and the presence of a male and female; or female with nesting material; or an individual on a large stick next in the top half of the tree canopy was observed during field surveys. However, surveys were undertaken outside of the recommended survey period (August to October). Potential breeding habitat (nest trees) exists within the investigation area in the form of live and dead large old trees.	Yes – This species is considered further as a species credit species, targeted surveys during optimal survey months (Aug-Oct) are recommended.

COMMON NAME	SCIENTIFIC NAME	BC ACT STATUS ¹	SPECIES PRESENCE	JUSTIFICATION	AFFECTED SPECIES?
Major Mitchell's Cockatoo	<i>Lophochroa leadbeateri</i>	V	No (surveyed)	Low – The NSW OEH species sightings search identified two records from the species within the locality of the investigation area from 1998 and 1999. No recent records of the species occur within the locality. Additionally, primary foraging resources for the species (seeds from native and exotic melons, saltbush, wattle and cypress pine) (Office of Environment and Heritage, 2017f) were limited across the investigation area. Given this it can be assumed that breeding habitat within the study area (living or dead tree with hollows greater than 10cm diameter) is unlikely to be utilised by this species. The species is considered unlikely to occur within the investigation area; however rare occurrences cannot be entirely discounted.	No – This species is not considered further.
Regent Honeyeater	<i>Anthochaera phrygia</i>	CE	No (surveyed)	Low – Regent Honeyeaters inhabit woodlands which contain a significant large number of mature trees, high canopy cover, and abundance of mistletoes. Suitable woodland habitat is generally in high condition and supports a significant abundance of bird species richness. Woodland habitat within the investigation area were of relatively small size, were generally lacking a significant number of mature trees, and no mistletoes were recorded across the investigation area. In addition, avifauna surveys recorded very low honeyeater activity, suggesting available resources are limited and would unlikely be significant for blossom nomads. Additionally, there is very low incidence of occurrence for the species locally.	No – This species is not considered further.

COMMON NAME	SCIENTIFIC NAME	BC ACT STATUS ¹	SPECIES PRESENCE	JUSTIFICATION	AFFECTED SPECIES?
Superb Parrot	<i>Polytelis swainsonii</i>	V	Yes (surveyed)	High – The species was recorded adjacent to the investigation area during avifauna surveys in July 2019 and suitable foraging and breeding habitat is present within the investigation area. Potential breeding habitat exists in large hollow bearing paddock trees, and remnant stands of vegetation which contain large hollow bearing trees.	Yes – This species is considered further as a species credit species, targeted seasonal surveys during September and November are recommended.
Swift Parrot	<i>Lathamus discolor</i>	E	No (surveyed)	Low – Low incidence of records locally, but there is a small amount of winter-flowering resources in the investigation area and rare occurrences during inland dispersals cannot be entirely discounted.	No – This species is not considered further.
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V	No (surveyed)	Low – The species preferred habitat is characterised by the presence of large areas of open water, such as large rivers, swamps, lakes, and the sea. No preferred breeding habitat, living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines, were identified within the investigation area. The species is considered unlikely to occur within the investigation area, however rare occurrences cannot be entirely discounted.	No – This species is not considered further.

COMMON NAME	SCIENTIFIC NAME	BC ACT STATUS ¹	SPECIES PRESENCE	JUSTIFICATION	AFFECTED SPECIES?
Mammals					
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V	No (surveyed)	Moderate – The species has been recorded locally and there is suitable foraging habitat within the study area. A Flying-fox camp is located to the south of the study area along the Murrumbidgee River (last surveyed in 2015) (Department of the Environment, 2019). No breeding camps were recorded within the study area during field surveys.	Yes – This species is considered further as an Ecosystem Credit Species
Koala	<i>Phascolarctos cinereus</i>	V	No (surveyed)	Low – occurs regionally at low densities, but study area habitats are scant and highly fragmented, such that it is unlikely to support local individuals on a permanent basis. Additionally, targeted surveys (SATS) were completed during recommended survey months and did not record this species.	No – This species is not considered further.
Southern Myotis	<i>Myotis macropus</i>	V	Yes (assumed)	Moderate – Suitable roosting and foraging habitat is present within the investigation area (hollow bearing trees within 200 m of riparian zone) and due to its mobility, seasonal occurrences may occur on and intermittent basis.	Yes – This species is considered further as a species credit species, targeted surveys during optimal survey months (Nov-Mar) are recommended.

COMMON NAME	SCIENTIFIC NAME	BC ACT STATUS ¹	SPECIES PRESENCE	JUSTIFICATION	AFFECTED SPECIES?
Squirrel Glider	<i>Petaurus norfolcensis</i>	V	Yes (assumed)	<p>Moderate – The species is known to occur regionally, but most available habitats within investigation area are scant and highly fragmented and the species has not been previously recorded within the investigation area.</p> <p>Previous records for the species occur to the south of the investigation area along the Murrumbidgee River (Atlas of Living Australia, 2019), and habitats within the investigation area are poorly connected. Large old hollow bearing trees are critical for movement for the species and typically need to be closely connected (i.e. no more than 50 m apart).</p> <p>Professional opinion remains that while habitats are fragmented, and no individuals were recorded during the field survey, potential breeding habitat for the species exists within the southwest portion of the investigation area.</p>	Yes – This species is considered further as a species credit species, targeted surveys during optimal survey months (Nov-Mar) are recommended.
Reptiles					
Pink-tailed Legless Lizard	<i>Apraisia parapulchella</i>	V	No (surveyed)	Low – there are no local records and onsite breeding and foraging elevated stony habitats (rocky areas) are highly degraded and isolated from higher quality habitats. This species is considered unlikely to occur in the study area.	No – This species is not considered further.

The WSP survey period was outside the optimal months of survey for the Little Eagle, Squirrel Glider, Southern Myotis and Superb Parrot. These species require seasonal surveys to determine the presence of breeding habitat in Spring and Summer. Alternatively, an expert report could be prepared by an expert appointed under the BC Act to cover off survey deficiencies for these species.

2.2.3.6 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The following biodiversity listed under the EPBC Act are known or predicted to occur:

- One threatened ecological community, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, listed as Critically Endangered under the EPBC Act has been recorded within the investigation area.
- Three threatened species are predicted to occur based on presence of suitable habitat
 - *Austrostipa wakoolica* (a spear-grass)- listed as Endangered
 - Grey-headed Flying-fox (*Pteropus poliocephalus*)- listed as Vulnerable
 - Superb Parrot (*Polytelis swainsonii*)- listed as Vulnerable.
- Four migratory species are predicted to occur based on presence of suitable habitat
 - Latham's Snipe (*Gallinago hardwickii*)
 - Fork-tailed Swift (*Apus pacificus*)
 - White-throated Needletail (*Hirundapus caudacutus*)
 - Yellow Wagtail (*Motacilla flava*).

2.2.3.7 RIPARIAN AREAS

Riparian habitats are mostly limited within the investigation area to low Strahler order creeks, many of which only occur as overland flow paths and lack any defined channel of remnant native vegetation. The main significant riparian area is in the south-west of the investigation area, being River Red Gum vegetation (PCT 9) associated with Dukes Creek and the broader Murrumbidgee floodplain. An area of riparian habitat also occurs to the east of the Olympic Highway just to the north of Horseshoe Road.

2.2.3.8 BUSHFIRE RISK

The majority of the site is serviced by NSW Rural Fire Service, with the Brucedale station location within the investigation area and Eunony station located less than one kilometre to the south. The southern portion of the investigation area is captured in the NSW Fire & Rescue response area, with stations located at Wagga Wagga, Turvey Park, Coolamon and Junee. Therefore, the investigation area has an acceptable coverage of fire services.

A review of historic fire history mapping indicates that the investigation area has not been subject to wildfire within the past 25 years.

Overall, there is a low risk of bushfire impacts within the investigation area.

2.2.3.9 BUSHFIRE PRONE LAND

Bushfire Protection Measures need to be considered for new development if the site is identified on the relevant local council's Bushfire Prone Land Map (BPLM) as containing Category 1, 2 or 3 vegetation, or is within the associated vegetation buffer zones. Category 1 vegetation is considered to be the highest risk for bush fire, followed by Category 3 then Category 2 vegetation. Further information on the categories is provided in Chapter 5 in Appendix B.

A small area of land within the north-western corner of the investigation area is currently mapped on the Wagga Wagga City Council BPLM as Category 2 Vegetation and its associated 30 metre bushfire zone (refer to Figure 2.4). This classification means that bushfire planning controls should be considered for any future development within this area. However, this area comprises a rural-residential subdivision, including sealed roads and driveways, dwellings and auxiliary structures and maintained curtilages. Therefore, the Category 2 Vegetation class on the BPLM may not be accurate, and may overrepresent the potential bushfire risk in this area.

However, the BPLM must be reviewed by Wagga Wagga City Council every five years (the last review was in 2016) to ensure currency and reliability of the data. There is potential that other areas of the investigation area, which are not currently mapped as bushfire prone, may be considered bushfire hazards due to the presence of existing vegetation including threatened ecological communities and mapped as Category 1, 2 and/or 3 Vegetation. Therefore, other vegetated areas within the investigation area, beyond the currently mapped Category 2 Vegetation, could be conservatively considered as bushfire prone land.



Figure 2.4 Location of land mapped as Category 2 Vegetation within investigation area (Bushfire Code & Bushfire Hazard Solutions, 2019)

2.3 HERITAGE

This section summarises the existing environment and methodology for the Aboriginal Cultural Heritage and Historic Heritage Assessment (ACHHHA) preliminary report that was prepared for the Wagga Wagga SAP and is provided in Appendix C.

2.3.1 AIMS AND OBJECTIVES

The purpose of the ACHHHA is to identify and assess heritage constraints relevant to the Wagga Wagga SAP. In particular, the objective of the:

- Aboriginal archaeological assessment is to undertake background research on the investigation area to formulate a predictive model for site location within the investigation area. The assessment follows relevant portions of the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice, DECCW 2010).
- Historic Heritage assessment is to identify whether historical heritage items or areas are, or are likely to be present within the investigation area. The assessment follows relevant portions of the *Historical Archaeology Code of Practice* (Heritage Council 2006).

2.3.2 METHODOLOGY

The ACHHHA method involved:

- reviewing relevant legislation, including the *Burra Charter*, a standard of best practice in heritage conservation
- desktop databases searches, to identify any potential previously-recorded heritage within the investigation area
- reviewing previous archaeological studies undertaken in the investigation area
- formulation of a predictive model for site location.

Aboriginal community consultation was completed in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs) (DECCW 2010). This first stage involved identifying the Registered Aboriginal Parties (RAPs) who wish to be consulted, advertising the proposed works in the Daily Advertiser newspaper and sending letter notifications to various relevant agencies. Following this, information about the assessment methodology and Wagga Wagga SAP was provided to the RAPs, and information from the RAPs was requested regarding Aboriginal cultural values. No feedback regarding survey methodology or cultural values of the area was provided by the RAPs. The last stage of the ACHCR process involved production of an Aboriginal Cultural Heritage Assessment Report (ACHAR), which was provided to RAPs for their review and comment. No specific comments were received from RAPs concerning the ACHAR.

A pedestrian survey sampling sections of the investigation area was undertaken by OzArk on 28–29 August 2019 and 5–6 November 2019. Representatives of two Registered Aboriginal Parties (RAPs) were present for during both field surveys.

2.3.3 EXISTING ENVIRONMENT

2.3.3.1 ABORIGINAL HERITAGE

The database search of the Aboriginal Heritage Information Management System (AHIMS) identified 103 previously-recorded Aboriginal heritage sites within a designated 3 km x 3 km search area (Eastings 532146–545149; Northings 6113938–6127880) that surrounds the Wagga Wagga SAP investigation area. Modified trees and artefact scatters are the most common site types identified within the search area. Figure 2.5 shows the locations of the AHIMS sites within and surrounding the investigation area.

Of the 103 AHIMS sites identified within the search area, 61 of the sites are located within the investigation area (listed in Table 2.3). The majority of the previously recorded sites within the investigation area are artefact scatters or isolated finds in the central east section of the investigation area. Modified trees accounted for 40 per cent of the site types within the wider search area, but only 7 per cent of the sites identified within the investigation area. The grouping of the sites in the central-east area is likely due to the number of development driven assessments which have been conducted there, as well as the presence of the Bomen Axe Quarry, a raw material procurement location.

Table 2.3 Site types and frequencies of AHIMS sites within the investigation area

SITE TYPE	NUMBER	% FREQUENCY
Artefact scatter	42	69
Isolated find	11	18
Modified tree	4	7
Artefact scatter & modified tree	1	2
Quarry and isolated find	1	2
Aboriginal ceremony and dreaming	1	2
Quarry and artefact scatter	1	2
Total	61	100

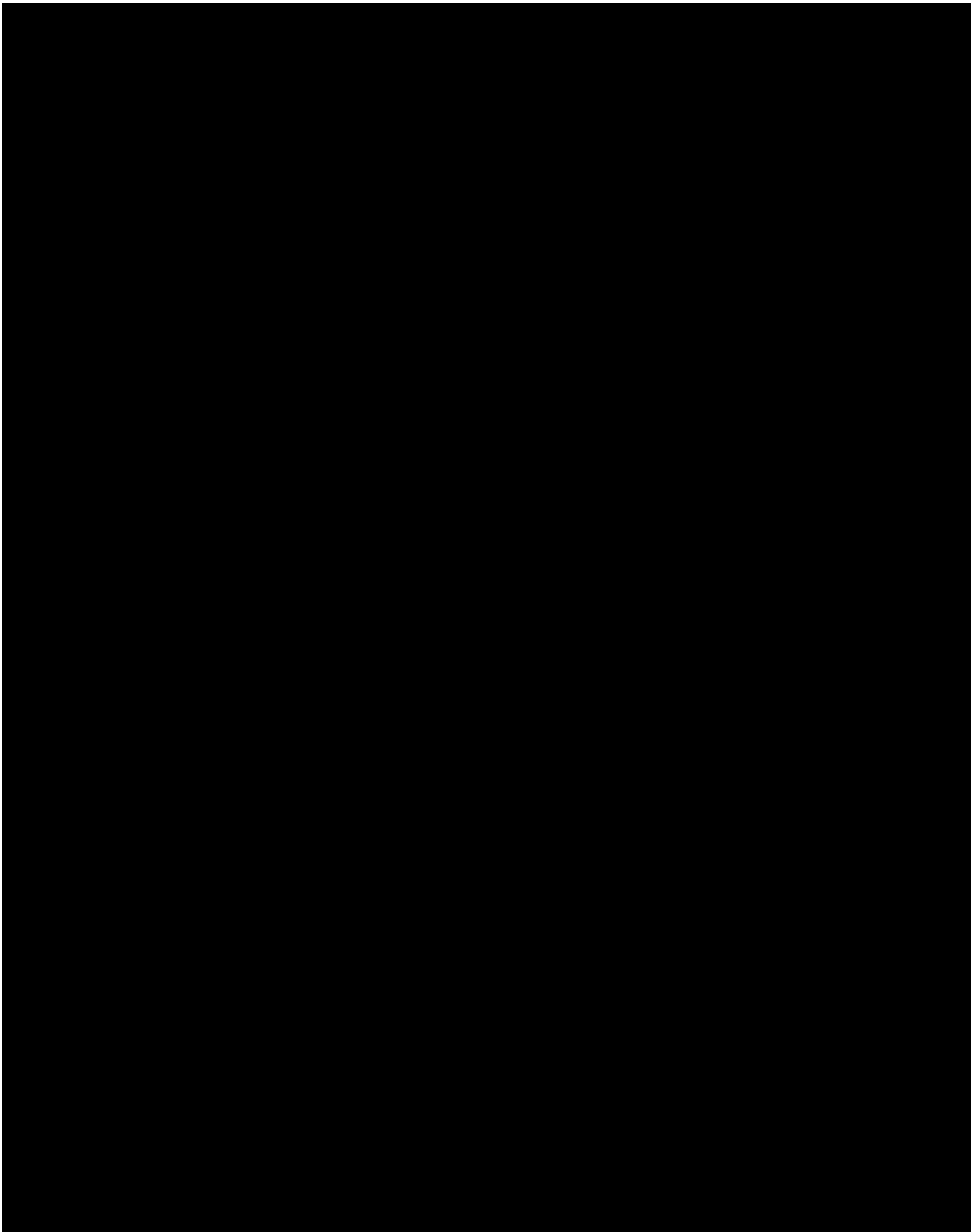


Figure 2.5 Location of previously recorded AHIMS sites with respect to the investigation area

Previous archaeological surveys and the AHIMS results indicate that the investigation area is a landscape that retains high Aboriginal cultural and archaeological values.

One of the previously recorded sites within the investigation area (#56-1-0043, East Bomen 1), is a gazetted Aboriginal Place (Bomen Axe Quarry). This site exists to the south of East Bomen Road, near the east side of the investigation area. This site was recorded by Navin Officer in 1998 and consists of a stone quarry and artefact site. The site is approximately 150 metres by 70 metres in size and is located on the crest of a spur near Bomen and consists of outcropping granite, naturally occurring basalt cobbles and artefacts. The site has been noted by Navin Officer as providing “evidence for the on-site procurement of basalt rock through the flaking of naturally occurring surface cobbles, and subsequent on-site reduction of this flaked material to form axe (or hatchet) preforms” (Navin Officer, 1998). It contains a surface scatter of around 500 artefacts, including primary flakes and secondary flakes (77 per cent of the artefacts) as well as cores, hammer stones and axe preforms. This site was visited by OzArk in 2011 and 2012 (OzArk, 2012), however, it was not possible to confirm the current extent of the site due to the lack of ground surface visibility.

Three new Aboriginal sites were recorded during fieldwork for the Wagga Wagga SAP (refer to Table 2.4).

Table 2.4 Aboriginal cultural heritage sites recorded during the survey

SITE NAME & NUMBER	FEATURE(S)	SURVEY UNIT	LANDFORM
Wagga SAP IF-01 #56-1-0609	Isolated artefact	■	Lower slopes and undulating flats
Wagga SAP OS-01 #56-1-0621	Artefact scatter	■	Rock outcrop
Wagga SAP ST-01 #56-1-0620	Culturally modified tree	■	Lower slopes and undulating flats

The pattern of recorded site dispersal and proximity to the Bomen Axe Quarry make it likely that additional sites will occur in the investigation area that has not been previously assessed. This is supported by more recent assessments in the area that have identified further Aboriginal sites/objects and potential archaeological deposits at Bomen.

2.3.3.2 NON-ABORIGINAL HERITAGE

A search of the Heritage Council of NSW heritage databases and the Wagga Wagga LEP 2010 identified eight records for historical heritage sites within the investigation area, and one place adjacent to the investigation area boundary. Table 2.5 and Figure 2.6 presents the non-Aboriginal heritage listed places identified within and surrounding the investigation area.

Table 2.5 Non-Aboriginal heritage listed places within and adjacent to the investigation area

NAME	SIGNIFICANCE	DESCRIPTION
Within the investigation area		
Bomen Railway Station (SHR 01093 & LEP I8)	State & local	The station building was constructed in 1877. Bomen Station Group and Residence has several rare or unusual features, including a continuous pitched roof which extends over the platform, an unusual veranda at the street entrance to the building, and a well. This station was the terminus of the southern line from September 1878 to September 1879 while the rail bridge over the Murrumbidgee River and flood plain was finished.
Bomen Stationmaster's Residence (LEP I9)	Local	Constructed in 1877, the Stationmaster's Residence is a simple rendered brick residence with a symmetrical facade and a timber post supported veranda across the front elevation. There is a hip roof and two well detailed chimneys.

NAME	SIGNIFICANCE	DESCRIPTION
Hopevale (LEP I26)	Local	An aesthetically pleasing stone residence situated at the top of a slope. The homestead was built in the 1870s and has been sympathetically extended to in the rear since 2000. The front [original] section of the house is random rubble roughly scored, with brick quoining to the window and door openings; stone and brickwork is now painted. There is a timber and paved encircling veranda. The broken-back, hip roof is clad with corrugated galvanised iron.
Former Brucedale Public School (LEP I24)	Local	The Brucedale School came into operation as a public school on 1 November 1872. Initially the school was conducted in the Wesleyan Church, a wooden structure which was burnt to the ground on 21 June 1875. A new stone school building was completed in 1879. The school building is constructed of granite blocks, quarried from Shepherds Hill.
Brucedale Hall & Tennis courts (LEP I23)	Local	The Brucedale Tennis Club commenced in 1899. These six courts, the third for Brucedale, were constructed in 1981 by male members and helpers. In 1983 the tennis club took over responsibility for the hall. The Brucedale Hall was constructed in 1935.
Holy Family Chapel (LEP I25)	Local	The first Wesleyan Church was constructed of slabs in about 1872 and burnt down in 1875. The foundation stone of a new Church was laid on 9 November 1875. The internal works were not completed for another 13 years. Listing consists of a simple brick church building. The original shingle roof has been replaced with iron. There are no original internal furnishings.
Surrounding the investigation area		
Pine Ridge Cottage (LEP I27)	Local	A simple timber settlers' cottage, in fair to poor condition. This item is adjacent to western boundary of investigation area.
Wattle Vale (LEP I31)	Local	Located on top of Cartwrights Hill. The building is a red brick residence and features include a hip roof and three well detailed chimneys. An encircling veranda has been enclosed to the sides.

