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DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT

FINAL MASTERPLAN REPORT INFRASTRUCTURE AND SERVICES PLAN

WAGGA WAGGA SPECIAL ACTIVATION PRECINCT

NOVEMBER 2019

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Final Masterplan Report
Infrastructure and Services Plan
Wagga Wagga Special Activation Precinct

Department of Planning, Industry and Environment

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REV	DATE	DETAILS
A	01/11/2019	Draft Masterplan Report
B	21/11/2019	Final Masterplan Report
C	15/07/2020	Amended Final Masterplan Report

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GLOSSARY

Distribution Network	Distribution systems operate at a lower voltage than transmission systems and deliver power from the transmission network to households and businesses
Energy Consumption	The amount of energy consumed in an hour is usually expressed as kilowatt-hours (kWh) or megawatt-hours (MWh). 1 MWh = 1,000 kWh
Forecast Load	Future asset loading patterns
Generator	A machine that produces power. Power can be generated from various sources, e.g. coal fired power plants, gas-fired power plants, wind farms
Load	The amount of electrical power that is drawn from the network
Maximum Transformer Delivery Power	Usually expressed in megavolt-ampere (MVA)
Power	Watts (W), usually expressed in kilowatts (kW) and megawatts (MW). 1 MW = 1,000 kW = 1 million W
Terminal Substation	This asset will usually represent the boundary of ownership between one Network Service Provider and another. It is the point where electricity leaves a transmission network and enters a distribution network. Typically, a terminal substation will transform voltage down from transmission level voltages to sub transmission level voltages
Transformer	A power transformer is used to change the voltages from one level to another. Different voltages are used for generation, high voltage transmission and local distribution the power transformer steps the voltage up or down before attaching to similar equipment and exiting the substation.
Transmission line	A high voltage power line running at 500 kV, 330 kV, 220 kV or 132 kV. The high voltage allows delivery of bulk power over long distances with minimal power loss
Voltage	Can be thought of as the ‘pressure’ that forces current to flow in a wire like the way in which pressure forces water to flow in a pipe. The higher the pressure the greater the flow. Voltage is measured in Volts and has the symbol “V”.

ABBREVIATIONS

ACT	Australian Capital Territory
AEMO	Australian Energy Market Operator
ARTC	Australian Rail Track Corporation
BISTF	Bomen Industrial Sewerage Treatment Facility
DAPR	Distribution Planning Report
DBYD	Dial Before You Dig
DPC	Department of Premier and Cabinet
DPE	Department of Planning and Environment
EbD	Enquiry by Design
FOGO	Food Organics and Green Organics
FTE	Full-Time Equivalent
GO	Green Organics
GWMC	Gregadoo Waste Management Centre
HPGTPs	High Pressure Gas Transmission Pipelines
IWCM	Integrated Water Cycle Management
kV	Kilo Volts
LMC	Livestock Marketing Centre
MAOP	Maximum Allowable Operating Pressure
ML	Measurement Length
MVA	Mega Volt-Ampere
MW	Mega Watt
NSW	New South Wales
PDD	Peak Day Demand
PJ	Petajoule
PV	Photovoltaic
RiFL	Riverina Intermodal Freight and Logistics (RiFL) Hub project
ROBE	Riverina Oils and Bio Energy Pty Ltd
RWCC	Riverina Water County Council
SAP	Special Activation Precinct
STS	Sub-Transmission Substation

TAPR	Transmission Planning Report
TL	Transmission Line
TS	Terminal Substation
TX	Transformer
VIC	Victoria
VPP	Virtual Power Plant
WWCC	Wagga Wagga City Council
WWTP	Waste Water Treatment Plant
ZS	Distribution Zone Substation

EXECUTIVE SUMMARY

The Wagga Wagga SAP area is relatively well serviced by enabling infrastructure and services except for digital infrastructure which is constrained by current connectivity to Regional NSW.

Access to water supply is provided by Riverina Water County Council which has an existing system servicing the Bomen Business Park and Brucedale, northern end of the Wagga Wagga SAP area. To meet future demands for both the SAP area and northern growth areas, the existing sources will require upgrades together with new reticulations, which are already being considered by Riverina Water. Key upgrades to the source and reticulation include upgrades to Bomen Reservoir, East Bomen Pump Station, Brucedale Reservoir including new pumps stations in North Wagga, Brucedale and East Bomen together with approx. 35 Km of new water mains from 2019-2060 period.

The wastewater system is provided by Wagga Wagga City Council and is similarly constrained by topology. Future infrastructure upgrades will be required as the Wagga Wagga SAP is developed. The area to the west of the ridgeline along Byrnes Road can be readily serviced by a gravity fed system connecting to the existing Bomen Waste Water Treatment facility. The area east of the ridgeline along Byrnes Road will be a gravity fed system but will require a new pump station to connect into the existing system. The 2 strategic treatments options being considered are to upgrade the common rising main system between Cartwrights Hill Area and Narrung St WWTP (4.7km) and upgrade the BISTF to be a stand-alone WWTP with new discharge arrangement to the Murrumbidgee River. Both options are expected to require significant investment at the stage 1 of Wagga SAP development.

The Wagga Wagga SAP area is not constrained by the floodplain. The existing stormwater network is limited to the Bomen Business Park area. As the Wagga Wagga SAP is developed an appropriate stormwater network will need to be developed taking into consideration the increase to impervious areas and the conveyance on stormwater flows within the catchment. Consideration should be given to ensure that development does not adversely impact on the recharge of groundwater within the Murrumbidgee Catchment as this is the primary water supply for the region. Key recommendations from the Flooding and Water Quality Land Take Report (2019) prepared by Rhelm Pty Ltd includes provision of detention basins and key culvert upgrades within the SAP area to reduce impact on developable land and incorporate those into riparian corridors.

The transmission power networks operated by TransGrid and Essential Energy are within the Wagga Wagga SAP area and are accessible. The current power distribution network operated by Essential Energy currently services the Bomen Business Park. As the SAP is developed, expansion of the distribution system will be required. Alternative options are being considered including consideration of renewable energy opportunities and potentially exploring the innovative solution of a Virtual Power Plant which may provide a feasible alternative to typical power network expansion within the subject area. The Renewable Energy Opportunities and Constraints Report has identified a way in which the SAP can be 100% provided through renewable energy sources. However, to ensure power security, network upgrades will be required, including the provision of substation and upgrades to existing Wagga North substation.

Access to gas is readily available with large transmission gas mains diagonally traversing the SAP area. There are some constraints related to the types of development activities in proximity to these transmission mains, however this does not sterilise the development of these areas. Appropriate planning controls including a safety assessment are appropriate to developments completed within these areas. The gas distribution network services several existing businesses in the Bomen Business Park. As the SAP area is developed this distribution network can be expanded to service new areas as required.

Telecommunication and digital connectivity to the area is constrained by the current connection status to Regional NSW. This has resulted to relatively poor internet quality in the surrounding areas of Wagga SAP. The Wagga Wagga SAP can take advantage of the NSW Digital Connectivity Improvement program which will establish a digital backhaul to Wagga Wagga. The connectivity to the SAP area will leverage this program and provide a connection directly to the existing Bomen Business Park area with a view to expand this as the SAP area is developed. The current preferred location for the Wagga Wagga Data Hub is within the Wagga Wagga SAP study area.

Provision of a Wagga SAP shared service corridor is required to allow for the reticulation of services and future provision of circular economy services (e.g. Hydrogen, recycled water, transfer of materials or livestock between businesses). The proposed Wagga SAP infrastructure corridor is a 10-m wide easement that follows either riparian corridors, road reserves that will serve as a key requirement in the staging of the future infrastructure required to support the Wagga SAP. The majority of easements follow the road reserve or existing rivers/streams. The easements that cover riparian areas are typically 50-60m in length and will only encroach on 5-10m of these areas. The strategy of these corridors will aim to not adversely affect the biodiversity along the easement.

1 INTRODUCTION

The Wagga Wagga Special Activation Precinct (SAP) is a joint Government Agency initiative, announced by the Deputy Premier, the Hon John Barilaro MP, to create a 20-year vision for job creation and regional development. The Department of Premier and Cabinet and the Department of Planning and Environment are leading the creation of the Wagga Wagga SAP.

A SAP contains five core components and this plan (included in the government-led studies package) will inform fast tracked planning for the SAP area, potential future infrastructure investment and government-led development. The five core components of a SAP are identified in Figure 1.1.

Wagga Wagga is a location of State and Regional significance and the SAP will aid economic development and jobs creation in this area through an assessment of economic enablers, market failures and catalyst opportunities.

Wagga Wagga is in a unique position for an inland city, lying at the cross-roads of the A20 Sturt Highway and A41 Olympic Highway. It is currently on the Sydney to Melbourne rail corridor and is on the inland rail corridor, which will link international ports in Brisbane and Melbourne. This combined with road access to Adelaide and Canberra makes Wagga Wagga an ideal location for a Special Activation Precinct.

The Wagga Wagga SAP will lead to investment in common-use infrastructure, including roads infrastructure, water, electricity, telecommunication, gas systems, high speed internet data connections and facilities, and other possible infrastructure or services.

Source: The Department of Planning, Industry and Environment

Figure 1.1 Wagga Wagga special activation precinct overview

The NSW Government announced the creation of a special activation precinct (SAP) in the north-east area of Wagga Wagga on 29 January 2019 to create a world-class business precinct, capitalise on the inland rail, and promote advanced manufacturing, agribusiness, and freight and logistics. The Department of Planning, Industry and Environment (DPIE) together with the Wagga Wagga City Council (WWCC) are commencing investigations to develop a master plan for the SAP. The master plan proposal will identify the scale, type and extend of the development in the SAP along with the infrastructure needed to support its development and mitigate its impact.

The Wagga Wagga Special Activation Precinct (SAP) is a joint Government Agency initiative, announced by the Deputy Premier, the Hon John Barilaro MP, to create a 20-year vision for job creation and regional development. The Department of Premier and Cabinet and the Department of Planning and Environment are leading the creation of the Wagga Wagga SAP.

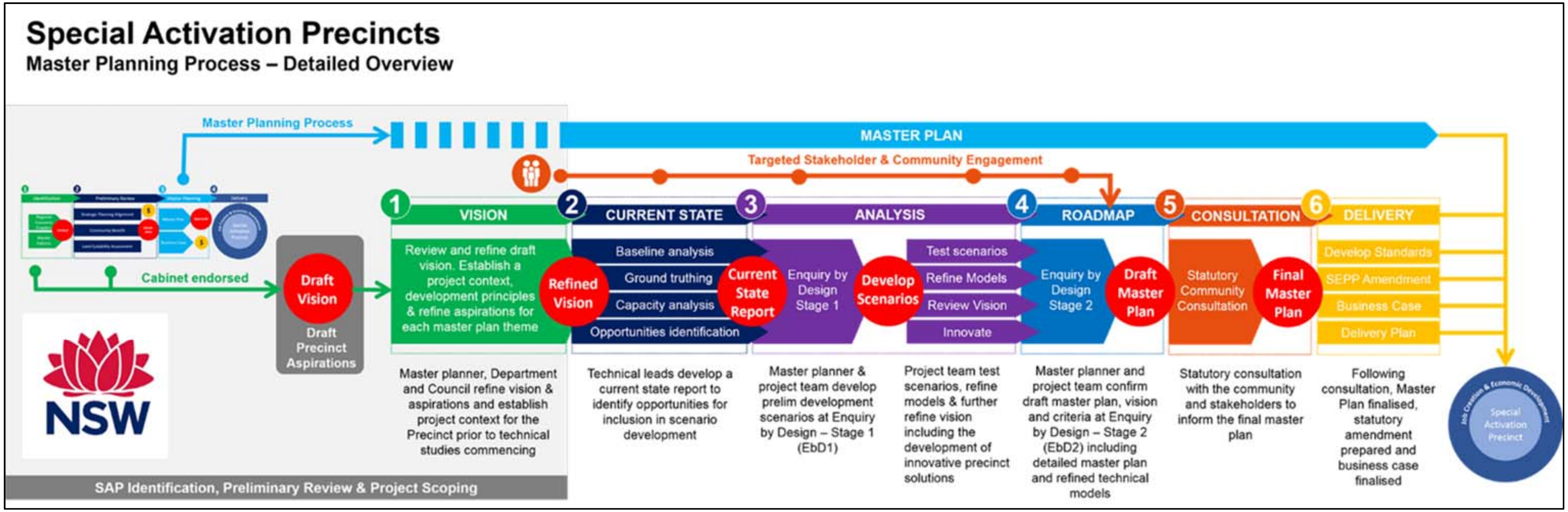
The DPIE commissioned several consultants to support the master plan process, which includes the Infrastructure and Services Plan (this study) prepared by WSP. The Infrastructure and Services plan supports the preparation of a master plan by providing specialists studies relating to infrastructure requirements to support the Wagga Wagga SAP.

Following the baseline analysis of the current infrastructure and services within the Wagga SAP area, a short Enquiry by Design (EbD) workshop was held on 8 and 9 August 2019 to develop three land use scenarios to be considered as part of the SAP master plan process.

Full Enquiry by Design workshop held on 17, 18 and 19 September 2019. The final structure plan was developed and refined by Master Plan consultants, Jensen Plus. As part of the development of the final scenario, the timing and sequencing of development and infrastructure was considered, and final demand analysis is completed to inform a final future infrastructure report to support the growth of the SAP in stages.

1.1 PURPOSE

The Master Plan process for the Wagga Wagga SAP investigation area follows six key stages as shown in Figure 1.2. The purpose of this report is complete assessment of all current existing infrastructure and services at both a local and regional level within the SAP investigation area. It offers an early understanding of opportunities and constraints in the SAP investigation area and identifies prospects for expansions, upgrades or new infrastructure that may be required to service the SAP area as it grows.



Source: The Department of Planning, Industry and Environment

Figure 1.2 Key stages of the master plan process

1.2 REGIONAL AND LOCAL CONTEXT

Wagga Wagga City Council (WWCC) is located approximately 455 kilometres south west of Sydney, in the Riverina Murray Region. The City of Wagga Wagga is the major centre in the Region with other key centres including Albury and Griffith. The main townships and settlements in the Wagga Wagga City Council Local Government Area (LGA) include Ladysmith, San Isidore, Uranquinty, Tarcutta, Humula, Oura, Mangoplah and Collingullie.

Bomen Business Park is located approximately 10 kilometres north east of Wagga Wagga Central Business District (CBD), bordering the Main Southern Railway between the Olympic Highway and Byrnes Road. The area is serviced by several major roads, including Bomen Road, which connects the area to Brisbane and Melbourne. Wagga Wagga Regional Airport is located south east of Wagga Wagga CBD and is located approximately 11 kilometres from Bomen Business Park.

The Riverina Murray Regional Plan 2036 identifies Bomen Business Park as a significant contributor to jobs and economic growth in the region and highlights the need to protect industrial areas from potential land use conflicts. The Regional Plan identifies that Wagga Wagga and its surrounds is:

- the largest inland regional city in NSW with a population of approximately 62,500 people (ABS, 2016)
- the future creation of a Riverina Intermodal Freight and Logistics Hub to take advantage of the area’s major freight and logistics activity, 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
- forecast to grow to a population of 89,800 people by 2038. (Source:Macroplan)

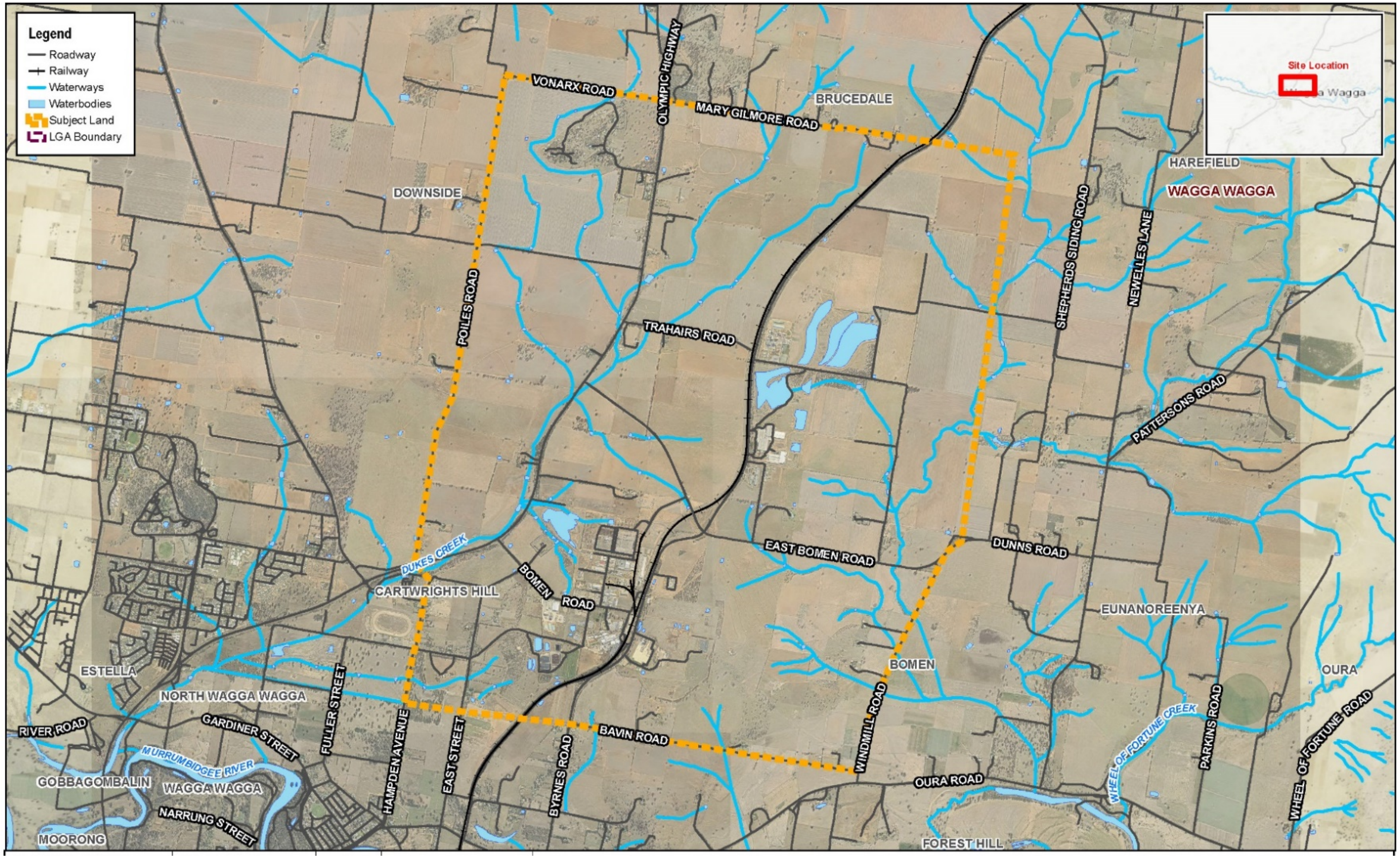
The establishment of a Wagga Wagga SAP is consistent with the Council’s vision and strategic planning policies for the project area.

1.2.1 WAGGA WAGGA SAP INVESTIGATION AREA

The Wagga Wagga SAP Investigation Area is located north-east of Wagga Wagga. The area covers approximately 4,180 hectares. Approximately 600 to 750 hectares of this is already developed as a business park. Most of the undeveloped land is privately owned, with some land owned by Wagga Wagga City Council.

Bomen Business Park supports a variety of existing businesses including 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.

The investigation area is shown in Figure 1.3.



Source: WSP and the Department of Planning, Industry and Environment

Figure 1.3 Location of Wagga Wagga SAP project area

1.3 REFINED VISION STATEMENT AND STRATEGIC ALIGNMENT

The refined vision that will guide the aspirations and outcomes for which the Wagga Wagga SAP precinct is expected to achieve, was developed collaboratively by the Department of Premier and Cabinet (DPC), Department of Planning, Industry and Environment (DPIE), and the Wagga Wagga SAP Masterplan Consultant Jensen PLUS.

The refined vision is:

> *"As NSW's Southern gateway supporting Australia's richest food and agricultural region, the Wagga Wagga SAP will be a sustainable hub of high value production and manufacturing supporting innovative industries and businesses which are connected to the world."*

It was also supported by seven aspirations to make the Wagga Wagga SAP stand out from other regional growth locations, by emphasising Wagga's competitive strengths with a focus on areas which the SAP will target for investment or attention. They included:

	ASPIRATION STATEMENTS
1	Design a modern area that respects its strong landscape setting and existing communities .
2	Provide certainty and confidence for industries and businesses to establish and expand (all SAPs).
3	Target secure, affordable renewable energy to support ESD and business investment.
4	Future-proof road and rail to accommodate larger trucks and longer trains, building from the new Riverina Intermodal Freight and Logistics (RiFL) hub.
5	Create an 'employment place of choice' by providing appropriate services and amenities.
6	Promote innovation and Resaerch &Development.
7	Accelerate the establishment of circular economies.

To align the purpose of the Infrastructure and Services Plan to the Wagga Wagga SAP refined vision and aspirations, the following considerations were incorporated:

	STRATEGIC ALIGNMENT TO ACHIEVE ASPIRATION STATEMENTS
1	— Minimise impact on existing aboriginal and non-aboriginal sites of significance, reduce noise impact on adjacent communities (i.e. acceleration and deceleration lanes location), consider connectivity (by way of active transport) to and from the SAP for workers from the surrounding community. — Consider renewable energy opportunities and prospects for recycled water use without adverse impact on recharge of groundwater.
2	— Leverage off NSW Transmission Infrastructure Strategy regional upgrades (i.e. TransGrid) and other planned upgrades. Understand the planned telecommunication upgrades and timing at both a local and regional context (particularly NBN, Telstra and Optus).

	STRATEGIC ALIGNMENT TO ACHIEVE ASPIRATION STATEMENTS
3	— Facilitate the transition to sustainable energy sources for vehicles – electric vehicles (i.e. Tesla). — Unpack the development of the Bomen Solar Farm development and its impact both locally and regionally. — Understand the waste and recycling for the SAP area and identify opportunities for generating power from waste. — Explore potential virtual power network opportunities to the SAP area, based on renewable energy providers, potential energy purchasing agreements.
4	— Our transport modelling future case scenarios will align to (i.e. 2036, 2046 or 2040) renewable businesses that are being considered by the renewables team to operate in the SAP and the utilities demands and constraints they will bring to the SAP area.
5	— Explore opportunities with utility service providers for the provision of asset renewal supporting providers. — Ensure that the infrastructure provided supports existing businesses in the area that are currently trying to establish circular economies.

1.4 REPORT STRUCTURE

The remainder of the report is structured as follows:

- Section 2 is the baseline assessment of the infrastructure and services. This section of the report summarises the existing infrastructure that currently services and is connected to the Wagga Wagga SAP study area. It identifies the current capacity and connection opportunities for future infrastructure. This information was used in the Short Enquiry By Design workshop which informed the development of scenario testing to be completed.

- Section 3 provides a summary of the scenario testing that was completed. This section of the report explores the impact of three proposed development structure plans of varying sizes and intensity. Each of the three scenarios tested identifies the required infrastructure upgrades that would be required to support development for each of the respective structure plans. This information was used at the Full Enquiry by Design workshop to inform the preferred structure plan.

- Section 5 tackles the refined structure plan and future infrastructure requirements. This section of the report analyses the demand requirements for the preferred structure plan, and identifies the required infrastructure upgrades to support development over time. It identifies recommended investment triggers to align to the expected growth of the Wagga Wagga SAP between now and 2060.

2 BASELINE ANALYSIS OF INFRASTRUCTURE AND SERVICES

2.1 INFRASTRUCTURE – REGIONAL AND LOCAL ANALYSIS

This desktop analysis seeks to understand the capacity and availability of utility infrastructure and services both within the Wagga Wagga SAP and its adjacent wider regions, depending on the supply of services. It has been based on information and spatial data received from the Department of Planning, Industry and Environment (DPIE), Wagga Wagga City Council and utility providers. The utility infrastructure and services assessed include:

- Water, wastewater and stormwater;
- Electricity and gas;
- Telecommunications and internet services; and
- Waste and resources recovery.

As a general disclaimer. It is noted that the utilities information shown in these plans have been compiled from multiple sources of information. it is the responsibility of the contractor to undertake their own site investigations prior to any construction activities. The information within this report and any drawings produced are never to be used for the purpose of locating services. WSP shall not be liable for any loss or damage caused using the utilities/services information shown on these drawings.

The Wagga Wagga SAP investigation area is largely a greenfield site with some water, wastewater, and stormwater infrastructure. This analysis focuses on assessing the remaining available capacity of existing water related infrastructure located in the Wagga Wagga SAP investigation area.

2.1.1 *WATER INFRASTRUCTURE*

WATER SUPPLY

Riverina Water County Council (RWCC) provides potable water to Wagga Wagga City Council by three major supply systems that are known as North Wagga, Western Trunk and Southern Trunk. The SAP investigation area is a greenfield site with significant areas of rural land. It is located within the North Wagga Wagga supply system where water is sourced from three groundwater bores and supplemented from the Murrumbidgee River as shown in Figure 2.1. The water sources, treatment and pumping systems are at or approaching their capacity. In early 2019 it was determined that allocation of groundwater and river water extraction volumes could not keep up with demand and water had to be transferred from the adjacent Wagga Wagga supply system across the river.

There are three existing pressure zones within the North Wagga Wagga supply system known as Estella, Brucedale and East Bomen Sub-systems. The SAP area is primarily within the Brucedale and East Bomen Sub-system zones. Each zone has a separate pumping, trunk main and storage infrastructure. Depending where development occurs and the proposed demand in each area, the existing infrastructure will require augmentation and/or a new pressure zone to be created. Figure 2.2 conceptually illustrates that water network servicing within the SAP area will need to be governed by topography, which varies significantly between 180 m to 300 m AHD.

Most of the SAP area is at suitable elevation to be supplied from East Bomen Reservoirs (TWL 285 m AHD). Lower elevation parts of the SAP, particularly in the south-west corner and along Olympic Hwy could be supplied from the Bomen Reservoirs (TWL 254.59 m AHD). The south-eastern part of the SAP is also low enough elevation to be supplied from Bomen Reservoirs however is distant (i.e. over the hill) and hence may not be practical to supply from this system.

The northern part of the SAP is too high to be supplied from East Bomen Reservoirs but could be supplied from Brucedale Reservoir (TWL 323.7 m AHD), which is located outside of the SAP to the north. This existing system has very limited capacity however.

There are two areas within the SAP investigation area which due to their high elevations, cannot be supplied by any of the existing pressure zones. They include the high elevation area east of the rail line, located in the southern part of the SAP investigation area and the small area within the SAP in Brucedale (i.e. the hill surrounded by Brucedale residential area). To service both areas would likely require a local booster pump station with no tank with reduced reliability and firefighting capability – and would be subject to Riverina Water accepting this configuration. Note these areas are likely unsuitable for industrial/commercial development in any case.

WATER DEMAND AND CAPACITY

The East Bomen system is likely to have substantial available capacity before tank and pump station upgrades would be required. This would be adequate to allow for suitable elevation/pressure level to service most of the SAP area. The Bomen pumps (which supply all systems in North Wagga), and possibly the Bomen Reservoir also, do not have much spare capacity and expected to require upgrading at some stage (both for the SAP and Estella development).

Estella pumps, and possibly the reservoir also, appear to have no spare capacity – however this system is downstream of the SAP and likely not applicable.

Brucedale capacity is assumed as very minimal due to the extremely small size of this reservoir and would likely require upgrade/replacement of both the pump station and reservoir to service any major new development within the SAP.

These conclusions are all simply inferred from the models and still need confirmation from Riverina Water but provides some quantitative information. Table 2.1 shows current demands per pressure zone.

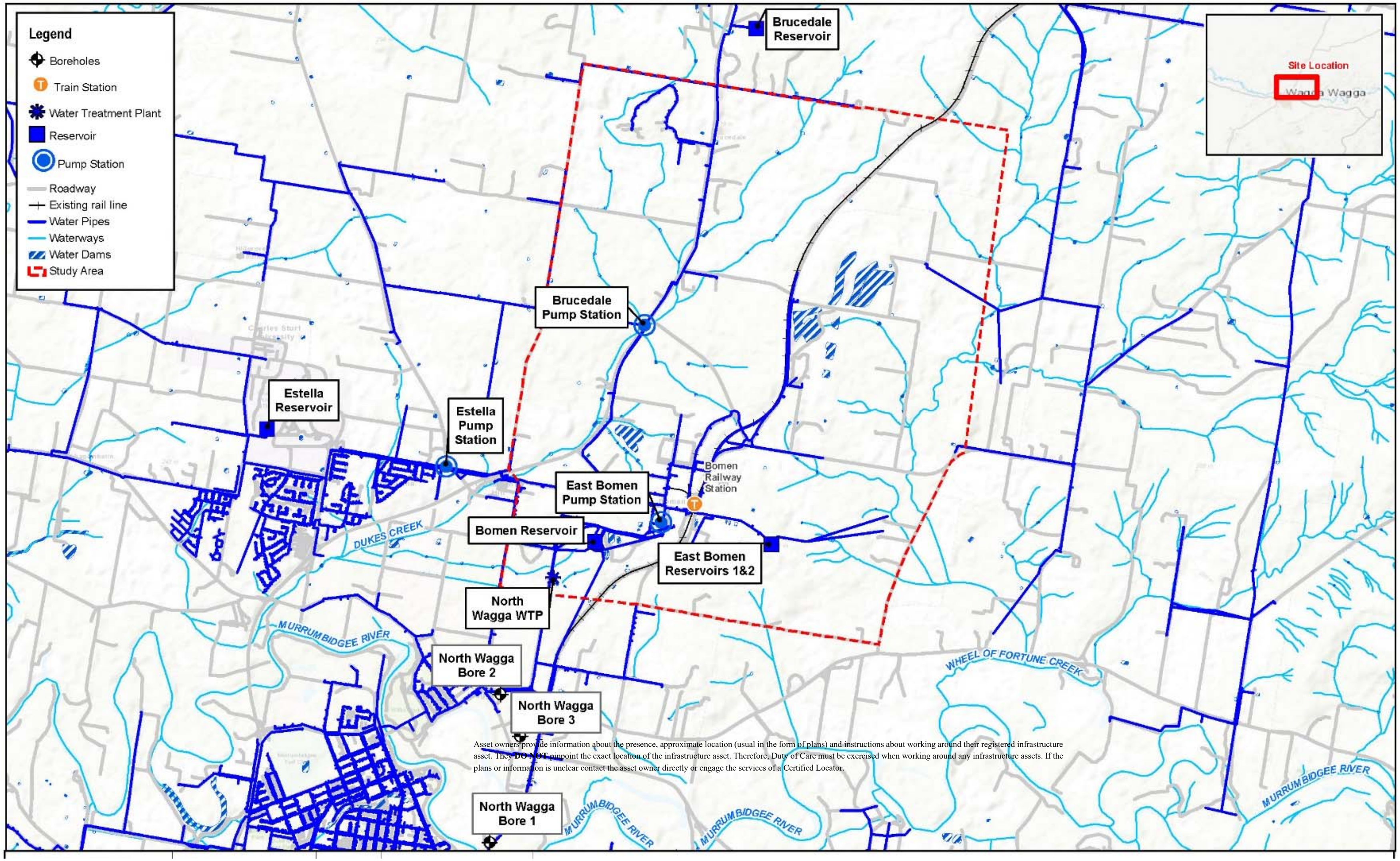
Table 2.1 Current demands per pressure zone

PRESSURE ZONE	TANK CAPACITY (KL)	MODEL PD DEMAND (KL)	HRS STORAGE AT PDD	MODEL PUMP OPERATING HOURS PER DAY (PDD DEMAND)
Bomen Reservoir	10,000	6,792	35.3	20 hours
East Bomen Reservoir	6,200	2,149	69.2	~6 hours
Estella **	11,000	9,524	27.7	24 hours
Brucedale*	750	N/A	N/A	N/A

Source: Riverina Water County Council

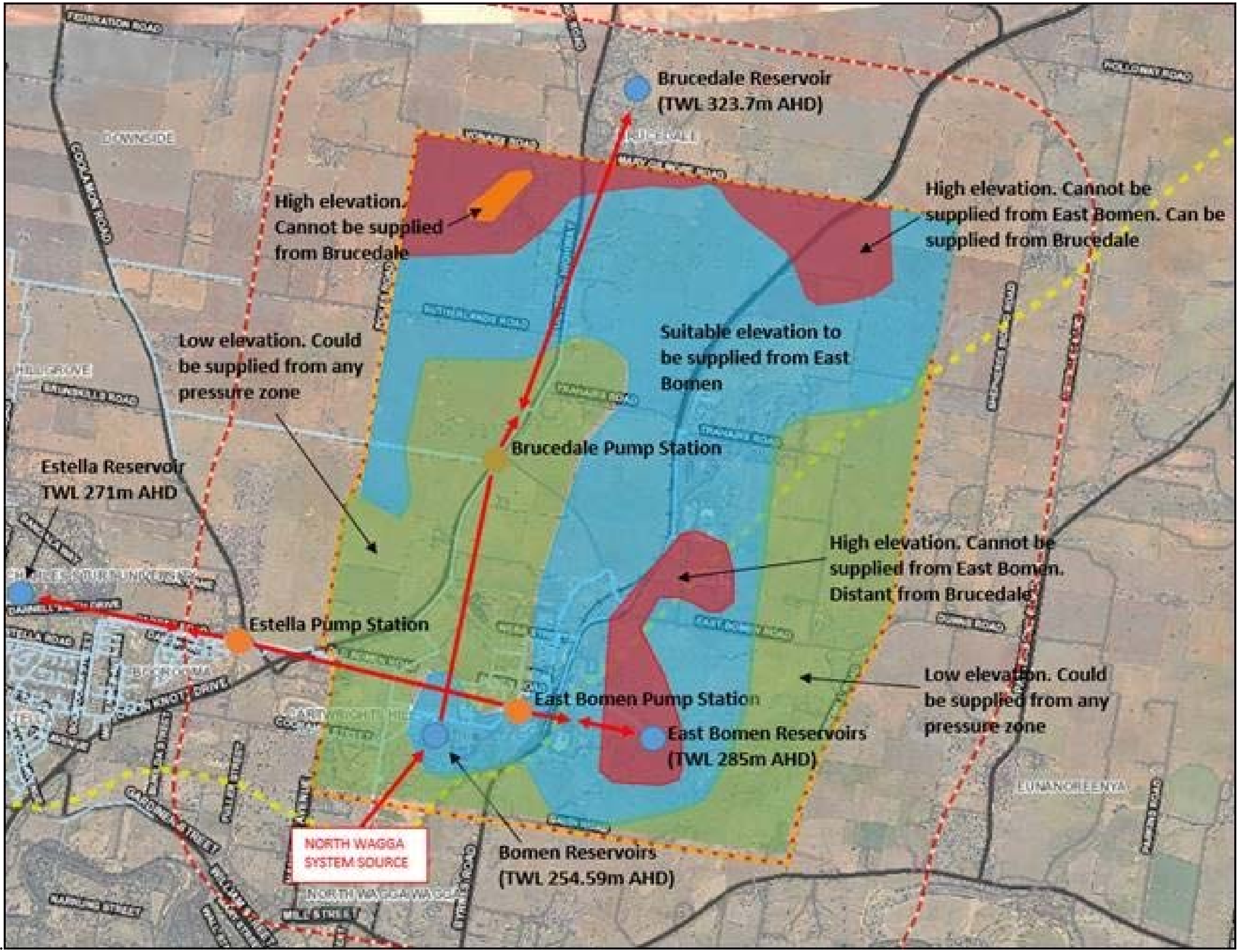
*Note Brucedale system not included within Hydraulic Model.

**Note Estella system is fully outside of the SAP and not expected to service the SAP. Hence capacity and upgrade requirements within that system are independent, only the demand/growth within this system is relevant to the SAP.



Source: WSP and Riverina Water County Council

Figure 2.1 Existing water infrastructure



Source: WSP and Wagga Wagga City Council

Figure 2.2 A conceptual plan of water network servicing within the SAP governed by topography

2.1.2 WASTEWATER INFRASTRUCTURE

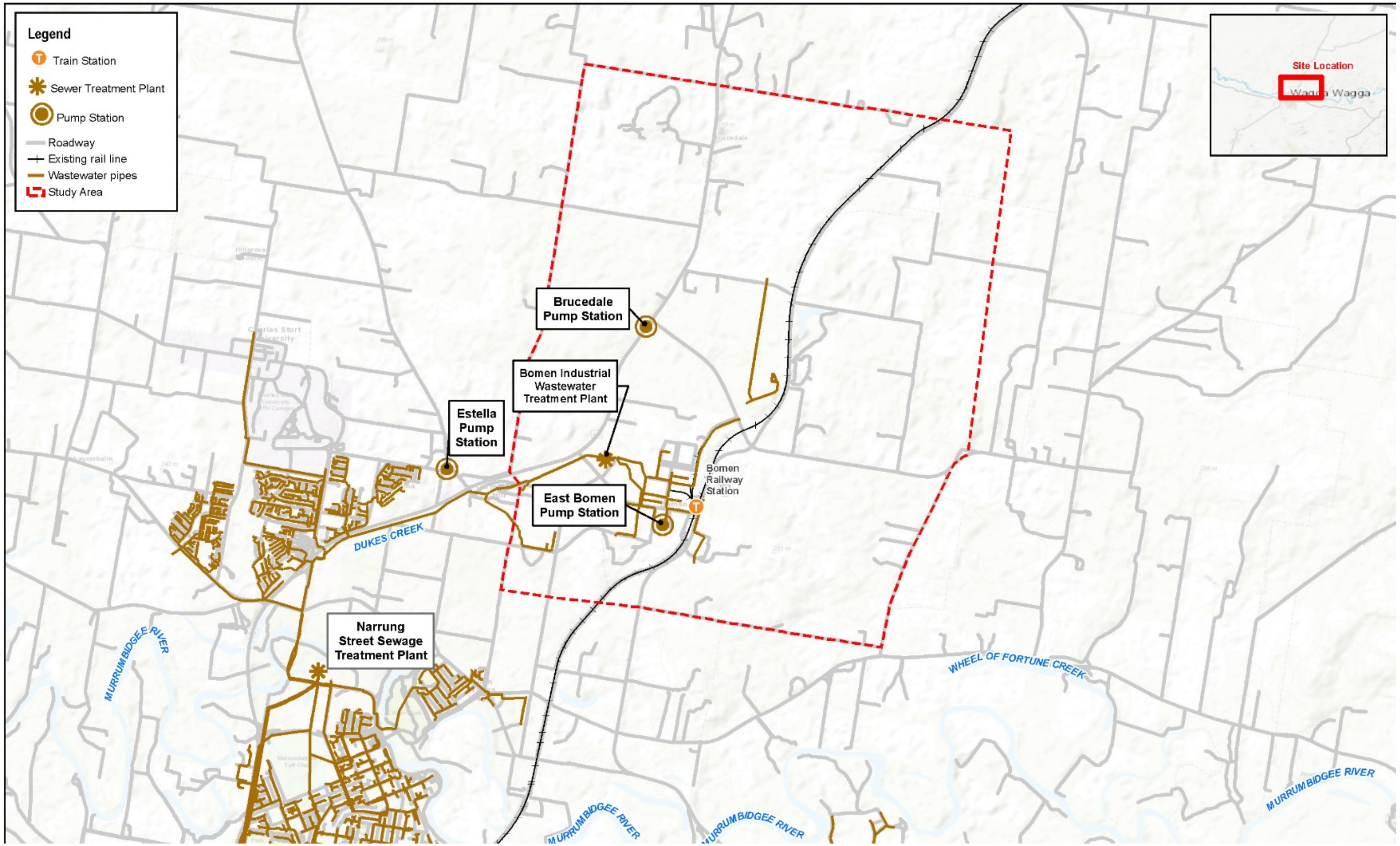
The existing Bomen industrial pre-treatment plant receives all wastewater loads from the local serviced area in Bomen. This includes an abattoir and other industrial customers which require additional treatment for their waste outputs which cannot be handled by the main town treatment plant at Narrung St. From here, partially treated sewage is pumped south-east into the town catchment and is conveyed to the Narrung St Waste Water Treatment Plant (WWTP). Treated effluent from the Narrung St WWTP is discharged to the Murrumbidgee River, a small part of this is further treated and re-used for open space irrigation at Council sites. Bomen industrial pre-treatment plant has capacity of 6 ML of effluent discharge per day. Currently we discharge about 4 ML. These figures have been provided by WWCC in absence of hydraulic modelling and are to be confirmed by current operator's usage rates.. Figure 2.3 illustrates the current configuration of the existing wastewater infrastructure.