Two additional non-Aboriginal sites (that are not currently listed) were recorded during fieldwork for the Wagga Wagga SAP:

- Wagga Wagga SAP HS-01 (Former Brucedale post office), which is a good example of a single storey brick cottage built in the Victorian Georgian style. It was built in 1898 by John Wells Shepherd.
- Wagga Wagga SAP HS-02 (Former Brucedale change over station stables), which consists of a large weatherboard and timber shed that was possibly used as stables for a horse change-over station.

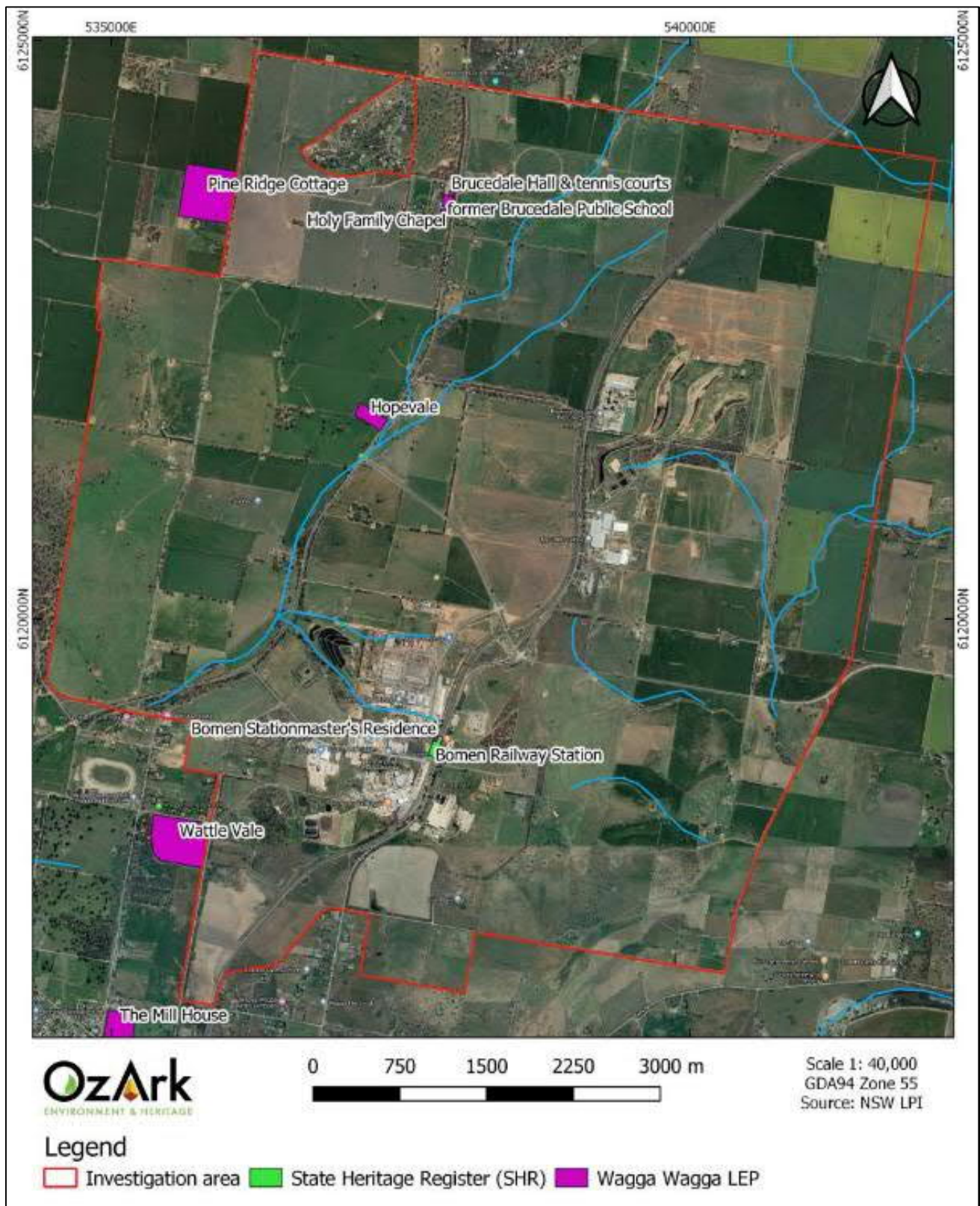


Figure 2.6 Location of listed non-Aboriginal heritage places within and surrounding the investigation area

2.4 GEOLOGY, SOILS AND CONTAMINATION

This section summarises the Preliminary Site Investigation (PSI) that was prepared for the Wagga Wagga SAP and is provided in Appendix D.

2.4.1 AIMS AND OBJECTIVES

The purpose of the PSI is to identify potential areas of environmental interest (AEI) which will assist in identifying potential development constraints within the investigation area with respect to contamination.

The objectives of the PSI are to:

- identify and document current and historical land uses to identify potential sources of contamination and associated contaminants of concern, potentially affected media and potential human and ecological receptors
- assess contamination risk from a future development viewpoint
- prepare a report in accordance with the *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (EPA, 2011), detailing the findings of the PSI
- identify any contamination issues and provide recommendation for further investigations (if required).

2.4.2 METHODOLOGY

The preparation of the PSI involved a desktop review of regional environmental setting and historical information including:

- physical site setting information such as topography, geology, hydrology, hydrogeology, and potential sensitive receptors on or near the investigation area
- information available from Wagga Wagga City Council
- regulatory notices or records relating to potential contamination on the site issued by the NSW EPA
- historical aerial photographs for investigation area and surrounds
- historical investigation reports for the investigation area (where available)
- neighbouring properties to identify the presence and proximity of sensitive receptors which could be significantly impacted upon by the project
- the Department of Defence unexploded ordnance database.

2.4.3 EXISTING ENVIRONMENT

2.4.3.1 EXISTING AND PREVIOUS LAND USES

The present Teys abattoir building was built prior to 1971. The Bomen Industrial Precinct has been progressively developed, including the Wagga Wagga Livestock Marketing Centre (present in imagery from 1980), the Caltex/Tasco fuel depot (present in imagery from 1995) and the Rodney's Transport facility (present in imagery from 2004).

To the east of the Main Southern Railway, development is visible from 1980, with a building present at the historic wool combing facility location. Development continued in subsequent decades, including the wool combing ponds, the Vinidex facility, the Enirgi battery recycling facility buildings and the ROBE facility.

Residential land development mainly occurred after 1980 in Cartwrights Hill in the south-west of the investigation area, and to a smaller extent in the north-west of the residential area.

The remaining land within the investigation area and the land surrounding the investigation area has remained relatively consistent over time, comprising vacant land or farmland with associated residential properties.

The investigation area currently includes a mixture of industrial, farmland, and residential properties (refer to Sections 1.1.2 and 1.1.1 for more information on the existing land uses within the investigation area). Table 2.2 in Appendix D provides a list and brief description of the current businesses within the investigation area.

2.4.3.2 SURFACE WATER

The western portion of the investigation area drains to Dukes Creek, an ephemeral surface water body which flows north to south through the investigation area. The eastern portion of the investigation area drains into Kurrajong Lagoon on the Wheel Of Fortune Creek, which is 3 kilometres to the south-east of the investigation area. Both Dukes Creek and Wheel Of Fortune Creek flow into the Murrumbidgee River, which is located outside of the investigation area.

Major man-made surface water features within the investigation area include ponds associated with the Wagga Wagga Livestock Marketing Centre and the ponds associated with the former wool combing facility to the east of Byrnes Road.

2.4.3.3 TOPOGRAPHY

The topography varies across the investigation area. Ridge lines run north to south near the western and eastern boundaries of the investigation area, with elevations up to 280 metres relative to Australian Height Datum (mAHD). The area between the ridges slopes generally toward the south-west, with an elevation of approximately 180 mAHD in the south-west of the investigation area. The land located east of the ridgeline that crosses through the Bomen Industrial Precinct slopes down toward the Eunony Valley in the east.

2.4.3.4 GEOLOGY

The geology within the investigation area is mapped on the Wagga Wagga 1: 250 000 geological sheet (Adamson & Loudon, 1966) and comprises multiple Quaternary formations (including alluvium and colluvium), overlying granites or sandstones that locally outcrop on topographic highs. A basalt outcrop is present at the site of the Bomen Axe Quarry. Refer to Figure 2.7 and Section 3.5 in Appendix E for more information.

2.4.3.5 REGISTERED GROUNDWATER BORES

A review of registered groundwater bores identified 86 registered bores within the investigation area. Most of these bores are located near the existing industrial land use areas and are used for monitoring purposes. There are also several bores which extract water from the alluvial aquifer for private and town water supply in the southern portion of the investigation area. For a more comprehensive understanding of groundwater in the investigation area, refer to section 2.5.

2.4.3.6 SOIL CONDITIONS

Most of the investigation area is characterised by the East Bomen Soil Landscape. The East Bomen Soil Landscape typically comprises imperfectly drained sandy loam or clay loam topsoil overlying reddish brown clay which lightens to yellow with depth. The East Bomen Soil Landscape is noted to have low limitations for urban development, slight to moderate limitations for cultivation and low limitations for grazing.

The granitic peaks within the investigation area are characterised by the Glenmornon Soil Landscape. This soil type generally consists of a dark red or reddish brown sandy loam surface overlying brown/yellow sandy clay or clay. This soil type has a high erosion hazard, which makes it unsuitable for building foundations. It also has high to moderate limitations for grazing and extreme limitations for cultivations. It has areas of soil acidity and aluminium toxicity.

Most of investigation area has no known occurrence or low probability of acid sulfate soils. However, the area near the ponds associated with the former wool combing factory has a high probability for acid sulfate soil occurrence.

Wagga Wagga City Council maintains a network of salinity monitoring bores, including four within the investigation area near the Bomen Industrial Sewage Treatment Facility. Recent monitoring results from these bores indicate slightly saline groundwater conditions.

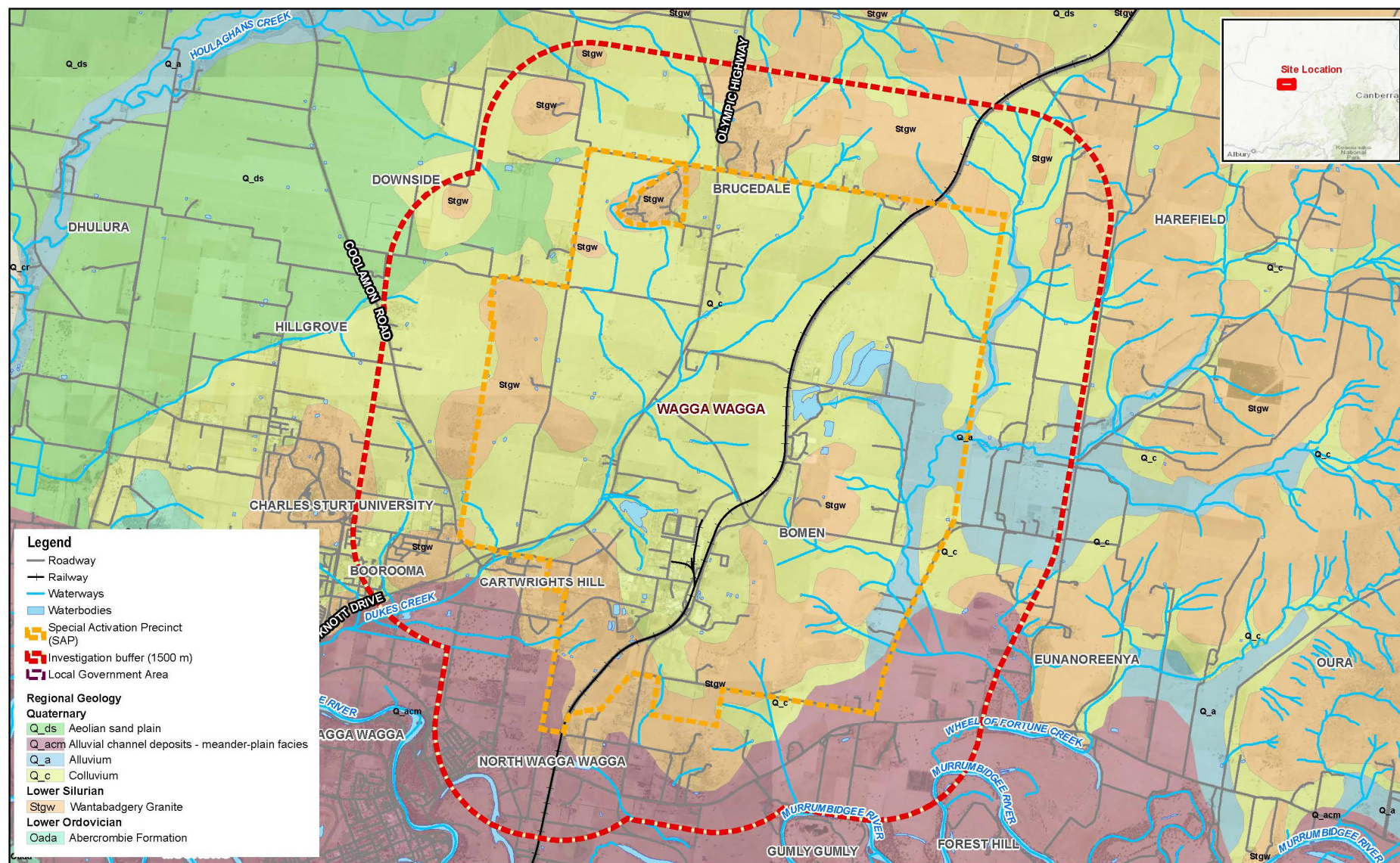


Figure 2.7 Regional geology

2.4.3.7 SENSITIVE RECEPTORS

There are several potential sensitive receptors within the investigation area, which may experience adverse ecological or human health impacts if exposed to contamination.

Potential environmental receptors identified include:

- Dukes Creek running through the investigation area
- Wheel Of Fortune Creek whose tributaries run through the investigation area
- Murrumbidgee River and its associated groundwater catchment
- aquifers present beneath the investigation area, used for private or municipal beneficial use.

Potential human health receptors identified within the investigation area include:

- residents
- farm workers
- commercial workers
- users of groundwater from the Wagga Wagga alluvial groundwater source.

2.4.3.8 POTENTIAL EXISTING CONTAMINATION RISKS

The PSI identified several potentially contaminating activities within the investigation area, which would result in potential areas of environmental interest (AEIs). Most of these activities are regulated by the NSW EPA under the *Protection of the Environment Operations Act 1997*.

Table 2.6 outlines the AEIs identified in the PSI, which are likely to be contaminated from current or historical activities. Figure 2.8 shows the location of these AEIs within the investigation area.

Table 2.6 Potential areas of environmental interest for contamination

POTENTIAL AEI	POTENTIAL CONTAMINATION SOURCE	CONTAMINANT OF CONCERN	POTENTIAL EXISTING CONTAMINATION IMPACT
General agricultural activities (sections of the investigation area have historically comprised of farm land).	Land application of pesticides. Use of hazardous materials (e.g. asbestos) in structures.	Pesticides, heavy metals, asbestos.	Surface soil impacted by pesticide applied to farmland. Surface soils impacted by former structures.
Farm dams (several located within the investigation area).	Land application of pesticides.	Pesticides, heavy metals, nutrients.	Accumulation of pesticides applied to land via surface run-off.
Former Riverina Wool Combing Facility (Lot 1 and 2, DP771340, Lots 2 and 4, DP1249028).	Storage and/or scouring of wool.	Total recoverable hydrocarbons (TRH), pesticides, heavy metals, chloride, sulfate, carbonate, nutrients, pH.	Localised surface soil impacted by chemical spillage. Contaminated sediment accumulation in evaporation ponds. Groundwater impacted by seepage from ponds.

POTENTIAL AEI	POTENTIAL CONTAMINATION SOURCE	CONTAMINANT OF CONCERN	POTENTIAL EXISTING CONTAMINATION IMPACT
Former wool hide merchant (Lots 1 and 2, DP 1228221).	Storage and scouring of wool.	TRH (confirmed), pesticides, heavy metals, chloride, sulfate, carbonate, nutrients, pH.	Localised surface soil impacted by chemical spillage. Contaminated sediment accumulation in evaporation ponds. Groundwater impacted by seepage from ponds.
Former Laminex facility (Lot 1, DP 260958) and associated filled land (Lot 22, DP1085826).	Wood processing and treatment.	Solvents, polycyclic aromatic hydrocarbons (PAHs), pesticides, heavy metals, ammonia, cresols.	Surface soil impacted by chemical spillage. Waste process deposits applied to land (associated leachate/gas generation).
Rail land and associated sidings.	Contaminants in ballast/rail materials. Residue from rail operations/train materials.	TRH, PAHs, heavy metals, pesticides, herbicides, asbestos.	Surface soil impacted by chemical spillage.
Enirgi Battery Recycling Facility and former Buckman chemical manufacturing (Lot 3, DP 594679 and Lot 21 DP 1128492).	Spillage of chemicals/ residue in battery recycling/chemical manufacturing.	Heavy metals (lead impacts are confirmed), acids, solvents, chemicals (depending on what was manufactured).	Surface soil impacted by chemical spillage. Surface/groundwater impacts from irrigation using waste water.
BOC facility (Lot 2, DP 1221188).	Spillage of chemicals.	TRH and other potential chemicals stored.	Surface soil impacted by chemical spillage.
Electrical substations – Lot 11, DP1132424, Lot 4, DP576937, Lot 1, DP1115229.	Spillage or leaking of dielectric fluid or transformer oil.	TRH, PAHs, heavy metals, polychlorinated biphenyl (PCBs).	Natural soils under the fill material impacted and potential migration offsite via runoff.
Fulton Hogan asphalt plant - Lot 4, DP 849385.	Spillage of asphalt materials.	TRH, PAHs, metals.	Surface soil impacted by chemical spillage.
Tasco Petroleum Fuel depot (Lot 5, DP 1217349).	Spillage/leakage of hydrocarbons. Degradation of pipework.	TRH, PAHs, oil and grease, solvents, asbestos.	Surface soil impacted by chemical spillage. Groundwater impacted by seepage or sub-surface leakage.
Southern Oil Refinery (Lot 4, DP 1217349).	Spillage/leakage of hydrocarbons, waste products.	TRH, PAHs, oil and grease, solvents, PCBs.	Surface soil impacted by chemical spillage. Groundwater impacted by seepage or sub-surface leakage.
Teyes abattoir (Lot 1, DP 1213252).	Spillage/runoff of effluent/waste materials.	Nutrients, biological oxygen demand, total suspended solids, oil and grease, pesticides.	Sediments/surface water in dams/ponds. Surface soils.

POTENTIAL AEI	POTENTIAL CONTAMINATION SOURCE	CONTAMINANT OF CONCERN	POTENTIAL EXISTING CONTAMINATION IMPACT
Wagga Wagga Livestock Marketing Centre (Lot 22, DP1120176).	Spillage/runoff of effluent/waste materials.	Nutrients, biological oxygen demand, total suspended solids, oil and grease, pesticides.	Sediments/surface water in dams/ponds. Surface soils.
Former fellmongery (Lot 1, DP 576940).	Storage and scouring of wool/skins.	TRH, pesticides, heavy metals, chloride, sulfate, carbonate, nutrients, pH.	Localised surface soil impacted by chemical spillage. Contaminated sediment accumulation in evaporation ponds. Groundwater impacted by seepage from ponds.
Various agricultural chemical retailers/wholesalers.	Spillage of chemicals.	Nitrates, ammonia, pesticides.	Surface soil impacted by chemical spillage.
Rodney's Transport facility (Lots 15 & 16, DP 1068876, Lot 7, DP 830975, Lot 4, DP 610914).	Storage of hazardous goods, petroleum storage, waste storage.	TRH, PAHs, heavy metals, pesticides, herbicides, asbestos.	Surface soil impacted by chemical spillage, groundwater impacted by underground fuel storage leakage.
Land Transport (Lot 2 DP 259924).	Potential storage of hydrocarbons.	TRH, PAHs.	Surface soil impacted by chemical spillage, groundwater impacted by underground fuel storage leakage.
Bomen Industrial Wastewater Treatment Plant (Lots 1 and 2, DP 1202669).	Leakage of effluent/waste streams.	Nutrient, heavy metals, phenols, pathogens.	Surface soils/waters impacted by effluent spillage.
Metal fabrication businesses (Lot 8, DP259505, Lot 15, DP 1130343).	Spillage of chemicals.	Heavy metals, acids, solvents, cyanide.	Surface soil impacted by chemical spillage.
Austrak concrete production facility (Lot 23, DP 1227522).	Spillage of chemicals.	Lime, alkalis, hydrocarbons.	Surface soil impacted by chemical spillage.
Scrap metal storage (Lot 14, DP 706964).	Residue of waste materials.	TRH, asbestos, heavy metals, PAHs, pesticides	Surface soil impact.

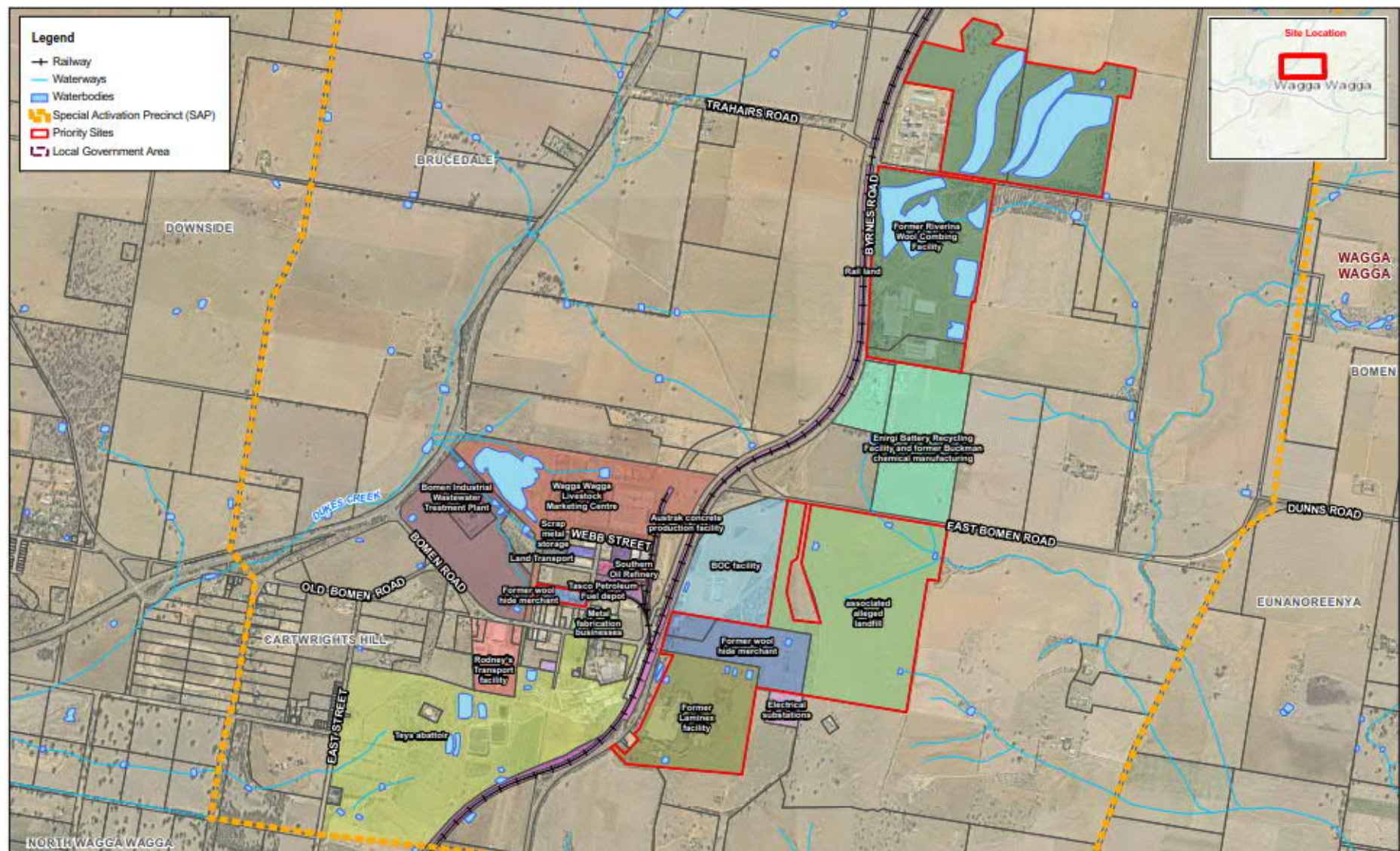


Figure 2.8 Location of areas of environmental interest within investigation area

2.5 HYDROGEOLOGY

This section summarises the methodology and existing environment for the Desktop Hydrogeology Assessment that was prepared for the Wagga Wagga SAP and is provided in Appendix E.

2.5.1 AIMS AND OBJECTIVES

The objectives of the desktop hydrogeology assessment are to:

- obtain a desktop understanding of the geology, hydrogeology, registered bore users and groundwater dependent ecosystems (GDE)
- identify areas of constraint, where certain land uses should be restricted
- identify potential groundwater source(s) for utilisation as a future SAP resource.

2.5.2 METHODOLOGY

The desktop hydrogeology assessment involved:

- reviewing relevant legislation, policies and guidelines to understand the regulatory context
- reviewing available information to determine groundwater availability and licensing within the investigation area and identify any regional features such as geological structures
- describing the existing subsurface and groundwater environment within the investigation area
- identifying groundwater related environmental values (registered bore users and GDE's) through a review of:
 - geological maps, geophysical imagery, Bureau of Meteorology's (BOM) GDE Atlas and National Groundwater Information System database search for registered bores
 - groundwater level and groundwater quality related to the investigation area
 - climatic data (rainfall and evapotranspiration) from the nearest available sources to the investigation area
- identifying possible groundwater systems to be utilised as future resources for the SAP
- identifying recommendations for the SAP Structure Plan to ensure protection of the Wagga Wagga alluvium.

For the purpose of this desktop hydrogeology assessment, an additional 1.5 kilometre buffer around the Wagga Wagga SAP investigation area (referred to as the 'investigation buffer') was assessed (shown on Figure 2.9). The purpose of this investigation buffer was to enable the Murrumbidgee River, connected alluvial groundwater to the south and east, and surrounding sensitive receptors to be considered in the assessment, which may be affected by future development within the SAP.

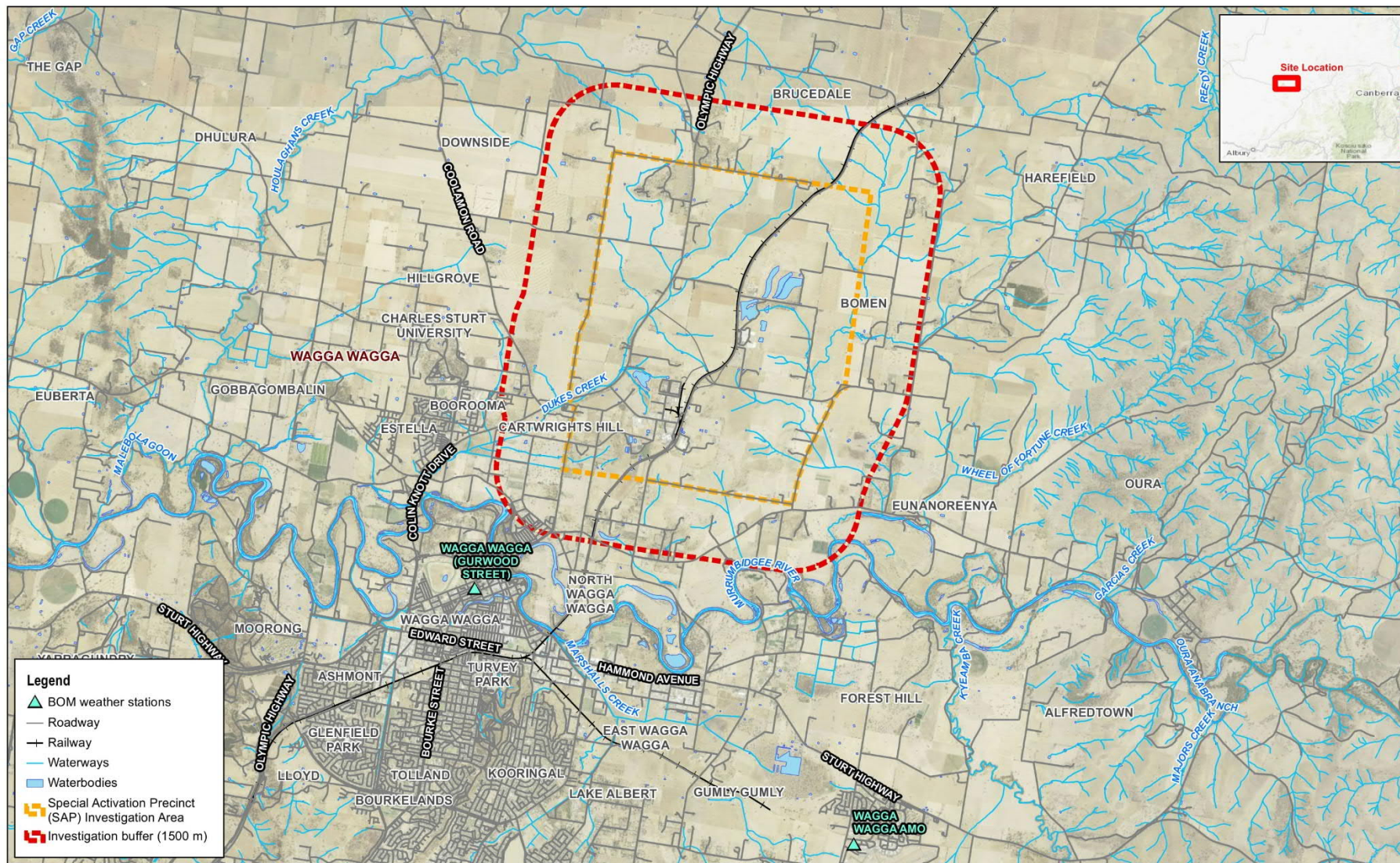


Figure 2.9 Map showing investigation buffer used in the Desktop Groundwater Assessment

2.5.3 EXISTING ENVIRONMENT

2.5.3.1 GROUNDWATER SOURCES, WATER SHARING PLANS AND WATER ACCESS LICENCES

The *Water Management Act 2000* governs the issue of water access licences and approvals for those water sources (rivers, lakes, estuaries and groundwater) in NSW where water sharing plans have commenced. Water sharing plans establish rules for sharing water between water users and the environmental needs of the river or aquifer, and also between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation. Water sharing plans describe the annual groundwater recharge volumes for each identified groundwater source and the volumes of water that are available for sharing. Water sharing plans are typically in place for ten years, however they may be suspended in times of severe water shortages.

Two water sharing plans are currently in place within the investigation area (refer to Figure 2.10 and Section 2.2.2 in Appendix E):

- Murrumbidgee Unregulated and Alluvial water source, which commenced in October 2012 and covers the south-east and south-west corners of the investigation area.
- NSW Murray-Darling Basin (MDB) Fractured Rock Groundwater Sources, which commenced in January 2012 and covers the majority of the investigation area.

The investigation area includes two primary hydrogeological units based on the water sharing plan boundaries, each containing an upper and lower groundwater source (aquifer):

- The Wagga Wagga alluvium – which is associated with the groundwater in the Murrumbidgee Unregulated and Alluvial water source, which is present in the southern portion of the investigation area.
- The Lachlan fractured rock – which is associated with the groundwater in the NSW MDB Fractured Rock Groundwater Sources, which is present in the majority of the investigation area.

The Wagga Wagga alluvium is associated with ‘high productivity aquifers’ due to typically encountered high yield rates and low total dissolved solid content. This Wagga Wagga alluvium is currently heavily utilised for town water supply within the City of Wagga Wagga and the surrounding Riverina (refer to Section 2.5.3.2).

The Lachlan fractured rock is less utilised as it is associated with ‘less productive aquifers’ due to low yield rates that are typically encountered. It also has variable water quality. However, an area located within the northwest portion of the investigation area, identified along a northeast – southwest geophysical lineament interpretation, has the potential to provide a reliable groundwater resource with yields recorded by a registered bore (GW402059) of up to 66 L/s.

To use water from the groundwater sources, water access licences (WALs) can be obtained (subject to restrictions outlined within the relevant water sharing plan) through purchasing or trading of an existing WAL. However, WALs for both groundwater sources within the investigation area are completely allocated and can only be obtained through trading (refer to Section 2.2.3 in Appendix E).

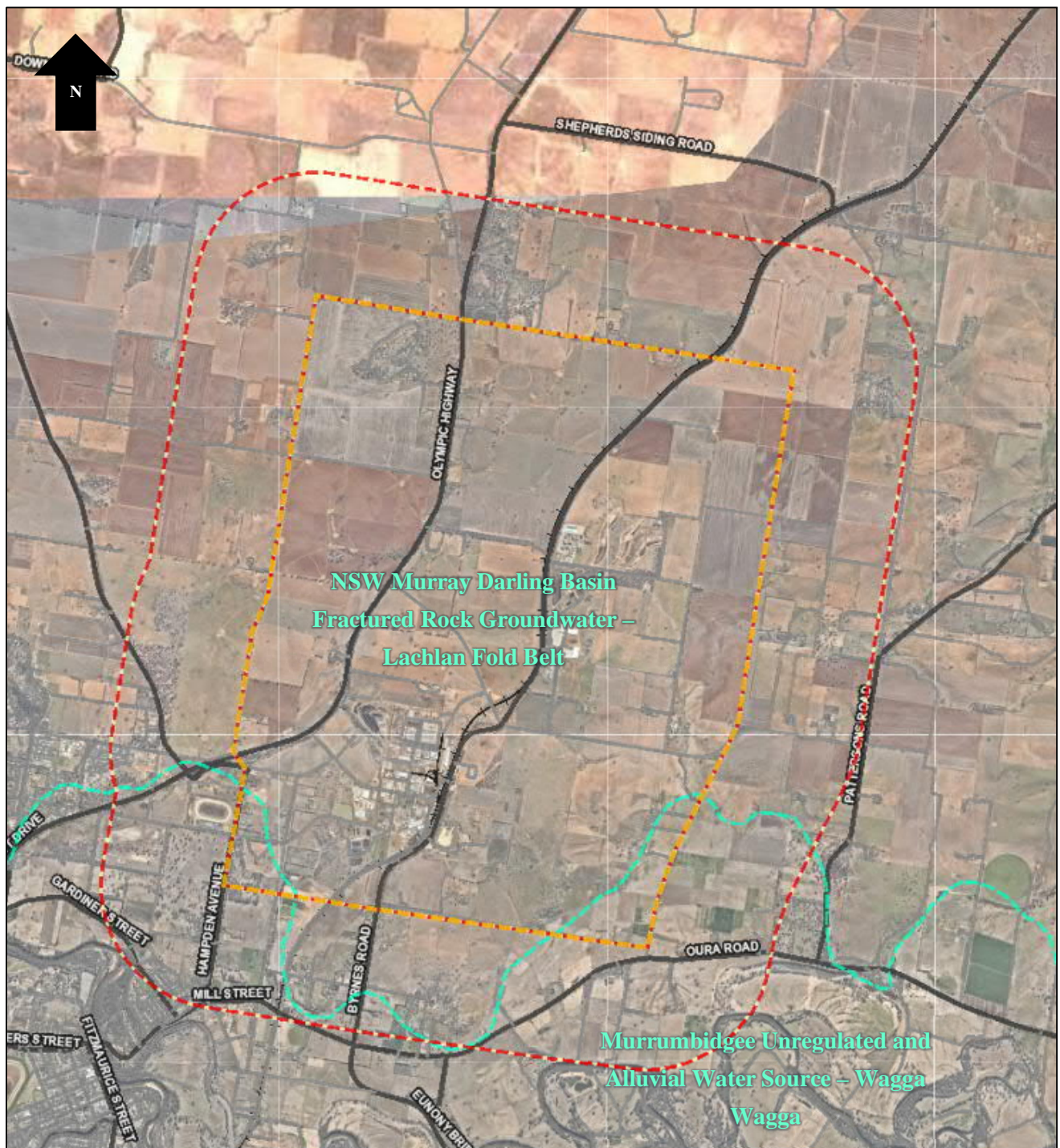


Figure 2.10 Location of water sharing plans within the investigation area

2.5.3.2 EXISTING WATER SUPPLY AND USE

Bore water (groundwater) has become an integral component of the Wagga Wagga water supply network since the late 1960's due to increase in demand from population growth and industry (predominately irrigation). Groundwater is the preferred source for water supply due to its high quality and reliability. Water use distribution across the Riverina is focused on the City of Wagga Wagga and has been consistent over the past few years with the bulk of annual water distribution used for residential purposes. Riverina Water County Council (RWCC) operates water supply to the City of Wagga Wagga and surrounding Riverina. The closest RWCC bore network to the Wagga Wagga SAP is located approximately 2.5 km south (North Wagga bore field) and is governed by the Murrumbidgee Unregulated and Alluvial Water Sources Water Sharing Plan – Wagga Wagga Alluvial Groundwater Sources.

There are 86 registered groundwater bores within the investigation area. 22 of these registered bores are considered sensitive receptors as they currently hold licenses for household water supply, municipal water supply, stock and domestic use or irrigation and industry. The remaining bores listed within the investigation area are licensed for monitoring or exploration or have a status listed as abandoned, removed or proposed, and are therefore not classified as a sensitive receptor.

2.5.3.3 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. There is uncertainty 'Potential' is used to reflect the uncertainty inherent in identifying ecosystems as groundwater-dependant using desktop methods.

Three high potential GDE's have been identified within the investigation area, spatially clustered towards the southern portion, including:

- one distinct terrestrial vegetation GDE (River Red Gum – Wallaby Grass)
- two distinct terrestrial vegetation GDE's (River Red Gum – herbaceous, and River Red Gum – Wallaby Grass).

There are no aquatic GDE's (ecosystems that rely on the surface expression of groundwater) within the investigation area, however one high potential aquatic GDE (Murrumbidgee River) has been identified within the investigation buffer.

Figure 2.11 shows the location of aquatic and terrestrial GDEs identified within and surrounding the investigation area.