The existing network around the Bomen Business Park may be of limited capacity and may have limited potential to be extended to service the broader SAP. This has not been assessed at this stage due to limited information about current loading and capacity from Wagga Wagga City Council and, as these are industrial customers, it is not accurate to estimate current loading based on number of connections or serviced area. There may be potential to extend it to service some additional local areas. Ideally, these existing assets should be utilised to the extent possible

Like water, wastewater servicing within the SAP will need to be governed by topography, which varies significantly between 180 m to 300 m AHD as conceptually shown in Figure 2.4.

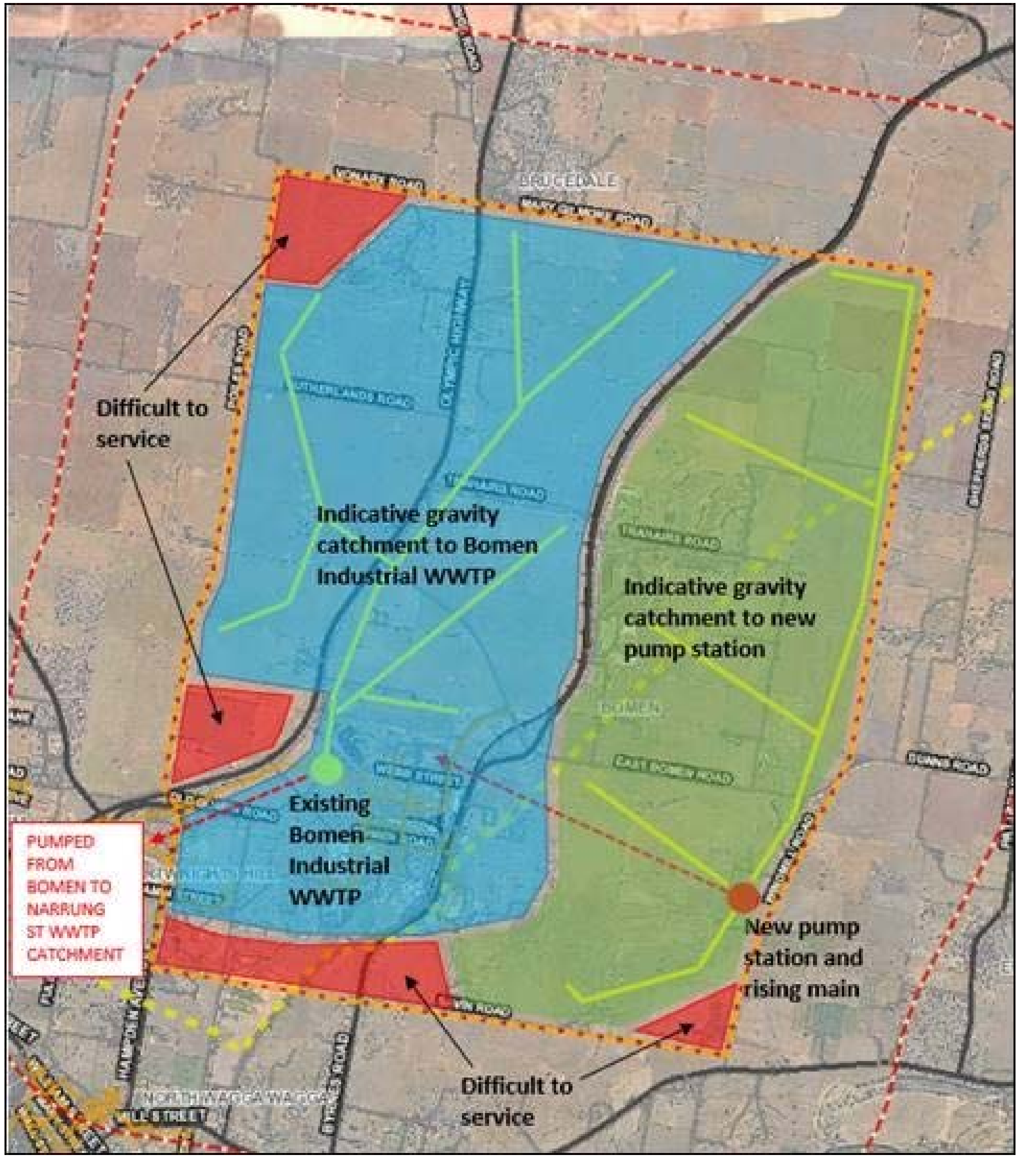
Most of the SAP area west of the rail line can drain south along Olympic Hwy towards the existing Bomen industrial treatment plant. Most of the SAP area east of the rail line is separated by a ridge and would need to drain to the east and be serviced by a new pump station located in the south-east part of the SAP. A small area immediately on the eastern side of the rail line around Bomen (i.e. west of the hill), if serviced, would need to drain west under the rail line – ideally into the existing network if there is available capacity.

Lower elevation parts of the SAP in the southern corners and immediately west of the Bomen industrial treatment plant will be difficult and uneconomical to service. Although not at low elevation, the north-west corner will also be difficult to service by gravity (as it's on the far side of a hill). Generally, areas distant from the existing network and treatment plant are likely to be less economical to service.



Source: WSP and Wagga Wagga City Council

Figure 2.3 Existing wastewater infrastructure



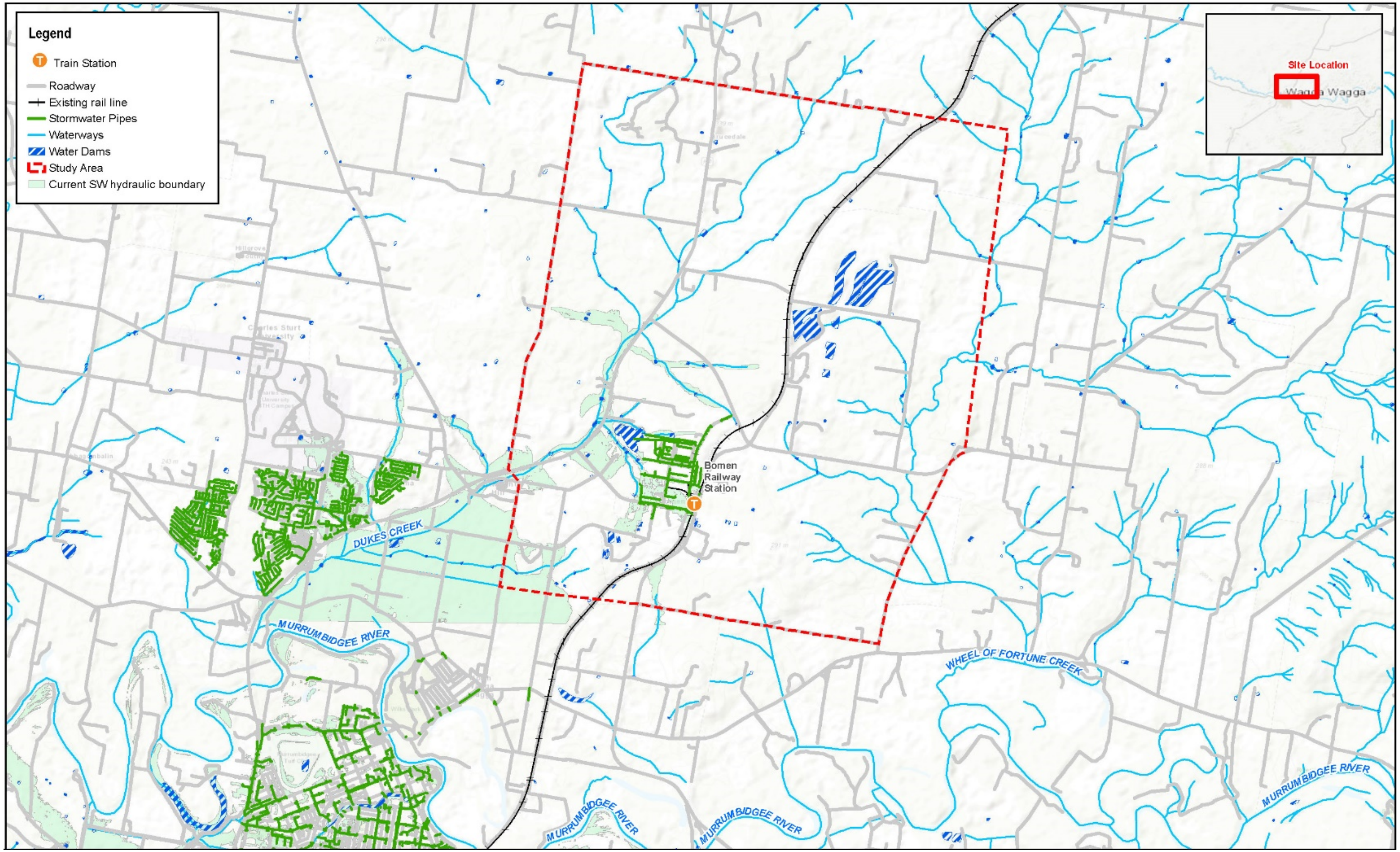
Source: WSP, Wagga Wagga City Council

Figure 2.4 A conceptual plan of wastewater network servicing within the SAP governed by topography.

2.1.3 STORMWATER INFRASTRUCTURE

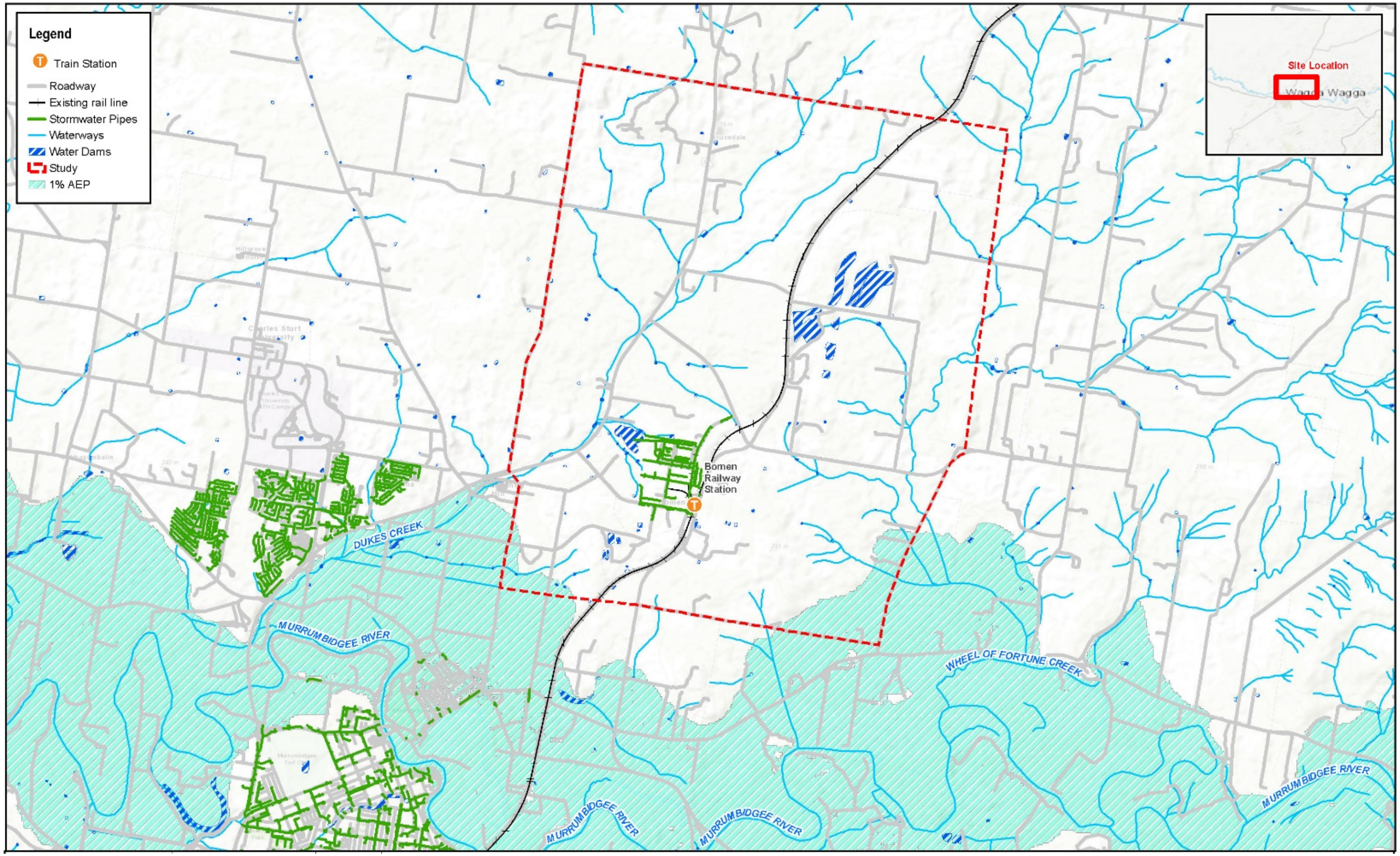
Stormwater within the SAP investigation area predominantly falls within the Murrumbidgee catchment boundary through natural flow paths. There is a current WWWC stormwater network around the Bomen Industrial Park which is collected and discharged into the natural channels immediately downstream of the industrial area. This discharge then flows to Dukes Creek. The exception is the stormwater which falls on the LMC and surrounds, is collected in the large basins nearby. The basins for the sheep saleyards are of unknown capacity and size and have not yet been assessed at this stage. It is likely some businesses may also collect their own local runoff from rooftops.

Available stormwater capacity is low with the maximum pipe diameter being a 1200 mm pipe. Most of any flood event would flow overland to the same discharge location but relatively frequent storm events would exceed the capacity of the stormwater system. A recent hydraulic flood study was carried out in 2018 near the SAP investigation are show in Figure 2.5. An analysis for 1% Annual Exceedance Probability (AEP) flood, which is the likelihood of occurrence of a flood of given size or larger occurring with an occurrence in any year of 0.01, and an associated ARI of 100 years is shown in Figure 2.6. Further modelling closer the SAP investigation is needed but initial analysis shows that the SAP area would be protected during such an event.



Source: WSP, DPE and WMA Water

Figure 2.5 Existing stormwater infrastructure including the extent of the stormwater hydraulic boundary



Source: WSP, DPE and WMA Water

Figure 2.6 Existing stormwater infrastructure including the extent of 1% AEP boundary

This preliminary analysis draws from publicly available information (DBYDs), information from utility providers as well as team knowledge of the assets within the area.

2.1.4 ELECTRICITY INFRASTRUCTURE

EXISTING TRANSMISSION AND DISTRIBUTION INFRASTRUCTURE

The transmission network which passes through the Wagga Wagga SAP investigation area is operated by TransGrid and Essential Energy while the distribution network is operated by Essential Energy. The majority of TransGrid's transmission occurs above ground through powerlines and a series of conductors supported by structures to maintain a safe electrical clearance to the ground. At transmission and distribution substations, high voltages are reduced for further transmission or for local distribution. Transmission feeder lines are greater than 132 kV while distribution feeder lines are less than 132 kV.

As development takes place within the SAP area, the demand for power will increase and the available network capacity will depend on several considerations.

Due to the proximity of the Wagga North 132/66 kV substation, it is most likely that the generation for future development within the SAP investigation area would be evacuated via Wagga North substation (See Figure 2.7). Whether these generations require a new distribution feeder or can be evacuated via an existing feeder depends on the size of the generation required.

Table 2.2 provides the existing capacity and the available spare capacity of the transmission and distribution network in the SAP area. The summer transformer rating was chosen as it indicates the maximum loading onto the network per year.

Table 2.2 T Feeder Load Forecast

FEEDER LINE	FEEDER VOLTAGE (KV)	FEEDER ORIGIN	FEEDER DESTINATION	LINE RATING (MVA)	FORECAST (MVA)	AVAILABLE SPARE CAPACITY (MVA)
99U	132	TransGrid Wagga North 132/66 kV STS	Temora 132/66 STS	128	32.4	95.6
9J5	132	TransGrid Wagga North 132/66 kV STS	Junee 132/66/11 kV ZS	140	30.7	109.3
9J5	132	Junee 132/66/11 kV ZS	Temora 132/66 STS	140	18.7	121.3
30–90	66	Junee ZS	Coolamon ZS	6	5.1	0.9
834:JUN	66	Junee ZS	Bethungra ZS	11	1	10

Source: 2018 Essential Energy Distribution Planning Report

From the Zone substation load forecast data available in the Distribution Annual Planning Report (DAPR), it appears that additional loads due to Wagga Wagga SAP will be accommodated by the Junee substation. Table 2.3 provides the available capacity at the Junee substation as per DAPR.

Table 2.3 Available capacity at Junee distribution substation

DISTRIBUTION SUBSTATION	KV	TRANSFORMER RATING (MVA)	TRANSFORMER FORECAST (MVA)	AVAILABLE CAPACITY (MVA)
Junee 66 kV	132/66	30	11	19
Junee 11 kV	66/11	15	7.3	7.7

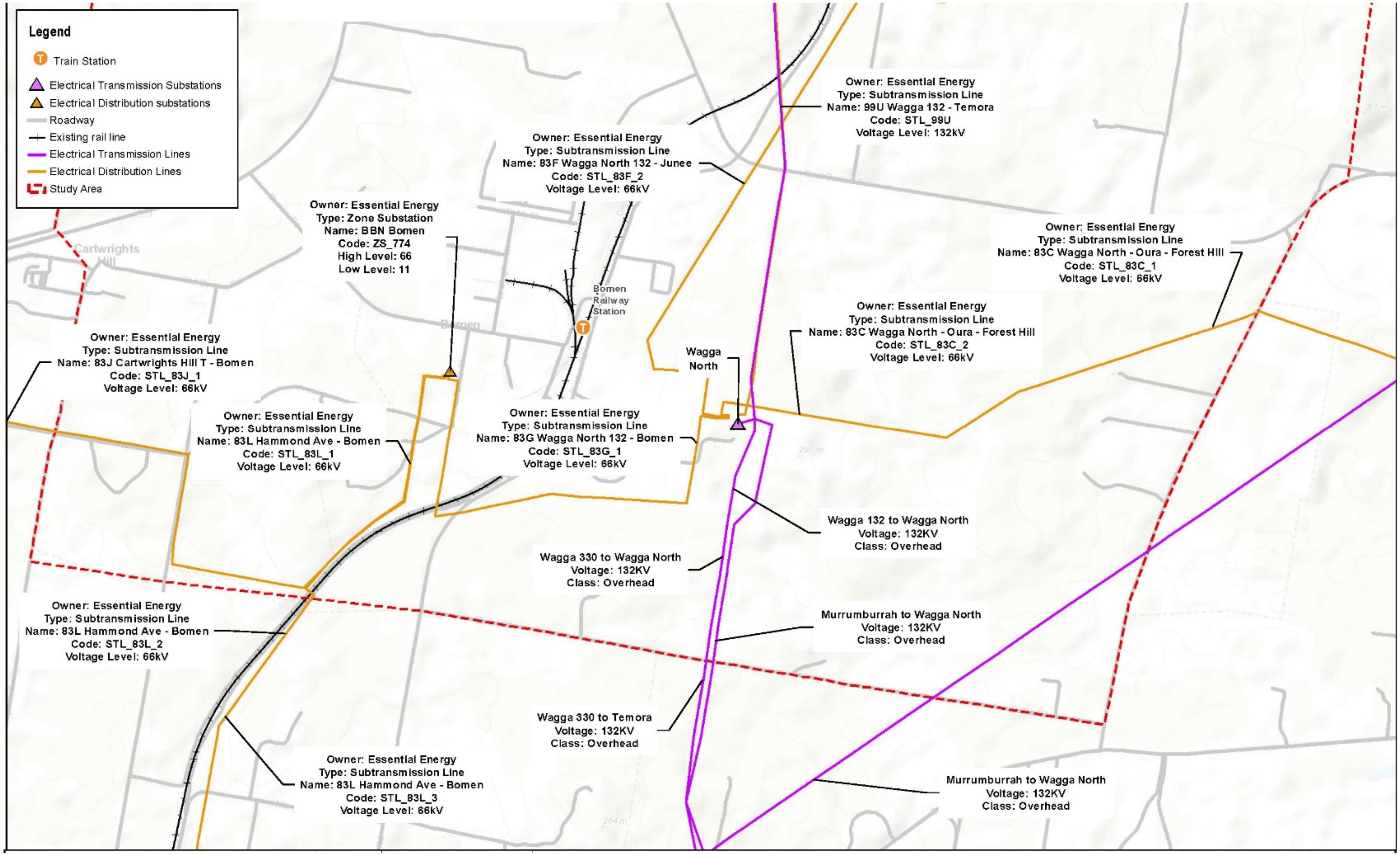
Source: 2018 Essential Energy Distribution Planning Report

DAPR for the year 2018 shows total spare capacity in excess of 50% is available for the network connected to Wagga North substation (See Figure 2.8) with the following exceptions;

- 66 kV feeder line between Wagga North to Bomen ZS: The thermal rating of this feeder is 34 MVA and the forecast shows the feeder will see more than 22 MVA.
- 66 kV feeder line between Junee ZS to Coolamon ZS: The thermal rating of this line is 6 MVA and the forecast shows the feeder will see more than 5 MVA.

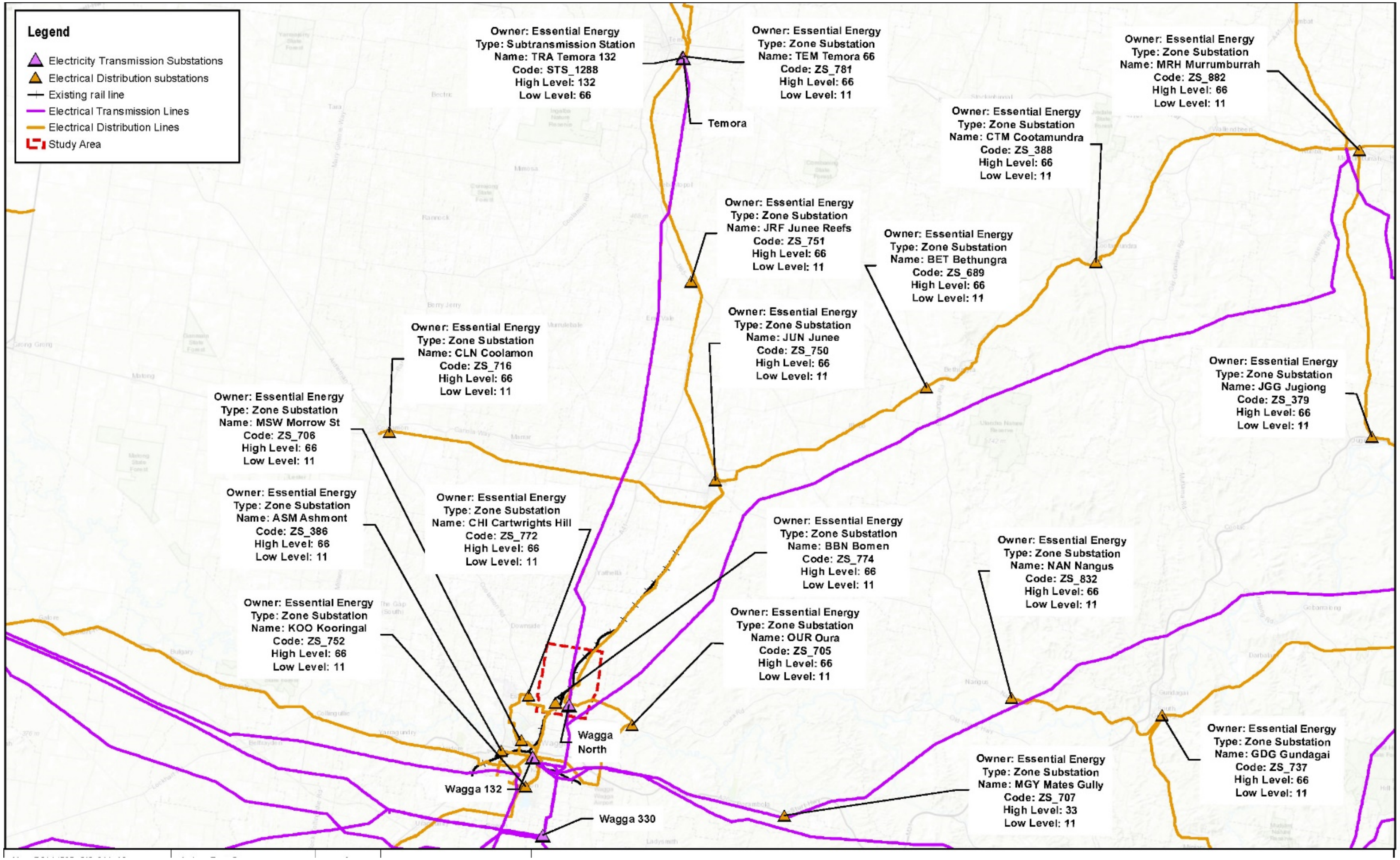
At this baseline assessment the amount of various new generations planned/committed in the Wagga area is not presently available. Depending on the technology and the capacity of these new generations, the available network capacity mentioned in Table 2.2 is likely to be different.

The mix and the amount of electrical load those come on the 11 kV feeders due to Wagga Wagga SAP is not known at this stage. It is recommended to check with the local distribution company which is Essential Energy in this case for the latest available capacity for each feeder and all transformers.



Source: WSP, DBYD, Essential Energy and TransGrid

Figure 2.7 Existing local electrical transmission and distribution network



Source: WSP, DBYD, Essential Energy and TransGrid

Figure 2.8 Existing regional electrical transmission and distribution network

2.1.5 GAS INFRASTRUCTURE

GAS TRANSMISSION NETWORK

APA Transmission owns and operates three high pressure gas transmission pipelines (HPGTPs) within easement through the Wagga Wagga SAP area (see Table 2.4 for details). They include the Young – Wagga Wagga Pipeline and Young – Wagga Wagga Looping which runs through the Wagga Wagga SAP on a south west alignment within a 20-metre-wide pipeline easement terminating at the APA Bomen site on land at 274 Byrnes Road or Lot 8 on. APA Transmission also owns and operates the Wagga Wagga – Culcairn Pipeline which originates at the APA Bomen site and runs in west / south west alignment away from the Wagga Wagga SAP within a 24-metre-wide easement via crossings of Byrnes Road / Railway line.

AS2885 specifies the minimum requirements for the maintenance, operation and safety of gas pipelines. In managing high pressure transmission pipelines and considering land use changes, APA applies a concept as defined by AS2885 known as the Measurement Length (ML). The ML area is the heat radiation zone associated with a full-bore pipeline rupture. APA is mandated to consider community safety within the ML zone due to the high consequences of pipeline rupture to life, property and the economy. The ML is determined by the design criteria of the pipe (driven by the surrounding environment at the time of construction) and the Maximum Allowable Operating Pressure (MAOP) of the pipe. APA must be informed of any changes of land use within the ML area to determine the effect of a new use on the risk profile of the pipeline.

In the southern part of the Wagga Wagga SAP investigation area, between Hampden Avenue and Byrnes Road there is a large ML area as shown in Figure 2.9 extending 463 m either side of the gas pipelines.

Current land use along the gas pipeline route is also associated with a type of primary and secondary location class. Primary location class type is determined from analysis of the predominant land use in the broad area traversed by the gas pipeline. If the gas pipeline passes through land use categorised as sensitive (S), environmental (E), industrial (I), heavy industrial (HI), common infrastructure corridor (CIC) and crowd (C), a secondary location class type is also provided with additional requirements which need to be adhered to.

The current primary / secondary location classes of the gas pipelines are presented in Table 2.4 and illustrated in Figure 2.10 and Figure 2.11. If the location classification changes a Safety Management Study (SMS) is required to assess the additional risk and ensure the risk is reduced to an acceptable level.

The cost of undertaking an SMS including any actions (i.e. protective slabbing of pipeline) is to be borne by the proponent known as the 'agent of change'. APA has developed a list of preferred SMS facilitators. This ensures facilitators are both independent and satisfactorily qualified to undertake this assessment. This list is available from APA on request. Mitigation may include slabbing of the pipeline, additional signage, marker tape, and controls during construction.

Table 2.4 Measurement lengths and associated location class types for gas pipelines within the Wagga Wagga SAP investigation area.

APA PIPELINE	DIAMETER (MM)	*MEASUREMENT LENGTH (M)	PRIMARY LOCATION CLASS	SECONDARY LOCATION CLASS
Young to Wagga Wagga	300	65	Rural Residential (R2)	Heavy Industrial (HI)
Young to Wagga Looping	450	65	Rural Residential (R2)	Heavy Industrial (HI)
Wagga Wagga to Culcairn	450	463	Residential (T1)	Industrial (I)

Source: APA Transmission

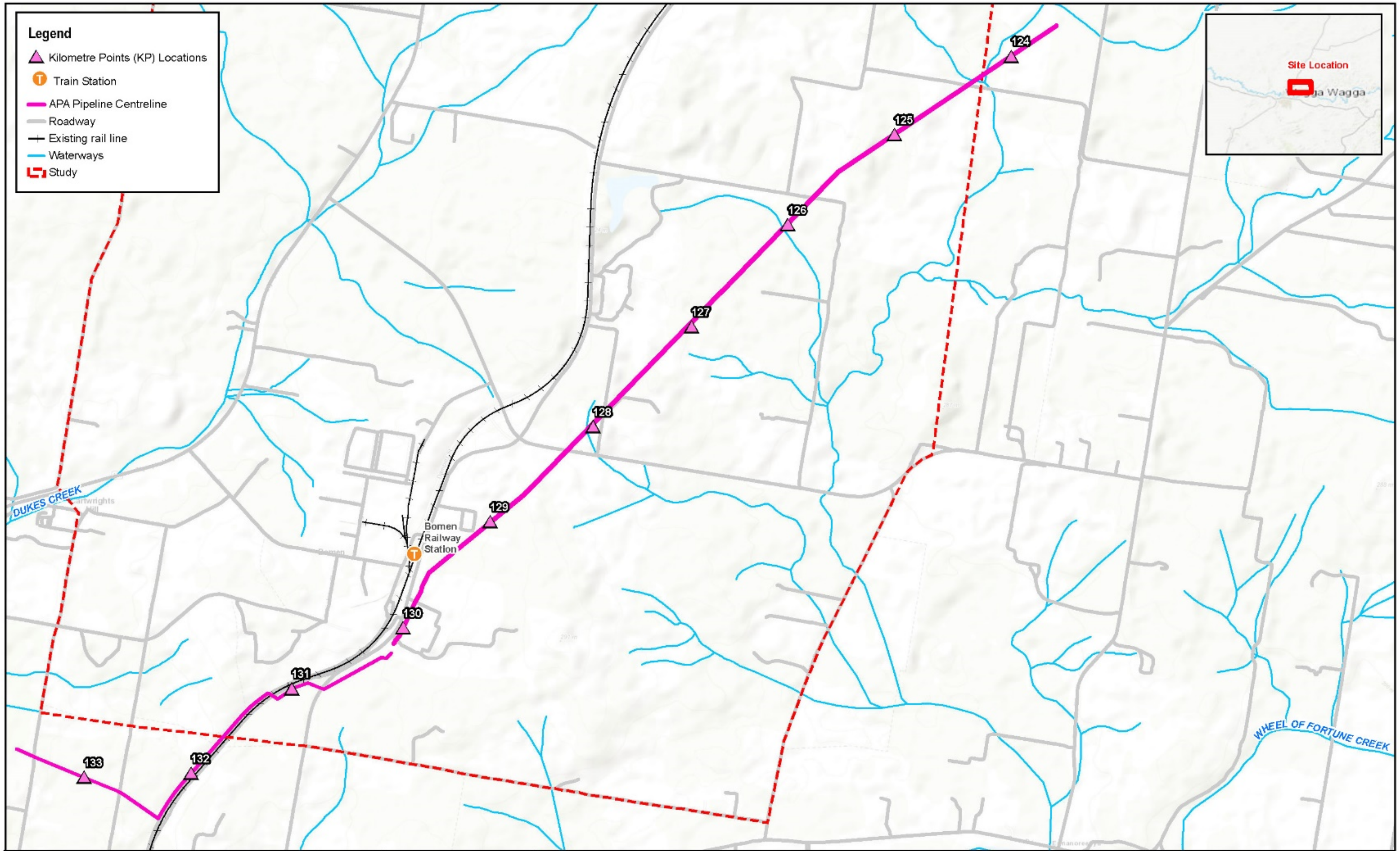
*Note measurement length is applied to either side of the pipeline.

APA has advised that there is no limit on supplying future growth from development within the SAP area and will be able to customise and augment to match demand requirements as they change.

GAS DISTRIBUTION NETWORK

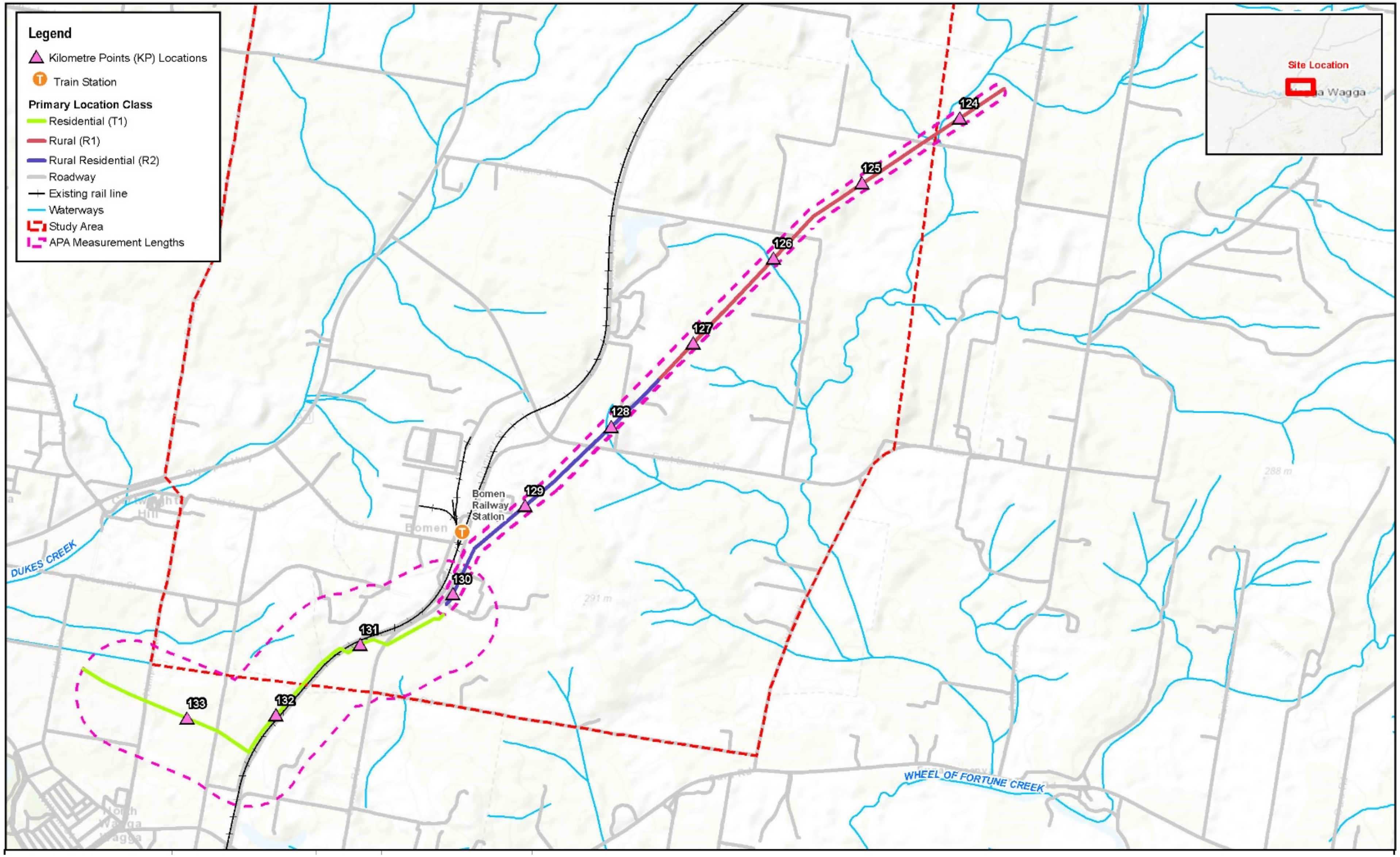
The Wagga Wagga gas network is a distribution pipeline located in southern NSW. The pipeline is operated by Australian Gas Networks (AGN – formerly known as Envestra) and is owned by the Cheung Kong Infrastructure. The network is approximately 690 km in length and delivers gas to around 23 800 customers. The network's throughput is 7.33 PJ/year. The network covers Wagga Wagga and its surrounds including the neighbouring town of Uranquinty as shown in Figure 2.12. It is connected to the Moomba to Sydney Pipeline (MSP) via the Young to Wagga Wagga lateral and is also connected to the Victorian Transmission System via 'the Interconnect'. Both transmission pipelines are owned and operated by the APA Group.