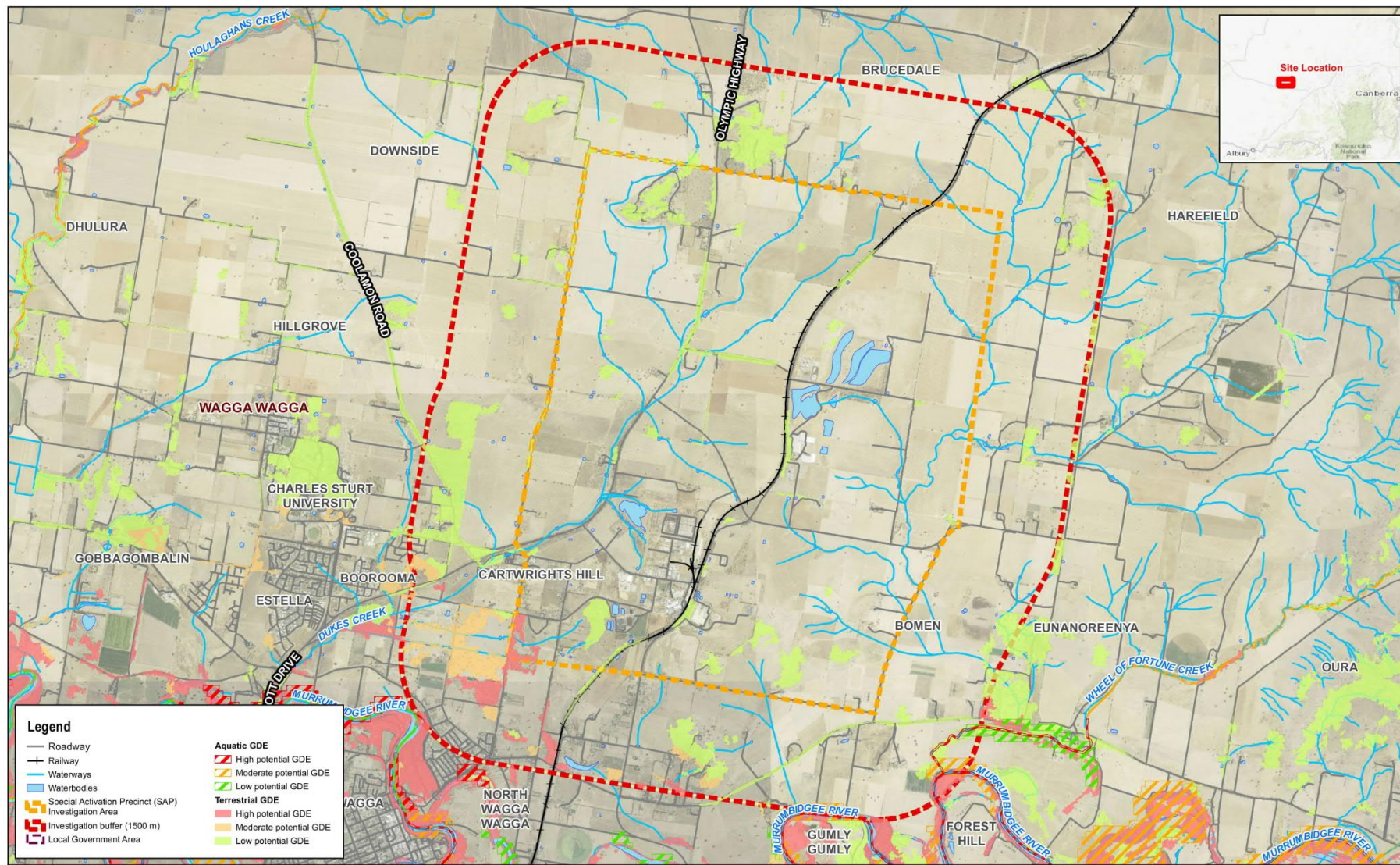


Figure 2.11 Location of aquatic and terrestrial GDEs within and surrounding the investigation area

3 SUMMARY OF OPPORTUNITIES AND CONSTRAINTS

As part of the baseline investigations for each specialist area, opportunities and constraints were identified, which informed the short Enquiry by Design workshop and scenario development. This chapter outlines these aspects for each specialist area.

3.1 BIODIVERSITY

3.1.1 OPPORTUNITIES

Overall the Wagga Wagga SAP and the biodiversity certification assessment for the project provides a unique opportunity to protect biodiversity and environmental values and plan an enhanced green infrastructure network.

The existing biodiversity certification is due to expire in 2020 (refer to section 1.1.3.1). The biodiversity certification provided landscape scale linkages particularly along the Olympic Highway corridor and protection to several native vegetation patches. The values and aims of this have been incorporated into the biodiversity assessment (refer to section 2.2). It is likely that the Wagga Wagga SAP would provide an updated certification under the BC Act that covers the entire investigation area. Any consideration of biocertification must be prepared in consultation with the Biodiversity and Conservation directorate of the Department of Planning, Industry and Environment.

Whilst the biodiversity values of the investigation area are generally limited (due to historic and ongoing disturbances from agricultural, industrial and residential land uses) opportunities exist to protect the existing native vegetation on the site and enhance its habitat value, conservation potential, overall landscape connectivity and develop and enhance biodiversity linkages and corridors. This could occur through incorporating planned open space zoning in the Wagga Wagga SAP Structure Plan such as by:

- linking significant roadside vegetation and native vegetation plantings
- strengthening riparian areas
- connecting larger vegetation patches south-west associated with Dukes Creek and the broader Murrumbidgee floodplain
- retention of smaller remnant patches and paddock trees to provide stepping stones for fauna movement.

These opportunities are described in the sections below.

3.1.1.1 LINKING SIGNIFICANT ROADSIDE VEGETATION AND NATIVE VEGETATION PLANTINGS

Opportunities exist to strengthen and expand the existing native plantings and remnant vegetation along the Olympic Highway and Trahairs Road to ensure the corridor provides safer fauna passage that would be less impacted by road usage. Opportunities also exist for enhancing native vegetation plantings east of Byrnes Road to the south that would connect with the tree-planting initiative of the Eunony Valley residents to improve biodiversity in the precinct.

Revegetation and enhancement opportunities include:

- the promotion of planting of local and climate adapted native species as part of the landscaping associated with future developments
- controls to manage introduced flora and pest fauna species.

3.1.1.2 RIPARIAN AREAS

As discussed in Section 2.2.3.6, there are two main areas of riparian habitats within the investigation area. The area of riparian habitat that occurs to the east of the Olympic Highway just north of Horseshoe Road is within the broader north/

south corridor link associated with native plantings and remnant vegetation along the Olympic Highway. Strengthening vegetation in this area is recommended to enhance the riparian habitat.

3.1.1.3 LARGER VEGETATION PATCHES SOUTH-WEST ASSOCIATED WITH DUKES CREEK AND THE BROADER MURRUMBIDGEE FLOODPLAIN

A large patch (>10 ha) of PCT 9 River Red Gum – wallaby grass tall woodland wetland on the outer River Red Gum zone provides landscape linkage for highly mobile fauna species to Dukes Creek and the broader Murrumbidgee floodplain in the south-western portion of the investigation area. Opportunity exists to further strengthen habitat connectivity between this area and the investigation area and potentially connect areas of native plantings and remnant vegetation within hilly sections of Teys Australia land holdings.

3.1.1.4 RETENTION OF SMALLER REMNANT PATCHES AND Paddock TREES TO PROVIDE STEPPING STONES FOR FAUNA MOVEMENT

An opportunity exists to retain smaller remnant patches and paddock trees to provide stepping stones for fauna movement throughout the investigation area. It is recommended that the retention of these features focuses on linking to larger existing corridors or vegetation patches and those paddock trees of higher biodiversity value such as Class 3 trees with hollows.

3.1.2 CONSTRAINTS

The biodiversity values recorded within the investigation area have been ranked in terms of biodiversity constraint to assist with avoiding and minimising impacts during the SAP Structure Plan development phase. Biodiversity constraints have been ranked based on the following criteria (shown on Figure 3.1):

- Tier 1 – High biodiversity constraint
 - native vegetation patches of PCT that correspond to Threatened Ecological Communities listed under the EPBC Act
 - native vegetation patches of PCT listed under the BC Act as serious and irreversible impact entities
 - potential habitat for EPBC listed flora species
 - potential habitat for EPBC listed fauna species
 - all hollow bearing trees
 - existing environmental covenants or Property Vegetation Management Plans
 - offset areas identified in existing biocertification
 - trees protected under the Wagga Tree Preservation Order
 - mapped tributaries associated with key fish habitat
- Tier 2 – Medium biodiversity constraint
 - native vegetation patches of PCT that correspond to Threatened Ecological Communities listed under the BC Act
 - paddock trees recorded as Class 2 or Class 3 that require biodiversity offsets at an ecosystem credit level
 - potential habitat for BC listed flora species
 - potential habitat for BC listed fauna species
 - native vegetation patches of PCT that do not that correspond to Threatened Ecological Community listed under either BC Act and/or EPBC Act but qualify to require biodiversity offsets at an ecosystem credit level.
 - planted native vegetation which provided habitat connectivity across the landscape
- Tier 3 – Other
 - non-native vegetation which does not provided habitat for Threatened fauna
 - all other paddock trees and paddock trees recorded as Class 1.

The aim of the Wagga SAP should be to avoid and enhance biodiversity. This includes avoiding or minimising impacts to Tier 1 and 2 biodiversity constraints. Residual impacts to biodiversity values would be assessed under the Biodiversity Certification Assessment Methodology and require biodiversity offsetting in accordance with the NSW Biodiversity Offset Scheme. Residual impacts to biodiversity listed under the EPBC Act would require assessment including the need for a referral to the Commonwealth Department of Energy and Environment.

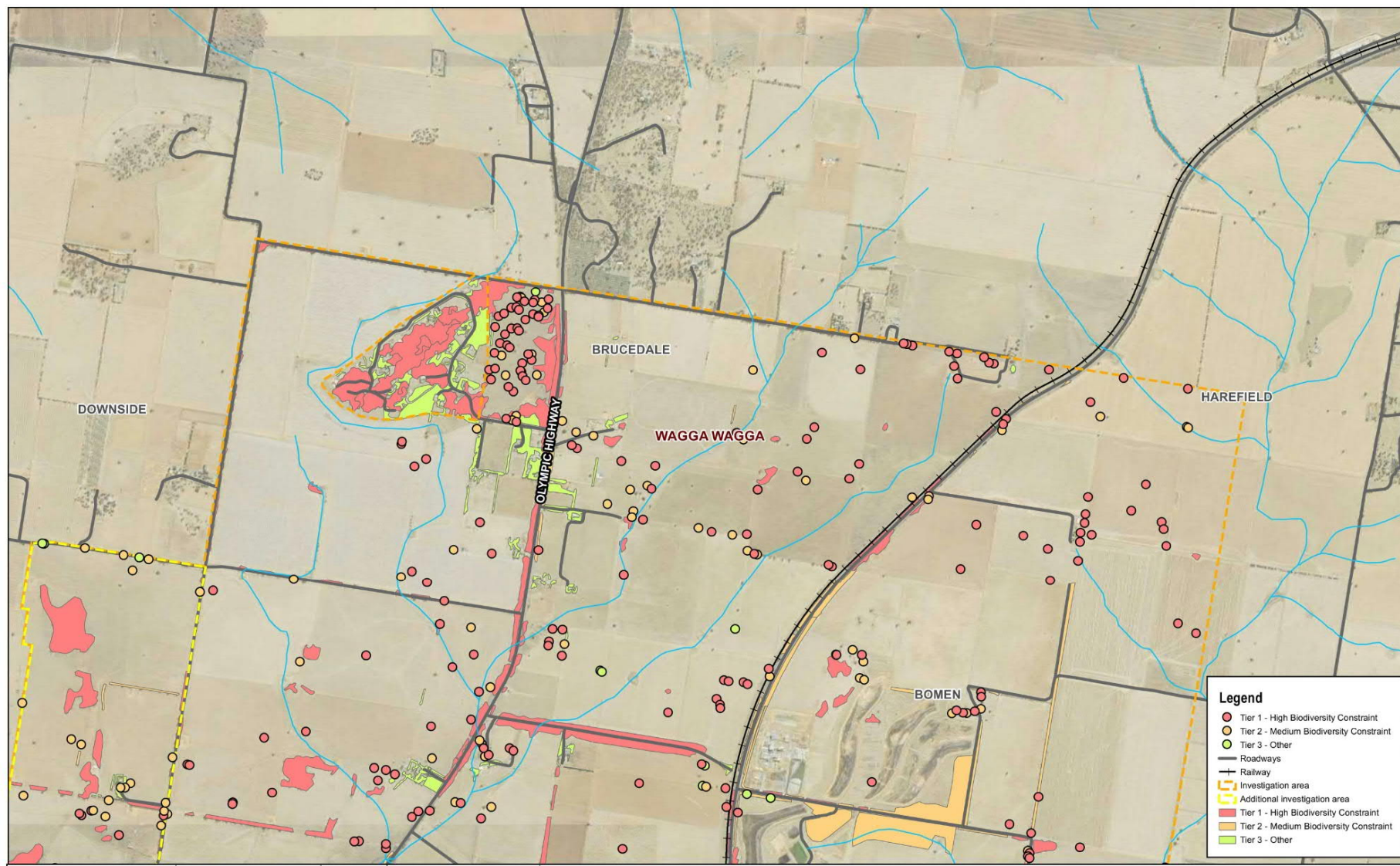


Figure 3.1 Biodiversity constraints (Page 1 of 3)

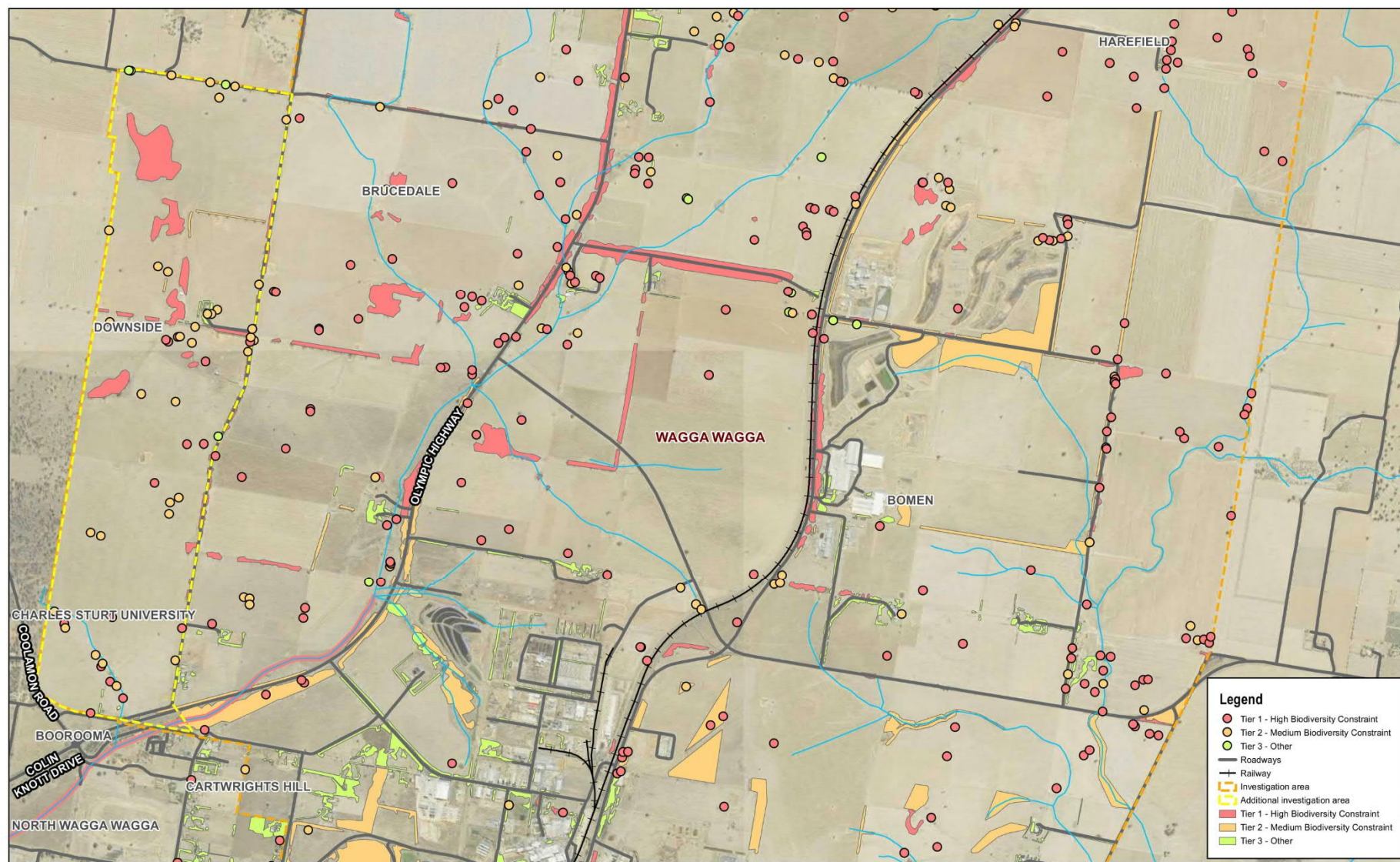


Figure 3.2 Biodiversity constraints (Page 2 of 3)

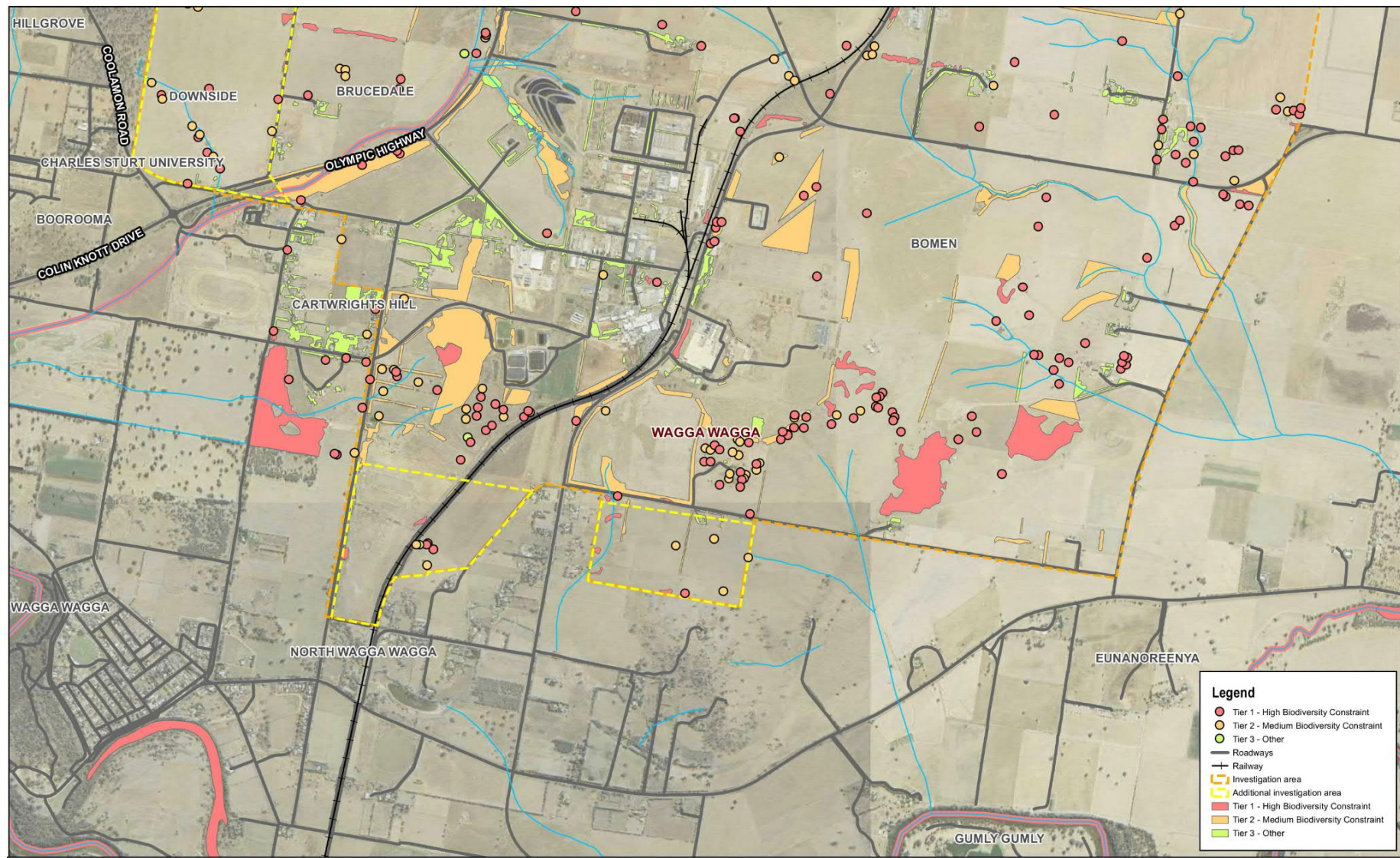


Figure 3.3 Biodiversity constraints (Page 3 of 3)

3.2 BUSHFIRE

3.2.1 OPPORTUNITIES

As discussed in Section 2.2.3.9, due to the potential for additional land to be mapped as Category 1, 2 and/or 3 Vegetation within the investigation area, vegetated areas within the investigation area could be conservatively considered to be bushfire prone land. As such, there is an opportunity to consider the relevant specifications and requirements of *Planning for Bushfire Protection* (NSW Rural Fire Services, 2018) during development of the Wagga Wagga SAP Structure Plan.

There may also be an opportunity to revise the current classification of Category 2 Vegetation in the north-western corner of the investigation area to a lesser bushfire classification, as this area comprises a rural-residential subdivision, and so the current classification may overrepresent the actual bushfire risk (refer to Section 2.2.3.9).

Suitable Asset Protection Zones should be identified for future buildings within the investigation area, which would result in a Bushfire Attack Level of BAL 29 or lower. To achieve a BAL 29 rating within the investigation area, a minimum Asset Protection Zone of 10-13 metres would generally be required (refer to Chapter 7 in Appendix B). Commercial and industrial development should be located outside the flame zone, which would require a minimum Asset Protection Zone of between 7–10 metres.

However, some land uses would be classified as “Special Fire Protection Purpose” development, which would require larger minimum Asset Protection Zones of 36-50 metres and more onerous Bushfire Protection Measures. Special Fire Protection Purpose development includes (in accordance with the *Rural Fires Act 1997*):

- a school
- a child care centre
- a hospital (including a hospital for the mentally ill or mentally disordered)
- a hotel, motel or other tourist accommodation
- a building wholly or principally used as a home or other establishment for mentally incapacitated persons
- seniors housing within the meaning of *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004*
- a group home within the meaning of *State Environmental Planning Policy No 9 – Group Homes*
- a retirement village
- any other purpose prescribed by the regulations.

The SAP Structure Plan should consider perimeter roads wherever possible, and designs which would exceed the minimum requirements in *Planning for Bushfire Protection* (NSW Rural Fire Services, 2018). To maximise the Asset Protection Zones and satisfy the NSW Rural Fire Service’s preferred position for access design, perimeter roads should be considered within Asset Protection Zones. If a perimeter road is not achievable, provision of a fire trail or other access arrangement should be considered.

3.2.2 CONSTRAINTS

Some types of developments may be hazardous for their ability to start bushfires or susceptibility to bushfires. Generally, these developments should not be permitted on bushfire prone land or located within 100 metres of a bushfire hazard or 50 metres of a grassland hazard. Types of development that may be considered as hazardous include:

- power generating works
- sawmills
- junk yards
- liquid fuel depots
- hazardous or chemical industries/storage
- service stations
- ammunition or fireworks storage/manufacture.

3.3 ABORIGINAL HERITAGE

3.3.1 OPPORTUNITIES

There is currently a proposal being considered by Wagga Wagga City Council to improve access for Aboriginal people to visit the Bomen Axe Quarry. This provides a significant opportunity to incorporate such a proposal into the initial design plans, including open/green space and convenient parking locations to improve the visitor experience to the Bomen Axe Quarry.

3.3.2 CONSTRAINTS

There is a range of recorded Aboriginal cultural heritage sites inside the investigation area. During the development of the Wagga Wagga SAP Structure Plan, known Aboriginal cultural heritage should be considered, and where possible, protected and conserved. This includes the listed Aboriginal Place Bomen Axe Quarry and other registered AHIMS sites. However, given the scattered distribution of AHIMS sites within the investigation area, it is likely that additional sites could be recorded within the investigation area during field surveys (refer to Section 5.3 in Appendix C).

Figure 3.4 shows the areas of high, moderate and low archaeological sensitivity within the investigation area. This has been determined by expanding upon findings of previous studies and considering the predictive model for archaeological potential (refer to Section 5.4 in Appendix C). Generally, areas with higher archaeological sensitivity are within proximity to watercourses and/or on higher elevated landforms. Areas classified as having lower archaeological potential are generally further away from any watercourses, have development and/or disturbance visibly present on aerial imagery or include sloped landforms away from water.

There are areas in the 'regional enterprise sub precinct' for the Wagga Wagga SAP that warrant heritage-based assessment. These are shown in Figure 3.5 and consist of areas which have not already been surveyed, are not already developed, are not heavily modified, and that have archaeological potential. The high number of sites recorded east of Byrnes Road, and the few recorded west of Byrnes Road, indicate that the overall investigation area has archaeological potential.

As the eventual purpose of the regional enterprise sub precinct is for further developments, the areas hatched in blue on Figure 3.5 are recommended for further heritage assessment prior to development and as part of the approvals process. Furthermore, there are areas in the landscape protection sub precinct that also warrant further investigation. If, in the future, development is planned to occur in the landscape protection sub precinct, that have not already been assessed, heritage assessment will be necessary.

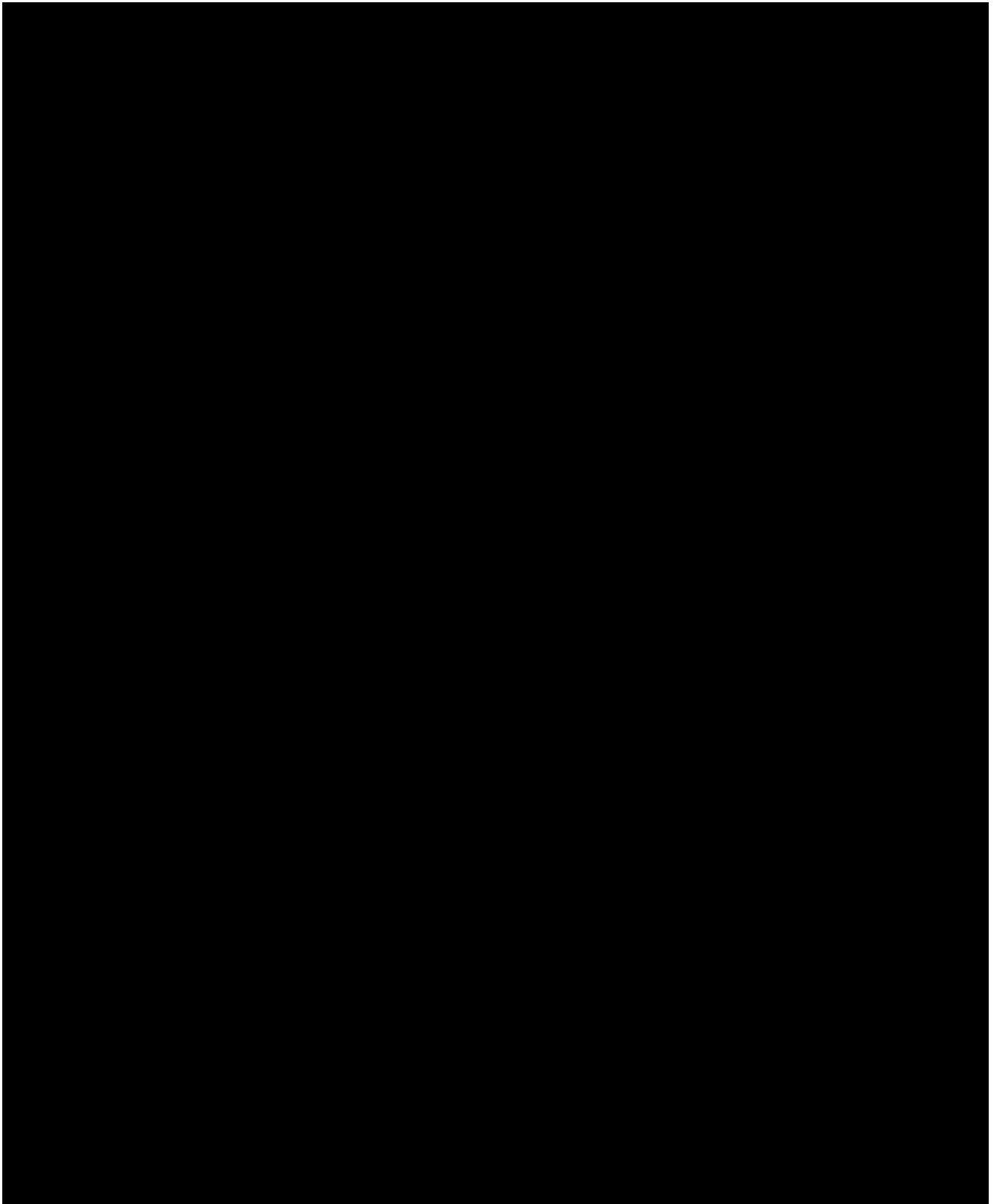


Figure 3.4 Map showing the areas of high, moderate and low archaeological sensitivity within the investigation area

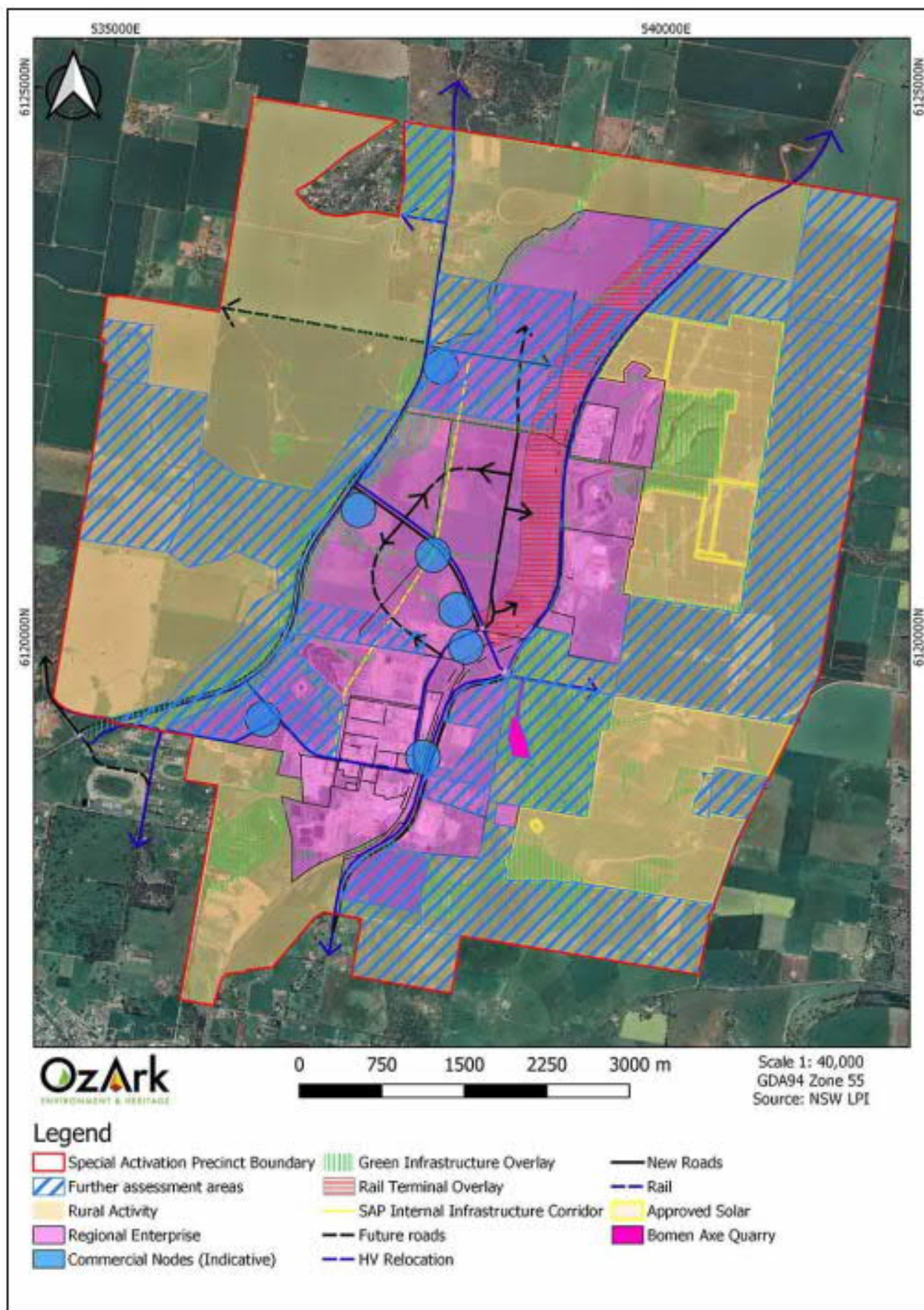


Figure 3.5 Further assessment areas inside the regional enterprise sub precinct

3.4 NON-ABORIGINAL HERITAGE

3.4.1 OPPORTUNITIES

Strategies on how to incorporate the state heritage listed Bomen Railway Station into the initial Wagga Wagga SAP design plans should be considered. There is potential to repurpose the Bomen Railway Station, perhaps as a museum or as a 'shopfront' for the Wagga Wagga SAP development.

3.4.2 CONSTRAINTS

Seven locally listed heritage items and one state and locally listed heritage item have been identified within the investigation area (refer to Section 2.3.3.2). Two additional non-Aboriginal sites (that are not currently listed) were recorded during fieldwork for the Wagga Wagga SAP. These places should be considered for protection during the development of the Wagga Wagga SAP Structure Plan.

3.5 GEOLOGY, SOILS AND CONTAMINATION

3.5.1 OPPORTUNITIES

During development of the SAP Structure Plan, consideration should be given to locating any new potentially contaminating land uses within existing industrial zones, where possible, to minimise the extent of potential contamination and enable more efficient monitoring of potential contamination impacts (if required).

3.5.2 CONSTRAINTS

The PSI identified several areas which may be subject to contamination from current or historical contaminating activities (AEIs, refer to Section 2.4.3.8). Priority areas of concern relate to historical land uses in the investigation area which have ceased, and where contamination risks associated with these land uses may not have been closed out and are not subject to current regulation. This includes the former Riverina Wool Combing facility, as the contamination status within the disused evaporation ponds is unknown and may result in contamination in neighbouring lots, and the former Laminex facility, which historically disposed of waste on a nearby block of land. The approved expansion of the Enirgi battery recycling facility (Lot 3, DP 594679 and Lot 21 DP 1128492) would also need to be monitored, to ensure that the conditions of consent relating to contamination are complied with to manage the potential risk to site users. If the land use within the AEIs is proposed to change, further investigation of the AEIs would be required in accordance with the State Environmental Planning Policy 55 – Remediation of Land to ensure that the land is suitable for its proposed future use.

As discussed in Section 3.6.2, the SAP Structure Plan should consider restricting potentially contaminating activities from the designated groundwater protection zone, to prevent adverse groundwater impacts from future development.

Figure 3.6 shows the location of the priority areas of concern and other AEIs in relation to the proposed groundwater protection zone.

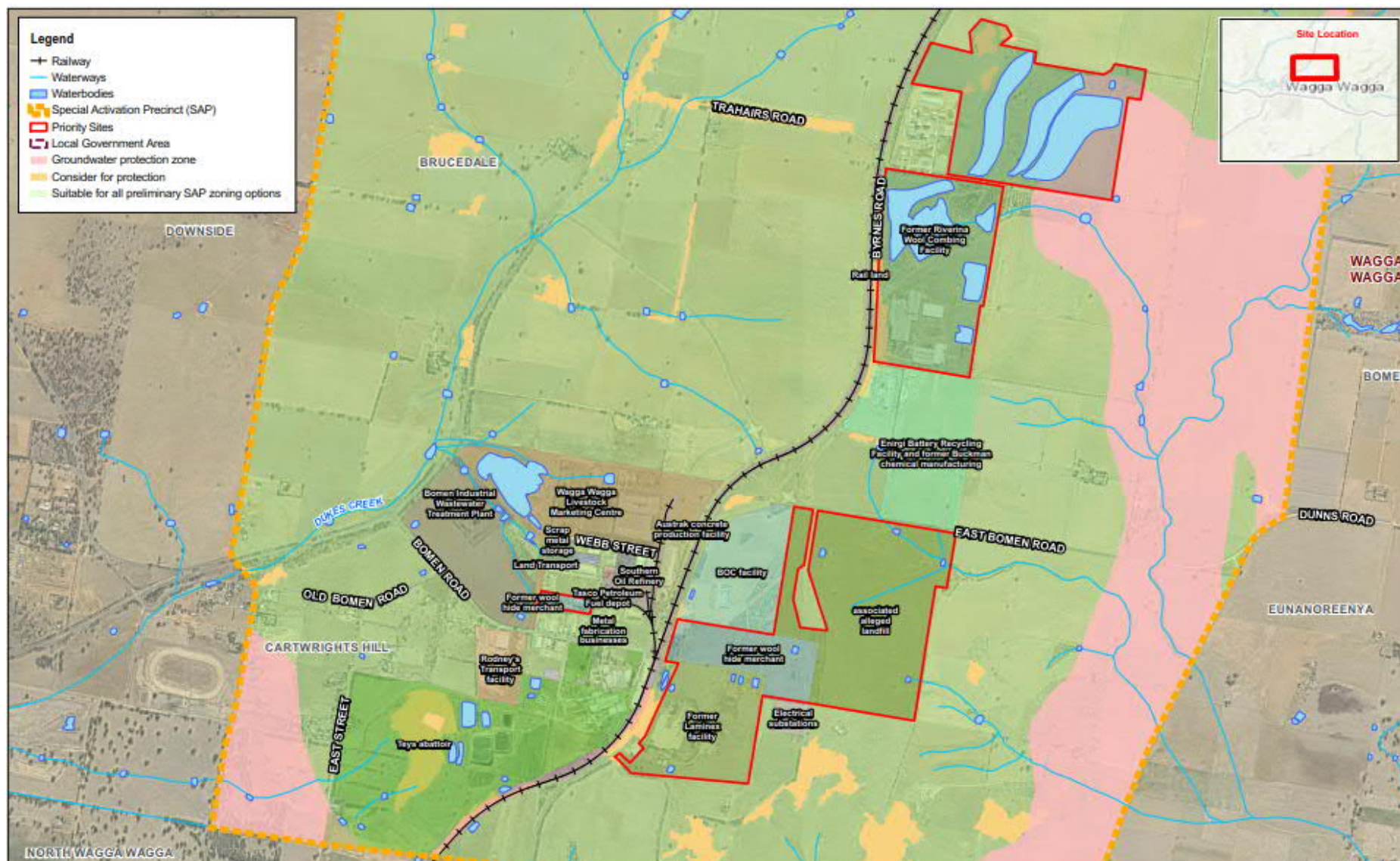


Figure 3.6 Location of AEIs with respect to proposed groundwater protection zones

3.6 HYDROGEOLOGY

3.6.1 OPPORTUNITIES

There are two distinct potential groundwater resources within the Wagga Wagga SAP: the lower Lachlan fractured rock aquifer and the upper Wagga Wagga alluvium. The lower Lachlan fractured rock aquifer is the preferred potential groundwater resource for the SAP, should groundwater take be required for future developments within the SAP. This is because the lower Lachlan fractured rock aquifer includes a potential area of high groundwater yield and the Wagga Wagga alluvial source should be already highly utilised and in a vulnerable state.

The area of high potential yield within the lower Lachlan fractured rock aquifer is located in the north-western portion of the investigation area, where a high yield of 66 L/S has been recorded at bore GW402059 (refer to Section 4.3.2.2 in Appendix E). This groundwater resource in its current form should be suitable for use in stock and domestic supply. However, this resource potential will need to be investigated further (due to the limitations of the desktop nature of this assessment) including confirming the findings at GW402059. Additionally, utilisation of the Lachlan fractured rock aquifer is subject to WAL availability. At the time of reporting, no WALs are available for purchase, and licenses must be obtained by trading through a licensed water broker.

3.6.2 CONSTRAINTS

The Wagga Wagga alluvium, including all registered bores screened within the Wagga Wagga alluvium, would be susceptible (medium to high potential risk) to changes in land practices that may result through the implementation of a SAP Structure Plan. This is primarily due to the susceptibility, connectivity and high productivity of the aquifers (upper and lower). To reduce the potential for future adverse effects on groundwater resources, the SAP Structure Plan should try to limit heavy industry and other businesses that have high contamination potential to regions overlying lower productivity and low utilised aquifers, and away from high productivity and highly utilised aquifers.

Figure 3.7 spatially illustrates the areas within the SAP that, from a hydrogeological perspective, should be protected from potentially contaminating development and therefore should be considered for land use restrictions during the development of the SAP Structure Plan. This includes the:

- groundwater protection zone (shaded in pink on Figure 3.7), which includes the Wagga Wagga alluvial groundwater source, the high-priority GDEs (refer to Section 2.5.3.3), any mapped alluvial sediments, sensitive receptors (refer to Section 2.5.3.1) and an indicative 200 metre buffer
- additional area to consider for protection (shaded in orange on Figure 3.7), which includes low to medium potential GDEs
- remaining area (shaded in green on Figure 3.7), which is considered suitable for all preliminary land uses from a hydrogeological perspective.

The Wagga Wagga alluvium groundwater source should be prioritised for protection (through imposing land use restrictions for the groundwater protection zone in the SAP Structure Plan) due to the:

- vulnerable state of the Wagga Wagga alluvium (WWCC, 2010)
- potential difficulty in securing WALs
- high connectivity between the Wagga Wagga alluvium aquifers
- critical reliance on the Wagga Wagga alluvium as a source for town water supply, triggering a key protection objective of the NSW Groundwater Quality Protection policy (DLWC, 1998).