At this present time, it is unknown whether there is a limit within the gas distribution network for supplying future growth from development within the SAP area.



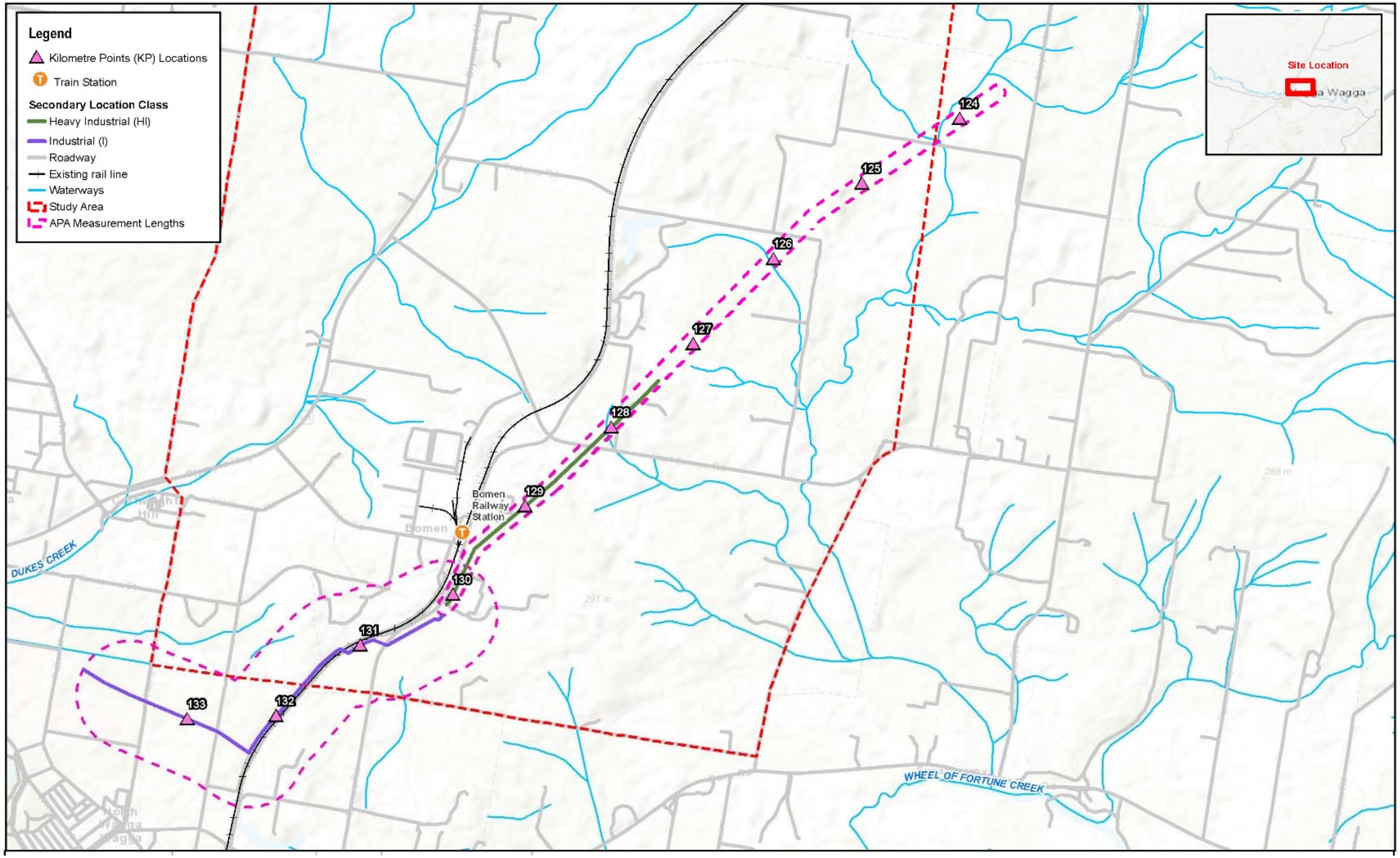
Source: WSP and APA Transmission

Figure 2.9 Existing gas transmission infrastructure



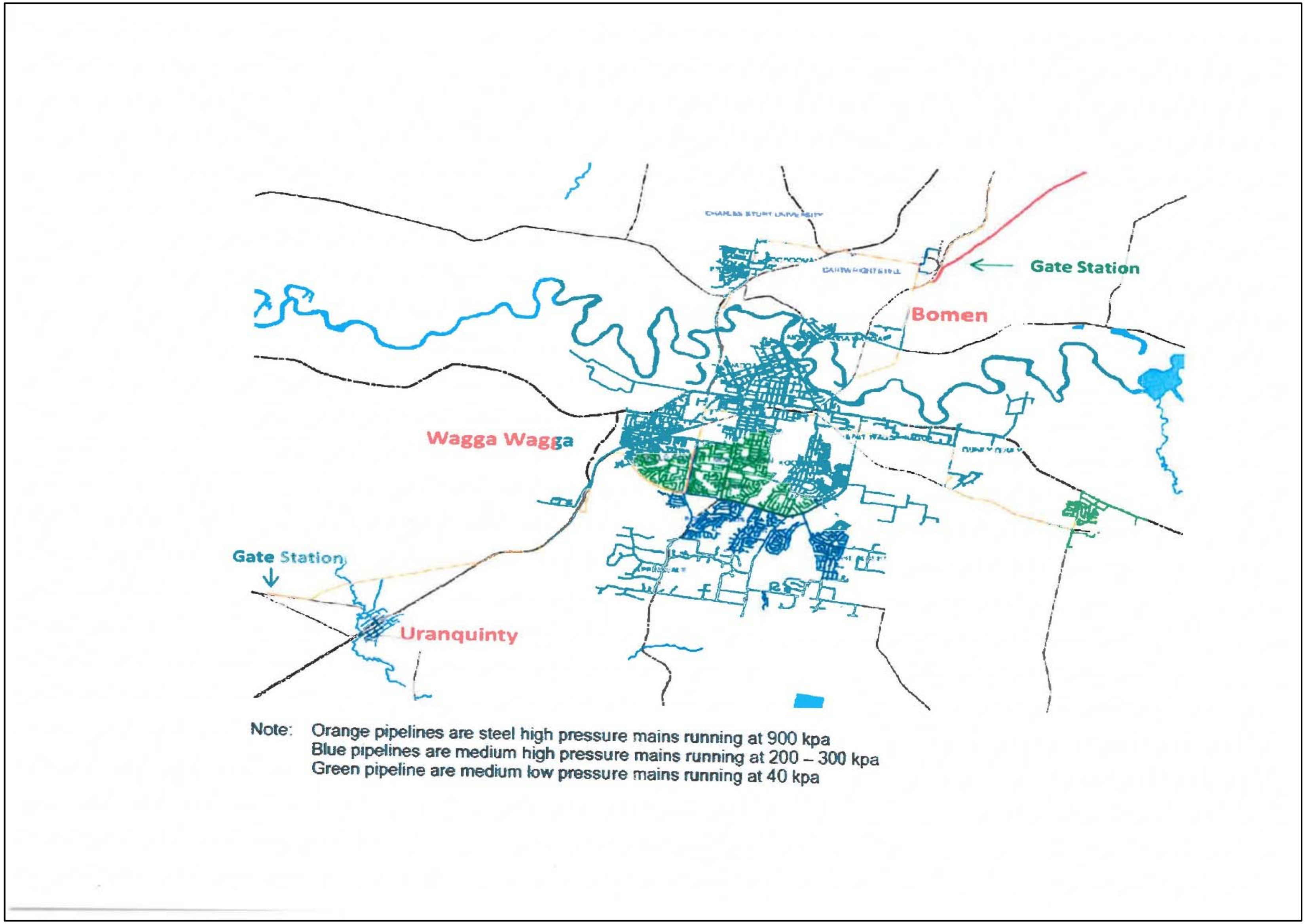
Source: WSP and APA Transmission

Figure 2.10 Existing gas transmission infrastructure with primary location class type



Source: WSP and APA Transmission

Figure 2.11 Existing gas transmission infrastructure with secondary location class type



Source: APA Networks

Figure 2.12 Existing gas distribution infrastructure

2.1.6 TELECOMMUNICATIONS AND INTERNET SERVICES

This preliminary analysis draws from publicly available information (DBYDs), information from utility providers as well as team knowledge of the assets within the area.

2.1.6.1 TELECOMMUNICATIONS INFRASTRUCTURE

OPTUS

Optus has underground cables which cross within the SAP area, along the Olympic Highway extending all the way to Oura Road (See Figure 2.13).

Telstra

Telstra has a fibre network that crosses within the SAP area, like the Optus network which follows along the Olympic Highway all the way to Oura Road (See Figure 2.13).

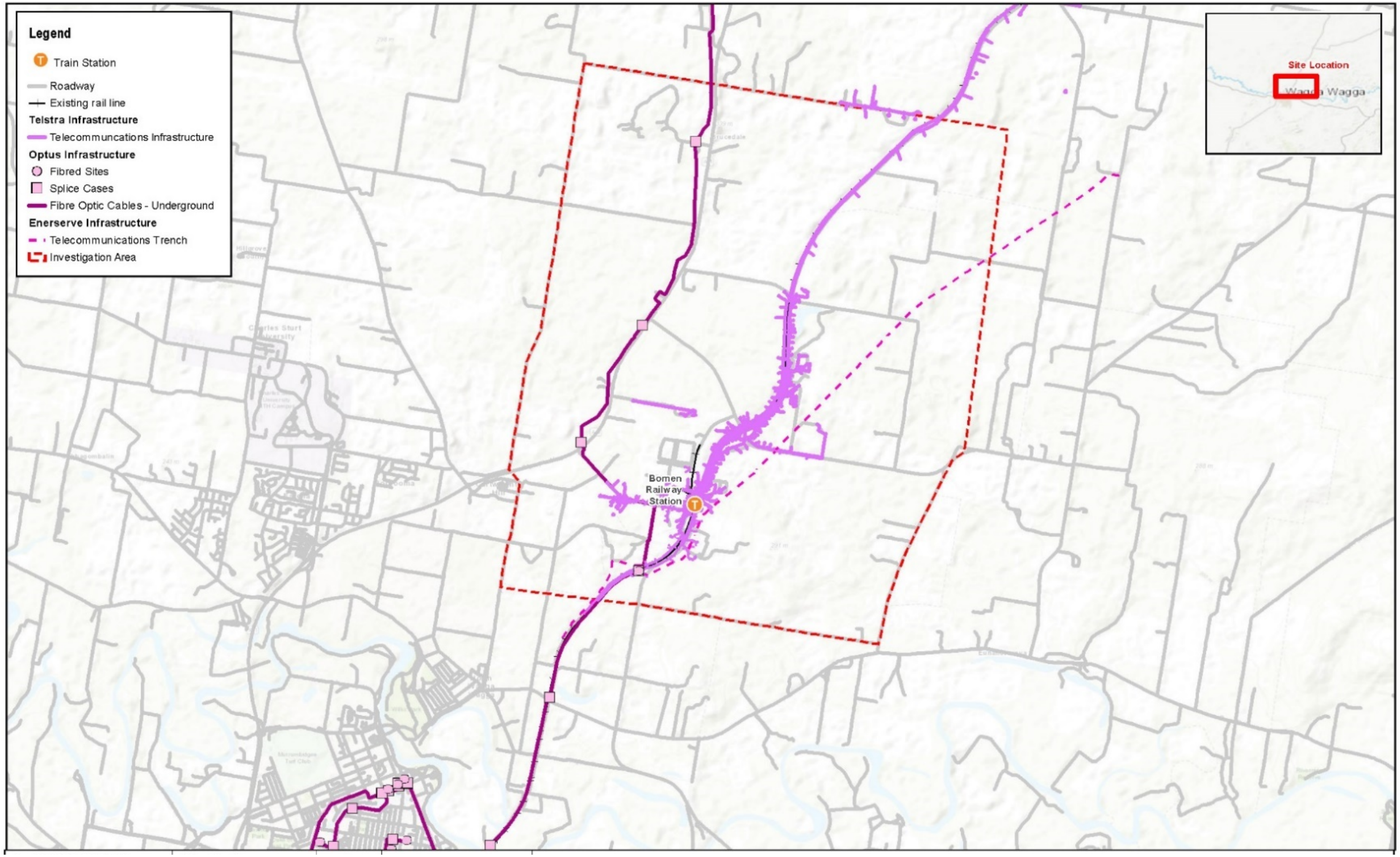
2.1.6.2 INTERNET INFRASTRUCTURE

AAPT

AAPT has advised that they have an asset known the main NBN cable between Brisbane, Sydney and Melbourne run by Powertel Networks. This asset extends through the SAP investigation area from the North-east to the South-west. It is not able to be used to service the SAP investigation area.

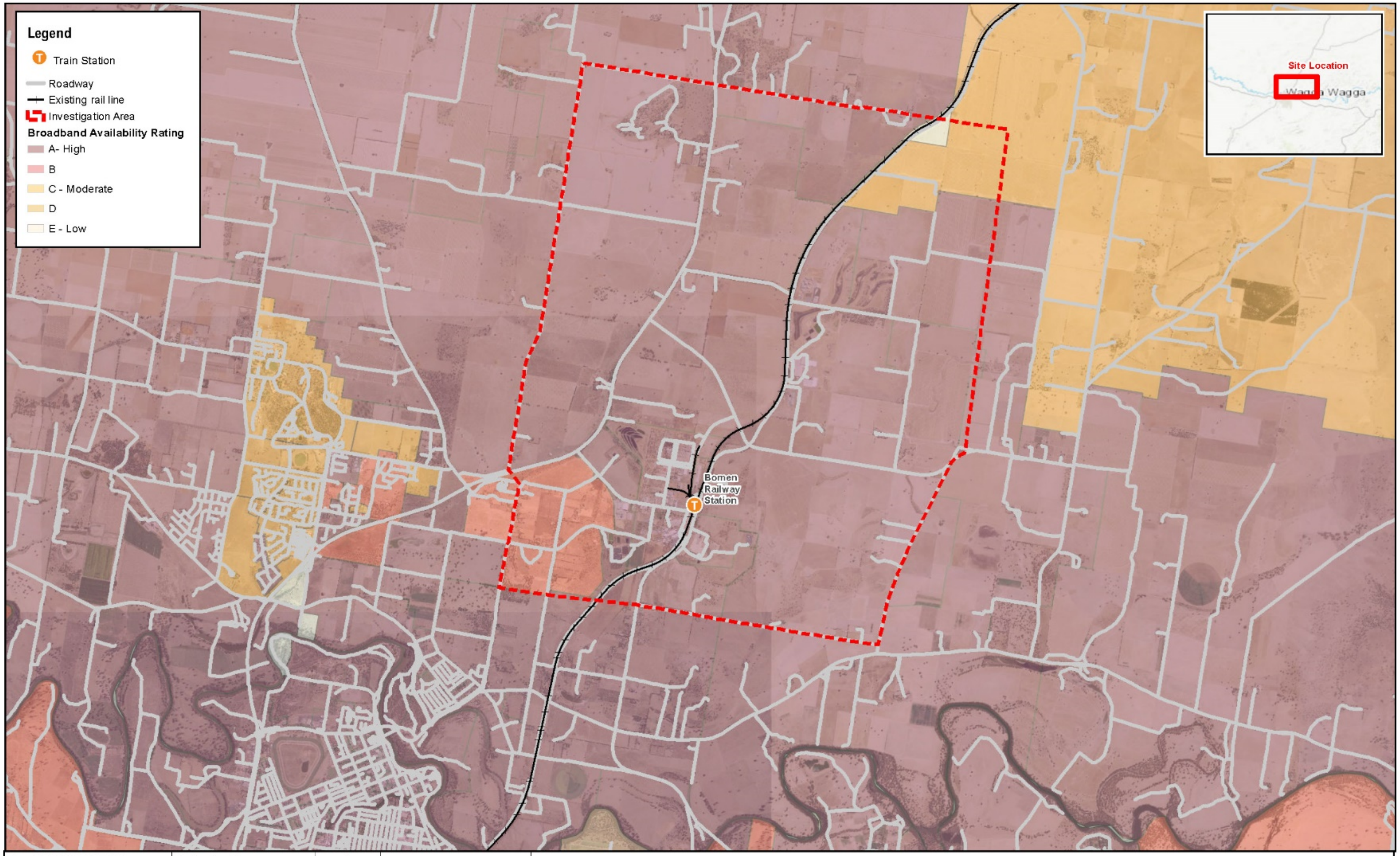
NBN

NBN is present in the area, servicing the residential/commercial city of Wagga Wagga with Fixed-line broadband. The surrounds are generally serviced by the NBN Fixed Wireless broadband service although there are areas within the SAP investigation receiving little to no coverage. Wagga Wagga has the potential for 5G capability although this has not yet been implemented now. Figure 2.13 and Figure 2.15 illustrate the broadband availability and quality around the SAP investigation area.



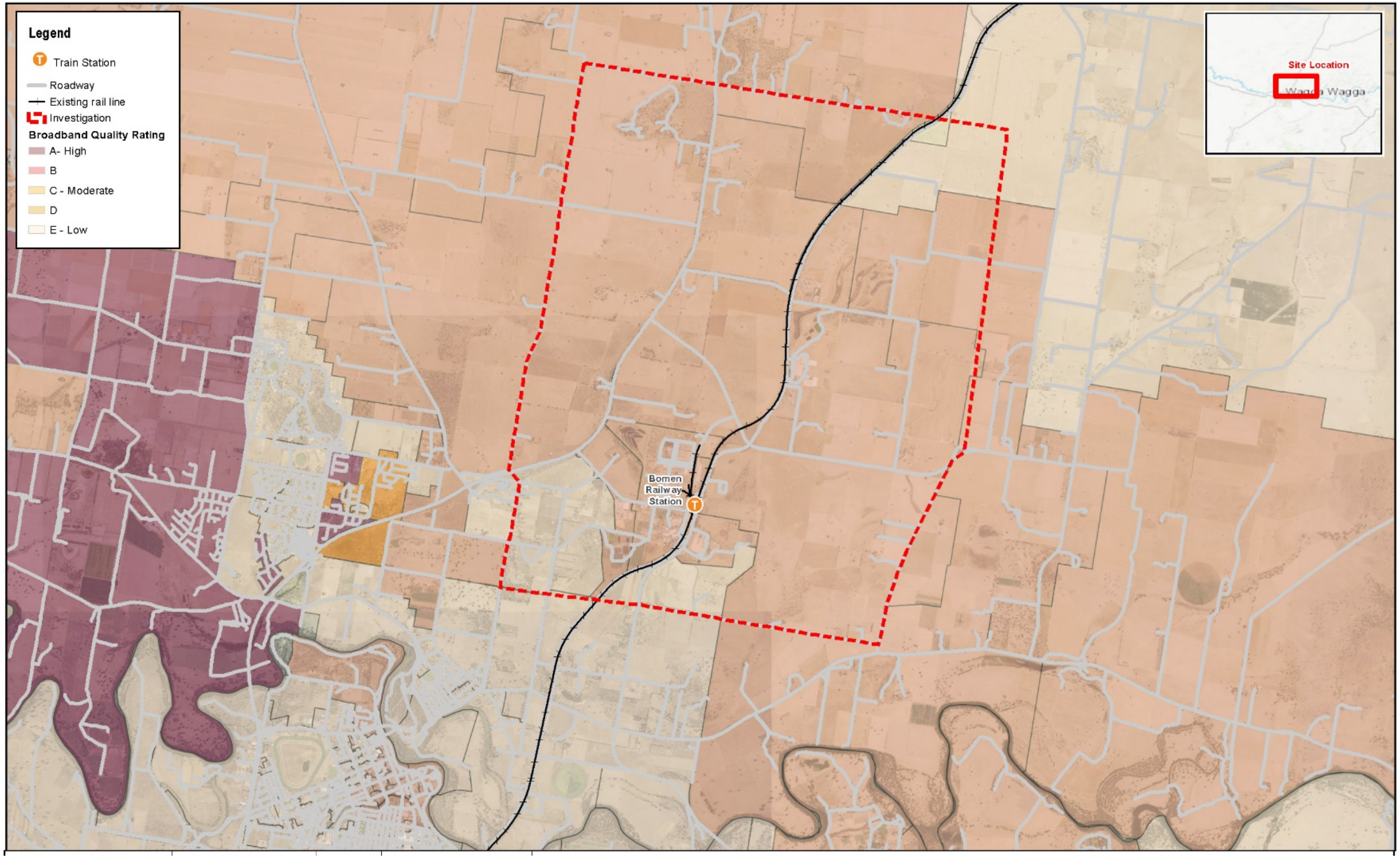
Source: WSP, AAPT, OPTUS and Telstra

Figure 2.13 Existing telecommunication assets



Source: WSP and Department of Communications and the Arts

Figure 2.14 Existing internet availability



Source: WSP and Department of Communications and the Arts

Figure 2.15 Existing internet quality

2.1.7 WASTE AND RESOURCES RECOVERY

The population of Wagga Wagga City Council (WWCC) is projected to gradually grow over the next 10 years. Waste generation is projected to grow at between 1.5% and 3% depending on the population growth rate.

2.1.7.1 OPERATIONS AND FACILITIES

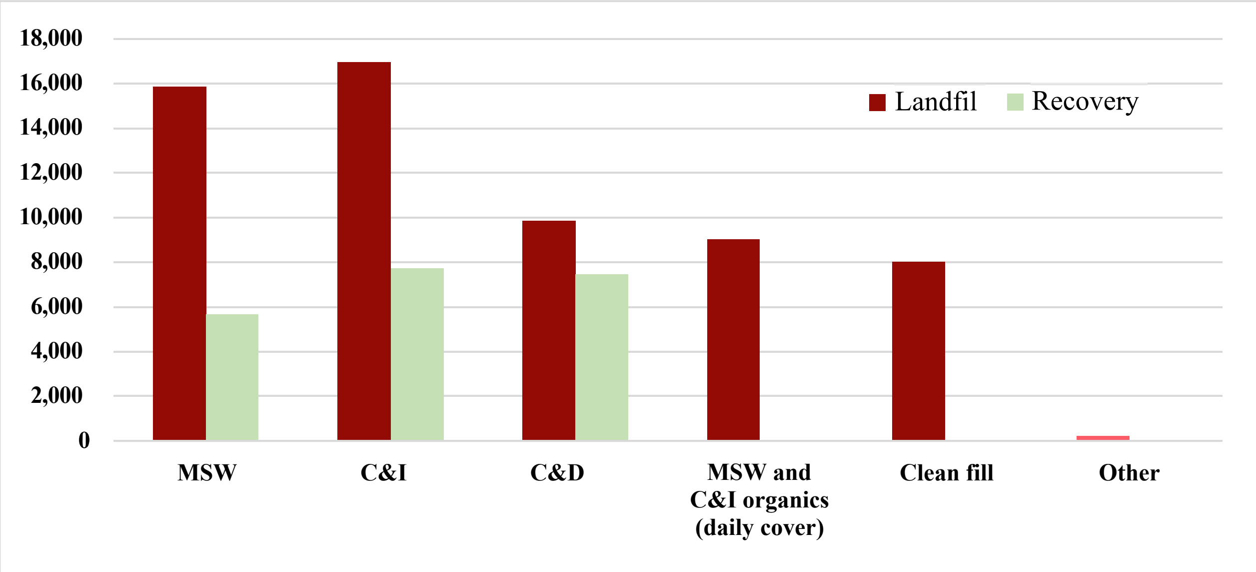
WWCC provides a kerbside collection service to Wagga Wagga and surrounding suburbs, as well as the villages of Oura, Mangoplah, Ladysmith and Tarcutta. In 2017, this amounted to more than 23,000 households, or almost 90% of all households in the Wagga Wagga LGA. Residential areas are provided with a waste, recycling and garden organics kerbside service. In addition, all residents have access to a self-haul and drop-off service at Gregadoo Waste Management Centre and seven rural transfer stations. Some business may have Commercial Waste Service Agreements. This is an optional agreement for those within the Bomen Industrial Park who may choose independent or third-party waste service providers. Table 2.5 summarises the domestic waste collection services provided by WWCC.

Table 2.5 Summary of WWCC municipal solid waste services in 2017

<table>
<tr><th>COLLECTION SERVICE (AS OF APRIL 2018)</th><th>TONNES MANAGED (2016)</th><th>BIN SIZE</th><th>BIN-LID COLOUR</th><th>SERVICE FREQUENCY</th><th>OPERATOR</th></tr>
<tr><td>Residual</td><td>17,740 (incl. FO)</td><td>120 L</td><td>Red</td><td>Fortnightly</td><td rowspan="3">SUEZ
(JJ Richards and Sons Pty to take over starting 2 April 2018)</td></tr>
<tr><td>Recycling</td><td>5,658</td><td>240 L</td><td>Yellow</td><td>Weekly</td></tr>
<tr><td>FOGO</td><td>8,060 (GO only)</td><td>240 L</td><td>Green</td><td>Weekly</td></tr>
<tr><td>Household Waste</td><td colspan="5">Hard/Bulk waste service to commence in 2017 – details to be determined – Currently can be dropped off at Gregadoo Waste Management Centre (GWMC) on four days every year.</td></tr>
<tr><td>Drop off residual</td><td>Included above</td><td colspan="2" rowspan="2">Network of 7 TS + GWMC</td><td rowspan="2">Facility opening hours</td><td rowspan="2">WWCC owned and supervised. Contractor removes waste. WWCC removes cardboard, paper, bottles cans, and styrene.</td></tr>
<tr><td>Drop off recyclables</td><td>Included above</td></tr>
</table>

Source: Wagga Wagga City Council

WWCC owns and operates a large capacity landfill facility at Gregadoo Waste Management Centre (GWMC) along with seven rural transfer stations whose opening hours vary. The GWMC is currently also taking in Junee Council's waste, amounting to less than 1,000t per year. In 2016/17, WWCC generated more than 80,000 tonnes of waste of which, 20,800 tonnes (26%) was recycled and the remainder sent to landfill for disposal. Figure 2.16 shows the tonnes disposed and recovered for each of the main waste streams.



Source: Wagga Wagga City Council

Figure 2.16 Fate of waste generated within WWCC in financial year 2016/17

Source: Wagga Wagga City Council

Figure 2.17 Map of current waste facilities in WWCC illustrates the location of the landfill and seven transfer stations

Table 2.6 provides an outline of the waste accepted by WWCC and its fate upon arrival at a waste facility. WWCC's waste facilities accept a wide range of wastes, including commercial and industrial wastes, construction and demolition waste, scrap metal and special wastes (i.e. household hazardous wastes, sump oil and empty gas bottles). This waste is often stored at each facility and transported for recycling when a sufficient amount has been stockpiled to justify the relevant transportation and processing costs. GWMC landfill currently accepts small amounts of asbestos (on average, less than 200 ton per year).

Table 2.6 Summary of waste accepted, stored and transported from WWCC's waste facilities

FACILITY	FACILITY TYPE	LANDFILLED AT SITE	SHORT-TERM STORAGE	LONG-TERM STORAGE (SEVERAL MONTHS OR LONGER)
Gregadoo Waste Management Centre	Landfill and resource recovery centre	General Waste, green organics, VENNM, asbestos	Paper and cardboard, glass, mixed plastic, aluminium, steel, liquid paperboard, e-waste, engine oil, batteries, gas bottles, mattresses, Styrofoam and paint	Oil Masonry Tyres Empty paint tins Empty gas bottles Scrap Metal (incl. electrical equipment)
Collingullie Currawarna Galore Humula Mangoplah Tarcutta Uranquinty	Transfer Stations	N/A	General Waste Paper/cardboard, glass, mixed plastic, aluminium, steel and liquid paperboard	N/A

Source: Wagga Wagga City Council

2.1.7.2 WAGGA WAGGA LIVESTOCK MARKETING CENTRE

The Wagga Wagga Livestock Marketing Centre (LMC) is NSW’s premier cattle and sheep selling centre. The LMC was established in 1979 and is within 15 minutes of the Wagga Wagga city centre and located within the SAP investigation area. It has played a significant role in the economic development of the City of Wagga Wagga and the broader region. With large numbers of animals concentrated in an area, odour and waste are inevitable by-products. How these are managed has important consequences for animal welfare, occupational health and safety (OHS) and the environment.

The Wagga Wagga LMC is identified to be performing adequately in terms of its environmental compliance. Town water is used for wash down of yards and trucks. All water is collected in settlement ponds at the back of the saleyards. The saleyards are extremely clean and well-kept; pens are cleaned out frequently and efficiently and a publicly available pollution incident response management plan is in place. There is an estimated 40–50 sheep and 6–8 cows which pass away each week. On average the LMC moves around 1.8 million sheep and 200,000 cattle each year. The LMC also has a projected production of 30 tonnes of manure each year.

3 LAND USE SCENARIOS AND TESTING

The following section of the report provides a summary of the scenario testing that was completed.

Following the Short Enquiry by Design workshop held on 8 and 9 August 2019, three land use scenarios were developed and refined by Master Plan consultants, Jensen Plus. These scenarios were the result of testing of ideas, solutions and concepts at a precinct-wide level across all technical streams. It also considered land use, transport, infrastructure, environmental, social and economic matters that the Master Plan must address. They include:

- Scenario 4 High growth scenario, low amenity industries close to RiFL, high amenity west of Olympic Highway.
- Scenario 5 Compact scenario, commercial precinct along Bomen Road.
- Scenario 7 High growth scenario, development directed north and north-east.

Each of the three scenarios tested identifies the required infrastructure upgrades that would be required to support development for each of the respective structure plans. This information was subsequently used at the Full Enquiry by Design workshop to inform the preferred structure plan.

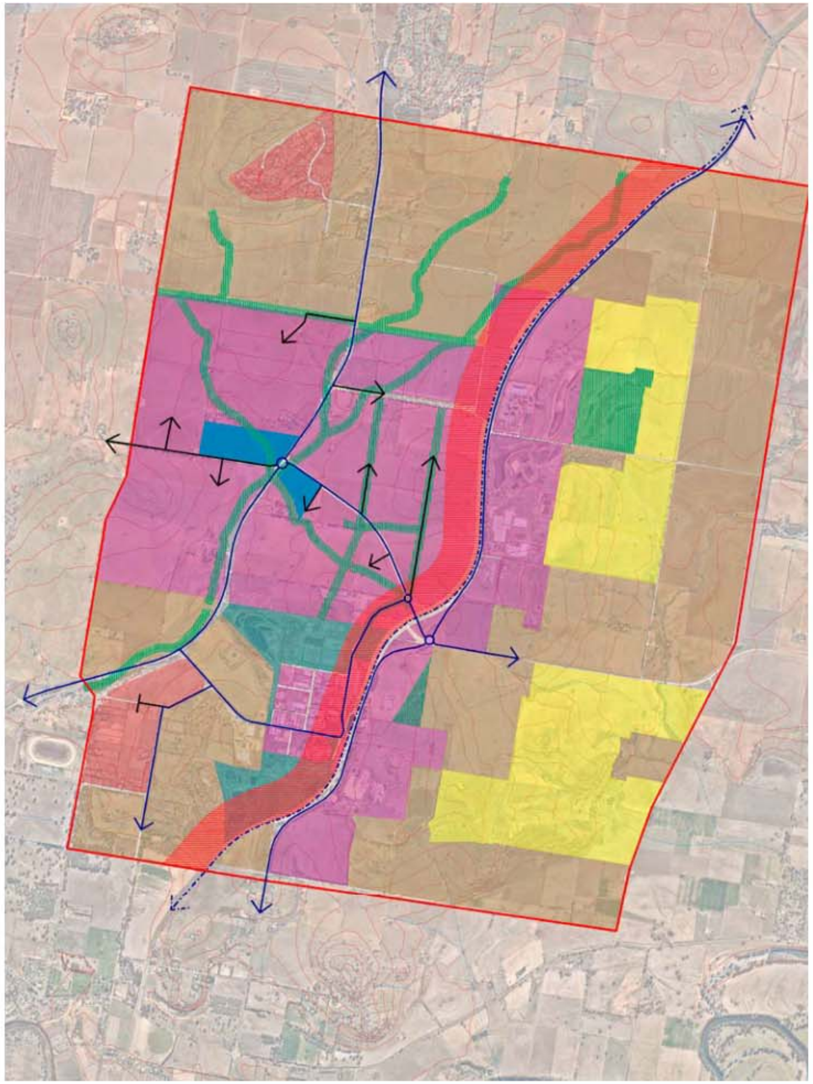
For detailed discussion about each precinct scenarios, please refer to Jensen Plus report (Wagga SAP A.3.A Concept Scenario Options and Workshop Summary).

3.1 LAND USE MAPS

The land use maps for the three scenarios (4, 5 and 7) are shown overleaf in Figure 3.1, Figure 3.2 and Figure 3.3 respectively.

Scenario 4

"Scenario 4 is a 'high growth' scenario featuring a central area for low amenity 'stack' industries, close to the RiFL hub. A Byrne Road industry cluster develops, along with green corridors, and a new area of high amenity tech and clean industries to the west of Olympic Highway."



Sub Precinct	ha
Regional Enterprise	1276
Intensive Liverstock Agriculture	112
Commercial Gateway	37
Solar	476
Landscape Protection	1911
Residential	118
Sub Total	3930
No sub precinct (e.g. existing road reserves)	250
Total	4180

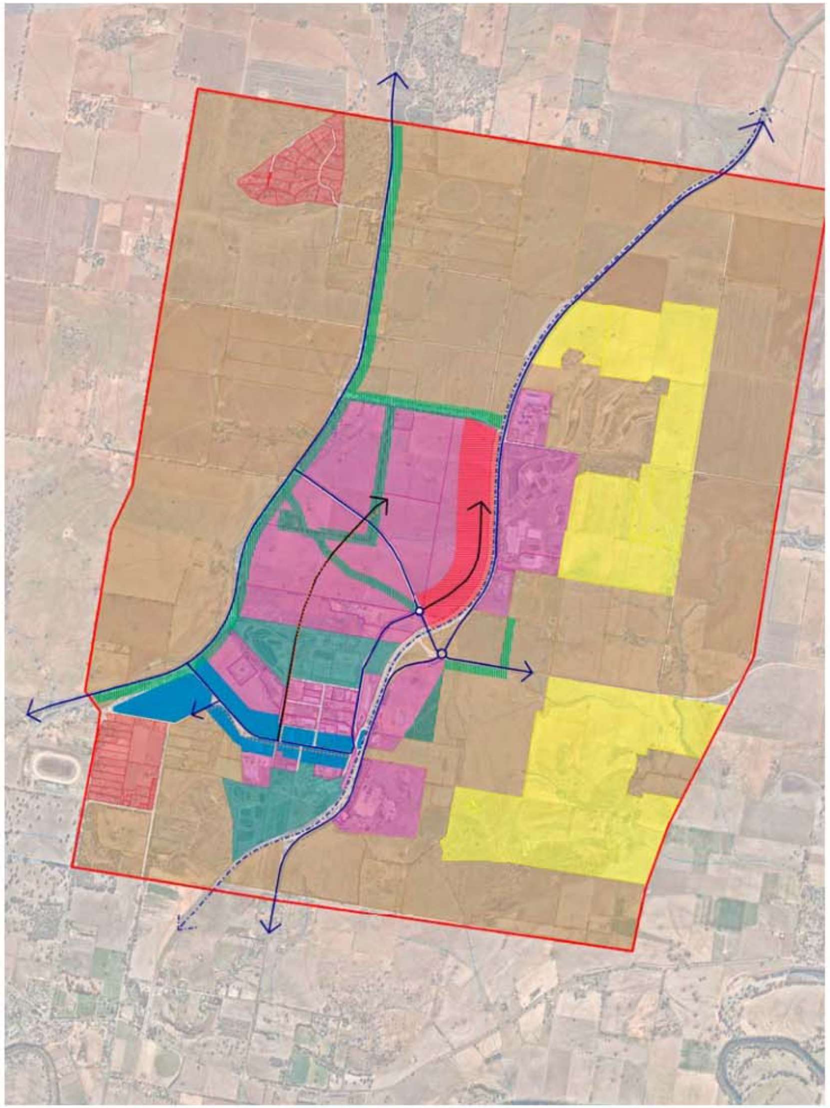
Overlay	ha
Rail Terminals	299
Green Infrastructure	249
Large Allotments	0

Source: *Wagga Wagga Special Activation Precinct A.3.A Concept Scenario Options (incorporating Short EbD Workshop Summary), Jensen Plus, August 2019*

Figure 3.1 Scenario 4 land use map and yields

Scenario 5

“Scenario 5 is a ‘compact’ scenario focussed on developing land north and south of Merino Drive. A Commercial Gateway precinct is also included along Bomen Road.”



Sub Precinct	ha
Regional Enterprise	647
Intensive Liverstock Agriculture	111
Gateway	63
Solar	502
Landscape Protection	2511
Residential	96
Sub Total	3930
No sub precinct*	250
Total	4180

Overlay	ha
Rail Terminals	68
Green Infrastructure	134
Large Allotments	0

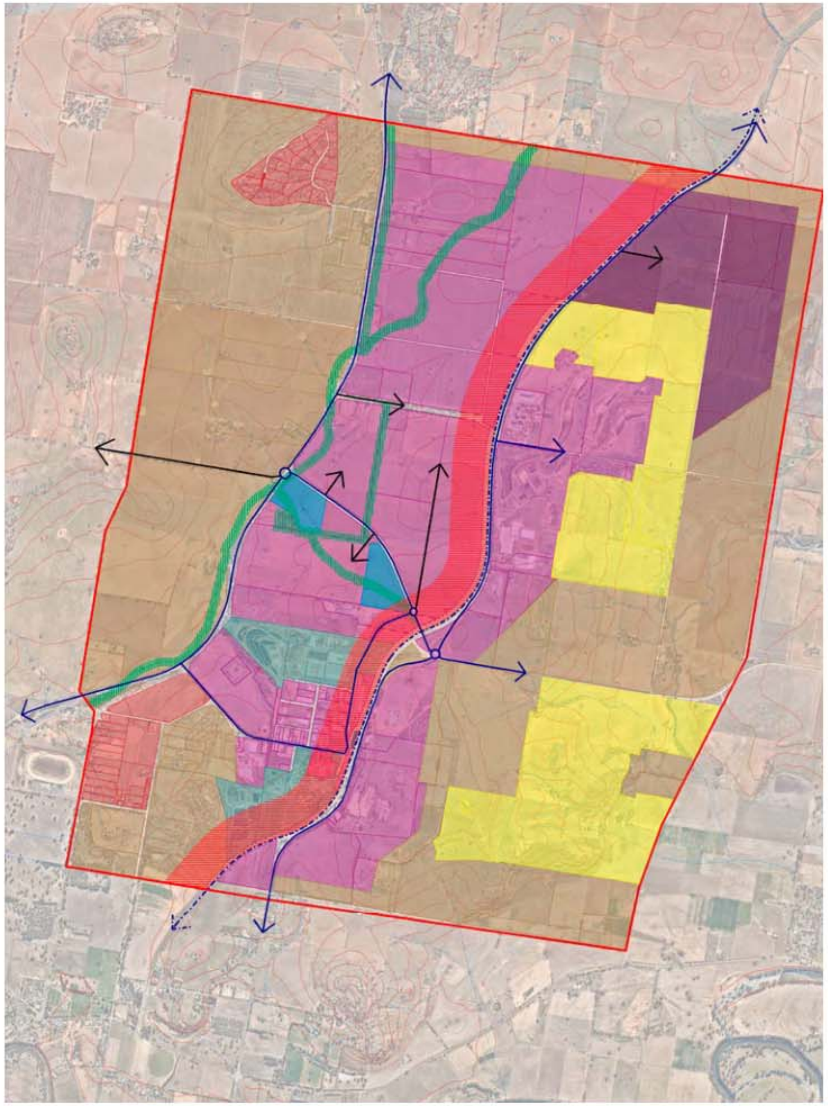
JENSEN PLUS Planning Landscape Architecture Urban Design Social Planning

Source: *Wagga Wagga Special Activation Precinct A.3.A Concept Scenario Options (incorporating Short EbD Workshop Summary), Jensen Plus, August 2019*

Figure 3.2 Scenario 5 land use map and yields

Scenario 7

"Scenario 7 is a 'high growth' scenario where development is directed north and north-east. It incorporates industry zoned land north-east of Byrnes Road and also new land along Olympic Highway. Additional rail terminals are included north of RiFL."



Sub Precinct	ha
Regional Enterprise	1508
Intensive Liverstock Agriculture	114
Gateway	34
Solar	502
Landscape Protection	1653
Residential	119
Sub Total	3930
No sub precinct*	250
Total	4180

Overlay	ha
Rail Terminals	299
Green Infrastructure	143
Large Allotments	219

JENSEN PLUS Planning Landscape Architecture Urban Design Social Planning

Source: *Wagga Wagga Special Activation Precinct A.3.A Concept Scenario Options (incorporating Short EbD Workshop Summary), Jensen Plus, August 2019*

Figure 3.3 Scenario 7 land use map and yield

3.2 METHODOLOGY AND ASSUMPTIONS FOR DEMAND CALCULATION

3.2.1 METHODOLOGY

For each infrastructure or service type WSP have completed a future demand analysis to determine the required infrastructure and service upgrades likely to be required within the Wagga Wagga SAP area. This future demand analysis is based on a consideration of the different land use types being proposed by the scenarios being considered. The future demand calculation was estimated based on the following process:

- for each land use type WSP applied a future demand rate based on either historical information from similar development types or reference relevant standards or code as prescribed by specific utility authorities
- unless sufficient level of detail or justification to use historical/similar development data is available, the standards/codes figures adopted by the authority will be adopted
- assessment of future demand loadings for each scenario to provide advice on the infrastructure and service upgrades likely to be required to support the growth.

WSP have liaised with each utility authority to ensure the future demand calculations meet expectations. This will ensure that the analysis completed by the scenario testing aligns with the future demand calculation process applied for each utility authority, enabling these authorities to inform their own planning processes.

3.2.2 ASSUMPTIONS AND LIMITATIONS

3.2.2.1 FUTURE DEMAND FORECASTING

Several assumptions have been used in establishing future demand factors. Future demand assumptions have been shared with the Ecological Sustainable Development Consultant (dsquared Consulting) and WSP's Renewable Energy Teams to ensure respective calculations are based on the same set of assumptions. Specific assumptions per services are further detailed in Section 3.3. The following table provides a summary of our future demand considerations and assumptions.

Table 3.1 Summary of future demand assumptions and considerations

AUTHORITIES	FUTURE DEMAND DATA CONSIDERATIONS AND ASSUMPTIONS
Water Supply – Riverina Water County Council (RWCC)	— In consultation with Riverina Water WSP have confirmed that Water Directorate Section 64 Determination of Equivalent Tenements Guidelines are to be used for developing future demands to the proposed land use types and areas. — RWCC's applicable local factors to be applied to the standard ET figures are 3.8kL/ET (peak day) and 0.7 x local factor. — The future demand calculations will be used to identify the required infrastructure to service the Wagga Wagga SAP area. Major upstream headworks requirements are not included in this assessment; however, WSP have informed the requirement to further investigate this if this is likely to be required.
Waste Water – Wagga Wagga City Council (WWCC)	— WWCC have provided guidance on the future loading parameters to be adopted, which will align with their revised development servicing plan for wastewater. These have been applied to the proposed land use types and areas. — The future loading calculations have been used to identify the required infrastructure to service the Wagga Wagga SAP areas. Major downstream headworks requirements are not included in this assessment, however WSP have informed the requirement to further investigate this if this is likely to be required.

AUTHORITIES	FUTURE DEMAND DATA CONSIDERATIONS AND ASSUMPTIONS
Electrical Transmission and Distribution – Transgrid and Essential Energy	— Essential Energy confirmed to calculate future energy demands they would take into account historical information together with known developments. — Require that future demand calculations follow the AEMO methodology where possible.
Gas – APA Gas (transmission) and AGN (Distribution)	— In consultation with APA and AGN they indicated that estimating future demand consumption is difficult therefore they do not typically strategically plan rather they provide infrastructure as required to support development. — Future demand calculations have been based on historical information and known development types.
Telecommunications and Internet – Various	— In consultation with Grex Consulting Group who are delivering on the NSW Regional Connectivity program the following approach has been taken: — Grex have completed a concept design and costings to provide a backhaul from the proposed Wagga Wagga Data hub into the Wagga Wagga SAP area. — Grex has also completed a concept design and costings to provide connectivity to the existing developed area in Bomen. — Grex will provide the above information to the Wagga Wagga SAP team to inform the infrastructure scenario testing. — WSP will complete a concept design and costings for the three precinct scenarios. The methodology will be consistent with the approach taken by Grex. — The combined view of the above will inform the future requirements for each of the precinct scenarios being considered.
Waste Services – Wagga Wagga City Council	— In consultation with WWCC WSP confirmed that Council do not rely on any specific standards to calculate future waste demands and in the past have reacted to growth rather than planned looking forward — WSP will calculate future waste generation on industry standards including the national waste data set provided by the Australian Government Department of Environment. — This will be used to inform options for consideration for each of the precinct scenario.

3.2.2.2 LAND USE

For the purpose of future demand forecasting, we assumed that the land use yields illustrated in Figure 3.1, Figure 3.2 and Figure 3.3 are for ultimate development scenarios which are assumed to occur at 2060.

3.3 SUMMARY OF SCENARIO TESTING

3.4 WATER AND WASTEWATER

3.4.1 MAJOR INFRASTRUCTURE REQUIREMENTS – WATER

3.4.1.1 RECOMMENDATIONS AND OPPORTUNITIES

Following the future demand analysis for each land use areas within the proposed Wagga Wagga SAP area, the following proposed water headworks items have been identified. Figure 3.4 shows regional context map of the North Wagga Supply System.

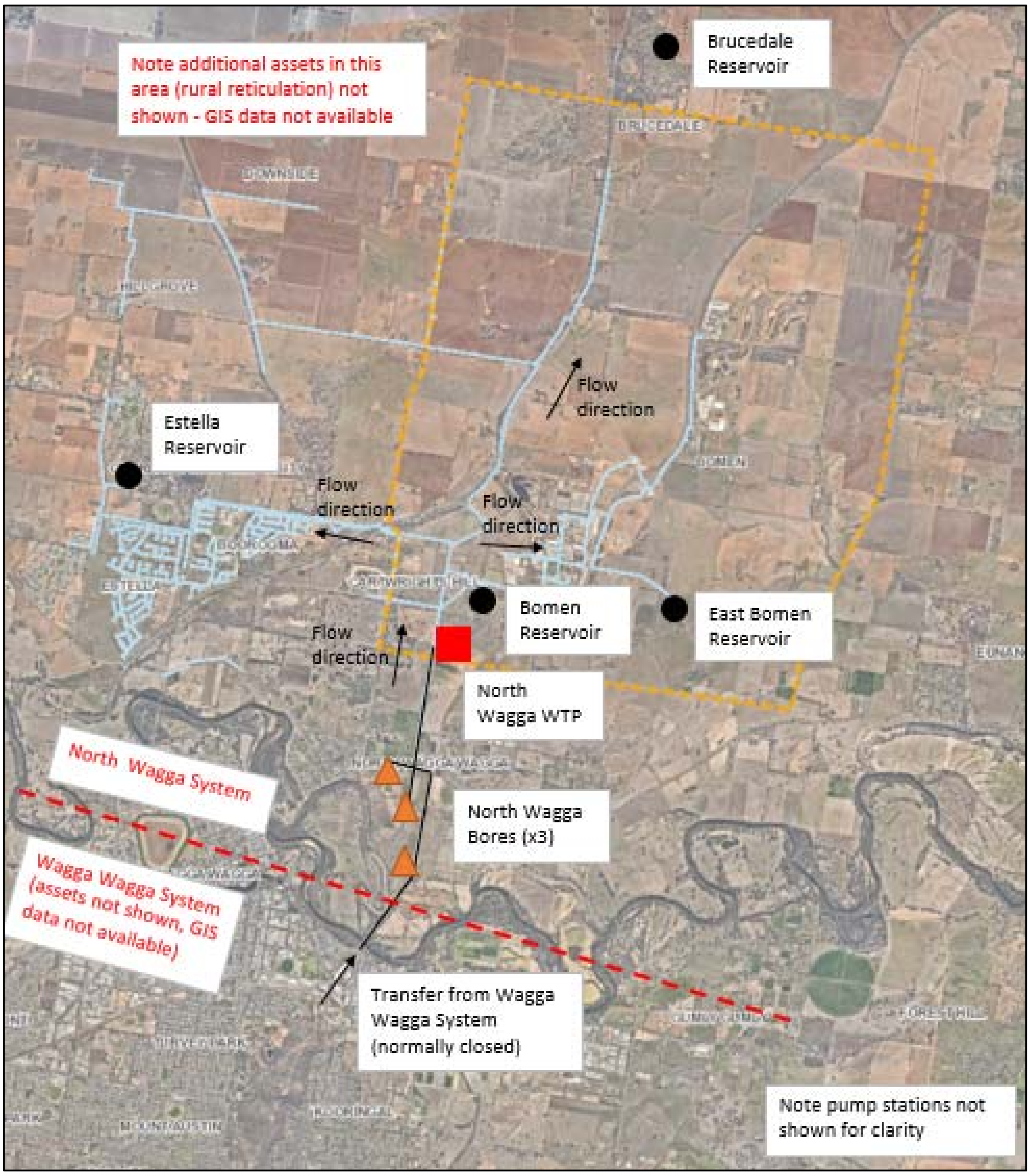


Figure 3.4 Water network – regional context map

1 North Wagga System source upgrades

The need for additional source capacity to accommodate growth is identified in Riverina Water (RWCC's) 2019 Draft Integrated Water Cycle Management (IWCM) Issues Paper as required within the next five years. Three potential options are identified in the Draft IWCM Issues Paper for investigation, as below:

- Augment source and treatment capacity for the North Wagga System
- Formalize the interconnection with the Wagga Wagga System
- Remove Estella Zone from the North Wagga Supply System.

It is noted that the assessed water demand of the proposed Wagga Wagga SAP (ranging between approx. 40–70 (Million Litres per day [ML/d] for the three scenarios) significantly exceeds the extent of growth in this area (East Bomen) which is assumed in the draft IWCM Issues Paper (approx. 15 ML/d) and the current North Wagga System source capacity (approx. 18 ML/d).

In addition to infrastructure capacity, additional water allocation will be required to supply the proposed Wagga Wagga SAP study area. Refer to the draft IWCM Issues Paper for details regarding RWCC's water allocation, which has not been investigated as part of this (network infrastructure) task.

2 Completion of Riverina Water's (RWCC) Integrated Water Cycle Management (IWCM) Issues Paper

This document is currently in draft format and stakeholder consultation is being undertaken by RWCC prior to finalizing the document. Inputs from the proposed Wagga Wagga SAP project are recommended to be considered.

WSP represented WWCC and DPIE at RWCC Project Reference Group informing the RWCC IWCM process to ensure that the impacts of WWSAP were incorporated into the RWCC planning processes.

3.4.2 MAJOR INFRASTRUCTURE REQUIREMENTS – SEWERAGE

3.4.2.1 RECOMMENDATIONS AND OPPORTUNITIES

The following recommendations relating to major headworks to support the development of the proposed Wagga Wagga SAP are identified. Figure 3.5 shows the proposed sewerage network for the proposed Wagga Wagga SAP.

1 Review and development of Wagga Wagga City Council's (WWCC) strategy for managing industrial trade waste associated with existing and new Intensive Livestock Industry within the Wagga Wagga SAP area.

This should include engineering assessment of the Bomen Industrial Sewerage Treatment Facility (BISTF), more accurately defining the expected wastewater quantity/quality from the Wagga Wagga SAP developments and WWCC's commercial/business case assessment of potential options.

2 Upgrade of the approx. 4.7 km length DN450 common rising main system conveying flow from the proposed Wagga Wagga SAP and Estella area to Narrung St sewage treatment plant (subject to above strategy – Item 1)

Given the significant load assumed for the proposed Wagga Wagga SAP scenarios, upgrades are certainly required. These upgrades are also driven by other growth, particularly the Henwood residential area west of the study area (including the suburb of Estella). These upgrades are already planned by WWCC although specific details of this project including design capacity and timing are unknown.

3 Upgrade of Narrung St Sewage Treatment Plant (subject to above strategy – Item 1)

RWCC have indicated the current treatment plant has capacity issues and constraints, including relating to the site's location in a floodplain. The existing capacity and potential upgrade requirements have not been investigated as part of this (network infrastructure) study.

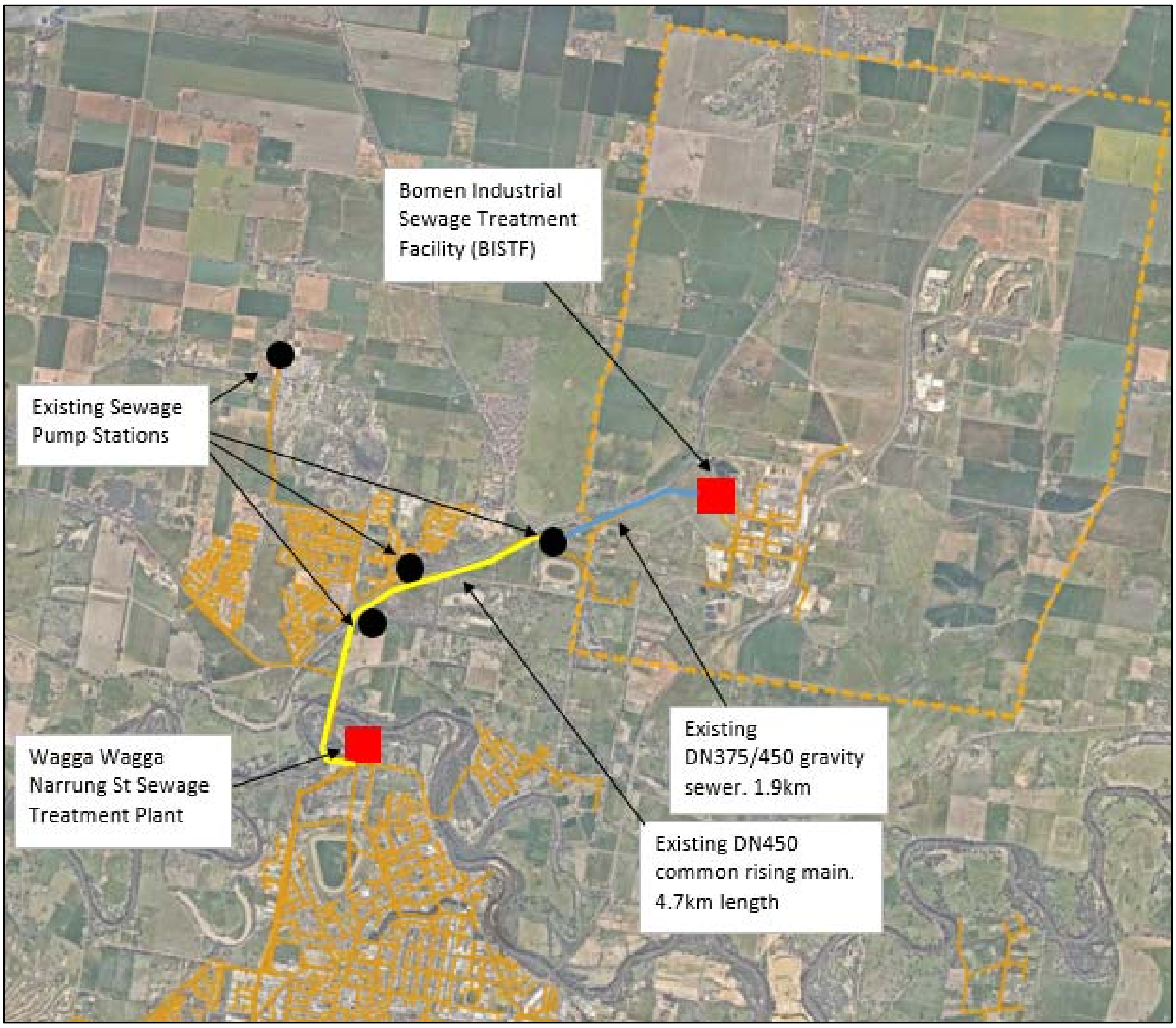


Figure 3.5 Sewerage network – regional context map

4 Upgrade of BISTF Plant (subject to above strategy – Item 1)

WWCC have indicated the BISTF has a capacity of 6ML/d Average Dry Weather Flow (ADWF) of approx. 4 ML/d is currently utilised. This requires further investigation but indicates some or all of the proposed SAP loads within this catchment may be able to be accommodated. Hydraulic capacity during wet-weather also needs to be considered, and no information was available from WWCC regarding this.

Note the ADWF loading to the BISTF for all three scenarios is predicted to be around 2 ML/d, based on the adopted theoretical loading parameters. The discrepancy between this and the above WWCC advice (approx. 4 ML/d) needs to be investigated further (this is potentially due to major customers with extremely high loading).

5 Completion of RWCC's new Development Servicing Plan, Sewer (DSP) and review/development of any interdependencies with the SAP planning

This project is currently in progress and a draft of the updated DSP is expected to be completed late 2019. Inputs from the SAP Project are likely to be relevant to include if available in time.

3.4.3 SCENARIO 4 – SAP WATER INFRASTRUCTURE REQUIREMENTS

The water servicing concept for Scenario 4 is shown in Figure 3.6. A summary of the new infrastructure is provided in Table 3.2, Table 3.3 and

Table 3.4.

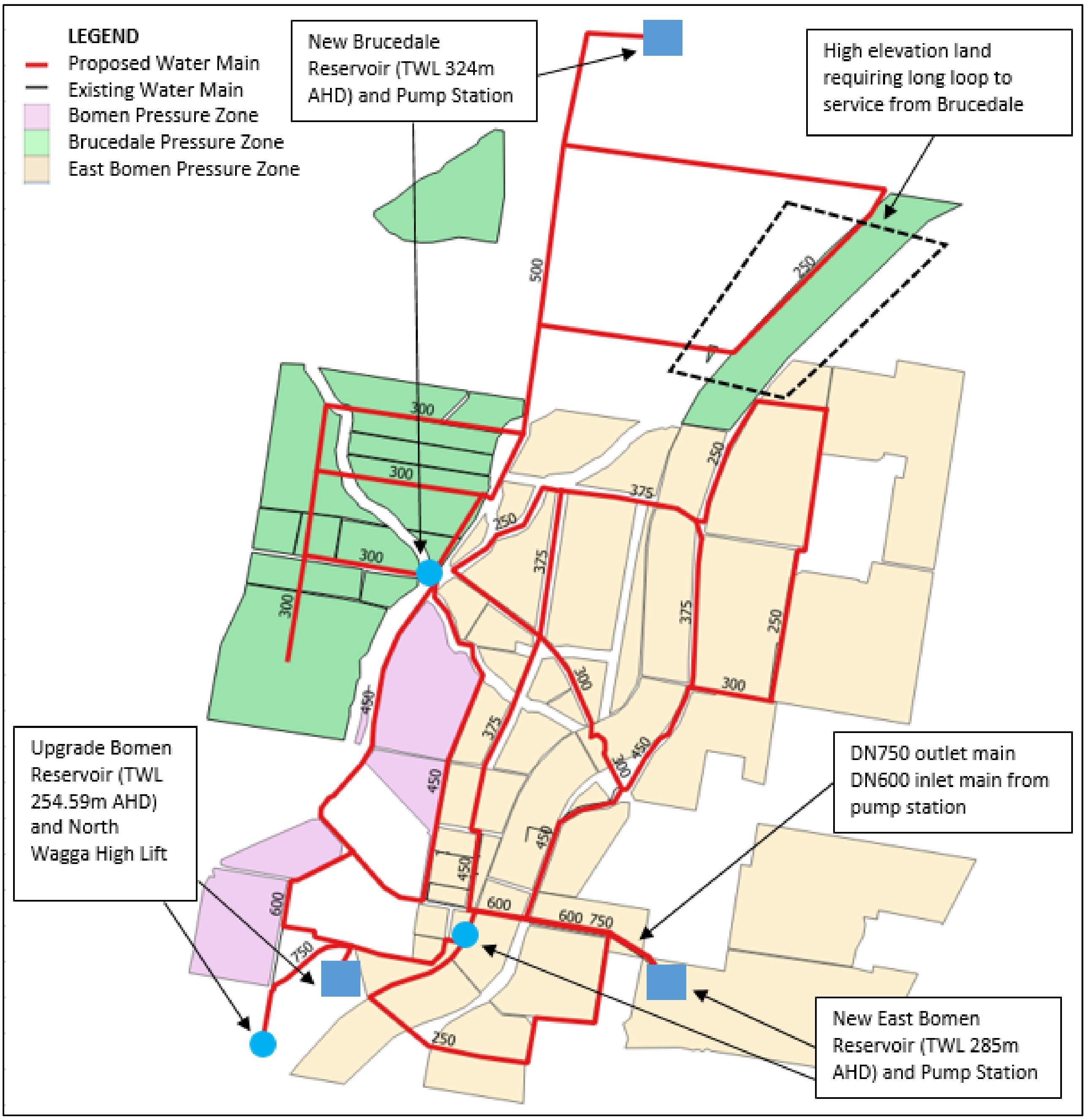


Figure 3.6 Scenario 4 – water servicing concept

Table 3.2. Scenario 4 – Reservoirs

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4R1	East Bomen Reservoir Upgrade	27 ML new ground level concrete tank at existing site to replace the existing 2 tanks. Allow for 100 x 100 m land acquisition Allow for typical associated civil works and connecting pipework.	As the required volume is much larger than the existing tanks (6ML total), it is assumed that retaining these (and matching or managing respective levels) is not preferable. It is assumed at least one of the existing 2 tanks needs to remain in operation during construction.
S4R2	Bomen Reservoir Upgrade	Single new 5 ML ground level concrete tank at existing site. Allow for typical associated civil works and connecting pipework Assume no land acquisition required.	This sizing is for the SAP demand requirements only. Additional upgrades to accommodate external growth are also expected to be required – subject to RWCC strategy.
S4R3	Brucedale Reservoir Upgrade	13 ML new ground level concrete tank at existing site, replacing existing tank. Allow for 100 x 100 m land acquisition Allow for typical associated civil works and connecting pipework.	New ground level concrete tank at existing site. As the required volume is much larger than the existing tank (0.75 ML total), it is assumed that retaining this is not preferable. It is assumed that the existing tank needs to remain in operation during construction.

Table 3.3. Scenario 4 – Pump stations

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4PS1	North Wagga High Lift Pump Station	New pump station to replace existing (705 L/s @ 70 m head performance) Allow for new building Allow for typical associated pipework Allow for power supply upgrade.	This is the flow attributable to the SAP demands only. Additional capacity is required to supply existing and future demands in Estella Zone – subject to RWCC's future network strategy. Assumed new pump station required due to substantial increase in capacity compared to existing (approx. 200–250 L/s). Existing pump station will need to remain operational during construction.
S4PS2	East Bomen Pump Station	New pump station to replace existing (424 L/s @ 45 m head performance) Allow for new building	It has not been investigated whether this larger pump station should be constructed at the existing pump station site or an alternative site.

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
		Allow for typical associated pipework Allow for power supply upgrade.	Assumed new pump station required due to substantial increase in capacity compared to existing (approx. 70 L/s) Existing pump station will need to remain operational during construction.
S4PS3	Brucedale Pump Station	Assumed complete new pump station in new building (200 L/s @ 80 m head) Allow for typical associated pipework Allow for power supply upgrade.	It has not been investigated whether this larger pump station should be constructed at the existing pump station site or an alternative site. Assumed new pump station required due to substantial increase in capacity compared to existing (negligible capacity) Existing pump station will need to remain operational during construction.

Table 3.4. Scenario 4 – Water mains

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4WM1	Total – DN250 Mains	15,050 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially PVC or PE).
S4WM2	Total – DN300 Mains	7,610 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially PVC or PE).
S4WM3	Total – DN375 Mains	5,020 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S4WM4	Total – DN450 Mains	8,600 m length.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S4WM5	Total – DN500 Mains	4,840 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL). The Brucedale Pump Station suction main is assumed to be DN500 (supplied from 2 x DN450) to enable a single crossing beneath Olympic Hwy.
S4WM6	Total – DN600 Mains	4,880 m length. 2 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL).

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4WM7	Total – DN750 Mains	2,280 m length.	Pipe material subject to RWCC preference (potentially DICL or MSCL).

The servicing concept contains many different pipe sizes, these are based on preliminary hydraulic analysis only and should be rationalized based on RWCC's material preferences and standard size requirements at the subsequent stage, if Scenario 4 is preferred.

For all water mains it is assumed construction will generally use conventional trenched excavation, 1 m typical depth and mains will generally be located within the nature strip or constructed during subdivision civil works.

It is assumed rail and Olympic Highway crossings will typically require a 40 m length MSCL sleeve pipe installed by trenchless methods.

Other noted issues and opportunities for Scenario 4 water servicing are:

- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with RWCC is recommended.
- The Rail Terminal sub-precinct area in the northern extent of the SAP area is at high elevation and cannot be serviced from East Bomen pressure zone. If serviced, this requires a long loop of mains from Olympic Hwy to service from Brucedale Zone, which is potentially uneconomical and undesirable for water quality if initial demands are low.
- Part of the proposed solar farm sub-precinct area surrounding the Bomen East Reservoir site and Regional Enterprise sub-precinct area approx. 2 km north of Bomen East Reservoir is at high elevation and is challenging to service. If development occurs above approx. 260 m AHD and 250 m AHD respectively, these areas booster pumping will be required – subject to RWCC's requirements/approval.
- New customers located west of Olympic Hwy which are proposed to be supplied from the Brucedale Pressure Zone will be see high maximum pressures (>80 m). If this scenario is preferred is should be reviewed whether this is an acceptable outcome and alternative options should be considered. These could include extending the East Bomen Zone into this area or using pressure reducing valves to manage pressure.
- The three land use scenarios were provided 26 August 2019 and information available from RWCC and WWCC is limited (i.e. sourced from initial preliminary meetings and readily available documents). Hence the level of detail of this analysis and development of water and sewer infrastructure requirements has been limited by the time available and contains assumptions as necessary to complete this task.

3.4.4 SCENARIO 4 – SAP SEWERAGE INFRASTRUCTURE REQUIREMENTS

The sewerage servicing concept for Scenario 4 is shown in Figure 3.7. A summary of the proposed sewerage infrastructure is provided in Table 3.5, Table 3.6 and Table 3.7.

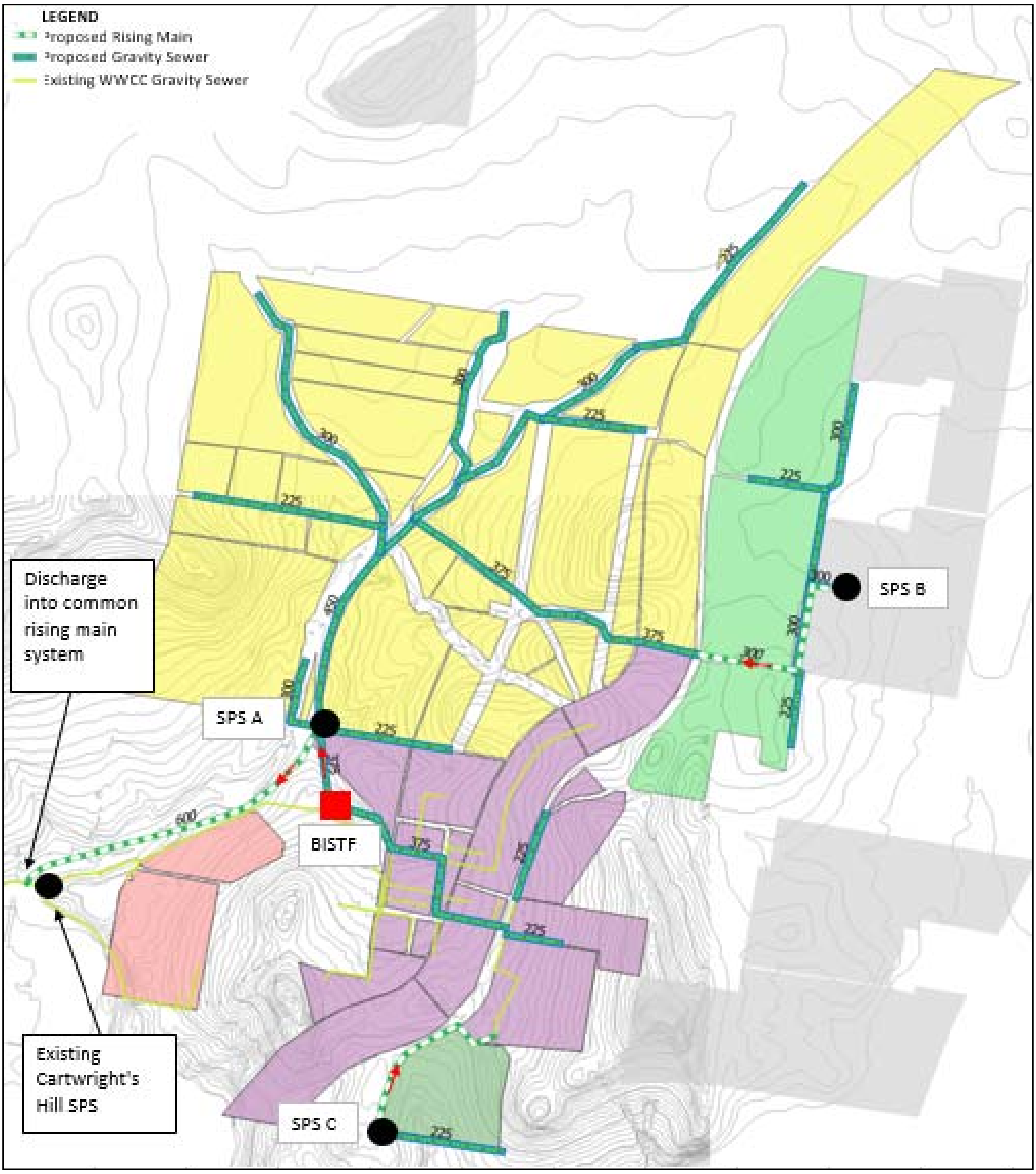


Figure 3.7 Scenario 4 – Sewerage servicing concept

Table 3.5. Scenario 4 – Sewage pump stations

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4SPSA	SPS A	585 L/s @ 50 m head. Submersible SPS with 3 pumps with variable speed drives. 6 m dia x 7 m deep wet-well (200 m^3 volume). Allow for 50 m x 50 m land acquisition. Assume no additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for small building, site civil works including security fencing and vehicle access/turning areas.	Main SPS servicing the SAP and receiving flow from BISTF. Assumed Variable Speed Drives (VSD) required for operation into the common rising main system. Pump head assumed – subject to common rising main system hydraulics (external to SAP).
S4SPSB	SPS B	91 L/s @ 35 m head. Submersible SPS with well and 2 pumps. 4 m dia x 6 m deep wet-well (75 m^3 volume). Allow for 30 m x 30 m land acquisition. Allow for additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for site civil works including security fencing and vehicle access/turning areas.	Pump head assumed from topography and rising main length.
S4SPSC	SPS C	21 L/s @ 30 m head. Submersible SPS with 2 pumps. 3 m dia x 6 m deep wet-well (35 m^3 volume). Allow for 20 m x 20 m land acquisition. Allow for additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for site civil works including security fencing and vehicle access/turning areas.	Pump head assumed from topography and rising main length.

Table 3.6. Scenario 4 – Rising mains

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4RMA	SPS A rising main	2,660 m length. DN600 or similar size. 1 x Olympic Hwy crossing.	Pipe material subject to WWCC preference (potentially PE, MSCL or GRP).

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4RMB	SPS B rising main	1,290 m length. DN300 or similar size.	Pipe material subject to WWCC preference (potentially PE or PVC).
S4RMC	SPS C rising main	1,220 m length. DN150 or similar size.	Pipe material subject to WWCC preference (potentially PE or PVC).

Table 3.7. Scenario 4 – Gravity sewers

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S4GS1	Total – DN225 Gravity Sewer	6,803 m length. PVC-U SN8 material. 1 x rail/highway crossings.	Nil.
S4GS2	Total – DN300 Gravity Sewer	7,606 m length. PVC-U SN8 material. 3 x rail/highway crossings.	Nil.
S4GS3	Total – DN375 Gravity Sewer	4,209 m length. 1 x rail/highway crossings.	Pipe material subject to WWCC preference (potentially PVC or GRP).
S4GS4	Total – DN450 Gravity Sewer	1,513 m length.	Pipe material subject to WWCC preference (potentially PVC or GRP).

For all sewer rising mains it is assumed construction will generally use conventional trenched excavation, 1 m typical depth and mains will generally be located within the nature strip or constructed during subdivision civil works.

For all sewer gravity mains depth is assumed to be 50% less than 1.5 m depth, 25% between 1.5–3 m depth and 25% between 3–4.5 m depth. It is assumed these are generally located within the nature strip or constructed during subdivision civil works.

It is assumed rail and Olympic Highway crossings will typically require a 40 m length MSCL sleeve pipe installed by trenchless methods.

Other noted issues and opportunities for Scenario 4 sewerage servicing are:

- The assessed loading basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of this loading including benchmarking against similar developments and consultation with WWCC is recommended.
- Total sewage ADWF load to the BISTF is approx. 1.9 ML/d in this scenario. This is lower than the current loading of approx. 4 ML advised by WWCC and requires investigation. This is potentially due to extreme demands of major existing industrial customers (i.e. beyond the assumed loading adopted for this study). These capacities have been provided WWCC in absence of hydraulic modelling and are to be confirmed by current operator’s usage rates.
- There is opportunity to optimize the load directed to BISTF vs the new SPS A to best utilise the BISTF treatment capacity. This depends where customers generating major trade waste loads (assumed to generally be the Intensive Livestock Industry sub-precinct areas) are located and depends on WWCC’s strategy regarding the future planning around this facility.
- The three land use scenarios were provided 26 August 2019 and information available from RWCC and WWCC is limited (i.e. sourced from initial preliminary meetings and readily available documents). Hence the level of detail of this analysis and development of water and sewer infrastructure requirements has been limited by the time available and contains assumptions as necessary to complete this task.

3.4.5 SCENARIO 5 – SAP WATER INFRASTRUCTURE REQUIREMENTS

The water servicing concept for Scenario 5 is shown in Figure 3.8. A summary of the proposed water infrastructure is provided in Table 3.8, Table 3.9 and

Table 3.10.