Potential land uses that would be considered unsuitable within the groundwater protection zone (to prevent future groundwater impacts) have been appropriated from the Wagga Wagga Local Environmental Plan (2010) groundwater vulnerability map, and are:

- aquaculture
- industries
- intensive livestock agriculture
- liquid fuel depots
- mines
- rural industries
- service stations
- sewerage systems
- turf farming
- waste or resource management facilities
- water supply systems
- works comprising waterbodies (artificial).

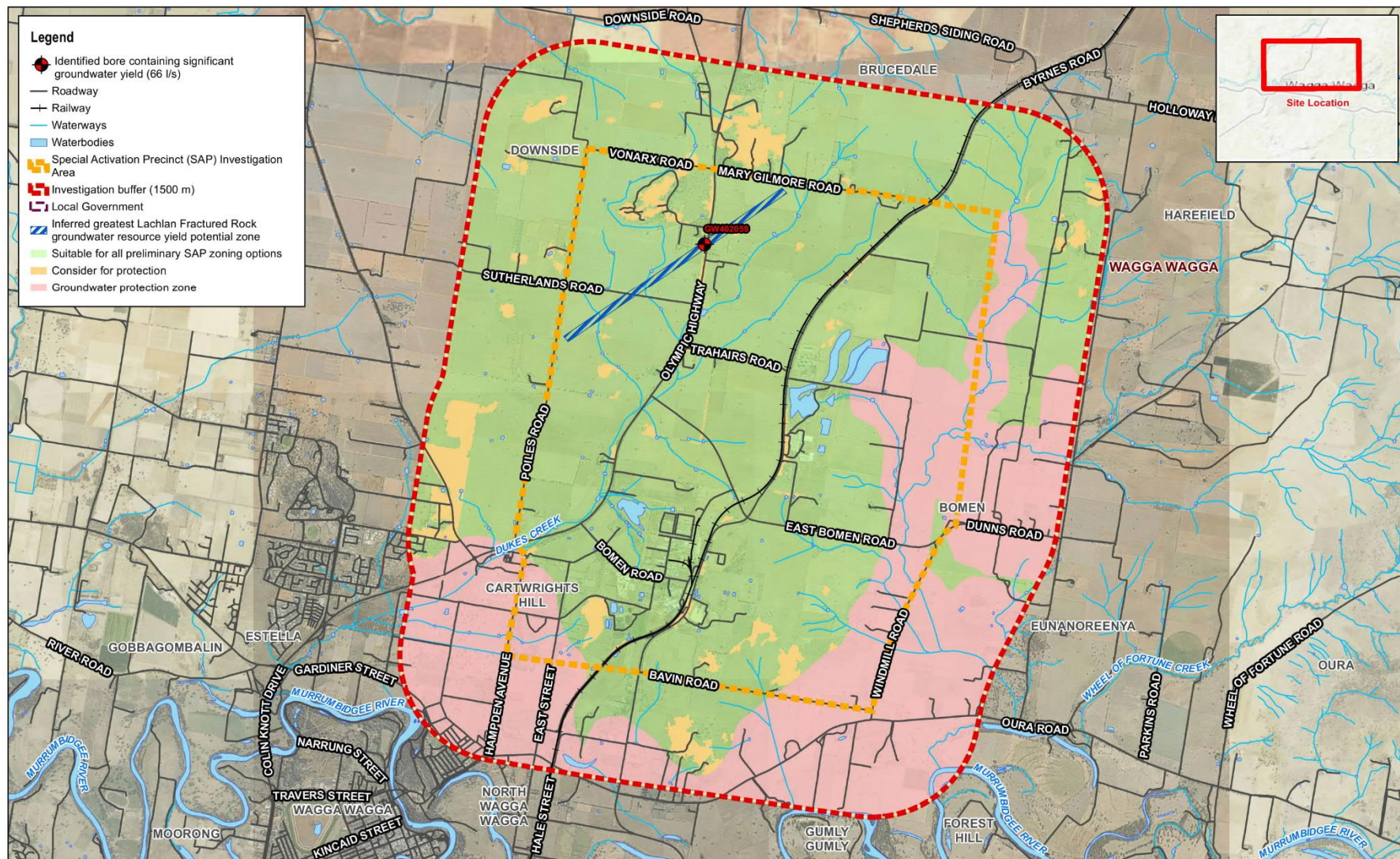


Figure 3.7 SAP Structure Plan hydrogeological recommendations

4 CONCEPT SCENARIO OPTIONS

4.1 SCENARIO DEVELOPMENT PROCESS

As shown on Figure 1.5, following the baseline analysis, a Short Enquiry by Design (EbD) workshop was held to develop, test and refine a list of concept precinct scenario options to be tested further. The Short EbD workshop was attended by representatives from WSP as well as DPIE and other consultants.

During the Short EbD workshop, the workshop participants developed seven preliminary concept precinct scenario options. These seven preliminary options were then tested against the objectives of the Wagga Wagga SAP, which resulted in the short-listing of three concept precinct scenario options.

4.2 SHORT-LISTED SCENARIOS

4.2.1 OVERVIEW

The three short-listed scenarios included:

- Scenario 4 – High growth, low/high amenity scenario
- Scenario 5 – Compact scenario
- Scenario 7 – Think big scenario.

Each concept precinct scenario option contained a combination of sub-precincts, which would be suitable for different anticipated land uses (refer to Table 4.2). All three short-listed scenarios include the following common considerations:

- no additional intensive livestock agriculture sub-precinct
- no large-scale energy from waste, resource recovery and recycling industries
- no new solar areas (for large scale solar projects)
- incorporation of the RiFL.

Table 4.1 outlines the total area of different sub-precinct types within each of the short-listed scenarios. Scenario 5 provides the smallest overall area for new development, while Scenario 7 provides the largest.

Table 4.1 Area of sub-precincts within each Scenario

SUB PRECINCT TYPE	TOTAL AREA (HECTARES)		
	SCENARIO 4	SCENARIO 5	SCENARIO 7
Regional Enterprise	1276	647	1508
Intensive Livestock Agriculture	112	111	114
Commercial Gateway	37	63	34
Solar	476	502	502
Landscape Protection	1911	2511	1653
Residential	118	96	119
Green Infrastructure (Overlay)	249	134	143
Rail Terminals (Overlay)	299	68	299

Table 4.2 Sub-precincts and anticipated land uses for the Wagga Wagga SAP

SUB-PRECINCT	ANTICIPATED LAND USES	
Regional Enterprise	<ul style="list-style-type: none"> — Agricultural produce industry (e.g. advanced manufacturing of agricultural products) — Intensive plant agriculture (e.g. glass houses) — Depot facility — Electricity generating Works (small scale with negligible offsite air, noise and odour impacts) — Emergency services facility — General industry (e.g. advanced manufacturing of non-agricultural products). 	<ul style="list-style-type: none"> — Liquid fuel depot facility — Local distribution facility — Road transport depot (e.g. container maintenance, refuelling, mechanics workshop etc.) — Truck depot (e.g. parking, provisioning, maintenance, refuelling) — Warehouse and/or distribution — Customs inspection facility.
Intensive Livestock Agriculture	<ul style="list-style-type: none"> — Bio-solids treatment facility (e.g. related to intensive livestock agriculture) — Depot facility — Electricity generating works (e.g. anaerobic digester related to intensive livestock agriculture). 	<ul style="list-style-type: none"> — Livestock processing industry (e.g. abattoirs, knackerries, tanneries, wool scours, and rendering plants) — Roads.
Commercial Gateway	<ul style="list-style-type: none"> — Highway service centre (fuel, food, etc.) — Industrial training facility — Information and education facility — Kiosk and visitor information. 	<ul style="list-style-type: none"> — Recreation area/park — Roads — Public domain lighting, markers and entry statements.
Solar	<ul style="list-style-type: none"> — Solar farm — Associated infrastructure (e.g. battery storage). 	<ul style="list-style-type: none"> — Roads.
Residential	<ul style="list-style-type: none"> — Dwellings. 	
Landscape Protection	<ul style="list-style-type: none"> — Agriculture — Rural industries. 	<ul style="list-style-type: none"> — Recreation areas — Environmental protection works.
Rail Terminal (Proposed Overlay)	<ul style="list-style-type: none"> — Car parks — Depot facility — Freight transport facility (e.g. rail-road intermodal terminal, grain storage) — Hazardous storage establishment (where related to a rail freight terminal) — Liquid fuel depot (where related to a rail freight terminal). 	<ul style="list-style-type: none"> — Roads — Transport depot (e.g. rail sidings, provisioning, maintenance, refuelling, container maintenance) — Truck depot — Warehouse or distribution centre (where related to a rail freight terminal e.g. freight forwarding).

4.2.2 SCENARIO 4 – HIGH GROWTH, LOW/HIGH AMENITY SCENARIO

Scenario 4 is a high growth scenario featuring a central area for low amenity “stack” industries, close to the RiFL. It includes a Byrnes Road industry cluster along with green corridors, a new area of high amenity tech and clean industries west of Olympic Highway (refer to Figure 4.1).

Other key features of Scenario 4 include:

- a high amenity area (492 ha), west of the Olympic Highway
- a medium amenity area (822 ha) in the centre, eastern and southern part of the precinct
- a rail terminal (including the current RiFL proposal) abutting Byrnes Road (299 ha) along its entire length in the investigation area
- a low amenity area (150 ha) located close to RiFL
- an intensive livestock agriculture sub-precinct in the south-western portion of the investigation area, parallel to Byrnes Road where intensive livestock agriculture businesses are already established
- a commercial gateway (37 ha) near the intersection of Bomen Road and Olympic Highway
- green corridors spread through the scenario, mainly along the Olympic Highway and in the regional enterprise sub-precinct

4.2.3 SCENARIO 5 – COMPACT SCENARIO

Scenario 5 is a compact scenario with most of the development proposed between Byrnes Road and Olympic Highway, near existing industries and the RiFL (refer to Figure 4.2).

Other key features of Scenario 5 include:

- a high amenity area (143 ha) near the existing industries in Bomen
- a medium amenity area (434 ha) near the centre of the investigation area
- a low amenity area (259 ha) north of east Bomen Road and west of Byrnes Road
- the current RiFL proposal (68 ha)
- an intensive livestock agriculture sub-precinct in the south-western portion of the investigation area, along Byrnes Road near existing intensive livestock agriculture businesses
- a commercial gateway sub-precinct parallel to Bomen Road
- green corridors, mainly along the Olympic Highway.

4.2.4 SCENARIO 7 – THINK BIG SCENARIO

Scenario 7 is a high growth scenario where development is concentrated in the south-west, central and north-east portions of the investigation area (refer to Figure 4.3). Most of the industrial development is proposed east of the Olympic Highway. The land west of the Olympic Highway is proposed as a landscape protection sub-precinct.

Other key features of Scenario 7 include:

- no high amenity area, with most of the precinct (1328 hectares) categorised as a medium amenity area
- a low amenity area (328 hectares) east of Byrnes Road (between East Bomen Road and Trahairs Road) and west of Byrnes Road in the northern portion of the investigation area
- a rail terminal (including the current RiFL proposal) abutting Byrnes Road (299 ha) along its entire length in the investigation area
- an intensive livestock agriculture sub-precinct in the south-western portion of the investigation area, along Byrnes Road near existing intensive livestock agriculture businesses
- two commercial gateway sub-precincts (34 hectares) near the centre of the investigation area
- an area for large allotments in the north-western corner of the investigation area
- green corridors, mainly along the Olympic Highway

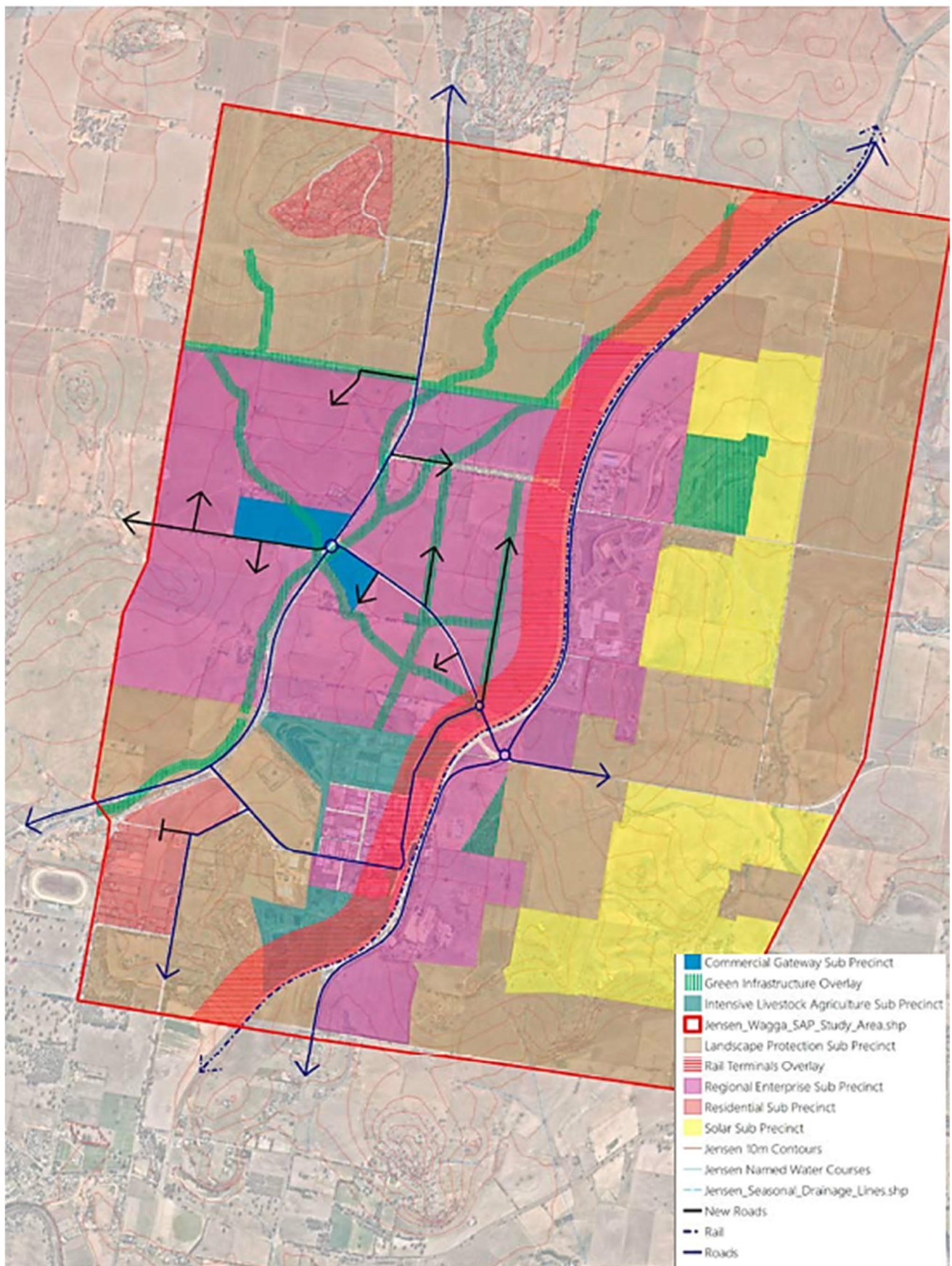


Figure 4.1 Scenario 4 – High growth, low/high amenity scenario

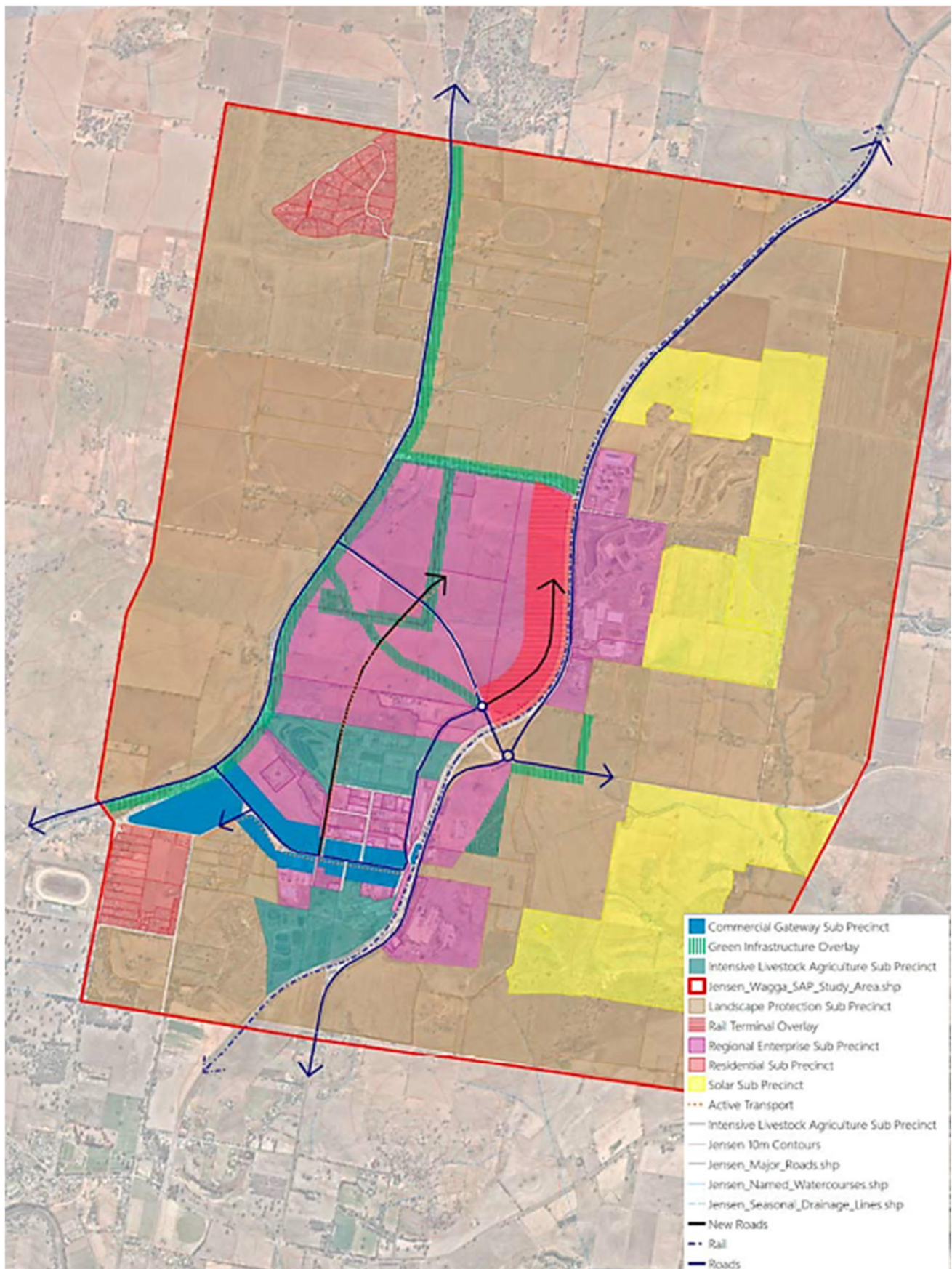


Figure 4.2 Scenario 5 – Compact scenario

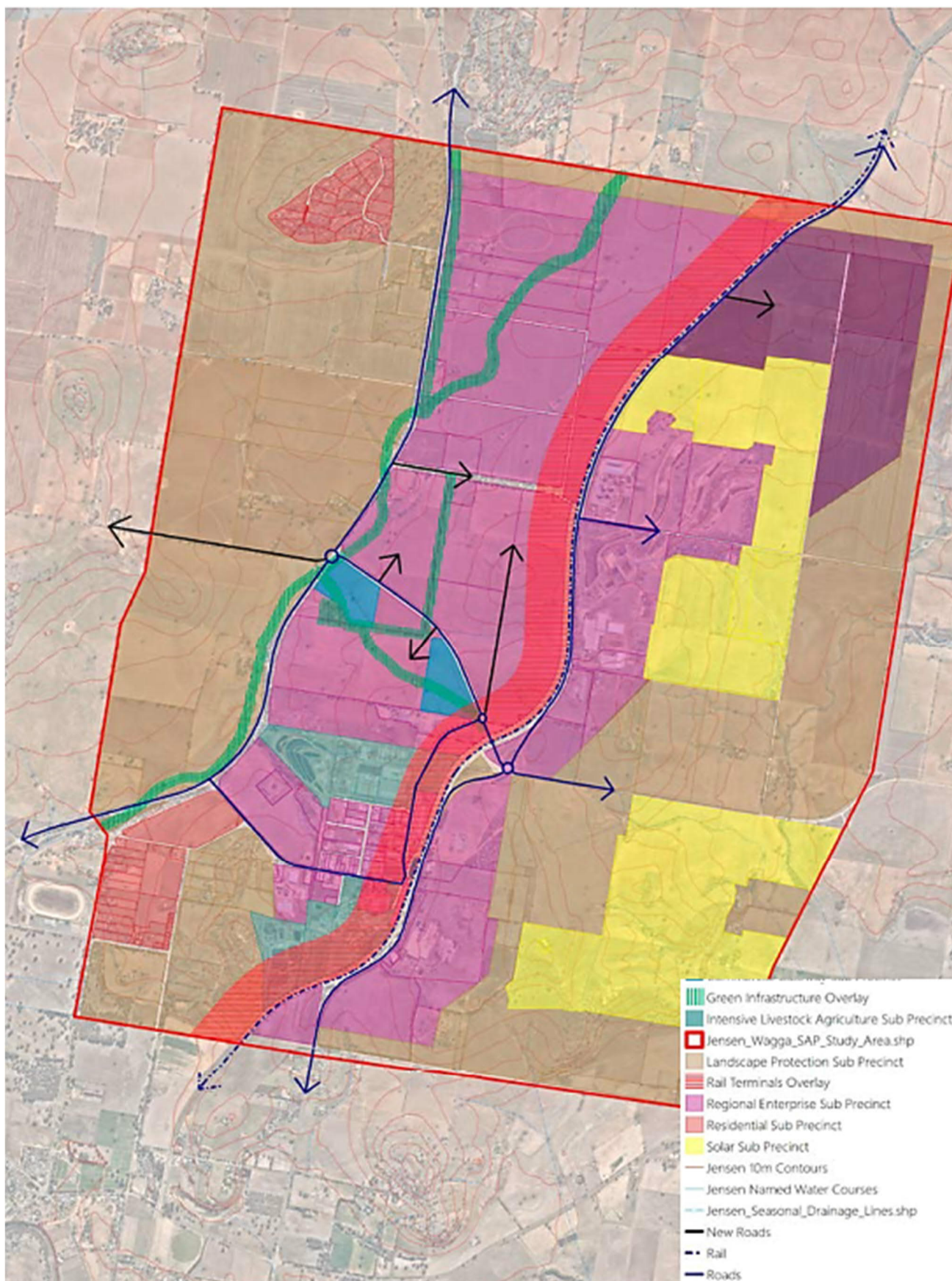


Figure 4.3 Scenario 7 – Think big scenario

4.3 SCENARIO TESTING RESULTS

4.3.1 BIODIVERSITY

This section provides an analysis and comparison of three scenarios developed for the Wagga Wagga SAP on the biodiversity constraints and opportunities identified within the investigation area (refer to section 0).