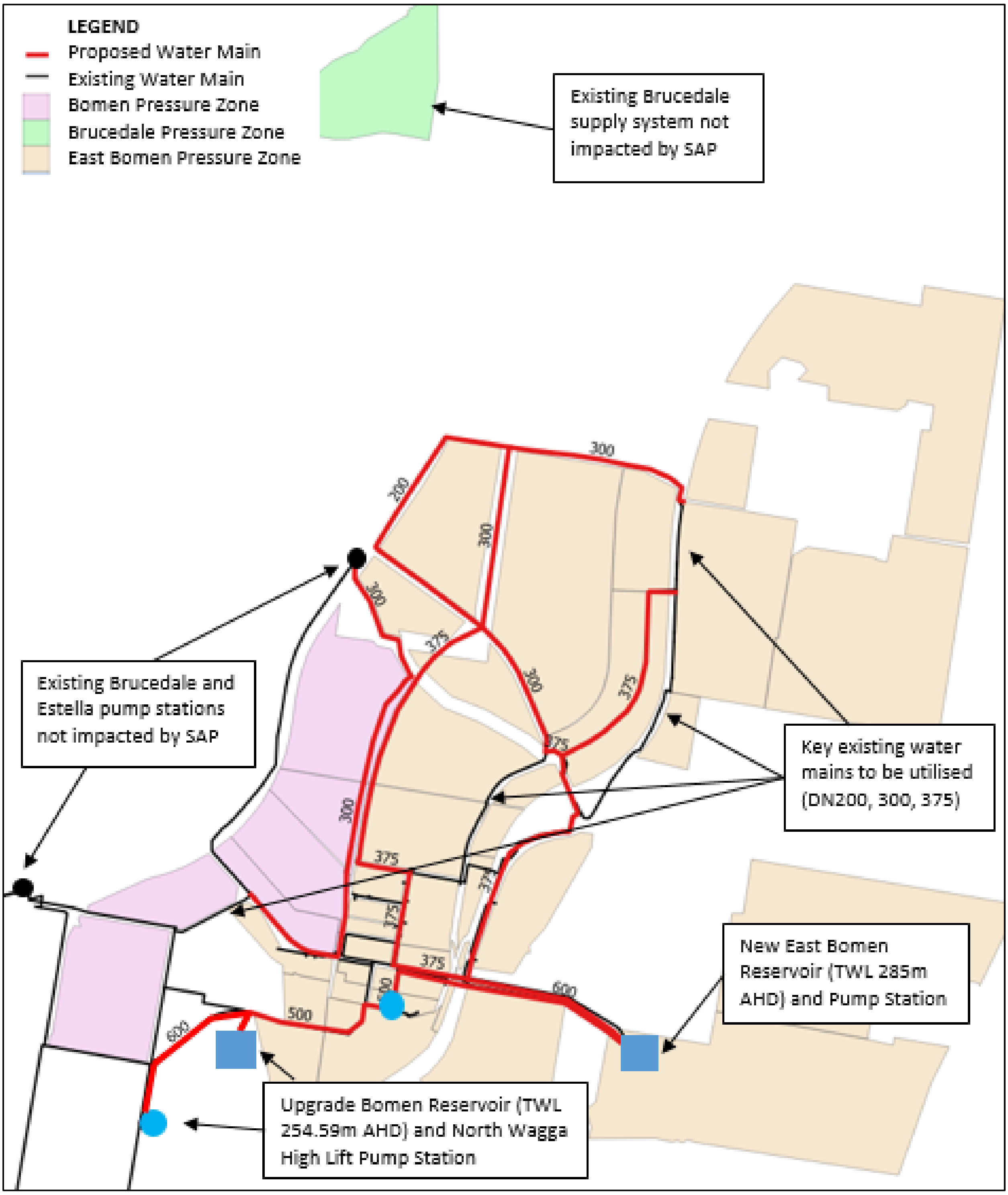


Figure 3.8 Scenario 5 – Water servicing concept

Table 3.8. Scenario 5 – Reservoirs

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S5R1	East Bomen Reservoir Upgrade	Single new 22 ML ground level concrete tank at existing site to replace the existing 2 tanks. Allow for 100 x 100 m land acquisition. Allow for typical associated civil works and connecting pipework.	As the required volume is much larger than the existing tanks (6 ML total), it is assumed that retaining these (and matching or managing respective levels) is not preferable. It is assumed at least one of the existing 2 tanks needs to remain in operation during construction.
S5R2	Bomen Reservoir Upgrade	Single new 6 ML ground level concrete tank at existing site. Allow for typical associated civil works and connecting pipework. Assume no land acquisition required.	This sizing is for the SAP demand requirements only. Additional upgrades to accommodate external growth are also expected to be required – subject to RWCC strategy.

Table 3.9. Scenario 5 – Pump stations

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S5PS1	North Wagga High Lift Pump Station	New pump station to replace existing (427 L/s @ 45 m head performance). Allow for new building. Allow for typical associated pipework. Allow for power supply upgrade.	This is the additional flow attributable to the SAP demands only. Further upgrades are also required due to external growth in Estella Zone – subject to RWCC's future network strategy. Assumed new pump station required due to substantial increase in capacity compared to existing (approx. 200–250 L/s). Existing pump station will need to remain operational during construction.
S5PS2	East Bomen Pump Station	New pump station to replace existing (332 L/s @ 53 m head performance). Allow for new building. Allow for typical associated pipework. Allow for power supply upgrade.	Assumed new pump station required due to substantial increase in capacity compared to existing (approx. 70 L/s). It has not been investigated whether this larger pump station should be constructed at the existing pump station site or an alternative site. Existing pump station will need to remain operational during construction.

Table 3.10. Scenario 5 – Water mains

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S5WM1	Total – DN200 Mains	1,990 m length.	Pipe material subject to RWCC preference (potentially PVC or PE).
S5WM2	Total – DN300 Mains	6,460 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially PVC or PE).
S5WM3	Total – DN375 Mains	6,250 m length. 3 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S5WM4	Total – DN500 Mains	3,020 m length. 1 x railway crossing.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S5WM5	Total – DN600 Mains	2,450 m length.	Pipe material subject to RWCC preference (potentially DICL or MSCL).

For all water mains it is assumed construction will generally use conventional trenched excavation, 1 m typical depth and mains will generally be located within the nature strip or constructed during subdivision civil works.

It is assumed railway and Olympic Highway crossings will typically require a 40 m length MSCL sleeve pipe installed by trenchless methods.

Other noted issues and opportunities for Scenario 5 water servicing are:

- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with RWCC is recommended.
- Part of the proposed solar farm sub-precinct area is at high elevation surrounding the Bomen East Reservoir site and is challenging to service. If development occurs above approx. 260 m AHD booster pumping will be required – subject to RWCC's approval.

3.4.6 SCENARIO 5 – SAP SEWERAGE INFRASTRUCTURE REQUIREMENTS

The sewerage servicing concept for Scenario 5 is shown in Figure 3.9. A summary of the proposed sewerage infrastructure is provided in Table 3.11, Table 3.12 and Table 3.13.

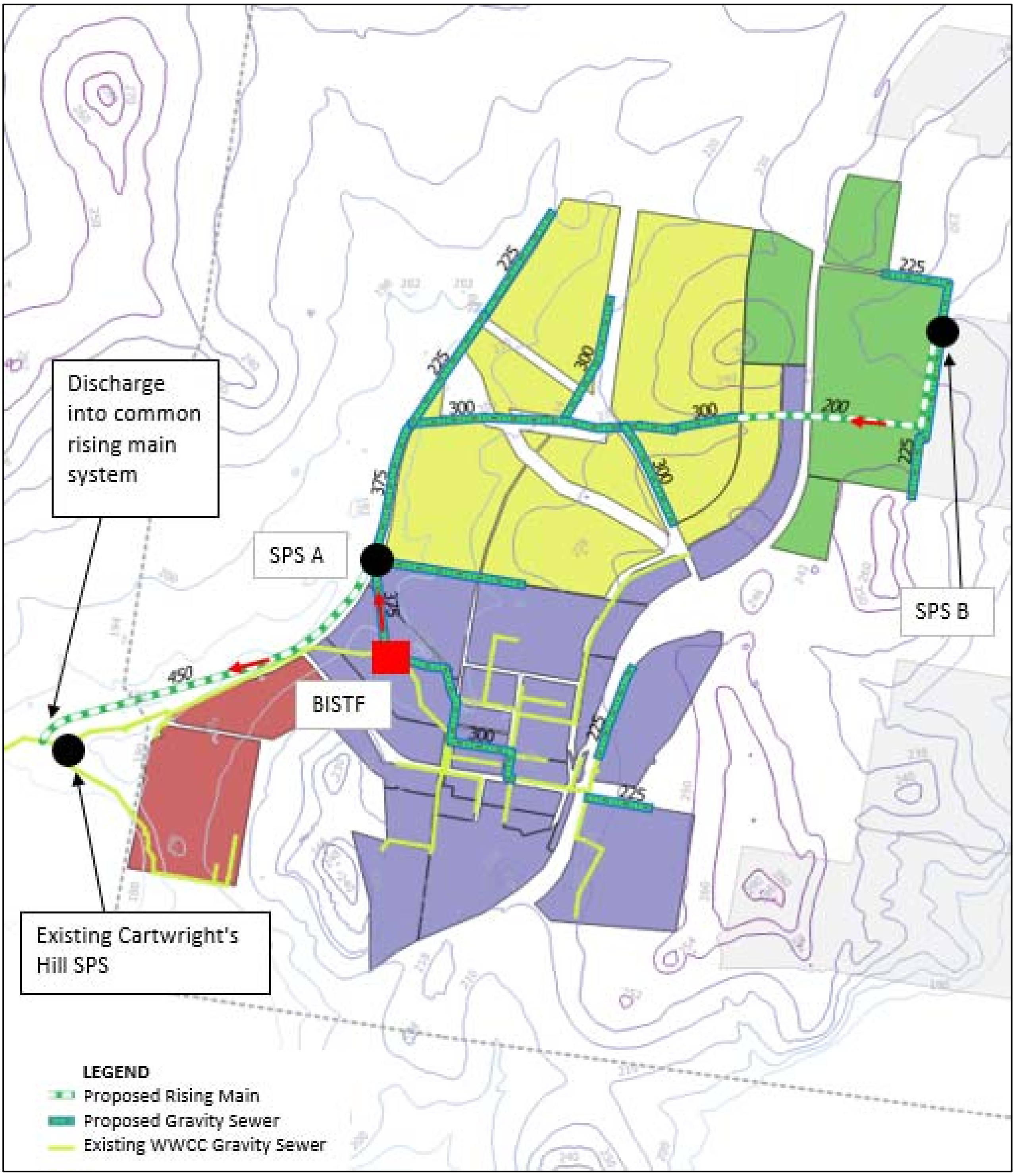


Figure 3.9 Scenario 5 – Sewerage servicing concept

Table 3.11. Scenario 5 – Sewage pump stations

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S5SPSA	SPS A	316 L/s @ 50 m head. Submersible SPS with 3 pumps with variable speed drives. 6 m dia x 7 m deep wet-well (200 m^3 volume). Allow for 50 m x 5 0 m land acquisition. Assume no additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for small building, site civil works including security fencing and vehicle access/turning areas.	Main SPS servicing the SAP and receiving flow from BISTF. Assumed Variable Speed Drives (VSD) required for operation into the common rising main system. Pump head assumed – subject to common rising main system hydraulics (external to SAP).
S5SPSB	SPS B	56 L/s @ 35 m head. Submersible SPS with 2 pumps. 3 m dia x 6 m deep wet-well (40 m^3 volume) Allow for 30 m x 30 m land acquisition. Allow for additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for site civil works including security fencing and vehicle access/turning areas.	Pump head assumed from topography and rising main length.

Table 3.12. Scenario 5 – Rising mains

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S5RMA	SPS A rising rain	2,660 m length. DN450 or similar size. 1 x Olympic Hwy crossing.	Pipe material subject to WWCC preference (potentially PE or PVC).
S5RMB	SPS B rising rain	1,900 m length. DN200 or similar size. 1 x railway crossing.	Pipe material subject to WWCC preference (potentially PE or PVC).

Table 3.13. Scenario 5 – Gravity sewers

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S5GS1	Total – DN225 Gravity Sewers	4,590 m length. PVC-U SN8 material. 1 x rail/highway crossings.	
S5GS1	Total – DN300 Gravity Sewers	4,386 m length. PVC-U SN8 material.	
S5GS3	Total – DN375 Gravity Sewers	1,291 m length. PVC-U SN8 material.	

For all sewer rising mains it is assumed construction will generally use conventional trenched excavation, 1 m typical depth and mains will generally be located within the nature strip or constructed during subdivision civil works.

For all sewer gravity mains depth is assumed to be 50% less than 1.5 m depth, 25% between 1.5–3 m depth and 25% between 3–4.5 m depth. It is assumed these are generally be located within the nature strip or constructed during subdivision civil works.

It is assumed rail and Olympic Highway crossings will typically require a 40 m length MSCL sleeve pipe installed by trenchless methods. Other noted issues and opportunities for Scenario 5 sewerage servicing are:

- The assessed loading basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of this loading including benchmarking against similar developments is recommended.
- Total ADWF load to the BISTF is approx. 1.8 ML/d in this scenario. This is lower than the current loading of approx. 4 ML advised by WWCC and requires investigation. This is potentially due to extreme demands of major existing industrial customers (i.e. beyond the assumed loading adopted fore this study). These capacities have been provided WWCC in absence of hydraulic modelling and are to be confirmed by current operator’s usage rates.
- There is opportunity to optimize the load directed to BISTF vs the new SPS A to best utilise the BISTF treatment capacity. This depends where customers generating major trade waste loads (assumed to generally be the Intensive Livestock Industry sub-precinct areas) are located and depends on WWCC’s strategy regarding the future planning around this facility.

3.4.7 SCENARIO 7 – SAP WATER INFRASTRUCTURE REQUIREMENTS

The water servicing concept for Scenario 7 is shown in Figure 3.10. A summary of the proposed water infrastructure is provided in Table 3.14, Table 3.15 and Table 3.16.

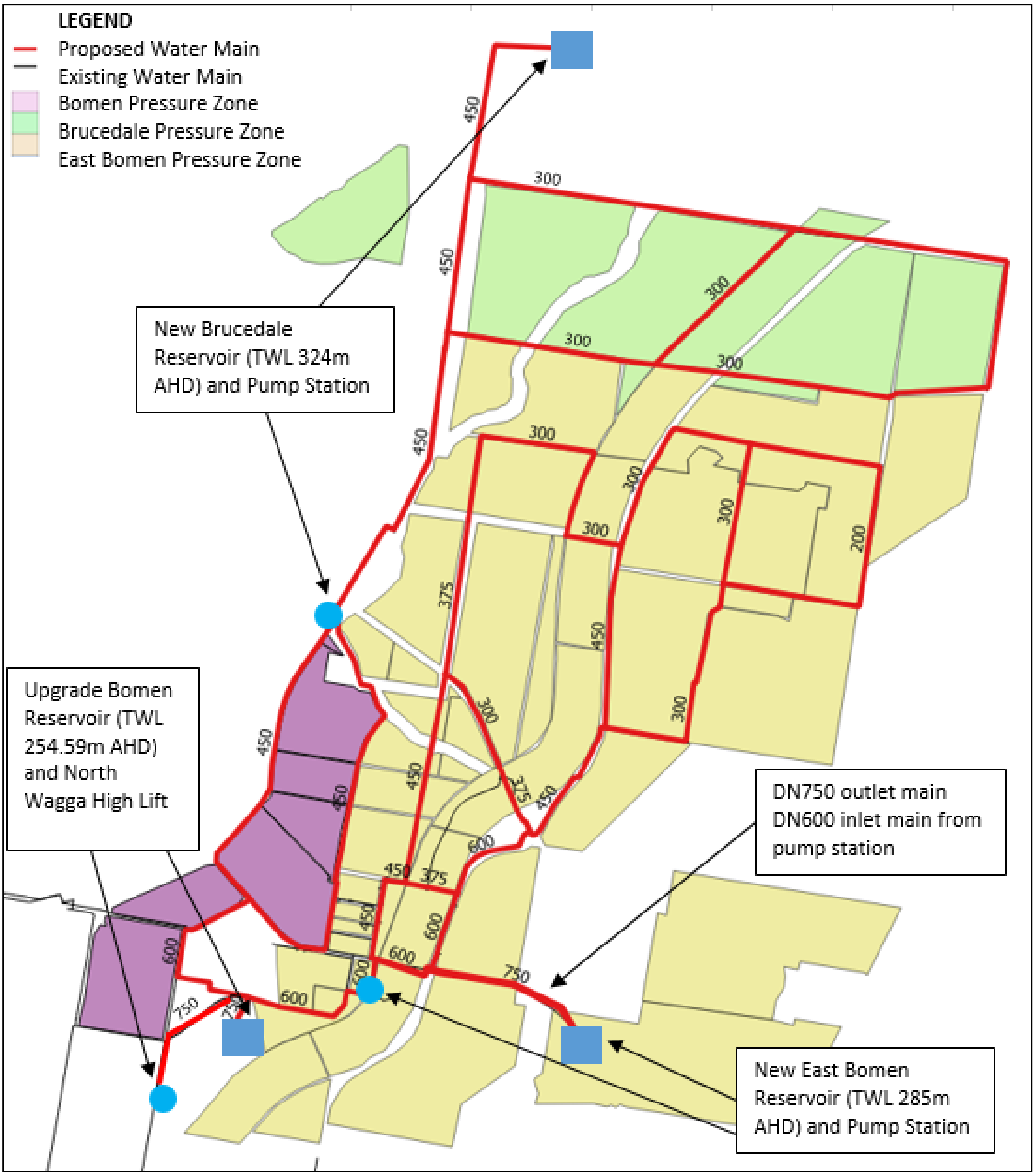


Figure 3.10 Scenario 7 – Water servicing concept

Table 3.14. Scenario 7 – Reservoirs

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S7R1	East Bomen Reservoir Upgrade	33 ML new ground level concrete tank at existing site to replace the existing 2 tanks. Allow for 100 x 100 m land acquisition. Allow for typical associated civil works and connecting pipework.	As the required volume is much larger than the existing tanks (6 ML total), it is assumed that retaining these (and matching or managing respective levels) is not preferable. It is assumed at least one of the existing 2 tanks needs to remain in operation during construction.
S7R2	Bomen Reservoir Upgrade	Single new 6 ML ground level concrete tank at existing site. Allow for typical associated civil works and connecting pipework. Assume no land acquisition required.	This sizing is for the SAP demand requirements only. Additional upgrades to accommodate external growth are also expected to be required – subject to RWCC strategy.
S7R3	Brucedale Reservoir Upgrade	12 ML new ground level concrete tank at existing site, replacing existing tank. Allow for 100 x 100 m land acquisition. Allow for typical associated civil works and connecting pipework.	As the required volume is much larger than the existing tank (0.75 ML total), it is assumed that retaining this is not preferable. It is assumed that the existing tank needs to remain in operation during construction.

Table 3.15. Scenario 7 – Pump stations

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S7PS1	North Wagga High Lift Pump Station	New pump station to replace existing (806 L/s @ 45 m head performance). Allow for new building. Allow for typical associated pipework. Allow for power supply upgrade.	This is the additional flow attributable to the SAP demands only. Further upgrades are also required due to external growth in Estella Zone – subject to RWCC's future network strategy. Pump head assumed based on topography and allowance for typical friction loss. Assumed new pump station required due to substantial increase in capacity compared to existing (approx. 200–250 L/s). Existing pump station will need to remain operational during construction.
S7PS2	East Bomen Pump Station	New pump station to replace existing (530 L/s @ 50 m head performance). Allow for new building. Allow for typical associated pipework. Allow for power supply upgrade.	It has not been investigated whether this larger pump station should be constructed at the existing pump station site or an alternative site.

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
			Assumed new pump station required due to substantial increase in capacity compared to existing (approx. 70 L/s). Existing pump station will need to remain operational during construction.
S7PS3	Brucedale Pump Station	Assumed complete new pump station in new building (180 L/s @ 85 m head). Allow for typical associated pipework. Allow for power supply upgrade.	It has not been investigated whether this larger pump station should be constructed at the existing pump station site or an alternative site. Assumed new pump station required due to substantial increase in capacity compared to existing (negligible capacity). Existing pump station will need to remain operational during construction.

Table 3.16. Scenario 7 – Water mains

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S7WM1	Total – DN250 Mains	2,960 m length.	Pipe material subject to RWCC preference (potentially PVC or PE).
S7WM2	Total – DN300 Mains	17,640 m length. 4 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially PVC or PE).
S7WM3	Total – DN375 Mains	2,020 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S7WM4	Total – DN450 Mains	15,070 m length.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S7WM5	Total – DN500 Mains	100 m length. 1 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL). The Brucedale Pump Station suction main is assumed to be DN500 (supplied from 2 x DN450) to enable a single crossing beneath Olympic Hwy.
S7WM6	Total – DN600 Mains	6,140 m length. 2 x rail/highway crossings.	Pipe material subject to RWCC preference (potentially DICL or MSCL).
S7WM7	Total – DN750 Mains	1,400 m length.	Pipe material subject to RWCC preference (potentially DICL or MSCL).

For all water mains it is assumed construction will generally use conventional trenched excavation, 1 m typical depth and mains will generally be located within the nature strip or constructed during subdivision civil works.

It is assumed rail and Olympic Highway crossings will typically require a 40 m length MSCL sleeve pipe installed by trenchless methods.

Other noted issues and opportunities for Scenario 7 water servicing are:

- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with RWCC is recommended.
- Part of the proposed solar farm sub-precinct area is at high elevation surrounding the Bomen East Reservoir site and is challenging to service. If development occurs above approx. 260 m AHD booster pumping will be required – subject to RWCC's requirements/approval.

3.4.8 SCENARIO 7 – SAP SEWERAGE INFRASTRUCTURE REQUIREMENTS

The sewerage servicing concept for Scenario 7 is shown in Figure 3.10. A summary of the proposed sewerage infrastructure is provided in Table 3.17, Table 3.18 and Table 3.19.

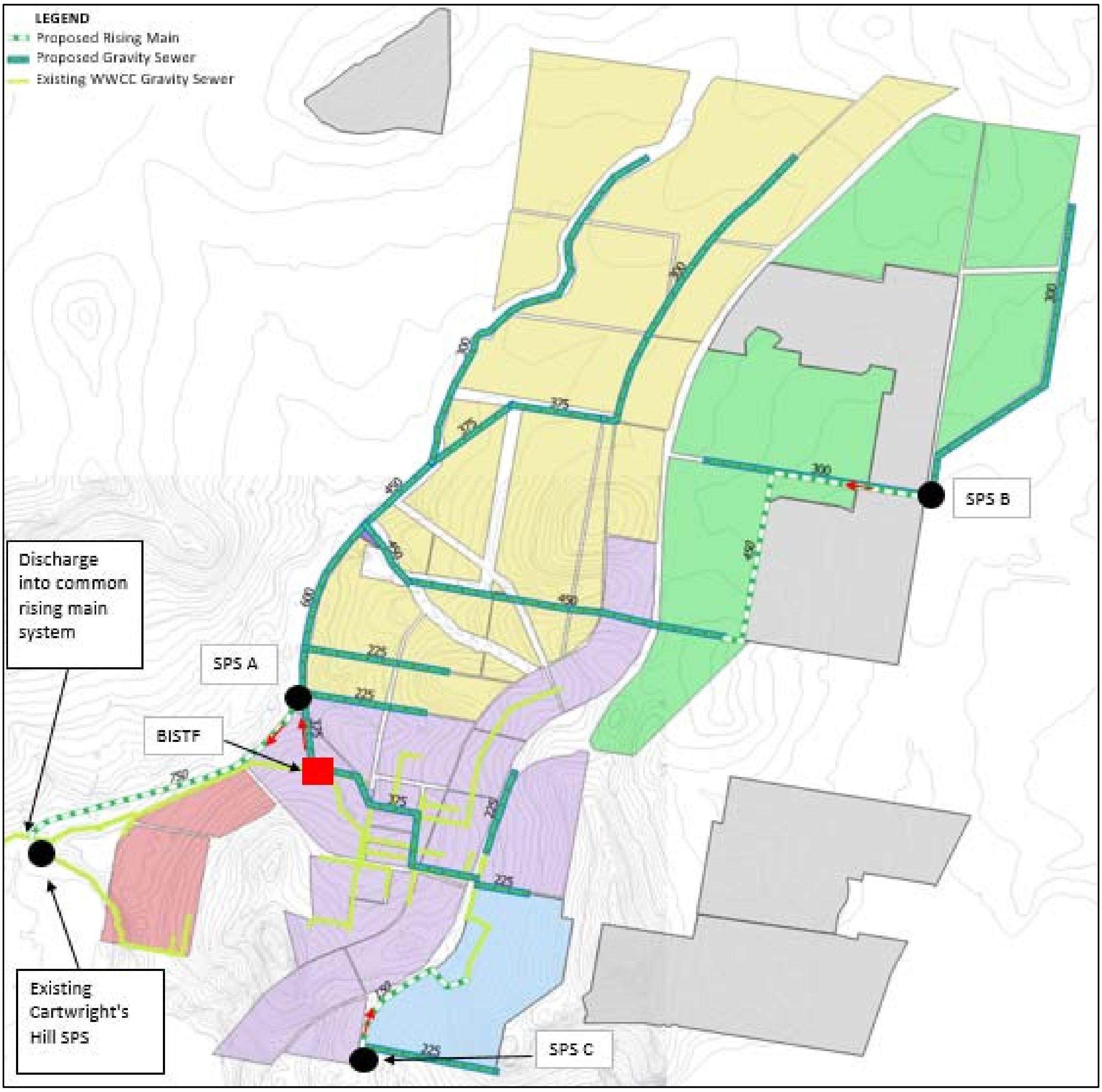


Figure 3.11 Scenario 7 – Sewerage servicing concept

Table 3.17. Scenario 7 – Sewage pump station

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S7SPSA	SPS A	748 L/s @ 50 m head. Submersible SPS with 3 pumps with variable speed drives. 6 m dia x 7 m deep wet-well (200 m^3 volume). Allow for 50 m x 50 m land acquisition. Assume no additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for small building, site civil works including security fencing and vehicle access/turning areas.	Main SPS servicing the SAP and receiving flow from BISTF. Assumed Variable Speed Drives (VSD) required for operation into the common rising main system. Pump head assumed – subject to common rising main system hydraulics (external to SAP).
S7SPSB	SPS B	256 L/s @ 35 m head. Submersible SPS with 3 pumps. 6 m dia x 7 m deep wet-well (200 m^3 volume). Allow for 50 m x 50 m land acquisition. Allow for additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for site civil works including security fencing and vehicle access/turning areas.	Pump head assumed from topography and rising main length.
S7SPSC	SPS C	Submersible SPS with 2 pumps. 3 m dia x 6 m deep wet-well (35 m^3 volume). Allow for 20 m x 20 m land acquisition. Allow for additional offline emergency storage structure. Allow for power supply to the site. Allow for establishment of SCADA telemetry connection to the site. Allow for site civil works including security fencing and vehicle access/turning areas.	Flowrate based on only half of sub-area RE6 draining to this catchment and half to existing BISTF catchment. Pump head assumed from topography and DN750 rising main length.

Table 3.18. Scenario 7 – Rising mains

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S7RMA	SPS A rising main	2,660 m length. DN750 or similar size. 1 x Olympic Hwy crossing.	Pipe material subject to WWCC preference (potentially PE, MSCL or GRP).
S7RMB	SPS B rising main	1,290 m length. DN450 or similar size.	Pipe material subject to WWCC preference (potentially PE, MSCL or GRP).
S7RMC	SPS C rising main	1,220 m length. DN150 or similar size.	Pipe material subject to WWCC preference (potentially PE or PVC).

Table 3.19. Scenario 7 – Gravity sewers

REF. NO	DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
S7GS1	Total – DN225 Gravity Sewer	3,610 m length. PVC-U SN8 material.	
S7GS2	Total – DN300 Gravity Sewer	8,890 m length. PVC-U SN8 material.	
S7GS3	Total – DN375 Gravity Sewer	3,450 m length. 1 x rail/highway crossings.	Pipe material subject to WWCC preference (potentially PVC or GRP).
S7GS4	Total – DN450 Gravity Sewer	3,270 m length. 1 x rail/highway crossings.	Pipe material subject to WWCC preference (potentially PVC or GRP).
S7GS5	Total – DN600 Gravity Sewer	1,250 m length. 1 x rail/highway crossings.	Pipe material subject to WWCC preference (potentially PVC or GRP).

For all sewer rising mains it is assumed construction will generally use conventional trenched excavation, 1 m typical depth and mains will generally be located within the nature strip or constructed during subdivision civil works.

For all sewer gravity mains depth is assumed to be 50% less than 1.5 m depth, 25% between 1.5–3 m depth and 25% between 3–4.5 m depth. It is assumed these are generally be located within the nature strip or constructed during subdivision civil works.

It is assumed rail and Olympic Highway crossings will typically require a 40 m length MSCL sleeve pipe installed by trenchless methods.

Other noted issues and opportunities for Scenario 7 sewerage servicing are:

— The assessed loading basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of this loading including benchmarking against similar developments and consultation with WWCC is recommended.

— Total ADWF load to the BISTF is approx. 2.0 ML/d in this scenario. This is lower than the current loading of approx. 4 ML advised by WWCC and requires investigation. This is potentially due to extreme demands of major existing industrial customers (i.e. beyond the assumed loading adopted fore this study). These capacities have been provided by WWCC in absence of hydraulic modelling and are to be confirmed by current operator's usage rates.

- There is an opportunity to optimize the load directed to BISTF vs the new SPS A to best utilise the BISTF treatment capacity. This depends where customers generating major trade waste loads (assumed to generally be the Intensive Livestock Industry sub-precinct areas) are located and depends on WWCC's strategy regarding the future planning around.

3.4.9 SUMMARY OF RISKS AND OPPORTUNITIES

The following items have been identified which will be taken forward to the Enquiry by Design Workshop:

- For both Scenario 4 and Scenario 7, the proposed development in the northern and western extent of the SAP area requires water serving via Brucedale Zone. The requirement to include and service these areas should be challenged as it may result in uneconomical water servicing outcomes.
- For Scenario 4, this requires a long loop of water mains from Olympic Hwy to service a relatively small area. This is likely to be uneconomical and is also undesirable for water quality (particularly if initial demands are low).
- For Scenario 4, new customers located west of Olympic Hwy which are proposed to be supplied from the Brucedale Pressure Zone will be see high maximum pressures (>80 m).
- Further investigation into the best approach for servicing this area is required.
- For all scenarios, the need to include and service high elevation land (above approx. 260 m AHD) near East Bomen Reservoir and approx. 2 km of East Bomen Reservoir should be challenged.
- Note that some of these areas are proposed as solar farms which may not require servicing. However, the area approx. 2 km north of East Bomen Reservoir includes Regional Enterprise sub-precinct land.
- For both Scenario 4 and Scenario 7, the development in the southern extent of the SAP should be challenged as it may result in uneconomical sewerage servicing outcomes. This requires a new sewerage pump station and rising main, for minimal additional load.
- The opportunity to optimize the load directed to the BISTF vs. the new SPS A to best utilise the BISTF treatment capacity should be considered. Whilst this opportunity depends where customers generating potential major trade waste loads (i.e. Intensive Livestock Industry) will be located and relies on WWCC's development of a strategy regarding the future planning around this facility, broader stakeholder input and perspective to help frame this opportunity would be of value.

3.5 STORMWATER

3.5.1 STORMWATER INFRASTRUCTURE – CURRENT STATE

As outlined in the final baseline assessment report, the existing stormwater infrastructure within the SAP investigation area predominantly falls within the Murrumbidgee catchment boundary through natural flow paths. It has been noted in the recent hydraulic flood study that majority of the area within Wagga Wagga SAP is unlikely to be impacted by flooding event. This is possible due to the existing stormwater network around the Bomen Industrial Park which collects stormwater and discharges into the natural channels immediately downstream of the industrial area to the Dukes Creek. F Figure 3.12 below shows the existing stormwater network.

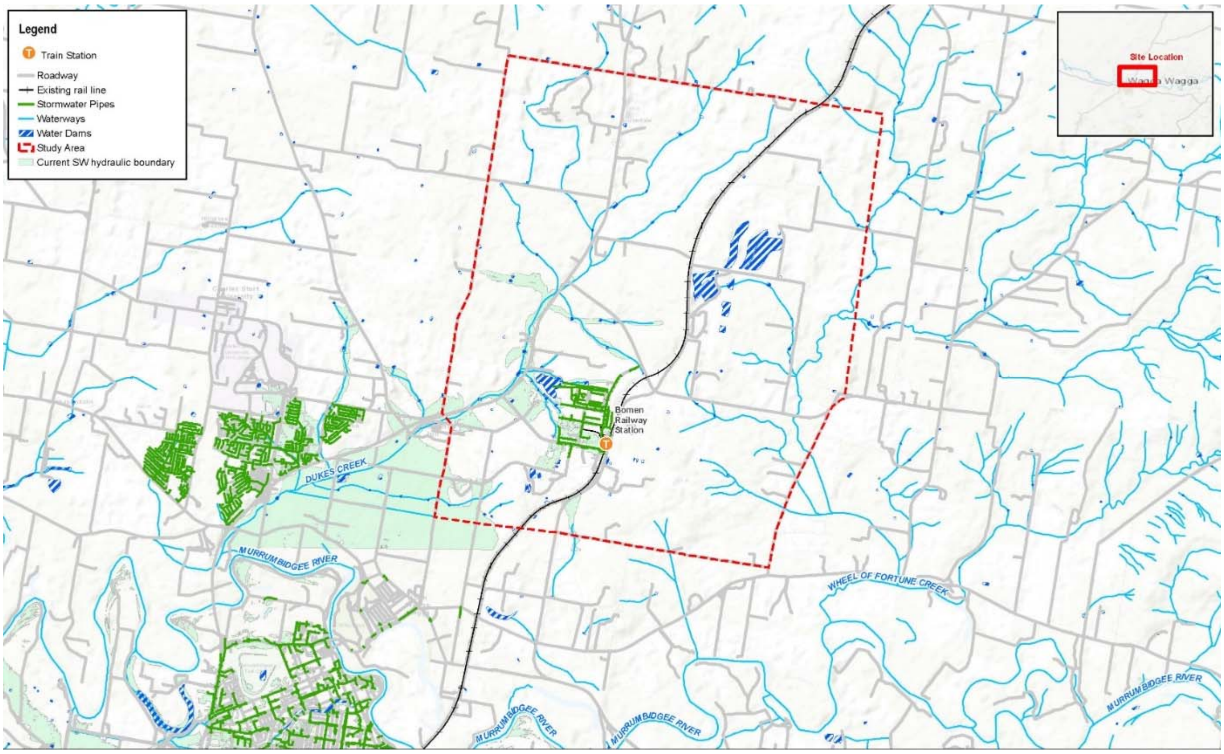


Figure 3.12 Existing stormwater infrastructure including the extent of the stormwater hydraulic boundary

3.5.2 WAGGA WAGGA SAP SCENARIO TESTING

Stormwater Infrastructure requirements to support the Wagga Wagga SAP has been detailed in the Flooding and Water Quality Scenario Testing Report (2019) prepared by Rhelm Pty Ltd. The key outcomes from the scenario testing in an infrastructure perspective are summarised in Table 3.20 below.

Table 3.20 Summary of stormwater scenario testing

KEY OUTCOMES OF SCENARIO TESTING	DESCRIPTION
Flood Impact	— The scenario testing shows there are some minor flood impacts which are largely outside of the Precinct. These are likely to be readily resolved by optimisation of the riparian corridor and waterway design and potential minor alterations to regional detention basin sizing. This optimisation could be undertaken as part of the concept design selected for the Precinct.
Culvert upgrades	— Minor upgrades to some culverts along the Olympic Highway are likely to be needed to ensure the Highway has a flood immunity up to the 1% AEP flood event. Sizing of these upgrades on a conceptual basis would be undertaken for the concept selected for the Precinct.
Regional Flood Detention	— With the provision of a system of regional detention basins the impact of the change in land use from a largely rural setting to an urbanised environment can be managed effectively. Sizing of the basins on a conceptual basis would be undertaken for the concept selected for the Precinct.

For all scenario options WSP recommends local stormwater network be provided to convey flows to the nearest downstream riparian corridor to ensure minimal impact on catchment flows.

3.6 ELECTRICAL TRANSMISSION AND DISTRIBUTION

Following the short Enquiry by Design (EbD) workshop where three precinct scenarios were identified, WSP undertook a more specific desktop assessment of the existing supply within Wagga Wagga SAP. The nearest existing zone substation present in the proposed Wagga Wagga SAP is the Bomen and the Cartwrights Hill Zone Substation which are supplied by 132/66 kV Wagga North Substation as noted in the baseline assessment study. These zonal substations are currently supplying the surrounding area of the proposed Wagga Wagga SAP. The maximum combined load this zonal substation can cater for is approximately 89 MVA.

Table 3.21 provides a summary of the spare capacity at the zone substation transformers level.

Table 3.21. Substation capacity assessment

SUBSTATION	TRANSFORMER RATING (MVA)	SUMMER DEMAND FORECAST (MVA) FOR THE YEAR 2022/2023 (ESSENTIAL ENERGY)	AVAILABLE SPARE CAPACITY (MVA)
Bomen (66/11 kV)	30 MVA x 2	11.9 MVA	48.1 MVA
Cartwrights Hill 11 kV (66/11 kV)	10 MVA x 2	8.9 MVA	11.1 MVA
Cartwrights Hill 33 kV (11/33 kV)	4 MVA x 1 5 MVA x 1	1.9 MVA	7.1 MVA
Total (MVA)	**89 MVA**	**22.7 MVA**	**66.3 MVA**

Source: Essential Energy Asset Management Distribution Annual Planning Report 2018

It is noted that the combined total spare capacity available at the zone substation level near Wagga Wagga SAP area is about 66.3 MVA.

AVERAGE LOAD DEMAND ESTIMATES (MW)

Table 3.22 shows the estimated average load demand for the three precinct scenarios. Refer to Appendix B for a detailed calculation of the load demand estimates.

Table 3.22. Load demand estimate

SUB-PRECINCT	AVERAGE LOAD DEMAND ESTIMATES (MW)		
	SCENARIO 4	SCENARIO 5	SCENARIO 7
Regional Enterprise	167	99	207
Intensive Livestock Agriculture	35	35	36
Commercial Gateway	3	6	3
Rail Terminal	36	8	36
Total load demand (MW)	**241**	**148**	**282**

WSP have assessed the required capacity upgrades by considering cases:

Case 1: the proposed Wagga Wagga SAP is to be serviced without in-house power generation
Case 2: the proposed Wagga Wagga SAP is to be serviced with in-house power generation.

CASE 1: PRECINCTS WITHOUT IN-HOUSE POWER GENERATION

In this scenario, we assumed that the Wagga Wagga SAP will not have any in-house power generation within the SAP area and the entire load demand will need to be met by the power coming from the grid.

This is an unlikely approach as the future developed areas will not have any power generation and the entire load will depend on the power supplied from Wagga North 132 kV substation. This approach was tested to demonstrate the high impact of not developing the SAP area with some form of in-house power generation.

WSP estimates the following additional capacity is required to supply a load of SAP based on the estimated load growth. The additional capacity required is provided Table 3.23 below.

Table 3.23. Required capacity upgrade – without in-house generation

PRECINCT SCENARIOS	TOTAL CAPACITY REQUIRED, MVA	PROPOSED ADDITIONAL SUBSTATIONS	TOTAL ADDITIONAL CAPACITY UPGRADE REQURIED	COMMENTS
Scenario 4	267 MVA	3–60 MVA substation 1–20 MVA substation	200 MVA	67 MVA requirement can be catered by existing substations
Scenario 5	164 MVA	1–60 MVA substation 1–40 MVA substation	100 MVA	
Scenario 7	313 MVA	4–60 MVA substation 1–10 MVA substation	250 MVA	

Consideration of the development of the SAP study area without in-house power generation would require major augmentation of existing capacity is necessary to service the development area. Under this condition, the existing capacity of the 66/11 kV substation is not sufficient to cater to the forecasted Wagga Wagga SAP load demands.

Furthermore, there is a massive upgrade required to the distribution lines (33 kV, 11 kV, 0.433 kV, etc.,) and transmission lines (132 kV,66 kV) to support the estimated demands.

CASE 2: PRECINCTS WITH IN-HOUSE POWER GENERATION

In this scenario, WSP have assumed that the where possible, various land use areas within Wagga Wagga SAP will have a rooftop Photo Voltaic (PV) and Biogas generation system. By implementing the combination of solar PV with Battery Energy Storage System (BESS), the higher percentage of clean solar can be utilized. Table 3.24 provides a comparison of the average load demands per precinct scenario and the assumed power generated from using solar PV and BESS technology.

To convert MVA in to MW of the Average Load Demand Estimate, WSP has assumed power factor as 0.9.

Table 3.24. Comparison of average load demand and power generation

	ESTIMATED GENERATION AND LOAD GROWTH WITHIN WAGGA WAGGA SAP					
SUB-PRECINCT	**SCENARIO 4**		**SCENARIO 5**		**SCENARIO 7**	
	Power Generation (MW)	Average Load Demand (MW)	Power Generation	Average Load Demand (MW)	Power Generation	Average Load Demand (MW)
Regional Enterprise (PV)	236	167	140	99	292	207
Intensive Livestock Agriculture (PV)	12	35	12	35	12	36
Commercial Gateway (PV)	9	3	15	6	8	3
Rail Terminal (PV)	84	36	19	8	84	36
Generation from Biogas	0.378	–	0.378		0.378	–
Total (MW)	**342 MW**	**241 MW**	**187 MW**	**148 MW**	**398 MW**	**282 MW**

From the assessment, it is observed that the total power generation is in surplus of estimated total load demand for all the scenario.

During the day time when the solar PV generation is available, all the proposed Wagga Wagga SAP load demands would be catered by the power generated by the solar PV and additional power will be utilised to charge the BESS system.

Scenario 5 would not require any additional transformer installation at the Zone Substation(s) for the evacuation of the excess power, whereas Scenario 4 and 7 would require additional transformer of 25 MVA and 40 MVA respectively at the Zone Substation(s) to re-distribute the excess power from the solar PV (when the BESS is fully charged and the solar PV is generating power to the full rating)

It should be noted that for scenarios when renewable energy is not available, additional back up plans should be investigated to ensure power security.

The implementation of Solar PV and BESS also helps for the effective operation of Virtual Power Plant (VPP) which is explained further in the Wagga Wagga Special Activation Precinct. Furthermore, it also helps in reducing the carbon emission and decreases the dependency on the power supply from the Grid all the time.

Other noted issues and opportunities noted are:

- The assessed loading basis is conservative. Further review and refinement of this loading including benchmarking against similar developments is recommended.
- During the off-peak time when there is no expected solar PV generation, the BESS will discharge the power it has stored and will cater to the Wagga Wagga SAP load. However, these should be operated in synchronism with the grid supply.
- With the combination of solar PV and BESS, we assumed that the capacity of the existing substations is sufficient to supply the estimated load growth of the Wagga Wagga SAP. However, it is recommended that the distribution network should be interconnected to include all the sub-precinct infrastructure for the effective usage of this technology.
- This assessment only covers the capacity upgrade required to support the future load demands of the Wagga Wagga SAP.
- Capacity of the transformers are indicative only. The actual rating will depend on the proximity of various sub-precinct, technical assessment, nature of the precinct loads. Further consultation and refinement of assumptions is still required.

The following section of the report considers the additional infrastructure requirements to subsequently provide connectivity to the areas of the Wagga Wagga SAP study area for each of the scenarios being considered.

3.6.1 SCENARIO 4 – SAP POWER CONNECTIVITY INFRASTRUCTURE REQUIREMENTS

The power servicing concept for Scenario 4 is shown in Figure 3.13. A summary of the proposed power distribution infrastructure is provided in Table 3.25.

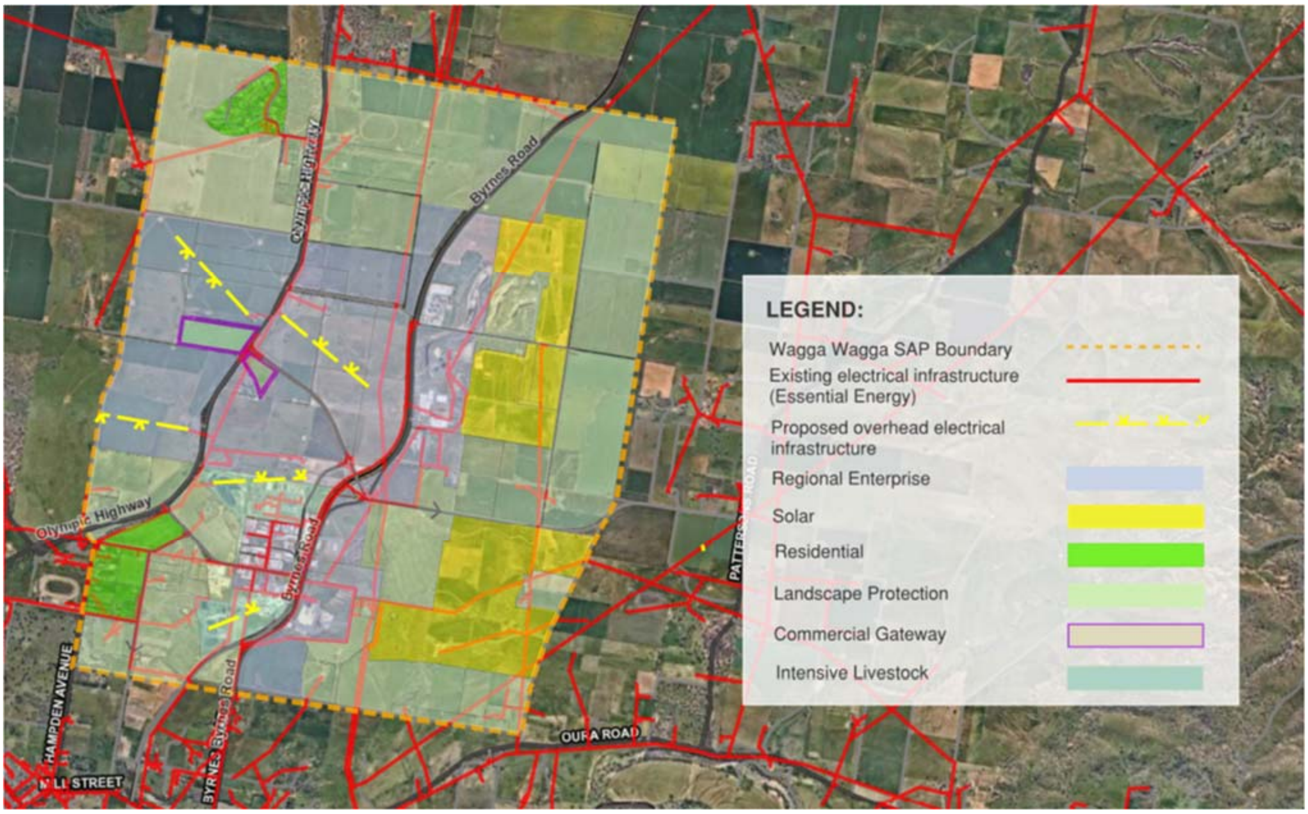


Figure 3.13 Scenario 4 – Concept power strategy

Table 3.25. Scenario 4 – Summary of network required

TOTAL LENGTH OF NETWORK REQUIRED	TYPOLOGY	COMMENTS
5.675 km in length.	— Overhead.	Pipe/cable material, size and length subject to utility authority requirements. The proposed connection for the distribution systems are typically 11 kV.

Data taken from Essential Energy assets shows that area within the proposed SAP have already access to distribution networks which are overhead in nature. The expected infrastructure upgrades are the expansion of these overhead cables to supply areas within the SAP area. Other noted assumptions for Scenario 4 are:

- Installation of the required distribution upgrades will remain overhead unless specified by the relevant authority. Underground cable installation is also an option with a more expensive installation cost. Furthermore, the proposed distributions for each scenario do not follow road reserves or riparian corridors. Distribution network for each option would typically follow road reserves or available shared service corridors to minimize the impact of provision of easements.
- Easement applications for overhead poles are required when located on private land (not within road reserves or service corridors).

- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with Essential Energy is required.

3.6.2 SCENARIO 5 – SAP POWER CONNECTIVITY INFRASTRUCTURE REQUIREMENTS

The power servicing concept for Scenario 5 is shown in Figure 3.1. A summary of the proposed power distribution infrastructure is provided in Table 3.26.

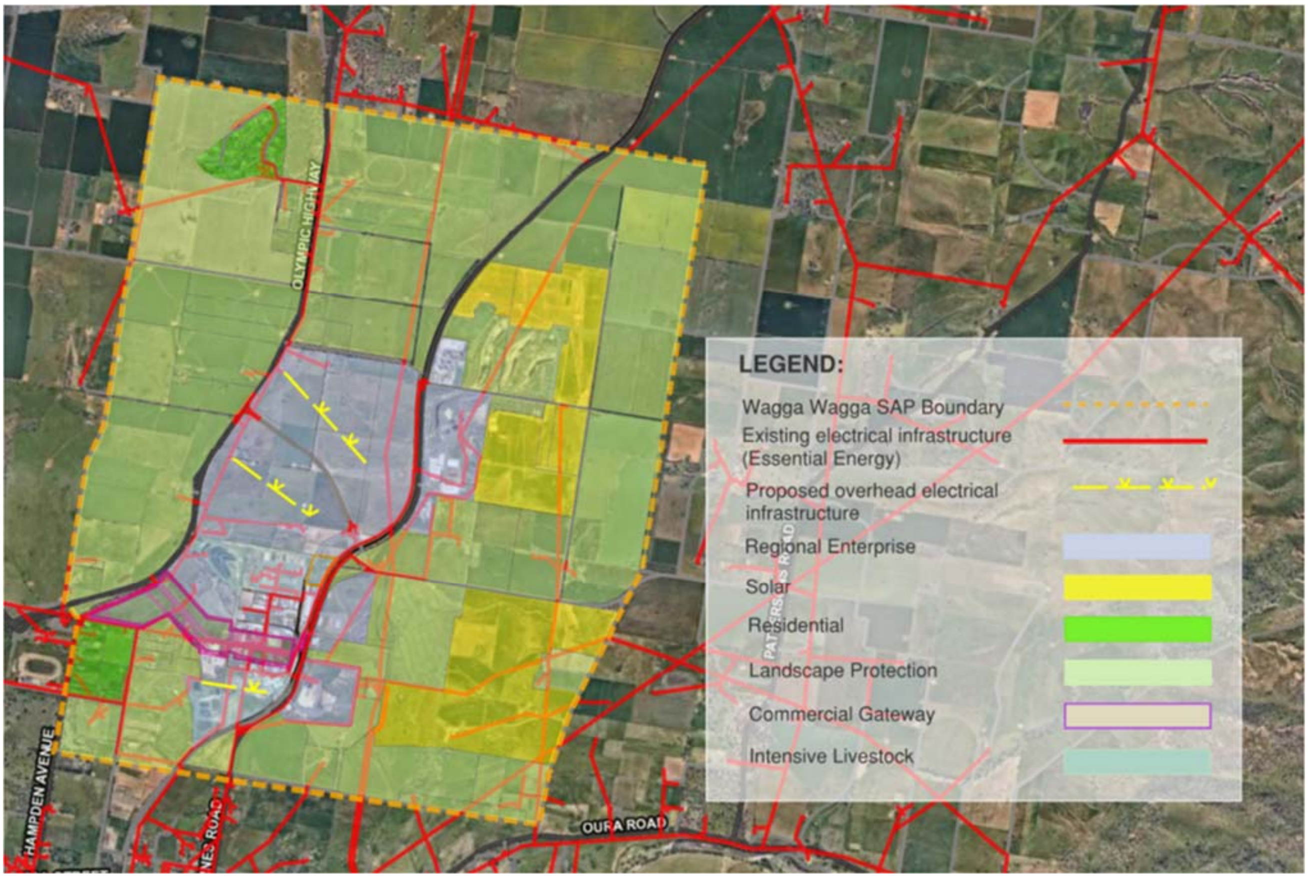


Figure 3.14 Scenario 5 – Concept power strategy

Table 3.26. Scenario 5 – Summary of network required

TOTAL LENGTH OF NETWORK REQUIRED	TYPOLOGY	COMMENTS
2.947 km in length.	— Overhead.	Pipe/cable material, size and length subject to utility authority requirements. The proposed connection for the distribution systems are typically 11 kV.

Data taken from Essential Energy assets shows that area within the proposed SAP have already access to distribution networks which are overhead in nature. The expected infrastructure upgrades are the expansion of these overhead cables to supply areas within the SAP area. Other noted assumptions for Scenario 5 are:

- Installation of the required distribution upgrades will remain overhead unless specified by the relevant authority. Underground cable installation is also an option with a more expensive installation cost.
- Easement applications for overhead poles are required when located on private land (not within road reserves or service corridors). Furthermore, the proposed distributions for each scenario do not follow road reserves or riparian corridors. Distribution network for each option would typically follow road reserves or available shared service corridors to minimize the impact of provision of easements.
- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with Essential Energy is required.

3.6.3 SCENARIO 7 – SAP POWER CONNECTIVITY INFRASTRUCTURE REQUIREMENTS

The power servicing concept for Scenario 7 is shown in Figure 3.15. A summary of the proposed power distribution infrastructure is provided in Table 3.27.

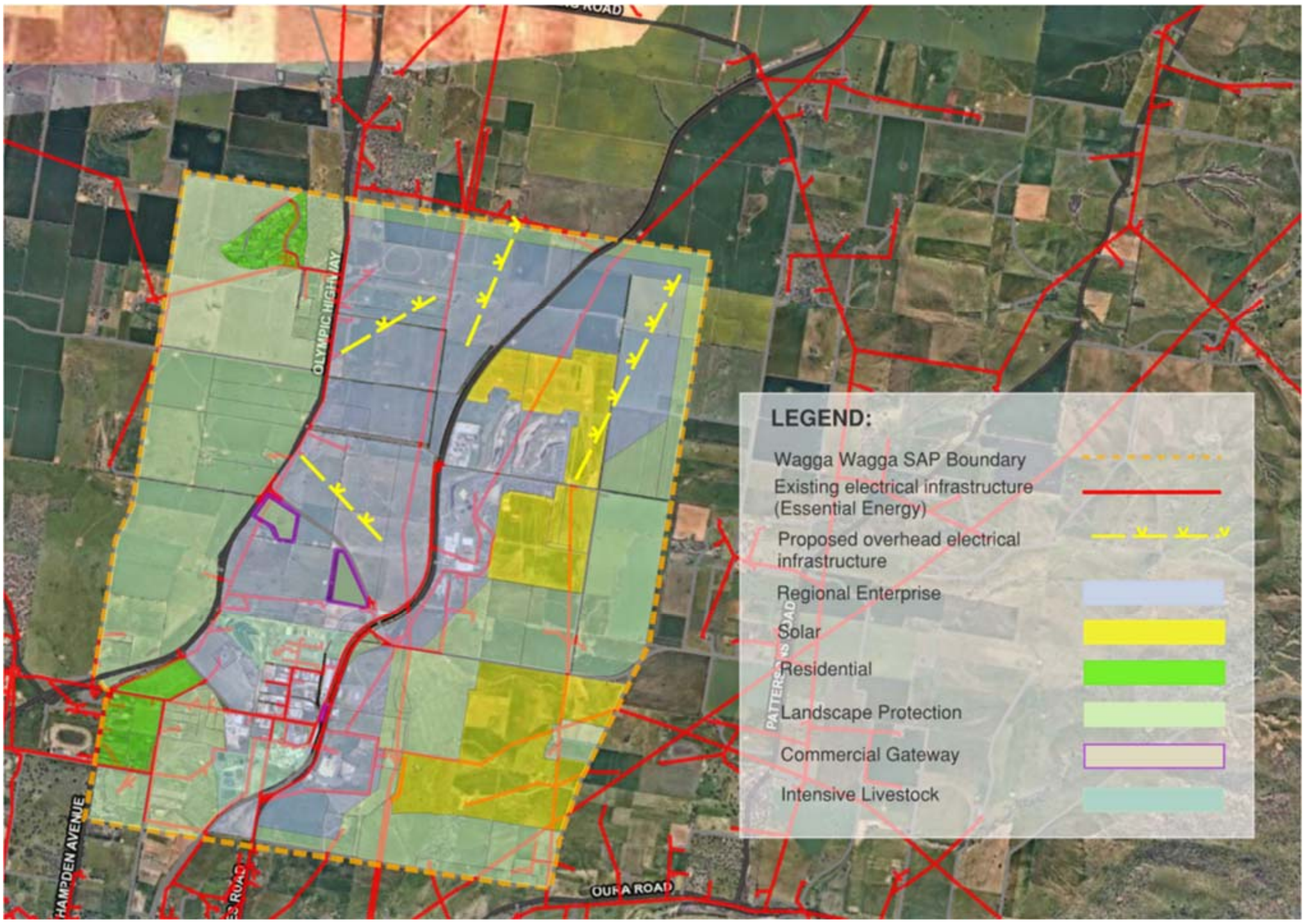


Figure 3.15 Scenario 7 – Concept power strategy

Table 3.27. Scenario 7 – Summary of network required

TOTAL LENGTH OF NETWORK REQUIRED	TYPOLOGY	COMMENTS
6.727 km in length.	— Overhead.	Pipe material, size and length subject to utility authority requirements. The proposed connection for the distribution systems are typically 11 kV.

Data taken from Essential Energy assets shows that area within the proposed SAP have already access to distribution networks which are overhead in nature. The expected infrastructure upgrades are the expansion of these overhead cables to supply areas within the SAP area. Other noted assumptions for Scenario 7 are:

- Installation of the required distribution upgrades will remain overhead unless specified by the relevant authority. Underground cable installation is also an option with a more expensive installation cost.
- Easement applications for overhead poles are required when located on private land (not within road reserves or service corridors). Furthermore, the proposed distributions for each scenario do not follow road reserves or riparian corridors. Distribution network for each option would typically follow road reserves or available shared service corridors to minimize the impact of provision of easements.

- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with Essential Energy is required.

3.7 GAS

3.7.1 MAJOR INFRASTRUCTURE REQUIREMENTS

APA has advised that there is a robust supply to support future growth from development within the SAP area and will be able to customise and augment to match demand requirements as they change. Expansion of the gas distribution system to the SAP area is readily available due to the close proximity to the City Gate which is a substation that distributes gas from the high-pressure gas main to the distribution network, regulating distribution network pressure which is located within the SAP area. Notwithstanding, reticulation works are still required within the servicing areas of Wagga SAP.

Provision of future infrastructure is covered in the tariff charges to the local area except for high demand users (that is demand greater than or equal to 10,000 GJ/Year). Provision for high demand users would be on a user pays system, and for those that are likely to use greater than 1TJ/day, they would negotiate a commercial agreement directly with APA gas.

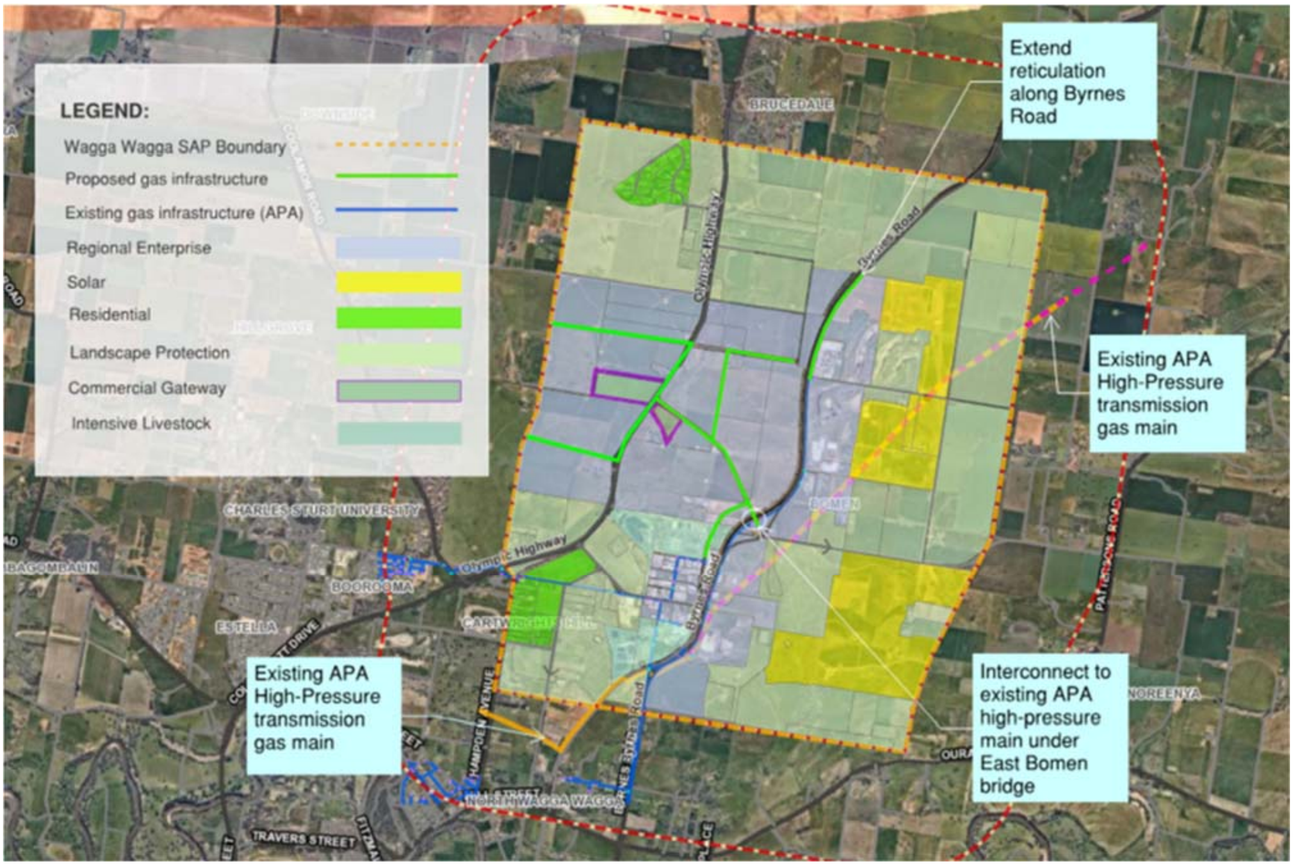
For all gas reticulation mains, it is assumed construction will generally use conventional trenched excavation, NSW Street Opening Coordination Council (SOCC) manual suggest 750–1000 mm typical depth and mains will generally be located within the nature strip or constructed during civil works. In carrying these assessments, we also assumed the following:

- Concept strategy for gas services is limited to Wagga Wagga SAP areas that we assumed to generate future gas demands. Furthermore, the concept reticulation presented is within the distribution level only as APA noted during discussions that their supply is robust and can cater additional future demand. With this assumption, source augmentation is not investigated in this study.
- The provision of pumps, gas regulators and other appurtenances have not been considered in this study and are assumed to be designed as part of the distribution network upgrades.
- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with the relevant authority is recommended.
- The future gas demand assumptions considered heating requirements for employment, health, research, laboratory, general industry, space-heating, hot water consumption, cooking etc. for a total of 625 MJ/day (Regional Enterprise), 240 MJ/day/dwelling at 60% diversity factor (Residential) and 56.40 MJ/day at 60% diversity factor (Commercial Gateway).

A review of Riverina Intermodal Freight and Logistics (RIFL) hub reference design report suggest that gas will not be provided to the terminal. Therefore, no additional demand is added from RIFL hub.

3.7.2 SCENARIO 4 – SAP INFRASTRUCTURE REQUIREMENTS

The concept infrastructure requirement to support Scenario 4 is shown in Figure 3.16. A summary of the new infrastructure is provided in Table 3.28.



Source: WSP Create – Wagga Wagga SAP

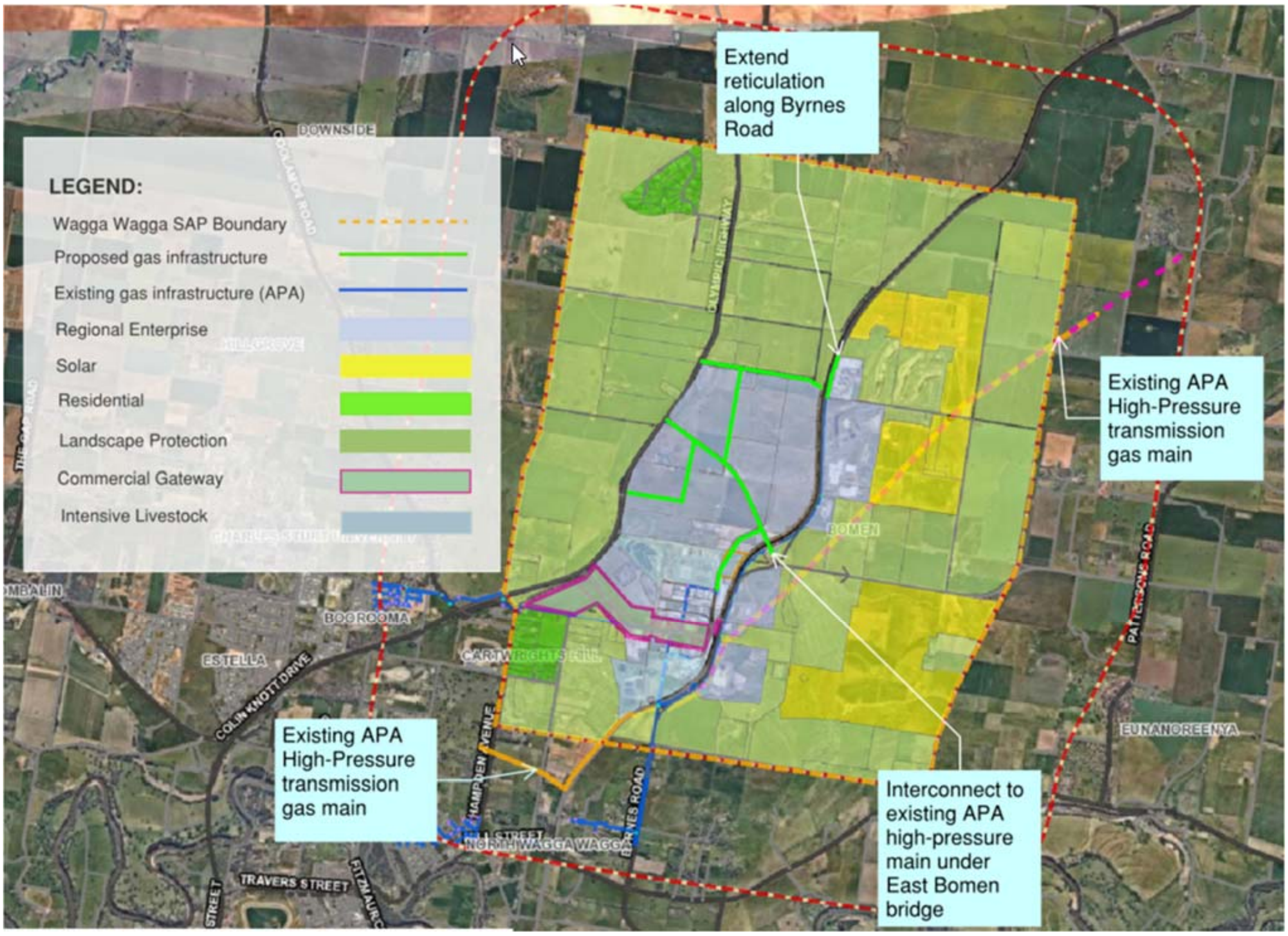
Figure 3.16 Scenario 4 – Gas servicing concept

Table 3.28 Scenario 4 – Gas servicing concept

ESTIMATED FUTURE DEMAND	ASSUMPTIONS FOR COSTING	COMMENTS
The estimated total gas demand is 11.20 TJ/d Regional Enterprise: 10.18 TJ/day Residential: 0.6372 TJ/day Commercial: 0.374 TJ/day	Approx. 10,700 meters of reticulation	Pipe material, size and length subject to utility authority requirements

3.7.3 SCENARIO 5 – SAP INFRASTRUCTURE REQUIREMENTS

The concept infrastructure requirement to support Scenario 4 is shown in Figure 3.17. A summary of the proposed infrastructure is provided in Table 3.29.



Source: WSP Create – Wagga Wagga SAP

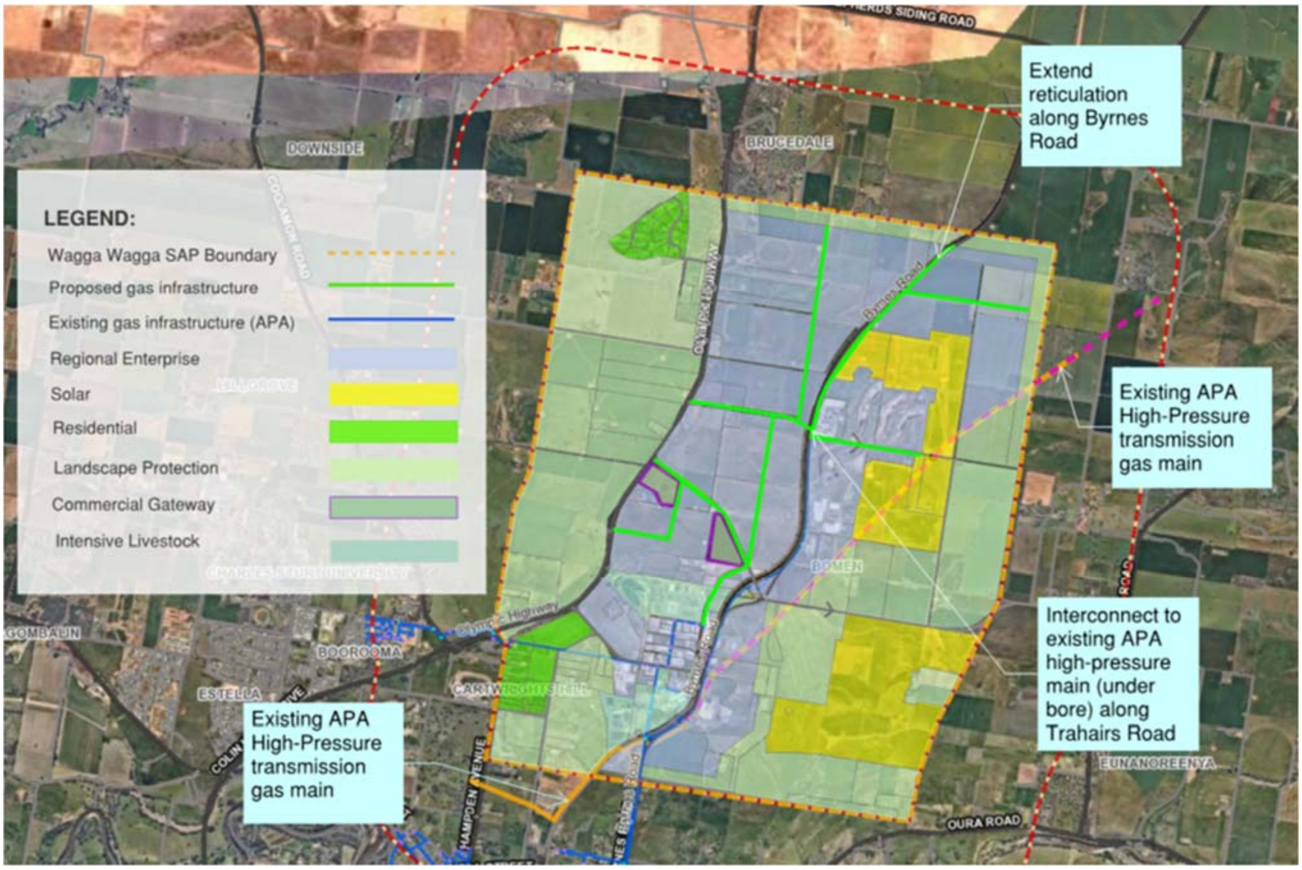
Figure 3.17 Scenario 5 – Gas servicing concept

Table 3.29 Scenario 5 – Gas servicing concept

ESTIMATED FUTURE DEMAND	ASSUMPTIONS FOR COSTING	COMMENTS
The estimated total gas demand is 6.32 TJ/d Regional Enterprise: 5.16 TJ/day Residential: 0.5184 TJ/day Commercial: 0.6369 TJ/day	Approx. 7,760 meters of reticulation	Pipe material, size and length subject to utility authority requirements

3.7.4 SCENARIO 7 – SAP INFRASTRUCTURE REQUIREMENTS

The concept infrastructure requirement to support Scenario 7 is shown in Figure 3.18. A summary of the new infrastructure is provided in Table 3.30.



Source: WSP Create – Wagga Wagga SAP

Figure 3.18 Scenario 7 – Gas servicing concept

Table 3.30 Scenario 7 – Gas mains

ESTIMATED FUTURE DEMAND	ASSUMPTIONS FOR COSTING	COMMENTS
The estimated total gas demand is 13.02 TJ/d Regional Enterprise: 12.03 TJ/day Residential: 0.6426 TJ/day Commercial: 0.3437 TJ/day	Approx. 16, 230 meters of reticulation 1 – proposed trenchless pipe installation (under bore) along Trahairs Road	Pipe material, size and length subject to utility authority requirements

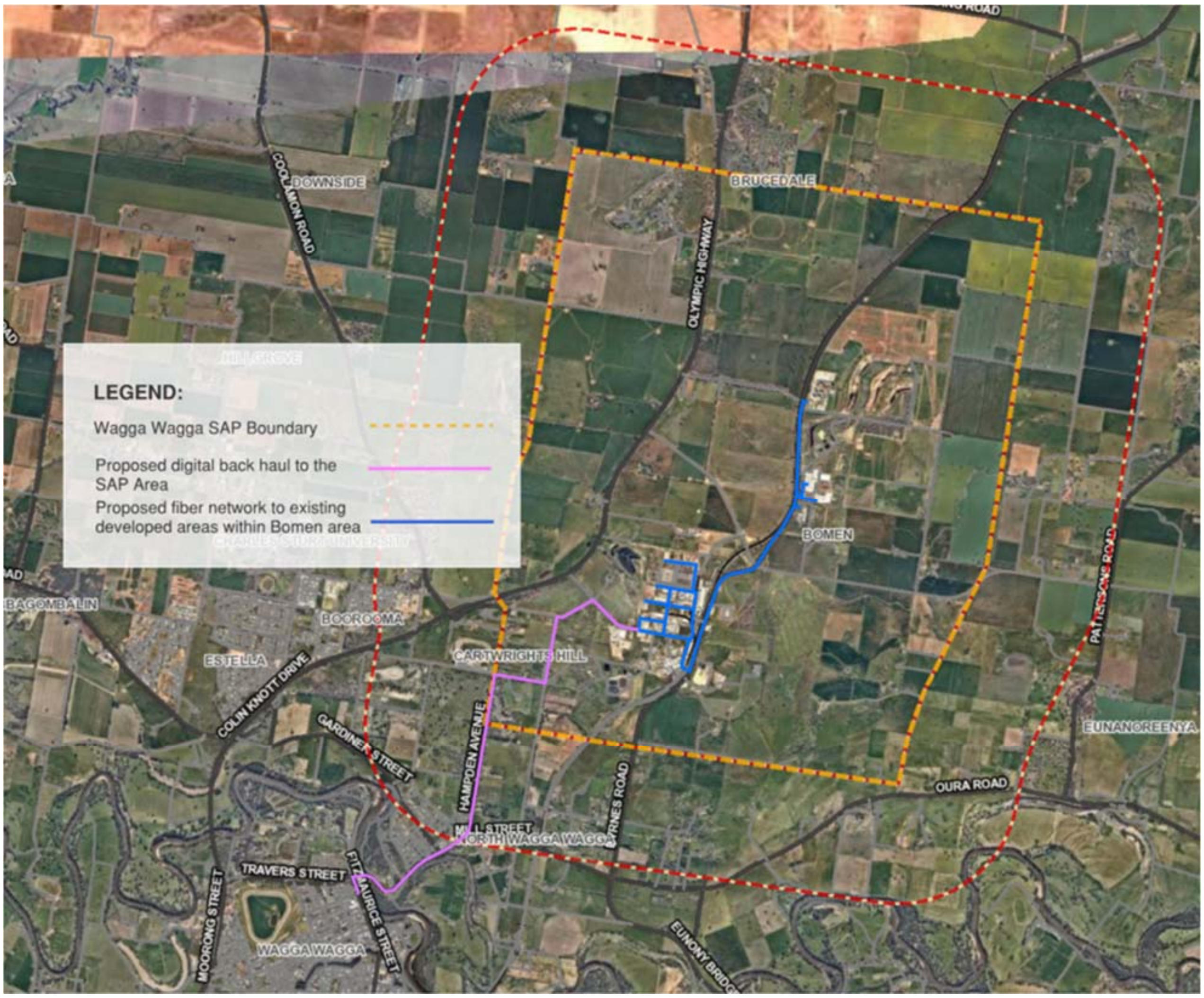
3.8 TELECOMMUNICATIONS AND DIGITAL CONNECTIVITY

3.8.1 NSW DIGITAL CONNECTIVITY IMPROVEMENT PROGRAM

As noted in the final baseline assessment report, the proposed Wagga Wagga SAP area is relatively well-serviced by enabling infrastructure and services except for digital infrastructure which is constrained by current connectivity to Regional NSW. Telecommunication and digital connectivity to the proposed SAP area is reliant upon the NSW Regional Connectivity Program for which concept design from The Grex Group has been received and shown in Figure 3.19.