4.3.1.1 COMPARISON OF BIODIVERSITY CONSTRAINTS FOR EACH SCENARIO

Table 4.3 and Table 4.4 show the areas of vegetation protection and paddock trees within the three short-listed scenarios.

These tables show that Scenario 5 is the preferred option in terms of retention of high biodiversity constraint vegetation communities and paddock trees overall. However, it is noted that Scenario 4 provides protection to the greatest number of paddock trees within the green infrastructure overlay.

Table 4.3 Vegetation protection areas within the scenarios

BIODIVERSITY CONSTRAINT TIER	TOTAL AREA ¹ (HA)	AREA PROTECTED IN GREEN INFRASTRUCTURE OR LANDSCAPE PROTECTION (ha)		
		SCENARIO 4	SCENARIO 5	SCENARIO 7
1 High Biodiversity Constraint	120	48	67	54
2 Medium Biodiversity Constraint	141	87	91	54
3 Other	64	25	26	22
Total Vegetation	325	160	184	130

(1) Area of each biodiversity constraint tier within the Wagga Wagga SAP investigation area

Table 4.4 Paddock trees within the scenarios

PADDOCK TREE TYPE AND BIODIVERSITY CONSTRAINT	NUMBER OF TREES ¹	NUMBER PROTECTED IN GREEN INFRASTRUCTURE OR LANDSCAPE PROTECTION (ha)		
		SCENARIO 4	SCENARIO 5	SCENARIO 7
1 Tier 1 High Biodiversity Constraint Hollow-bearing Trees	331	187	227	169
2 Tier 2 Medium biodiversity constraint Class 2 or Class 3 Paddock Trees that require biodiversity offsets	109	73	84	56
3 Tier 3 Other Class 1 Paddock trees and all other paddock trees	12	4	6	4
Total Paddock Trees	452	260	317	229

(1) Number of each paddock tree type available in the Wagga Wagga SAP investigation area

4.3.1.2 COMPARISON OF BIODIVERSITY OPPORTUNITIES FOR EACH SCENARIO

Table 4.5 compares the biodiversity opportunities (refer to section 3.1.1) for each scenario. In summary:

- Scenario 5 (preferred scenario):
 - provides the greatest protection of biodiversity values overall
 - has the lowest impacts to biodiversity constraints for the rail terminal layout, intensive livestock agriculture and regional enterprise sub-precincts
 - provides enhancement opportunities in green infrastructure areas including Trahairs Road
 - protects key biodiversity areas and linkages including Trahairs Road and vegetated links along Olympic Highway
 - could be enhanced by including additional linking corridors (such as provided for in Scenario 4).
- Scenario 4:
 - provides protection to greatest number of paddock trees within green infrastructure
 - provides the greatest opportunity for revegetation within green infrastructure, particularly along drainage lines
 - does not provide adequate protection to key biodiversity areas along Trahairs Road.
- Scenario 7:
 - has the lowest impacts to biodiversity constraints for the commercial gateway sub-precinct
 - is the only scenario that includes large allotments
 - retains no significant patches of remnant vegetation in green infrastructure
 - includes some vegetation along the Olympic Highway in the green corridor.

Table 4.5 Comparison of opportunities for each scenario

OPPORTUNITY	SCENARIO 4	SCENARIO 5	SCENARIO 7
Linking significant roadside vegetation and native vegetation plantings	<ul style="list-style-type: none"> — Traffic on Trahairs Road is likely to impact remnant vegetation — Proposed traffic routes along minor roads incompatible with revegetation of green corridors — Existing vegetation along Olympic Highway not included in green corridor. 	<ul style="list-style-type: none"> — Maintains significant roadside vegetation along Trahairs Road in a green corridor — Maintains/expands vegetation south of Trahairs Road along paddock boundaries providing vegetated corridor links to south — Maintains/improves linking vegetation on the Olympic Highway — Enhances the Olympic Highway green corridor. 	<ul style="list-style-type: none"> — Traffic on Trahairs Road is likely to impact remnant vegetation — Identification of proposed traffic routes along minor roads incompatible with revegetation of green corridors — Only existing vegetation along Olympic Highway in the north of the investigation area included in green corridor.
Strengthening riparian areas	<ul style="list-style-type: none"> — Mapped drainage lines are not defined and are likely to occur as swales with drainage linked by farm dams. These areas have little existing native vegetation. Many have been included as green infrastructure. — Revegetation of Dukes Creek would widen and strengthen existing vegetated corridor along Olympic Highway. 	<ul style="list-style-type: none"> — Drainage lines not included in green infrastructure — Dukes Creek appears to be realigned to the east of the Olympic Highway. 	<ul style="list-style-type: none"> — Mapped drainage lines are not defined and are likely to occur as swales with drainage linked by farm dams. These areas have little existing native vegetation. Some have been included as green infrastructure. — Revegetation of Dukes Creek would widen and strengthen existing vegetated corridor along Olympic Highway.
Strengthening larger vegetation patches	<ul style="list-style-type: none"> — Larger vegetation patches are generally within landscape protection — Total of 160 ha of vegetation within green infrastructure and landscape protection. 	<ul style="list-style-type: none"> — Larger vegetation patches are generally within landscape protection — Total of 184 ha of vegetation within green infrastructure and landscape protection. 	<ul style="list-style-type: none"> — Larger vegetation patches are generally within landscape protection — Total of 130 ha of vegetation within green infrastructure and landscape protection.
Retention of smaller remnant patches and paddock trees	<ul style="list-style-type: none"> — One small patch of vegetation retained to south of East Bomen Road in green infrastructure. — Majority of patches occur in landscape protection. 	<ul style="list-style-type: none"> — One small patch of vegetation retained to south of East Bomen Road retained in green infrastructure. 	<ul style="list-style-type: none"> — No significant patches of remnant vegetation retained in green infrastructure.

4.3.2 ABORIGINAL HERITAGE

Table 4.6 outlines the potential impact of each scenario on known Aboriginal sites that are not currently within existing project boundaries (e.g. the solar farms and RIFL). It conservatively assumes that the Aboriginal sites would be impacted completely if they are located within a sub-precinct other than a "landscape protection" sub-precinct.

Overall, the assessment shows that Scenario 5 has least amount of potential Aboriginal heritage impacts (potential impact on one Aboriginal heritage site) and Scenario 7 has the greatest amount of potential Aboriginal heritage impacts (potential impact on three Aboriginal heritage sites).

Table 4.6 Potential Aboriginal heritage impacts for each scenario

SCENARIO	SITE NAME & NUMBER	TYPE/DEGREE/CONSEQUENCE OF HARM
Scenario 4	Wagga SAP IF-01	None – in landscape protection sub-precinct
	APA36 56-1-0120	Direct total harm – in regional enterprise sub-precinct
	BSSC-IF1 56-1-0110	Direct total harm – in solar sub-precinct
	Windmill Rd 1 56-1-0384	None – located in road corridor
	Bomen Axe Quarry 56-1-0043	None – in landscape protection sub-precinct
Scenario 5	Wagga SAP IF-01	None – in landscape protection sub-precinct
	APA36 56-1-0120	None – in landscape protection sub-precinct
	BSSC-IF1 56-1-0110	Direct total harm – in solar sub-precinct
	Windmill Rd 1 56-1-0384	None – located in road corridor
	Bomen Axe Quarry 56-1-0043	None – in landscape protection sub-precinct
Scenario 7	Wagga SAP IF-01	Direct total harm – in regional enterprise sub-precinct
	APA36 56-1-0120	Direct total harm – in regional enterprise sub precinct
	BSSC-IF1 56-1-0110	Direct total harm – in solar sub-precinct
	Windmill Rd 1 56-1-0384	None – located in road corridor
	Bomen Axe Quarry 56-1-0043	None – in landscape protection sub-precinct

4.3.3 NON-ABORIGINAL HERITAGE

Table 4.7 outlines the potential impact of each scenario on sites of known non-Aboriginal heritage value, including state listed and locally listed heritage items.

The assessment shows that Scenario 5 has the least potential impact on non-Aboriginal heritage, and Scenario 7 has the greatest potential for non-Aboriginal heritage impacts.

Table 4.7 Potential non-Aboriginal impacts for each scenario

SCENARIO	SITE NAME	SCENARIO LOCATION	IMPACT
Scenario 4	Bomen Railway Station (SHR 01093 & LEP I8)	Rail Terminal overlay	Maybe
	Bomen Stationmaster's Residence (I9)	Rail Terminal overlay	Maybe
	Wattle Vale (I31)	Landscape protection sub-precinct	No
	Hopevale (I26)	Regional enterprise sub- precinct	Yes
	Former Brucedale Public School (I24)	Landscape protection sub-precinct	No
	Brucedale Hall & Tennis courts (I23)	Landscape protection sub-precinct	No
	Holy Family Chapel (I25)	Landscape protection sub-precinct	No
	Former Brucedale post office (Wagga SAP HS-01)	Landscape protection sub-precinct	No
	Former Brucedale change over station stables (Wagga SAP HS-02)	Landscape protection sub-precinct	No
Scenario 5	Bomen Railway Station (SHR 01093 & LEP I8)	Outside any overlays or sub precincts	No
	Bomen Stationmaster's Residence (I9)	Outside any overlays or sub precincts	No
	Wattle Vale (I31)	Landscape protection sub-precinct	No
	Hopevale (I26)	Landscape protection sub-precinct	No
	Former Brucedale Public School (I24)	Landscape protection sub-precinct	No
	Brucedale Hall & Tennis courts (I23)	Landscape protection sub-precinct	No
	Holy Family Chapel (I25)	Landscape protection sub-precinct	No
	Former Brucedale post office (Wagga SAP HS-01)	Green infrastructure overlay & landscape protection sub-precinct	No
	Former Brucedale change over station stables (Wagga SAP HS-02)	Landscape protection sub-precinct	No
Scenario 7	Bomen Railway Station (SHR 01093 & LEP I8)	Rail Terminal overlay	Maybe
	Bomen Stationmaster's Residence (I9)	Rail Terminal overlay	Maybe
	Wattle Vale (I31)	Landscape protection sub-precinct	No
	Hopevale (I26)	Landscape protection sub-precinct	No
	Former Brucedale Public School (I24)	Landscape protection sub-precinct	No
	Brucedale Hall & Tennis courts (I23)	Landscape protection sub-precinct	No
	Holy Family Chapel (I25)	Landscape protection sub-precinct	No
	Former Brucedale post office (Wagga SAP HS-01)	Green infrastructure overlay & regional enterprise sub-precinct	Maybe
	Former Brucedale change over station stables (Wagga SAP HS-02)	Regional enterprise sub-precinct	Yes

4.3.4 GEOLOGY, SOILS AND CONTAMINATION

Table 4.8 presents a comparison of the three scenarios with respect to various contamination considerations such as the location of the priority areas of concern, the land-uses proposed in areas vulnerable to groundwater contamination, the location of residential areas and effectiveness of monitoring potential impacts.

Table 4.8 shows that the priority areas of concern, which are associated with contamination risks (refer to section 3.5.2) are generally located with a regional enterprise sub-precinct or a landscape protection sub-precinct. The landscape protection sub-precincts could provide an opportunity to regenerate the land associated with the wool combing ponds and former Laminex facility. However, development in the regional enterprise sub-precincts may be constrained by the uncertainty of potential contamination associated with the priority areas of concern, especially if more sensitive land uses (such as high amenity regional enterprise) are proposed.

Overall, Scenario 5 would result in the least constraints and most opportunities related to contamination, whereas Scenario 7 would result in the most contamination related constraints.

Table 4.8 Contaminated considerations within each Scenario

CONSIDERATION	SCENARIO 4	SCENARIO 5	SCENARIO 7
Location of priority areas of concern			
Former Laminex facility (and associated landfill/wool hide merchant)	<ul style="list-style-type: none"> — Former Laminex family/wool hide merchant within regional enterprise sub-precinct (with medium amenity overlay) — Associated landfill within landscape protection sub-precinct. 	<ul style="list-style-type: none"> — Former Laminex family within regional enterprise sub-precinct (with medium amenity overlay) — Associated landfill/wool hide merchant within landscape protection sub-precinct. 	<ul style="list-style-type: none"> — Former Laminex family/wool hide merchant within regional enterprise sub-precinct (with medium amenity overlay) — Associated landfill within landscape protection sub-precinct.
Former Riverina Wool Combing Facility (and associated wool combing ponds)	<ul style="list-style-type: none"> — North-eastern ponds within landscape protection sub-precinct (with green infrastructure overlay) — Rest of ponds/wool combing facility within regional enterprise sub-precinct (with medium amenity overlay). 	<ul style="list-style-type: none"> — Northern ponds within landscape protection sub-precinct — Rest of wool combing facility within regional enterprise sub-precinct (with medium amenity overlay). 	<ul style="list-style-type: none"> — North-eastern ponds within regional enterprise sub-precinct (with medium amenity overlay) — Rest of wool combing facility within regional enterprise sub-precinct (with low amenity overlay).
Former fellmongery, 15 Lewington Street (Lot 1, DP 576940)	Within regional enterprise sub-precinct		

CONSIDERATION	SCENARIO 4	SCENARIO 5	SCENARIO 7
Other contamination related considerations			
Land uses proposed in areas vulnerable to groundwater contamination (i.e. east of Burns Road)	— The solar sub-precinct, which is beneficial as this land-use is less likely to cause contamination.	— The solar sub-precinct, which is beneficial as this land-use is less likely to cause contamination — Little new commercial/ industrial land-uses, which is beneficial.	— The solar sub-precinct, which is beneficial as this land-use is less likely to cause contamination — Regional enterprise sub-precincts and commercial/industrial land-uses, which may encroach on vulnerable groundwater resources.
Location of residential areas	— Residential areas are separated from potential commercial/industrial land-uses, which is beneficial.	— Residential areas are separated from potential commercial/industrial land-uses, which is beneficial.	— Residential areas are close to potential commercial/ industrial land-uses in the north-west/south-west.
Other considerations	— Some existing commercial/industrial land-uses are within the landscape protection sub-precinct (e.g. Rodney's Transport site and WWTP).	— The compact, consolidated commercial/industrial land-use may enable more effective monitoring of potential impacts.	— The disperse regional enterprise sub-precinct may make monitoring of impacts less effective.

4.3.5 HYDROGEOLOGY

To determine potential groundwater impacts of the scenarios, the location of the sub-precincts in each short-listed scenario were compared with the location of the nominated groundwater protection zone (refer to section 3.6).

In Scenarios 4 and 5, the residential, solar and landscape protection sub-precincts overlap with the location of the nominated groundwater protection zone. As a result, Scenarios 4 and 5 would align with the recommended limitations for the groundwater protection zone, subject to appropriate controls for residential sewerage systems.

In Scenario 7, the residential, solar, regional enterprise and landscape protection sub-precincts overlap with the location of the nominated groundwater protection zone. The regional enterprise sub-precinct type has potential land-uses that conflict with the limitations of the groundwater protection zone as they may result in potential groundwater impacts. This is most likely within the following overlay areas within the regional enterprise sub-precinct:

- the large allotment overlay within the north-eastern portion of the investigation area
- the additional medium amenity overlay, east of the wool combing ponds.

4.4 SCENARIO TESTING CONCLUSIONS

Table 4.9 to Table 4.11 present the strengths, weaknesses, opportunities and threats (SWOT) identified for the short-listed scenarios from the biodiversity, heritage, contamination and hydrogeology scenario testing results (refer to chapter 4.3).

Overall, for the specialist areas of biodiversity, heritage, contamination and hydrogeology, Scenario 5 was considered the preferred scenario to develop further for the Wagga Wagga SAP Structure Plan.

Table 4.9 SWOT Matrix for Scenario 4

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> — Provides protection to the greatest number of paddock trees within green infrastructure areas — Residential areas are separated from potential commercial/industrial land-uses — Proposed sub-precincts would align with the recommended limitations for the groundwater protection zone. 	<ul style="list-style-type: none"> — Does not provide adequate protection to key biodiversity areas along Trahairs Road — Some existing commercial/industrial land-uses are within the landscape protection sub-precinct.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> — Provides the greatest opportunity for revegetation within green infrastructure, particularly along drainage lines. 	<ul style="list-style-type: none"> — Highest potential for biodiversity offset requirements.

Table 4.10 SWOT Matrix for Scenario 5

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> — Provides the greatest vegetation protection and potential for the retention of high biodiversity constraint vegetation communities and paddock trees — Least potential Aboriginal and non-Aboriginal heritage impacts — Few commercial/industrial land-uses proposed in areas vulnerable to groundwater contamination — Residential areas are separated from potential commercial/industrial land-uses — Proposed sub-precincts would align with the recommended limitations for the groundwater protection zone. 	<ul style="list-style-type: none"> — None
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> — Potential for biodiversity enhancement opportunities and additional linking corridors including along Trahairs Road and the Olympic Highway green corridor — The compact, consolidated commercial/industrial land-uses may enable more effective monitoring of future potential impacts. 	<ul style="list-style-type: none"> — None

Table 4.11 SWOT Matrix for Scenario 7

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> — None 	<ul style="list-style-type: none"> — Retains no significant patches of remnant vegetation in green infrastructure — Provides the least vegetation protection — Highest potential for Aboriginal and non-Aboriginal heritage impacts — The regional enterprise sub-precincts and commercial/industrial land-uses may encroach on vulnerable groundwater resources and conflict with the limitations of the groundwater protection zone — Residential areas are close to potential commercial/industrial land-uses.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> — Potential for revegetation along drainage lines and at Dukes Creek, which would strengthen existing vegetated corridor along Olympic Highway. 	<ul style="list-style-type: none"> — The disperse regional enterprise sub-precinct may make monitoring of future potential impacts less effective — May require strict development conditions for the regional enterprise sub-precinct to provide groundwater protection.

5 WAGGA WAGGA SAP STRUCTURE PLAN

5.1 OVERVIEW OF STRUCTURE PLAN

Following the results of the concept scenario testing and the Full Enquiry by Design Workshop (refer to Section 4.3), the three short listed scenarios were further developed to a refined Structure Plan (shown in Figure 5.1). This refined Structure Plan was developed based on, among others, the following factors:

- existing rail infrastructure and regional enterprise associated with the RiFL Hub, Inland Rail project and Bomen Business Park
- approved solar farms in the east
- strategic biodiversity linkages and riparian corridors
- known environmental constraints including noise and air dispersal patterns, groundwater vulnerability and existing contamination.

The refined Structure Plan was then subject to further testing and refinement. At the time of this study, the Structure Plan showed indicative staging and land use sub-precincts, which were used as a basis for ongoing testing and analysis of the structure plan.

Following this study, the Draft Master Plan and planning framework for the Wagga Wagga Special Activation Precinct was developed by the NSW Department of Industry, Planning and Environment. The draft planning framework proposes processes to determine staging (i.e. the Delivery Plan) and zoning controls and performance measures for noise, odour and air quality that would have a similar effect on controlling land use as the earlier sub-precincts approach. As such, the final Structure Plan in the draft planning framework no longer indicates staging and sub-precincts. The final structure plan, as included in the Draft Wagga Wagga Master Plan currently on exhibition is shown in Figure 5.2.

The Structure Plan includes the following SAP elements:

- Regional Enterprise zone – the primary industry and business area, which is mainly located between the Olympic Highway and Byrnes Road, including Teys Australia’s abattoir and the Livestock Marketing Centre.
- Commercial Nodes along the centreline of Regional Enterprise sub-precinct, due to the elongated geography of the industry area.
- Rail Terminals overlay on the western side of the Main South Railway, leveraging rail access and Inland Rail connectivity.
- Noise, Odour and Air Quality – a series of overlays have been established to define preferred locations and limits for the protection of amenity and provide industry certainty.
- Green Infrastructure overlay, a network of green infrastructure across the Precinct, which includes:
 - High value biodiversity and riparian corridor protection, which represents a combination of riparian areas (defined by the Strahler stream orders and flooding area offsets) and biodiversity patches of existing Tier 1 and Tier 2 vegetation and paddock trees. Additional land around this core area has been included to enhance linkages to high value biodiversity patches near the northern and southern extents of the investigation area, the potential fauna movement corridor along Duke’s Creek and the Olympic Highway corridor and dense paddock tree areas. This includes regional biodiversity linkages and stormwater management, detention and treatment.

- Revegetation and buffer planting, screening and windbreaks, which includes proposed native vegetation plantings within the wool scouring ponds, council land east of Byrnes Road close to the Bomen Axe Quarry and other areas to support the core green infrastructure areas. This would provide opportunities for future improvement of biodiversity, visual buffering, non-motorised movement and service infrastructure corridors.
- Rural Activity zone primarily located to the east and west of the Regional Enterprise sub-precinct, as a rural buffer between industry areas and neighbouring landowners and residents.

In addition, the Structure Plan proposes a Wagga Wagga SAP boundary, which has been developed as a refinement of the original investigation area. This Wagga Wagga SAP boundary has a surface area of about 4506 ha, which is larger than the original investigation area. This refinement allows for additional Rural Activity zoned land to the west, and excludes established residential areas and undevelopable land.

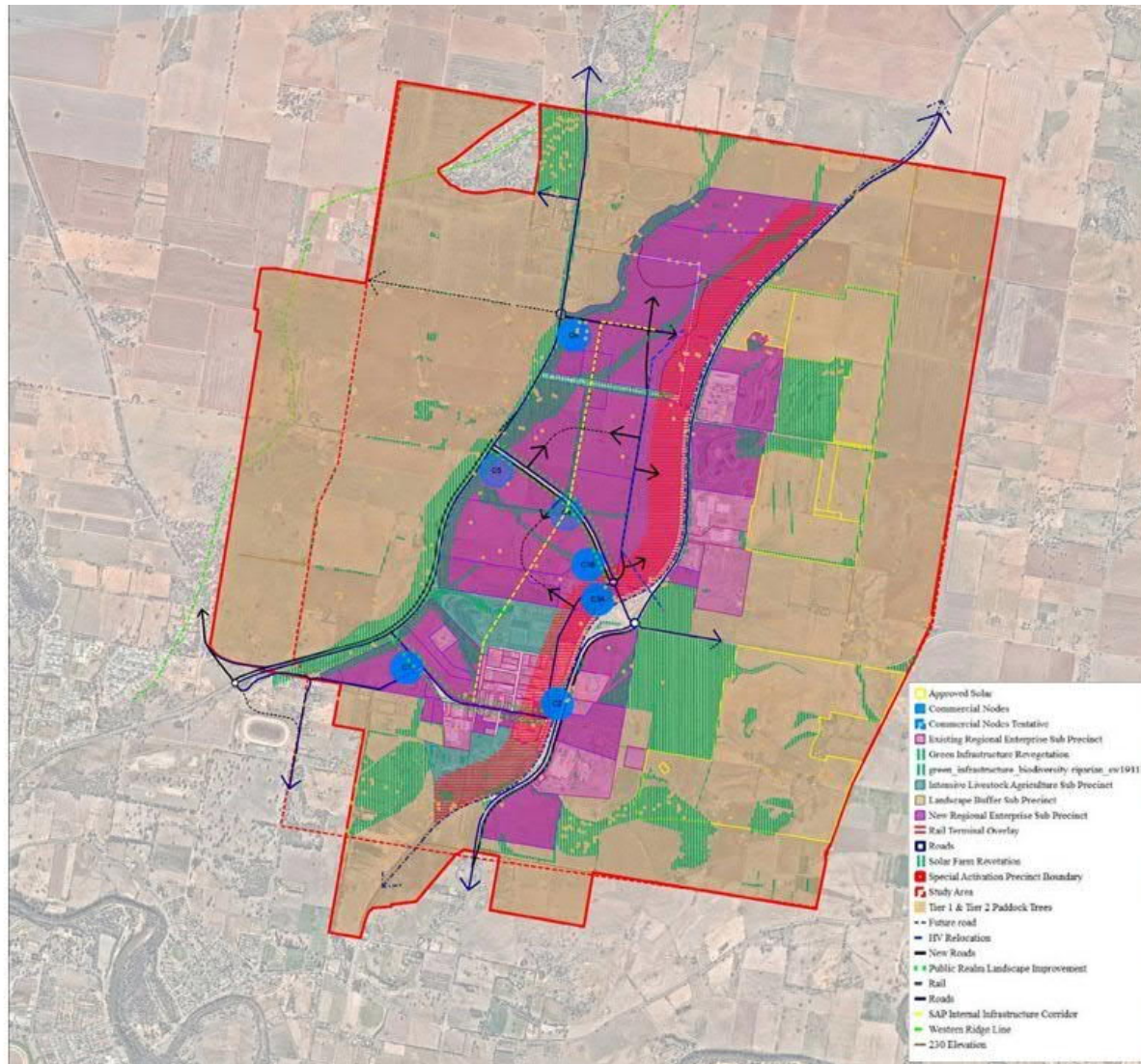
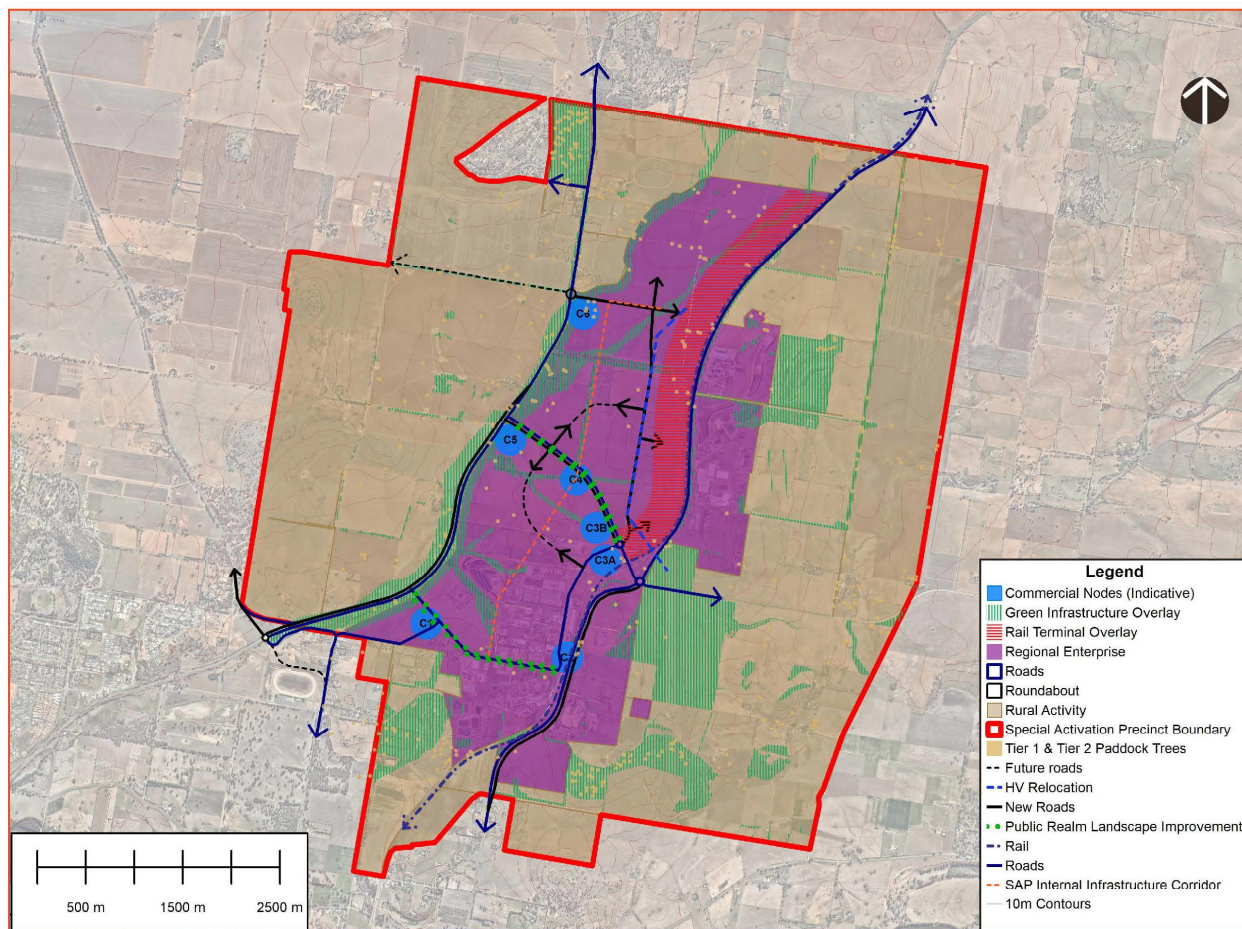


Figure 5.1 Wagga Wagga SAP refined Structure Plan



Source: JensenPlus, 2020

Figure 5.2 Wagga Wagga SAP final Structure Plan

5.2 RESULTS

5.2.1 BIODIVERSITY

During the Final Enquiry by Design Workshop, there was a focus on retaining biodiversity values wherever possible and the Structure Plan was refined to reflect this. Where possible, Tier 1 and 2 biodiversity constraints (refer to Section 3.1.2) have been incorporated into Green Infrastructure areas to strengthen and enhance existing biodiversity and fauna movement corridors. This includes the Green Infrastructure areas proposed along Trahairs Road, the Olympic Highway and around major patches of existing paddock trees. This would provide opportunities to improve regional linkages with Brucedale to north (through Brucedale Paddock, Olympic Highway and Trahairs Road) as well as vegetation in south-west corner associated with Dukes Creek.

Further recommendations are as follows:

- The existing vegetation in the investigation area is not suitable for inclusion in the national reserve system due to its relatively small size and isolation.
- To strengthen the resilience of the vegetation along Trahairs Road, this road should remain a dirt track with restricted access for residents only, and not be surfaced or upgraded. A 100 metre wide “no development” area over this vegetation would serve as sufficient protection area in the SAP masterplan. Pedestrian uses such as bird routes or walking trails would be desirable.
- To minimise disturbance and fragmentation to the Trahairs Road Green Infrastructure area, the eastern future road link and internal infrastructure corridor would be limited to about 50 metres in width whilst the western crossing would be reduced to about 30 metres.
- Remaining paddock trees should be retained wherever possible, ideally with a buffer. The size of the buffer depends on the size of each tree, but would be a minimum of 10 metres.

Based on the refined Structure Plan, impacts to Tier 1 and Tier 2 biodiversity values have been mostly avoided and only minor impacts such as those associated with the internal road and infrastructure network are expected. All residual impacts to biodiversity values would be assessed under the Biodiversity Assessment Methodology as part of a Biodiversity Certification process and require biodiversity offsetting in accordance with the NSW Biodiversity Offset Scheme. Residual impacts to biodiversity listed under the EPBC Act would require assessment including the need for a referral to the Commonwealth Department of Agriculture, Water and Environment.

5.2.2 BUSHFIRE

When considering the 20-year delivery program, the characteristics of the Wagga Wagga SAP and the potential for additional vegetation to be mapped as Category 1, 2 and 3 Vegetation, it is recommended that vegetated areas within the Wagga Wagga SAP boundary is considered ‘bushfire prone’ land. As such, the relevant specifications and requirements of *Planning for Bushfire Protection* (NSW Rural Fire Services, 2018) should be incorporated into the development standards for the SAP, including standards related to suitable Asset Protection Zones and perimeter roads (refer to Section 3.2).

5.2.3 ABORIGINAL HERITAGE

61 previously recorded Aboriginal cultural heritage sites and three additional Aboriginal sites have been identified within the investigation area.

As some of the proposed survey areas have not yet been surveyed due to access issues, further fieldwork is necessary to meet the standard requirements of an ACHAR. Such additional fieldwork would allow greater accuracy around the ACHAR for the preferred scenario. Current planning is for this fieldwork to take place on 5–6 November 2019, with the ACHAR to be completed thereafter.

The long-term management of these sites would be undertaken through an Aboriginal Cultural Heritage Management Plan, which would be agreed to by the RAPs, DPIE and Heritage NSW. Three of the four scarred trees within the investigation area already have management measures or AHIPs in place: #56-1-0459 (AHIP to remove tree – RIFL Hub), #56-1-0542 & #56-1-0590 (both sites conserved for the northern Bomen Solar Farm development).

Appropriate management of Aboriginal cultural heritage items would be determined based on their assessed significance as well as the likely impacts of the proposed development. In general:

- Avoid impacts by altering the development proposal or avoiding impact to a recorded Aboriginal site. This would include establishing a suitable curtilage around the site to ensure its protection during the short-term construction phase and in the long-term. The general recommended size of the curtilage is dependent on the type of site, such as:
 - isolated finds – 5–10 m
 - artefact scatters and scarred trees – 10–15 m.

If plans are altered to avoid identified impacts, care must be taken to ensure that impacts do not occur to areas not previously assessed.

- If impacts are unavoidable, the potential impact would need to be assessed and approved in accordance with relevant heritage legislation.

Regional cultural heritage opportunities would continue to be identified during consultation with the RAPs and local Aboriginal community. This could involve enhancement and/or incorporation of Aboriginal planning and design principles. These Aboriginal principles would be developed in consultation with a reference group made up of Traditional Owners, elders and artists and incorporate Wiradjuri design and culture. This could involve planning infrastructure (roads, paths, parks, buildings, facilities etc.) for the appreciation of Wiradjuri sites within the Wagga Wagga SAP, such as through special wall treatments, significant site markers, entry statements and other design measures (WSP, 2019).

5.2.4 NON-ABORIGINAL HERITAGE

Appropriate management of non-Aboriginal heritage items is primarily determined based on their assessed significance as well as the likely impacts of the proposed development.

Seven locally listed heritage items and one state and locally listed heritage item have been identified within the investigation area (refer to Section 2.3.3.2). Two additional non-Aboriginal sites (that are not currently listed) were recorded during fieldwork for the Wagga Wagga SAP. To avoid impacts to these sites, a suitable curtilage around the sites must be provided to ensure their protection both during the short-term construction phase and the long-term. A curtilage for the listed heritage items has already been defined on the State Heritage Register and/or the Wagga Wagga LEP.

Specific recommendations for the management of the Bomen Railway Station (which is of State and local significance) are to:

- adapt it for use (which may protect it from deteriorating) - the Bomen Railway Station is within a Commercial Node, which would make it well positioned for a 'shop-front' or museum; or
- leave as is and protect with a curtilage.

5.2.5 GEOLOGY, SOILS AND CONTAMINATION

Several AEIs have been identified within the investigation area, which may be subject to contamination from current or historical contaminating activities (refer to Section 2.4.3.8). These sites would need to continue being managed in accordance with:

- any existing regulations issued by the NSW EPA under the *Protection of the Environment Operations Act 1997*
- State Environmental Planning Policy 55 – Remediation of Land, which would require further investigation of the AEI if it is proposed to be developed and/or rezoned. Details of the assessment requirements should be included in the development standards for the SAP
- the *Contaminated Land Act 1997*, which requires individual site operators and/or land owners to investigate the land if they suspect that the land may be contaminated, under the duty to report obligations

To resolve potential contamination risks, which have not been confirmed and/or are not subject to current regulation, the following is recommended:

- Inclusion of requirements for detailed site investigations (DSIs) in the development standards for the SAP, to further understand the contamination risk to neighbouring lots for the priority areas of concern. The priority areas include:
 - the entire former wool combing facility lands (Lot 1 and 2, DP771340, Lots 2 and 4, DP1249028), including the sediment within the disused evaporation ponds
 - the land where waste from the former Laminex facility was disposed of (Lot 22 DP1085826)
 - the former fellmongery at 15 Lewington Street (Lot 1, DP 576940).
- On-going liaison with council to monitor that contamination conditions associated with the approved expansion of the Enirgi battery recycling facility (Lot 3, DP 594679 and Lot 21 DP 1128492) are complied with. A contamination assessment completed in 2018 revealed that there are potential unacceptable risks to current site users at this location, and interim management controls were recommended.
- For future developments on former agricultural land, potential contamination impacts during construction should be managed through an unexpected finds protocol and a construction environmental management plans (CEMP). This could be incorporated as part of the development standards for the SAP.

5.2.5.1 WOOL COMBING PONDS

On the Structure Plan, the western wool combing ponds are located within the New Regional Enterprise Sub Precinct and the eastern pond is located within Green Infrastructure. There are several options available for rehabilitation/remediation of the wool combing ponds to allow for the future reuse of the land in accordance with the Wagga Wagga SAP Structure Plan. This includes excavation and offsite disposal of impacted shallow soils, capping and in-situ fixation. The ponds would likely need to be lined as part of the rehabilitation process. Any remediation would be undertaken in accordance with the *Environmental Guidelines: Solid waste landfills – Section 9* (NSW EPA, 2016).

5.2.6 HYDROGEOLOGY

The groundwater protection zone (refer to Figure 3.7) has been used to inform the development of the Structure Plan and determine potential suitable land uses. For long-term groundwater management, a groundwater management strategy should be developed as part of the SAP development standards to provide guidance on the management and sustainability of the groundwater resource within the investigation area. This may prescribe ongoing groundwater monitoring in certain areas to ensure the aquifer is not affected by contamination and to prevent adverse future groundwater impacts.

Depending on confirmation of bulk water availability from Riverina Water in alignment with the staging of the Structure Plan, further hydrogeology investigations to confirm the opportunity to use the lower Lachlan fractured rock aquifer as a viable groundwater resource may be required. These include:

- drilling to a depth where significant fractures are intersected and further investigations (such as a pumping test)
- assessing GW402059 further to ascertain the accuracy of recorded yield values and groundwater levels and localised aquifer characteristics (such as groundwater quality and storativity).

6 REFERENCES

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7 LIMITATIONS

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APPENDIX A

BIODIVERSITY ASSESSMENT REPORT – STAGE 1



APPENDIX B

BUSHFIRE CONSTRAINTS AND OPPORTUNITIES REPORT



APPENDIX C

ABORIGINAL CULTURAL HERITAGE AND HISTORIC HERITAGE ASSESSMENT PRELIMINARY REPORT



APPENDIX D

PRELIMINARY SITE INVESTIGATION



APPENDIX E

DESKTOP HYDROGEOLOGY ASSESSMENT



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