The NSW Regional Digital Connectivity program will focus on three priority areas:

- Internet and data – Dubbo and Wagga Wagga will be the first locations to investigate the design of data hubs and fibre cables to make internet connectivity faster and more reliable.
- Farm and water – Infrastructure to enhance competitiveness and productivity for our farming industry.
- Mobile – eliminating mobile black spots where people live and work.



Source: Concept Design sketch: Digital Connectivity Improvement program, The Grex Group, September2019

Figure 3.19 Concept digital connectivity to Wagga Wagga SAP

3.8.1.1 SHORT TERM SOLUTION TO SUPPORT THE WAGGA WAGGA SAP AREA

One of the key priority areas of the NSW Digital Connection Program is to improve digital connectivity to Wagga Wagga with the design of data hubs and fibre cables to make internet connectivity faster and more reliable.

In consultation with Wagga Wagga City Council the location and design of the Wagga Wagga data hub is currently being considered. This will provide a location for a fibre back haul to be provided to the region. Establishment of a digital back haul from the Wagga Wagga data hub to Bomen area (shown in Figure 4.12) will provide the digital connectivity to the future Wagga Wagga SAP area. This solution is consistent for all three scenarios to be tested.

Note – the location of the Wagga Wagga Data Hub requires a parcel of land that can be expanded in future and is not impacted by flood prone land. This is currently being investigated by WWCC in consultation with the NSW Digital Connection Program. Given that the Wagga Wagga SAP area is largely not impacted by flooding the location of the data hub within the study area might be a viable alternative. If this is the case, the digital backhaul between Bomen and Wagga Wagga CBD will still be required as this will provide the digital connection between the data hub and the greater Wagga Wagga region.

Once the data hub and fibre back haul connection to the existing Bomen area is provided, this will enable the roll out of a fibre network to connect the existing Bomen brown-field areas to the new data hub.

It is recognised by the NSW Digital Connection Program that this solution will provide immediate improvement to the poor internet connection experienced by current businesses within the Bomen area. This short-term solution will not only provide improvement to the existing areas of Bomen but provide the infrastructure connection to provide future development within the Wagga Wagga SAP study area for all three scenarios being considered.

The capital investment required to deliver these short-term solutions are in the following table:

Table 3.31 Summary of short-term investment for digital connectivity

NSW DIGITAL CONNECTION PROGRAM INITIATIVE	ESTIMATE OF CAPITAL INVESTMENT REQUIRED
Establishment of a digital fibre back haul between the future Wagga Wagga data hub and existing Bomen Business Park.	$300 k – to – $500 k
Provision of fibre network connection to existing Bomen Brown-field areas connected to the new Wagga Wagga data hub.	$500 k – to – $1 m

The following assumptions were used in estimating the capital investment required:

- For the fibre backhaul and network installation, it is assumed construction will generally use conventional trenched excavation, 700–1000 mm typical depth and cable will generally be located in the verge, where possible.
- It was assumed that cost of $65 per meter for the installation of pipe and pits and $35 per meter for the deployment of fibre within the ducts.

The following section of the report considers the additional infrastructure requirements to subsequently provide connectivity to the green-field areas of the Wagga Wagga SAP study area for each of the scenarios being considered.

3.8.2 SCENARIO 4 – SAP DIGITAL CONNECTIVITY INFRASTRUCTURE REQUIREMENTS

The digital connectivity servicing concept for Scenario 4 is shown in Figure 3.20. A summary of the proposed communication infrastructure is provided in Table 3.32.

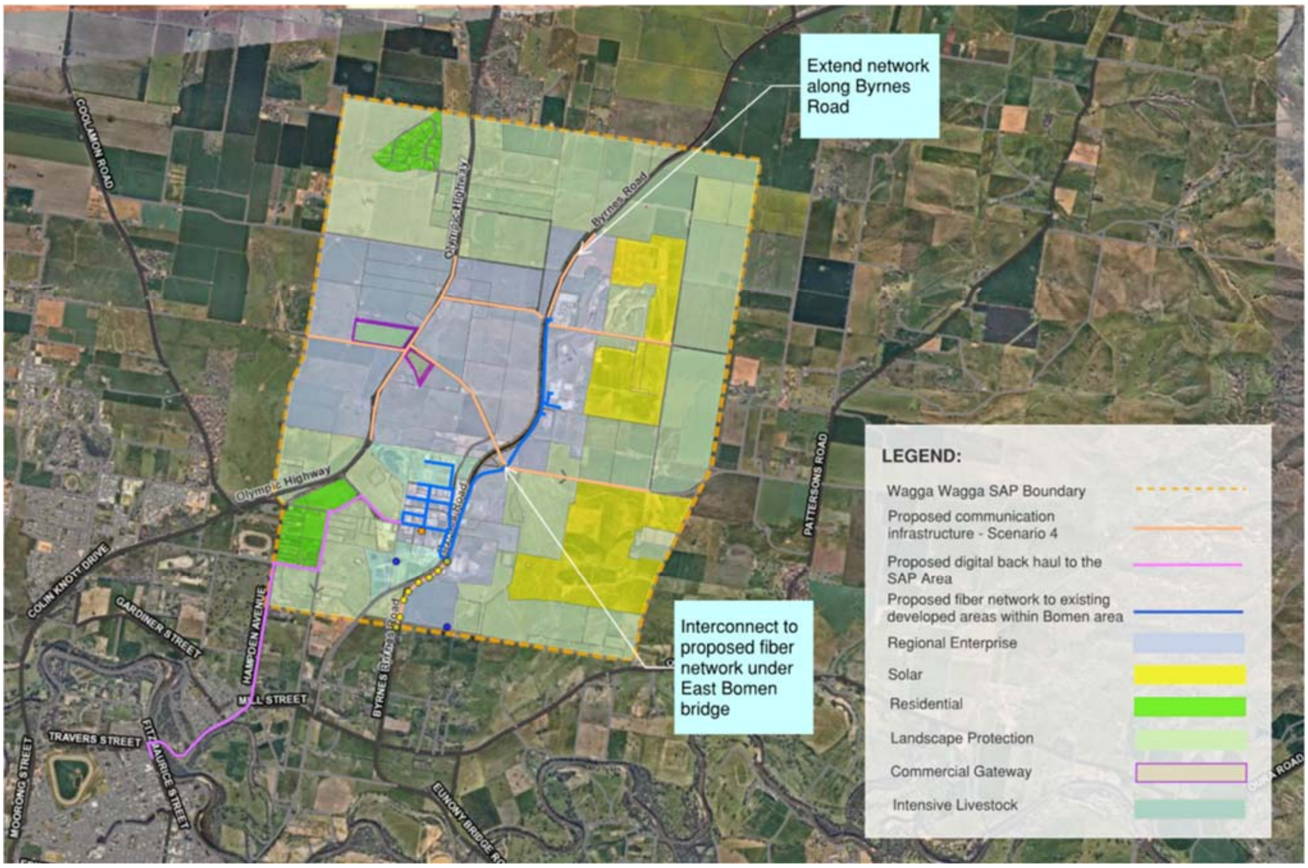


Figure 3.20 Scenario 4 – Concept communication strategy

Table 3.32. Scenario 4 – Summary of network required

TOTAL LENGTH OF NETWORK REQUIRED	ASSUMPTIONS FOR COSTING	ESTIMATE OF CAPITAL INVESTMENT REQUIRED
14,888 km in length	\$65 per meter (for the installation of pit & pipes on one side at approx. 60% of roads and both sides at 40% of roads) with P6 pits spaced at an average of 300 m. \$35 per meter for the deployment of fibre within the duct described in above Approximately \$13–\$15 k for the new greenfield premise connections	\$1.489 M

For the fibre backhaul and network installation, it is assumed construction will generally use conventional trenched excavation, 700–1000 mm typical depth and cable will generally be located in the verge, where possible.

3.8.3 SCENARIO 5 – SAP DIGITAL CONNECTIVITY INFRASTRUCTURE REQUIREMENTS

The digital connectivity servicing concept for Scenario 4 is shown in Figure 3.21. A summary of the proposed communication infrastructure is provided in Table 3.33.

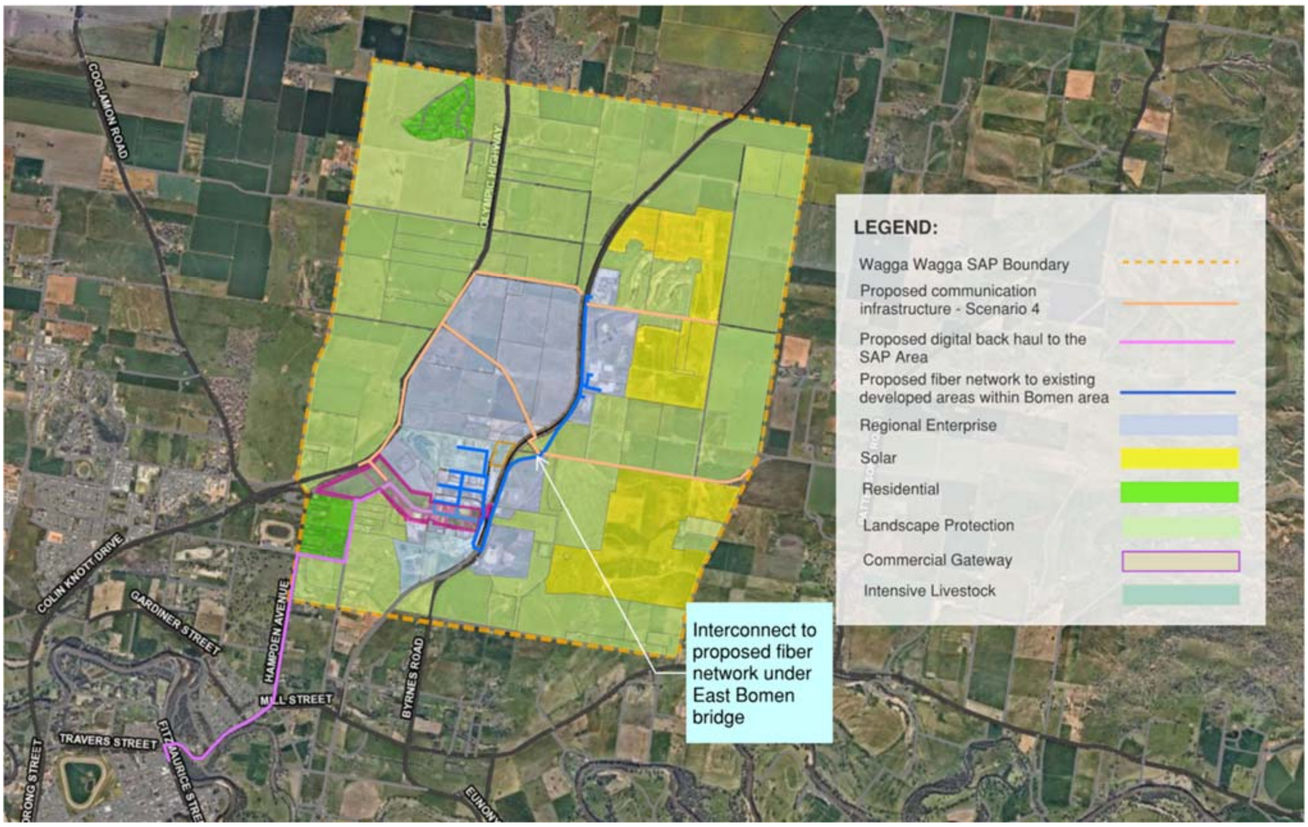


Figure 3.21 Scenario 5 – Concept communication strategy

Table 3.33 Scenario 5 – Summary of network required

TOTAL LENGTH OF NETWORK REQUIRED	ASSUMPTIONS FOR COSTING	ESTIMATE OF CAPITAL INVESTMENT REQUIRED
11,835 km in length	$65 per meter (for the installation of pit & pipes on one side at approx. 60% of roads and both sides at 40% of roads) with P6 pits spaced at an average of 300 m. $35 per meter for the deployment of fibre within the duct described in above Approximately $13–$15 k for the new greenfield premise connections	$1.183 M

For the fibre backhaul and network installation, it is assumed construction will generally use conventional trenched excavation, 700–1000 mm typical depth and cable will generally be located in the verge, where possible.

3.8.4 SCENARIO 7 – SAP DIGITAL CONNECTIVITY INFRASTRUCTURE REQUIREMENTS

The digital connectivity servicing concept for Scenario 4 is shown in Figure 3.22. A summary of the proposed communication infrastructure is provided in Table 3.34.

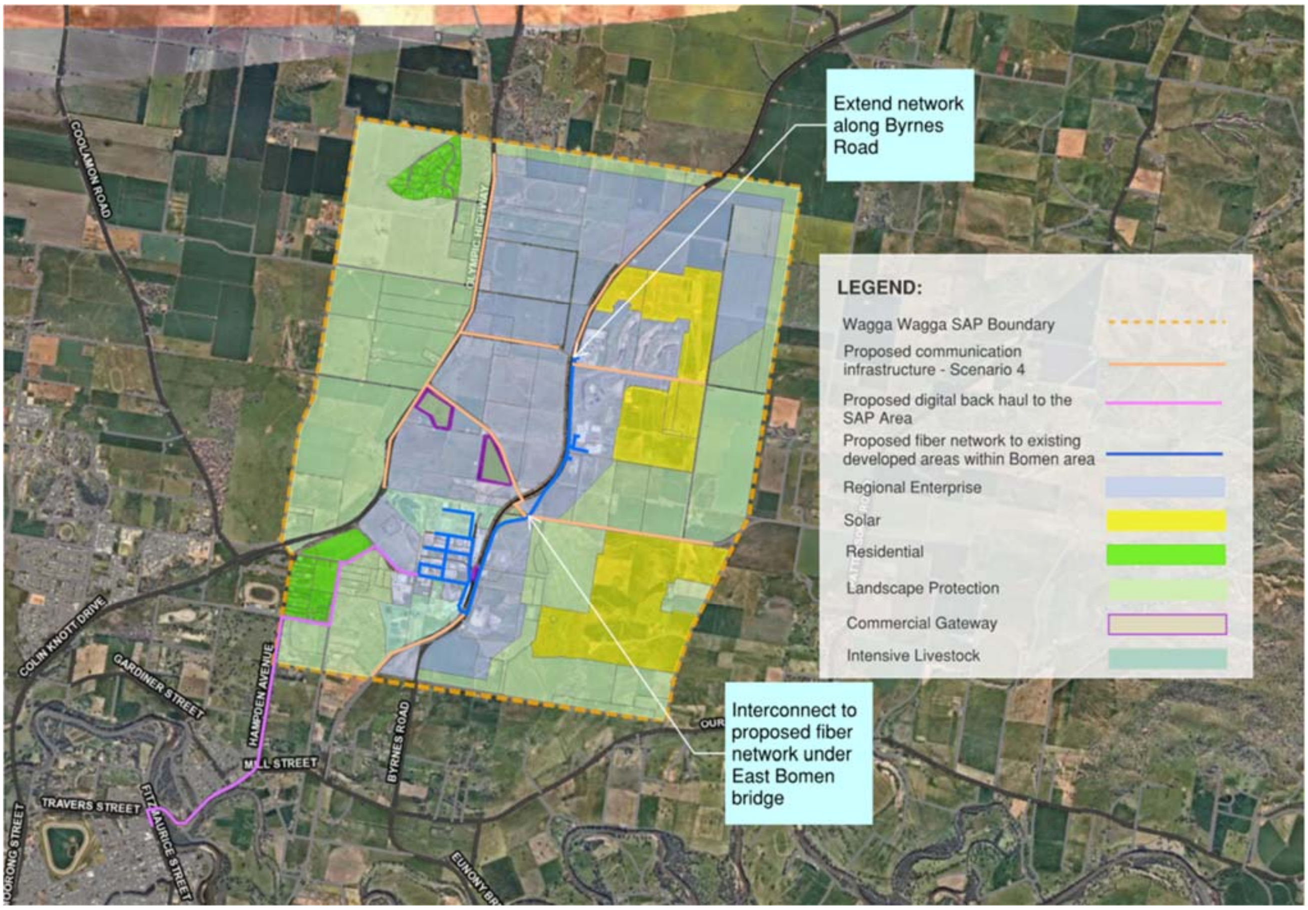


Figure 3.22 Scenario 7 – Concept communication strategy

Table 3.34 Scenario 7 – Summary of network required

TOTAL LENGTH OF NETWORK REQUIRED	ASSUMPTIONS FOR COSTING	ESTIMATE OF CAPITAL INVESTMENT REQUIRED
17,713 km in length.	$65 per meter (for the installation of pit & pipes on one side at approx. 60% of roads and both sides at 40% of roads) with P6 pits spaced at an average of 300 m. $35 per meter for the deployment of fibre within the duct described in above. Approximately $13–$15 k for the new greenfield premise connections.	$1.77 M

For the fibre backhaul and network installation, it is assumed construction will generally use conventional trenched excavation, 700–1000 mm typical depth and cable will generally be located in the verge, where possible.

3.9 WASTE

3.9.1 WASTE MANAGEMENT – CURRENT STATE

As noted in the final baseline assessment report, Waste services within Wagga Wagga is currently provided by Wagga Wagga City Council and/or commercial waste agreements (private operators). WWCC owns and operates a large capacity landfill facility at Gregadoo Waste Management Centre (GWMC) which is approximately 20 km away from Wagga Wagga SAP area as shown in the Figure 3.23 below. WWCC anticipates that waste generation from the LGA will increase between 1.5–3% depending on population growth over the next 10 years

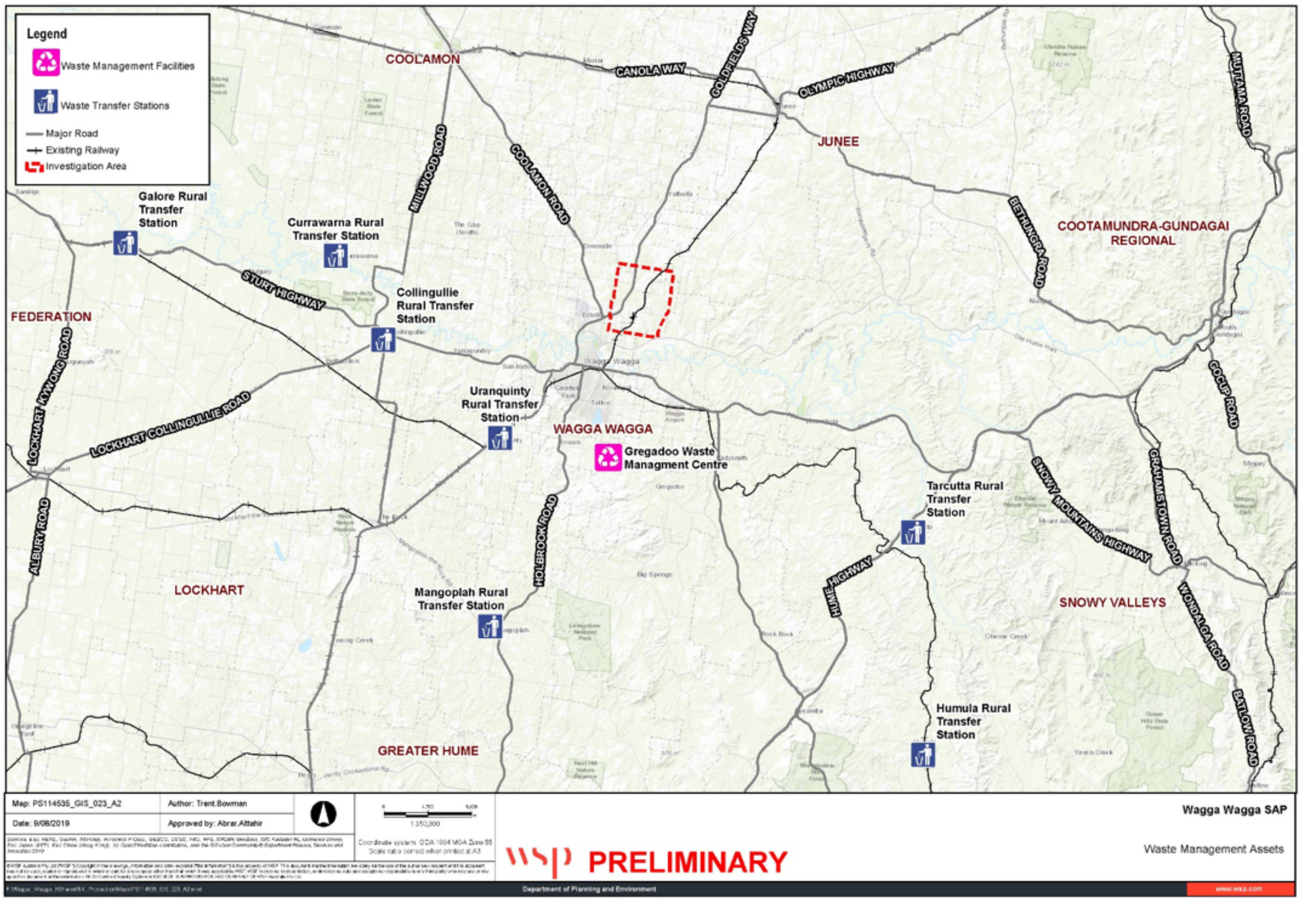


Figure 3.23 Gregadoo waste facility to Wagga Wagga SAP

3.9.2 WAGGA WAGGA SAP SCENARIO TESTING

The three scenarios being considered in the proposed Wagga Wagga SAP are expected to increase the waste generation. We have estimated the waste generation of each of these three scenarios based on the following sources:

- National Waste Report 2018
- Commercial and Industrial Waste Management – Plan guidelines
- Waste Management Planning Guidelines for Multi-Unit Dwellings (MUD's), Mixed Use and Commercial Developments
- https://www.epa.vic.gov.au/business-and-industry/lower-your-impact/~/media/Files/bus/EREP/docs/wastematerials-densities-data.pdf (Density of waste materials).

Table 3.35 provides summary of the expected waste generated of Wagga Wagga SAP study area for each of the scenarios being considered.

Table 3.35 Wagga Wagga SAP waste generation

SCENARIO	ESTIMATED TOTAL WASTE GENERATION (TONNES/YEAR)
Scenario 4	21,703.4 tonnes/year
Scenario 5	18,978.79 tonnes/year
Scenario 7	22,989.97 tonnes/year

Other assumptions used in the assessment of expected waste generation includes:

- Waste from Solar land use areas are excluded in the assessment due to lack of parameters available. It is noted that the usage life of solar panels is ranging from 15 to 25 years. Data from National Waste report 2018 suggests that About 1.1 Mt or 44 kg per capita of glass waste was generated in 2016–17 in Australia. It is noted that about 76–89% of the solar panels are made of plastics.

3.9.3 WASTE MANAGEMENT – FUTURE STATE

Waste generation from all three scenarios show that the management of waste from the Wagga Wagga SAP area in the future will not be efficient if it is managed as per the current state arrangements.

The recommended solution is that a Wagga Wagga SAP area Waste Transfer and Recycling Centre is considered for development within the study area. The size and capacity of this facility will vary pending the preferred scenario.

There are several key facility considerations for the Wagga Wagga SAP area Waste Transfer and Recycling Centre:

- Waste separation and recycling (pre-handling)
- Efficient transportation of land-fill to the Gregadoo site
- Waste drop off point for businesses operating within the SAP and recycling materials from members of the public.

It is recommended that a further detailed business case be explored in alignment with the Handbook for Design and Operation of Rural and Regional Transfer Stations – Department of Environment and Conservation NSW.

https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/warrlocal/060362-transferstation1.pdf?la=en&hash=FA2C668130BFBA811BFFB532031349EFC4585A47

3.10 SUMMARY OF SCENARIO TESTING

This section of the report summarises the result of scenario testing from an infrastructure and services lenses as one input to a full Enquiry by Design workshop.

SERVICE TYPE	CONCLUSIONS	SUMMARY OF RECOMMENDATIONS FOR FULL ENQUIRY BY DESIGN WORKSHOP
Water and Sewerage	The estimated total water demand and sewage loading for all three scenarios is extremely high, based on the theoretical/standard per hectare rates normally used by RWCC and WWCC. These are considered conservative and likely to significantly overestimate actual demand and loading for this type of development. Major headworks infrastructure upgrades (That is upstream/downstream of the SAP area) will be required. These are beyond the scope of this study however have been identified for consideration. The high demands of the SAP will require additional water allocation. Refer to RWCC's Draft IWCM Issues Paper for details regarding this item. The three precinct scenarios would require significant new water and sewerage network infrastructure.	Refinement of the water demand and sewage loading assumptions is undertaken for the preferred scenario, with the aim of reducing the potentially excessive values presented in this document. This should include research and benchmarking of actual demand and loading for similar areas/developments in Australia to challenge the theoretical design standards. This recommendation is well supported by both RWCC and WWCC from preliminary engagement undertaken in development of this document. Logical staging of development to avoid undesirable/uneconomical water and sewerage infrastructure outcomes is investigated and incorporated into the SAP planning for the preferred scenario. This should aim to utilise existing infrastructure capacity in the near term, where possible and defer development in areas which are distant from the current network infrastructure. Detailed input (to the extent possible within the project timeframe) is sought from RWCC and WWCC regarding the major headworks items listed in Section 3 to enable these to be costed and addressed in the SAP reporting as best possible. It is noted these items will likely require further detailed investigations, separate to the SAP Project.

SERVICE TYPE	CONCLUSIONS	SUMMARY OF RECOMMENDATIONS FOR FULL ENQUIRY BY DESIGN WORKSHOP
		The discrepancy between the theoretical ADWF for the existing BISTF catchment calculated in this study (approx. 2 ML/d for all three scenarios) and WWCC's advice of actual loading (approx. 4 ML/d) is investigated further. This is potentially due to major existing customers with extremely high loading. These capacities have been provided WWCC in absence of hydraulic modelling and are to be confirmed by current operator's usage rates.
Storm Water	The scenario testing shows there are some minor flood impacts which are largely outside of the Precinct. These are likely to be readily resolved by optimisation of the riparian corridor and waterway design and potential minor alterations to regional detention basin sizing. This optimisation could be undertaken as part of the concept design selected for the Precinct. (Rhelm (2019) The provision of stormwater infrastructure should be provided in accordance with WWCC current development requirements and relevant standards.	For the preferred scenario, identify the required upgrades to culverts and stormwater infrastructure (such as along the Olympic Highway) that are likely to be needed to ensure the flood immunity up to the 1% AEP flood event.
Power	The total available spare capacity at the distribution substation level is approximately 66 MVA Based from the scenario testing, it is concluded that the total power generation for the "SAP precincts with in-house solar PV generation" condition exceeds the calculated load demands of all the scenarios of Wagga Wagga SAP. Based from the outcomes of scenario testing it is recommended to utilise Solar PV and BESS technologies as it will yield enough power generation to sustain the expected load demands of the SAP. However, power security should be consider in the event that the renewable energy are not available.	The report covers a desktop assessment and does not include the detailed technical analysis. It is recommended to carry out a detailed technical analysis in terms of the voltage drop, line loadings, distribution loss, system security etc., for the preferred scenario.
Gas	APA has advised that there is a robust supply to support future growth from development within the SAP area and will be able to customise and augment to match demand requirements as they change. Therefore, no expected source upgrade is required to support the SAP expected gas demands.	The report covers a desktop assessment and does not include the detailed technical analysis and refinement of the gas loading assumptions is undertaken for the preferred scenario, with the aim of reducing the potentially excessive values presented in this document. This should include research and benchmarking of actual demand from AGN and APA.

SERVICE TYPE	CONCLUSIONS	SUMMARY OF RECOMMENDATIONS FOR FULL ENQUIRY BY DESIGN WORKSHOP
Telecommunication and Digital Connectivity	The NSW Digital Connection Improvement program has proposed a short-term solution that will provide a Wagga Wagga Data Hub and digital connection to the existing brown-field areas of Bomen. Connection to the remaining three scenarios will connect to the digital network being proposed by the NSW Digital Connection Program. The cost is directly related to the size of each scenario being considered.	It is recommended that opportunities like shared trenching and synergies with other planned construction activities should be explored to improve construction cost of the proposed network. The concept design for the green-field area of the preferred solution is further developed.
Waste	Waste generation from all three scenarios show that the management of waste from the Wagga Wagga SAP area in the future will not be efficient if it is managed as per the current state arrangements. The recommended solution is that a Wagga Wagga SAP area Waste Transfer and Recycling Centre is considered for development within the study area	For the preferred scenario, it is recommended that a further detailed business case considering the size and operation of the proposed Waste Transfer and Recycling Centre be explored in alignment with the Handbook for Design and Operation of Rural and Regional Transfer Stations – Department of Environment and Conservation NSW.

4 REFINED STRUCTURE PLAN

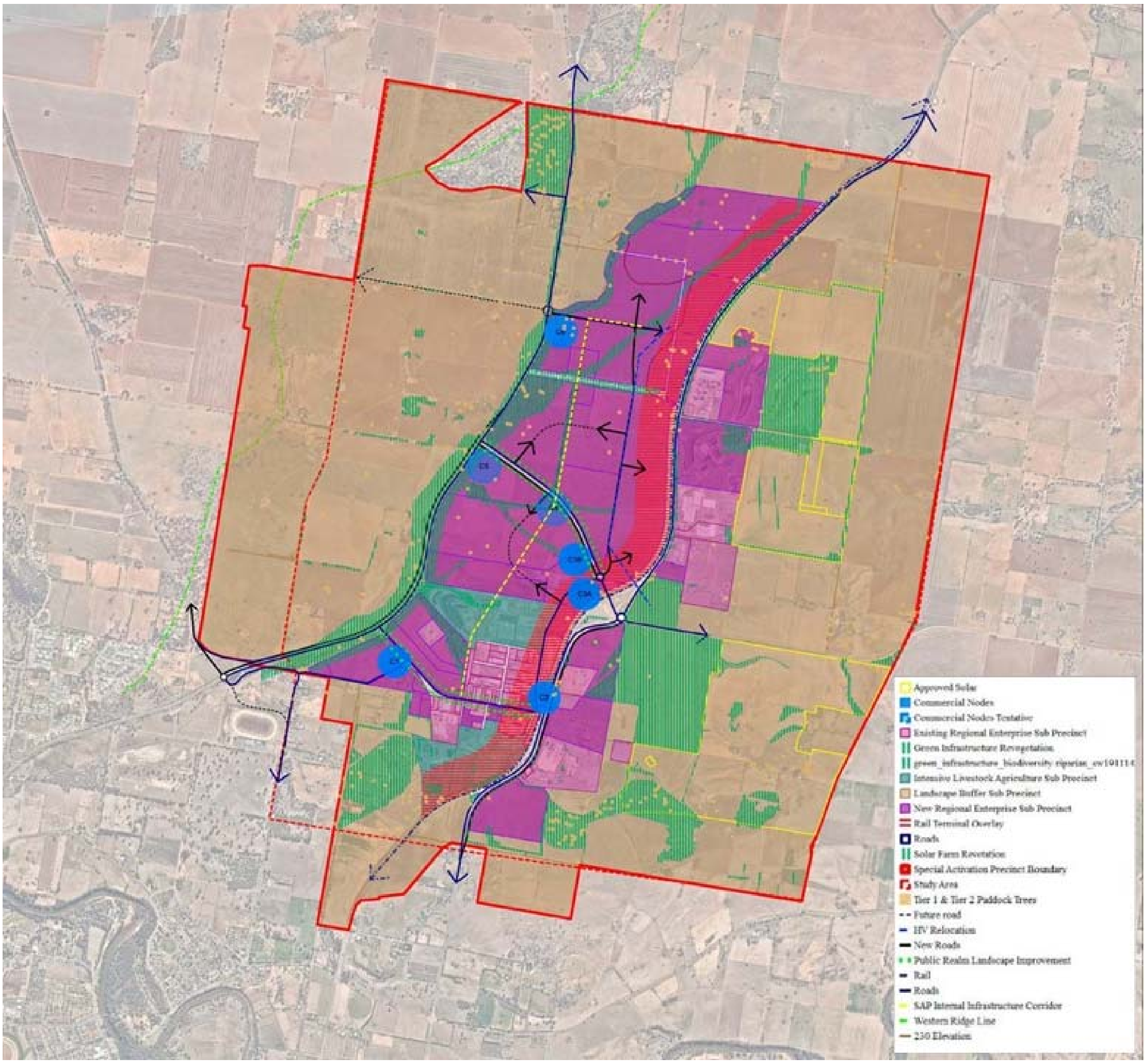
The following section of the report explores the refined structure plan and future infrastructure requirements.

Following the full Enquiry by Design workshop held on 17, 18 and 19 September 2019, a refined structure plan was developed by Master Plan consultants, Jensen Plus.

This section of the report analyses the demand requirements for the preferred structure plan, and identifies the required infrastructure upgrades to support development over time. It identifies recommended investment triggers to align to the expected growth of the Wagga Wagga SAP between now and 2060.

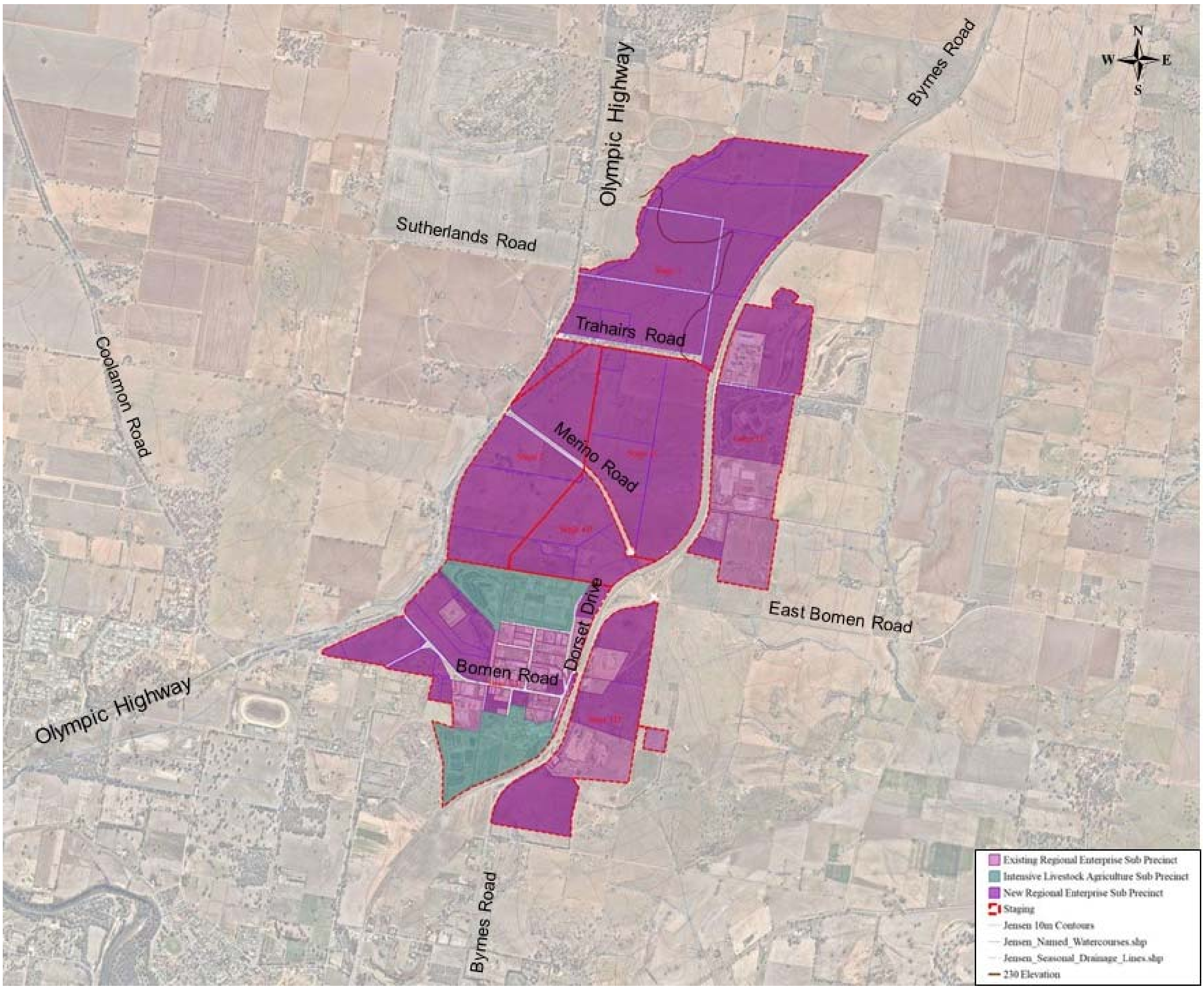
This includes identifying required land and/or infrastructure items needed upfront to 'activate' the growth of the precinct.

For detailed discussion about each precinct scenarios, please refer to Jensen Plus report (P2119 Wagga SAP EbD Workshop 3 Summary). The refined land use structure plan is shown in Figure 4.1.



Source: Wagga Wagga Special Activation Refined Structure Plan, Jensen Plus, October 2019

Figure 4.1 Refined Wagga Wagga SAP structure plan



Source: *Wagga Wagga Special Activation Refined Structure Plan, Jensen Plus, October 2019*

Figure 4.2 Refined Wagga Wagga SAP indicative staging plan

FINAL STRUCTURE PLAN

Following the Final Enquiry by Design workshop, the preferred Structure Plan was 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 4.3.

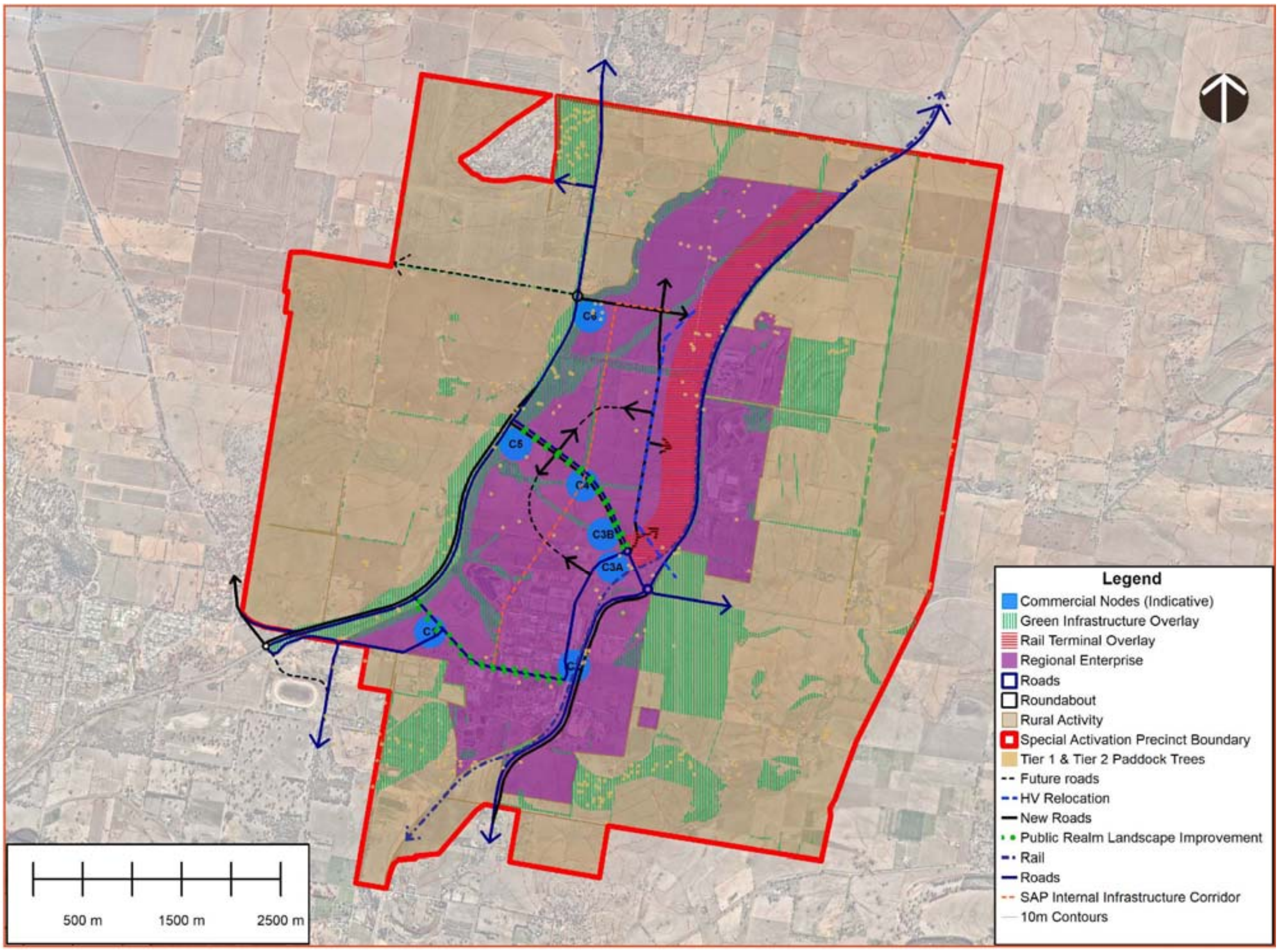


Figure 4.3 Final Wagga Wagga SAP structure plan

FUTURE INFRASTRUCTURE REQUIRED

This section of the report describes the future infrastructure required to support the refined structure plan for Wagga Wagga SAP. Most of the future demand calculations are based from 3.2.1 with several assumptions being revised based from the full Enquiry by Design workshop.

4.1 WATER

4.1.1 DEMAND ASSESSMENT

To enable water infrastructure assessment, the structure plans sub-precincts have been further divided into smaller sub-areas aligning with water network constraints and staging.

The existing water supply network in the vicinity of the Wagga Wagga SAP study area comprises three pressure zones, which strategically service customers at different elevation range as shown in Table 4.1. Sub-areas have been assigned to one of the three existing pressure zones based on topography. This assignment has subsequently been tested and refined via hydraulic modelling as described in the following sections. The sub-areas and their associated pressure zones are shown in Figure 4.3

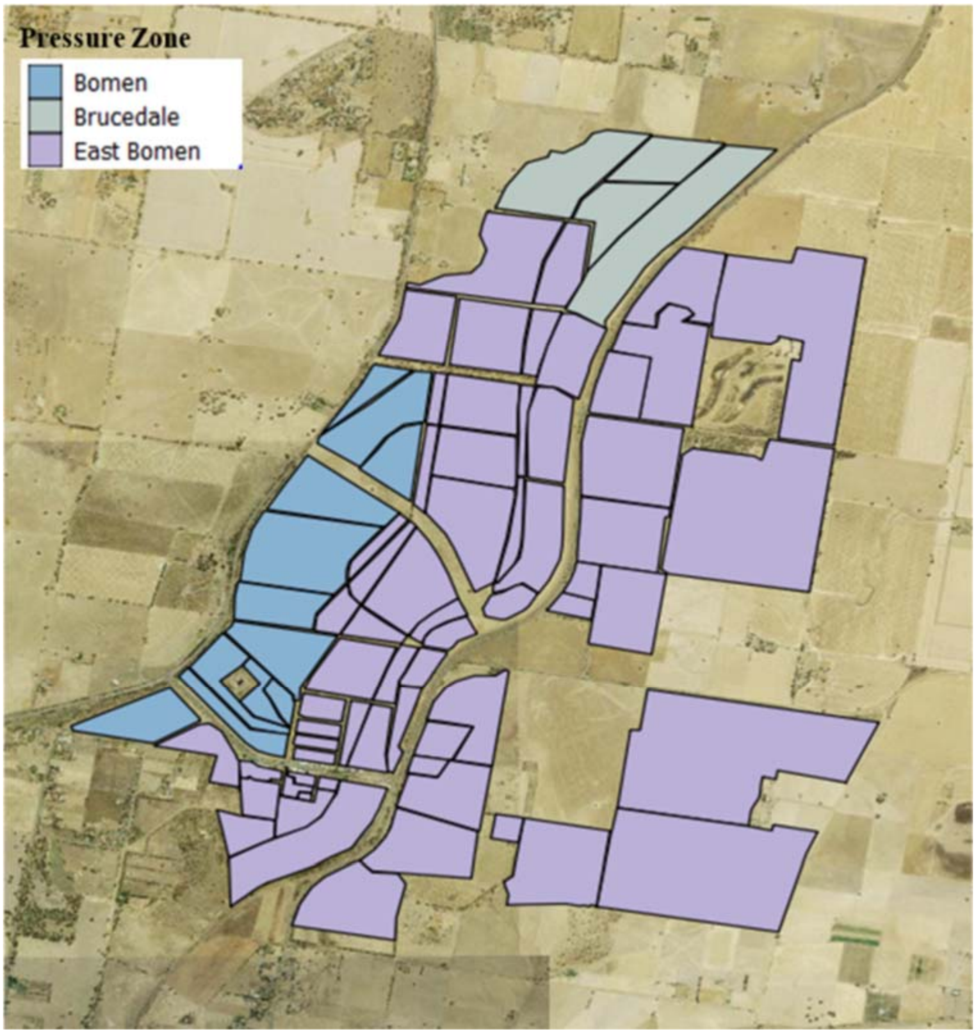


Figure 4.3 Refined structure plan servicing Strategy - Pressure Zone

For hydraulic analysis, peak day demands have been developed based on:

- NSW Water Directorate Section 64 Determination of Equivalent Tenements (ET) Guidelines Scenario Final Servicing Strategy – Pressure Zone
- Riverina Water County Council (RWCC) standard Local Factor of 0.7 x Standard ET
- A Peak Day Demand of 1.8kL/ET which was selected for this project based on a benchmarking exercise.

The summary of calculated demands is shown in Table 4.2 below. The RWCC standard peak day demand figure of 3.8kL/ET is considered overly conservative for use in this study, which comprises non-residential development and is an order-of-magnitude larger scale than typical development applications. A basic benchmarking exercise was undertaken using readily available information and comparable standards/guidelines to determine the Peak Day Demand parameter of 1.8kL/ET which has been adopted for this study. Further refinement of demand parameters should be undertaken in design, or when additional master planning detail becomes available.

Table 4.1 Existing pressure zones and their servicing elevation range

PRESSURE ZONE	SUPPLYING RESERVOIR	ELEVATION RANGE (APPROXIMATE)
Bomen	Bomen Reservoir	190 to 220 mAHD
East Bomen	East Bomen Reservoir	210 to 250 mAHD
Brucedale	Brucedale Reservoir	230 to 280 mAHD

Table 4.2 Peak Day Demand Summary

PRESSURE ZONE	ET	PEAK DAY DEMAND (ML/D)	PEAK DAY DEMAND (L/S)
Bomen	2,483	4.47	52
East Bomen	7,188	12.90	150
Brucedale	802	1.44	17
Total SAP	**10,473**	**18.81**	**219**

4.1.2 HEADWORKS

The following water headworks items have been re-visited from the scenario testing for water infrastructure. Refer to Figure 3.4 for a regional context map of the North Wagga Supply System.

1 North Wagga System – Water Source Requirements

The need for additional source capacity to accommodate growth in North Wagga Wagga is identified in RWCC's 2019 Draft IWCM Issues Paper as being required within the next five years. The following potential strategies regarding this are identified in the Draft IWCM Issues Paper for investigation:

- Develop additional local source and treatment capacity for the North Wagga System
- Formalize the interconnection with the Wagga Wagga System to transfer water into the North Wagga System during peak periods
- Remove Estella Zone from the North Wagga Supply System (i.e. supplying it from the Wagga Wagga System instead)

The assessed peak day demand for the SAP exceeds the extent of growth in this area (East Bomen) which is assumed in the Draft IWCM Issues Paper (approx. 15ML/d) and also exceeds the current North Wagga System source capacity (approx. 18ML/d, which also includes supply to Estella Zone, beyond the SAP study area).

For the purpose of this study, it is assumed that capacity upgrades to source assets (i.e. bores or river pumping system) and the North Wagga Water Treatment Plant will be required.

Capacity upgrades to some assets shared between the SAP and other growth areas, such as the Northern Growth Area which is located to the north west of the SAP project, are also required (i.e. North Wagga High Lift Pump Station, Bomen Reservoir and some water mains).As the extent of growth and requirements for external areas is unknown, the capacity requirements attributable to the SAP plus existing demands only have been assessed.

In addition to infrastructure capacity, additional water allocation will be required to supply the SAP. Refer the Draft IWCM Issues Paper for details regarding RWCC's water allocation, which has not been investigated as part of this study.

2 Completion of RWCC's IWCM Issues Paper.

This document is currently in draft format and WSP have provided input on behalf of the SAP project to RWCC's stakeholder consultation process

4.1.3 WATER INFRASTRUCTURE REQUIREMENTS

The summary of proposed water servicing concept is shown in Figure 4.4. A summary of the proposed new infrastructure is provided in Table 4.3 and Table 4.4.

A pressure reducing valve is required to manage pressure in the area supplied from the Brucedale Zone. Whilst this area is at too high elevation to be supplied from East Bomen Zone, the Brucedale Zone operates at significantly (approximately 40 m) higher pressure.

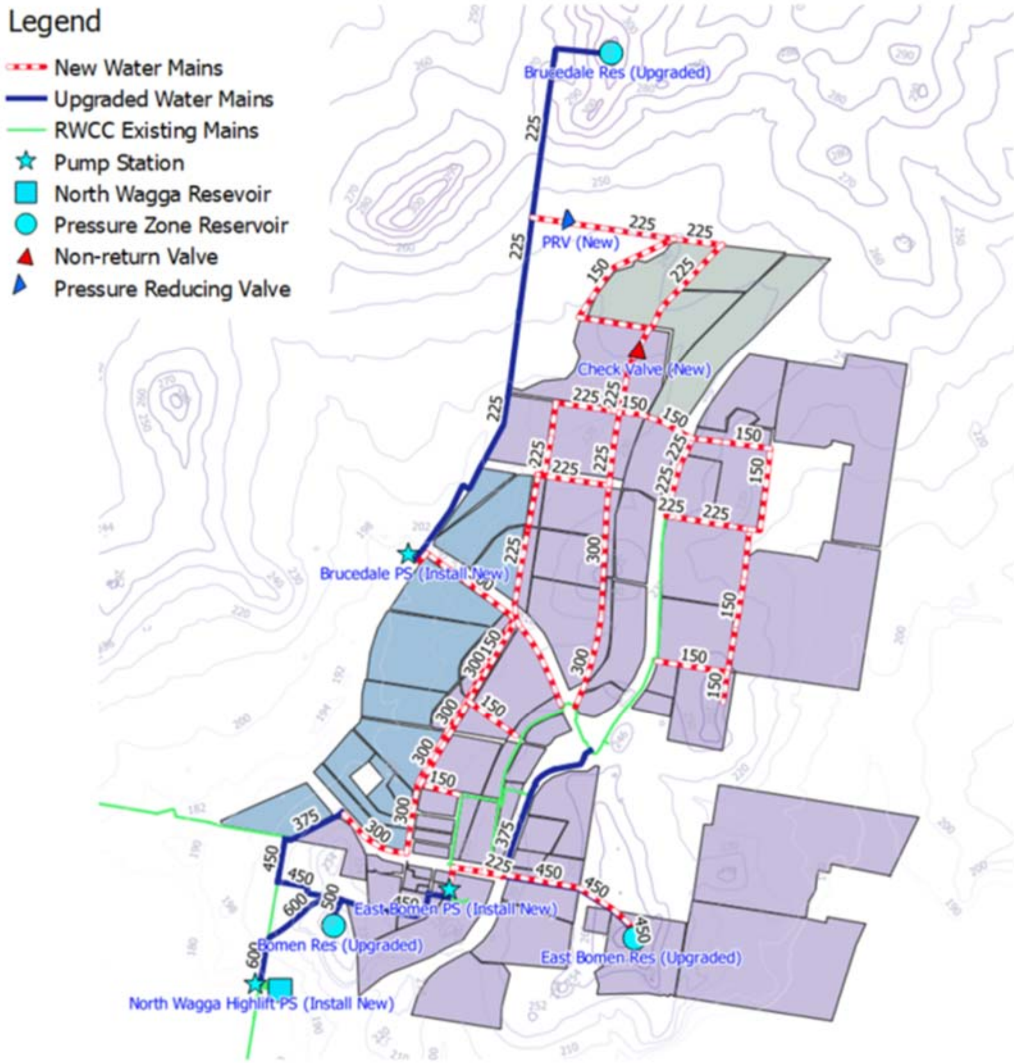


Figure 4.4 Final structure plan – Water Servicing Concept

Table 4.3 Reservoir upgrades

REF. NO	STAGING	DESCRIPTION	INFRASTRUCTURE REQUIRED	COMMENTS
R1	1	East Bomen Reservoir Upgrade	New 6.6 ML concrete tank to replace existing smaller tank Associated inlet /outlet pipework, valving, flowmeter Assumed 50 m x 50 m land acquisition	9.6 ML total volume required. Assumed that existing larger tank is to be retained and smaller tank replaced. Various options regarding this which should be considered in design. There is limited opportunity to defer this upgrade to later stages due to most of the demand occurring in Stage 1
R2	1	Bomen Reservoir Upgrade	New 6.4ML concrete tank Associated inlet /outlet pipework, valving, flowmeter Assumed 50 m x 50 m land acquisition	This volume is attributable to the SAP growth and existing demand only. A larger upgrade may be required to also accommodate external growth, subject to RWCC strategy
R3	3	Brucedale Reservoir Upgrade	New 1.3 ML tank to operate in addition to existing 0.75 ML tank Associated inlet /outlet pipework, valving, flowmeter Assumed 50 m x 50 m land acquisition	Total volume required 1.9 ML. An alternative option is to replace the existing tank with a new single 1.9ML tank if preferred (i.e. if existing tank has minimal remaining life or if existing tank levels significantly constrain the design of the new tank).

Table 4.4 Pump Station upgrades

REF. NO	STAGING	DESCRIPTION	INFRASTRUCTURE REQUIRED	COMMENTS
PS1	1	North Wagga High Lift Pump Station	New pump station (218 L/s @ 70 m head performance) to replace existing New building Associated suction and discharge pipework, valving, flowmeter Power supply upgrade	This capacity is attributable to the SAP growth only. A larger upgrade may be required to also accommodate external growth. Assumed that a new pump station would be built within the existing site
PS2	1	East Bomen Pump Station	New pump station (150 L/s @ 38 m head capacity) to replace existing New building Associated suction and discharge pipework, valving, flowmeter Power supply upgrade	Limited opportunity to defer these upgrades to later stages due to most of the demand occurring in Stage 1. Assumed that a new pump station would be built within the existing site (alternative options exist however have not been investigated).

REF. NO	STAGING	DESCRIPTION	INFRASTRUCTURE REQUIRED	COMMENTS
PS3	3	Brucedale Pump Station	New pump station (26.7 L/s @ 90 m head) to replace existing New building Associated suction and discharge pipework, valving, flowmeter Power supply upgrade	Assumed that a new pump station will be required, based on existing minimal capacity of associated mains and reservoir. No information regarding the existing pump station has been reviewed (not included in RWCC hydraulic model). Assumed that a new pump station would be built within the existing site.

4.1.4 WATER SERVICES CORRIDOR

Proposed water mains have generally been located within existing and future road reserves, including the Wagga Wagga SAP north-south infrastructure service corridor road within a 10-m easement nominated in the structure plan. Some proposed mains are not located in defined roads, however there will be significant flexibility to modify the alignment in design, providing the required loops remain connected. Hence additional easement and service corridor requirements have not been nominated. Crossing of the railway line with two new mains is required near East Bomen Reservoirs and with one main north of the RIFL hub site. These will require an easement/agreement with the rail authority.

It has been assumed for the purpose of this study that all reservoir upgrades will require some land acquisition and that all pump station upgrades can be located within existing land parcels. These land requirements have not been investigated in detail for specific sites.

The proposed pressure regulating valve (PRV) located near Olympic Highway in the Brucedale Zone is assumed to require minimal footprint and be located within the road reserve (as is typical for this type of asset).

4.1.5 INFRASTRUCTURE STAGING AND TIMELINE

The proposed servicing strategy shown in Figure 4.3 will accommodate different stages of Wagga Wagga SAP development assuming the growth for each stage achieves 100% potential. Figure 4.5 below shows the proposed staging for the water infrastructure networks assuming full growth for each stage is achieved. A breakdown of total SAP demand by stage is presented in Table 4.5.

Table 4.5 Total Water demand for all stages

	PD DEMAND (ML/D)			
Pressure Zone	**Stage 1**	**Stage 2**	**Stage 3**	**Total**
Bomen	1.9	2.4	0.1	4.5
East Bomen	10.9	0.1	1.9	12.9
Brucedale	0.0	0.0	1.4	1.4
TOTAL	**12.8**	**2.5**	**3.5**	**18.8**
CUMULATIVE	**12.8**	**15.3**	**18.8**	**18.8**

The headworks items identified in section 4.1.2 all need to be resolved for Stage 1, although the full capacity requirements and water allocation are not. Note that Stage 1 represents a large proportion of the total development and opportunities exist to optimize staging of major infrastructure items by breaking this stage down further.

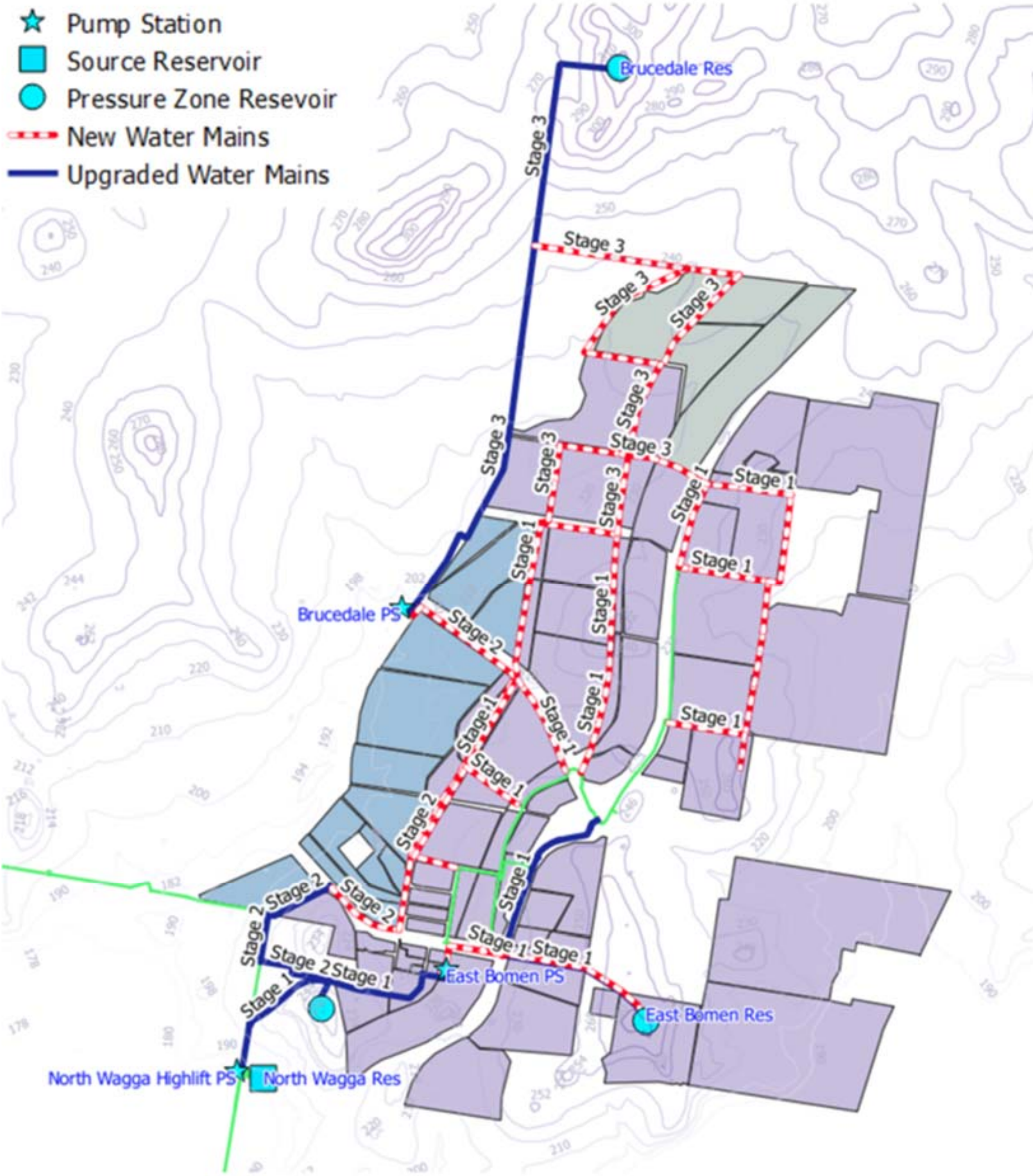


Figure 4.5 Staging of the proposed water infrastructure servicing the SAP development at 100% growth

4.1.6 INVESTMENT TRIGGERS FOR WATER INFRASTRUCTURE

Table 4.6 below shows Macroplan's growth series 2 projection. It indicates that 35% of the land in stage 1 will be developed by 2030, 87% by 2040 and 95% by 2060. Similarly, Stage 2 is not expected to grow until after 2040 and will be 80% developed by 2060. Stage 3 will not start until after 2060.

Table 4.6 Projection Series 2 timeframe of development (Macroplan)

STAGE	GROWTH PROJECTIONS BY 2030	GROWTH PROJECTIONS BY 2040	GROWTH PROJECTIONS BY 2060
1	35%	87%	95%
2	0%	0%	80%
3	0%	0%	0%

In other words, a few Stage 1 infrastructure investments can be further deferred to only consider 35% growth within 2018–2030 period. Table 4.7 summarises the water infrastructure staging considering the Macroplan series 2 growth scenario.

North Wagga High Lift Pump Station, Bomen Reservoir Upgrades and Source augmentations likely required in the 2018–2030 period as there is minimal spare capacity and other external growth occurring which utilises these assets. East Bomen Pump Station and East Bomen Reservoir upgrades likely able to be deferred to 2030–2040 period as these assets appear to have significant spare capacity. Proposed water mains for stage 1 are assumed to be built proportionate to the development of the land.

Table 4.7 Water infrastructure staging considering growth projections

STAGE	INFRASTRUCTURE STAGING 2019 – 2030	INFRASTRUCTURE STAGING 2030 – 2040	INFRASTRUCTURE STAGING 2040 – 2060	INFRASTRUCTURE STAGING POST 2060
Stage 1	Stage 1 North Wagga High Lift pump station (228 L/S @ 70 m)			
Stage 1	Bomen Reservoir Upgrade, new 5 ML concrete tank			
Stage 1		East Bomen Pump station upgrade, (160 L/s @ 45 M)		
Stage 1		East Bomen Reservoir upgrade, new 6.6 ML concrete tank		
Stage 1	Stage 1 water mains (18.4 km), DN 375 Avg			
Stage 2			Stage 2 water main (5.2 km), DN 375 Avg	
Stage 3				Stage 3 Brucedale pump station, 27 L/s @ 80 m, (associated suction & discharge pipes, valves & flowmeter, PSU)
Stage 3				Stage 3 Brucedale reservoir upgrade 1.3 ML

STAGE	INFRASTRUCTURE STAGING 2019 – 2030	INFRASTRUCTURE STAGING 2030 – 2040	INFRASTRUCTURE STAGING 2040 – 2060	INFRASTRUCTURE STAGING POST 2060
Stage 3				Stage 3 Brucedale Pressure reducing valve
Stage 3				Stage 3 water main (12 km), DN 200 Avg

4.1.7 ASSUMPTIONS

The development of water servicing concepts for the masterplan has utilised best available information sourced from preliminary engagement with RWCC and applicable guidelines and standards. No investigation of input data, site inspection or detailed asset analysis has been undertaken. Other key assumptions made during the development of water servicing strategy are detailed below:

HEADWORKS

- Limited assessment has been undertaken with recommendations relying on RWCC Draft IWCM Issues paper and preliminary engagement with RWCC.
- It is assumed that capacity upgrades to source assets (i.e. bores or river pumping system) and the North Wagga Water Treatment Plant will be required.
- Where capacity upgrades for assets shared between the SAP and other growth areas are required (i.e. North Wagga High Lift Pump Station, Bomen Reservoir and some water mains, Northern growth area located to the north west of the SAP project), the requirements attributable to the SAP demands plus existing demands only have been assessed.

NETWORK ANALYSIS

- Pump station capacity requirement assumed equal to Peak Day Demand (i.e. over 24 hours).
- Reservoir sizing requirement based on RWCC standard formula (i.e. Operating + Emergency + Fire storage). Bomen reservoir operating storage requirement has been determined specifically from hydraulic modelling, as it needs to address significant transfer of flow to other zones.
- Network analysis based on RWCC provided hydraulic model including standard diurnal patterns.
- It is assumed that two isolation valves associated with trunk water mains immediately downstream of North Wagga High Lift pump (i.e. cross connections to adjacent mains) are required to be closed. This arrangement isolates the pumping main to Bomen Reservoir from the surrounding network, avoiding considerable fluctuation in velocities and pressures. This operational configuration should be reviewed with RWCC in design
- Where capacity upgrades for assets shared between the SAP and other growth areas, such as the Northern Growth Area, are required (i.e. North Wagga High Lift Pump Station, Bomen Reservoir and some water mains), the requirements attributable to the SAP demands plus existing demands only have been assessed.
- The servicing concept contains a range of assumed pipe sizes, based on hydraulic analysis only. These sizes should be rationalized/updated based on RWCC's material preferences and standard size requirements during design.

RESERVOIR AND PUMP STATION CONSTRUCTION

Table 4.3 and Table 4.4 summarise various assumptions regarding construction of specific reservoir and pump station upgrades (i.e. regarding scope of work, land acquisition requirements, utilisation of existing assets). These assumptions are high-level to enable cost estimating and have not been investigated in detail.

- No allowance has been made for any new SCADA/telemetry sites, assuming that these systems exist at each reservoir and pump station site. These requirements have not been investigated.

WATER MAIN CONSTRUCTION

- It is assumed that water mains will generally be constructed using conventional trenched excavation, 1 m typical depth and located within the nature strip or constructed during subdivision civil works.

– It is assumed that railway crossings will require steel enveloper pipes installed by trenchless methods.

4.2 WASTEWATER

4.2.1 DEMAND ASSESSMENT

To enable wastewater infrastructure assessment, the structure plans sub-precincts have been further divided into smaller sub-areas aligning with topographic constraints and staging. The sub-areas have been separated into five gravity catchments as shown in Figure 4.6.Catchment boundaries were developed considering topography and physical constraints and opportunities such as rail crossings and existing network assets.

Wagga Wagga County Council's (WWCC) standard loading rates and wet weather flow parameters have been used to estimate average dry weather flow (ADWF) and peak wet weather flow (PWWF) for infrastructure assessment. This loading is summarised in Table 4.8. Note these figures are stated as either 'local' (i.e. based on loading for that catchment only) or 'cumulative' (i.e. inclusive of loading from upstream catchments).

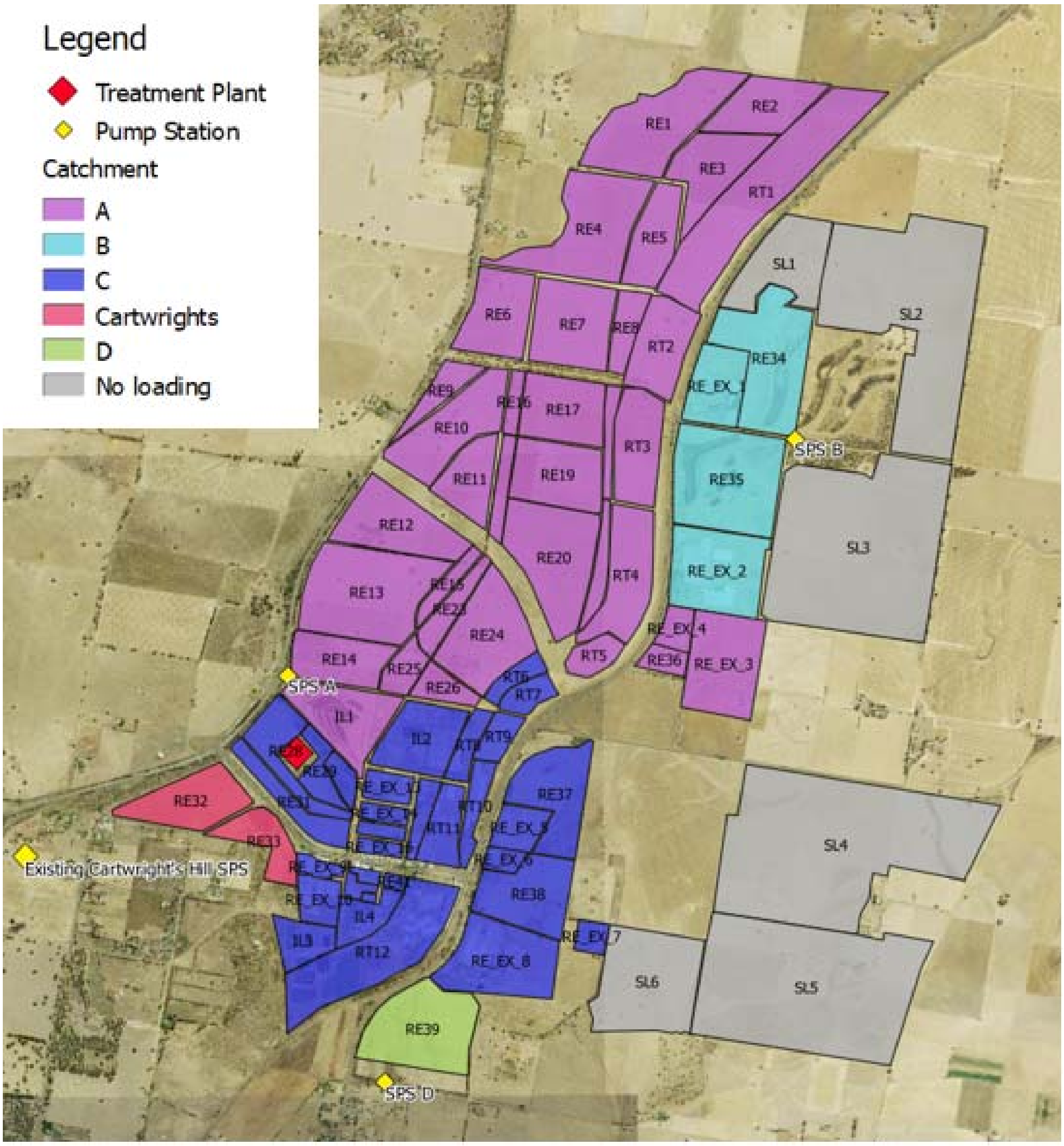


Figure 4.6 Wastewater catchment and sub-area overview

**Grey parcels are solar farms, which are assumed to generate no wastewater loading

Table 4.8 Wastewater loading summary

CATCHMENT	TOTAL ET – LOCAL	ADWF (L/S) – LOCAL	ADWF(L/S) – CUMMULATIVE	PWWF (L/S) – LOCAL	PWWF(L/S) – CUMMULATIVE
A	5,356	33.8	56.7	224.9	387.0
B	1,271	8.0	8.0	56.9	56.9
C	2,042	12.8	14.8	89.1	105.3
D	329	2.1	2.1	16.2	16.2
CARTWRIGHT'S HILL	329	2.1	2.1	16.2	16.2
Total	**9,327**	**59**	**59**	**403.3**	**403.3**

4.2.2 TREATMENT AND EXTERNAL INFRASTRUCTURE

The below treatment and external works items have been identified, but not investigated in detail. Regional context map of sewerage network is shown in Figure 4.7.

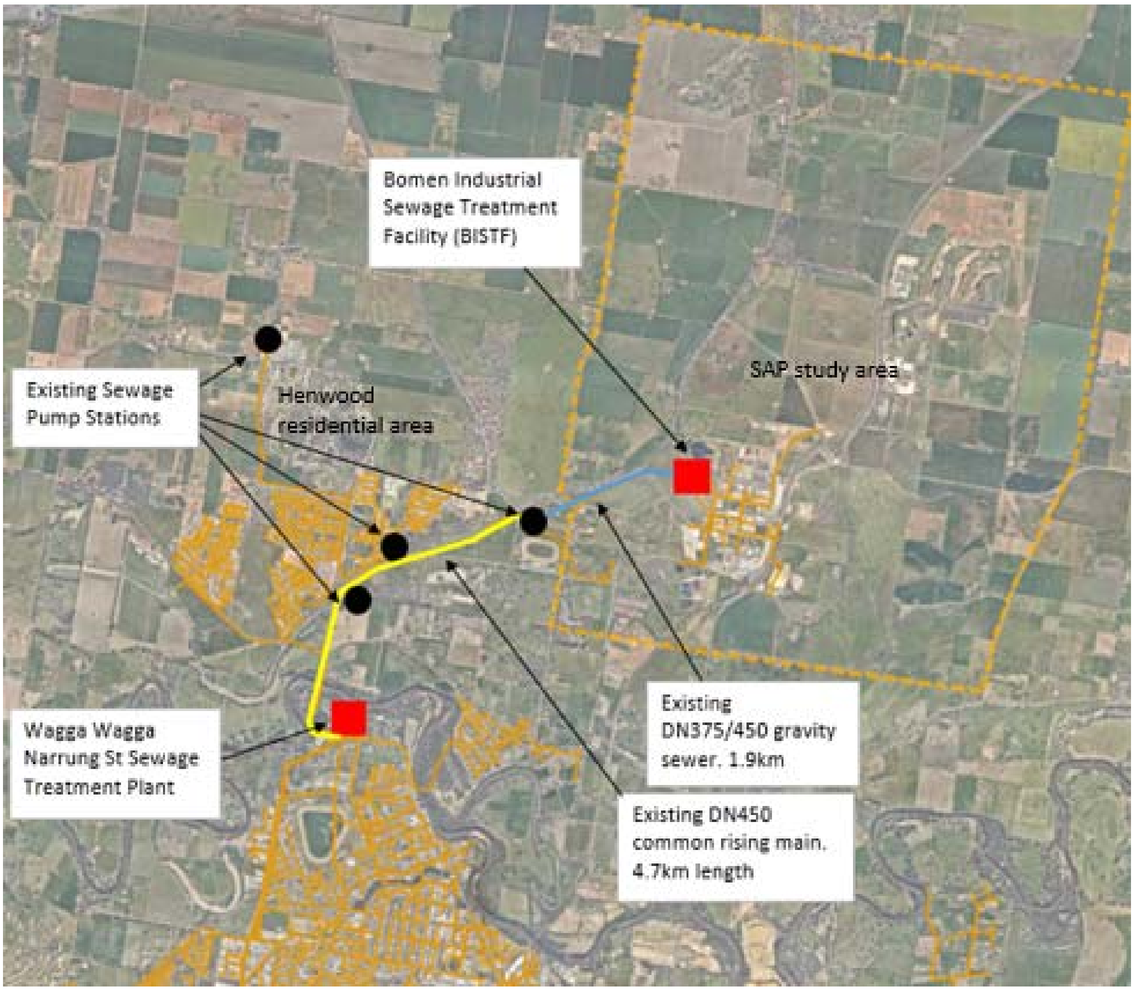


Figure 4.7 Wastewater catchment and sub-area overview

Review and development of WWCC's overall wastewater treatment strategy for Wagga Wagga is required to guide prudent wastewater infrastructure development for the SAP. The following relevant issues and opportunities have been identified based on limited discussions with WWCC:

- Issue: The extent of growth in the SAP plus Henwood residential area (west of the SAP study area) is significant and will likely require short-term network upgrades and medium-term treatment upgrades if all load is to continue to be conveyed to the Narrung St Wastewater Treatment Plant (WWTP)
- Issue: The Narrung St WWTP consists of two separate plants, one of which has extremely high operational costs for WWCC. This plant currently receives load pumped from the BISTF and North Wagga area
- Issue: The Bomen Industrial Sewage Treatment Facility (BISTF) is currently underutilized, with major industrial customers having installed on-site pre-treatment since the original commissioning of the BISTF
- Issue: The Narrung St WWTP is located within the floodplain and (compared to the BISTF) may be a less desirable location for major new treatment infrastructure
- Opportunity: The BISTF could be upgraded to be a standalone WWTP with its own discharge to the river, avoiding major network upgrades required to convey this load to the Narrung St WWTP
- Opportunity: If upgraded to a standalone WWTP, the BISTF could receive additional load pumped from the Henwood residential area or even from the Narrung St WWTP (this concept has previously been considered by Council at a high-level)
- Opportunity: The BISTF could be upgraded to produce recycled water for use within the SAP, or agricultural irrigation, substituting potable water demand and providing economic development opportunities. The feasibility of such a project has not been investigated
- Opportunity: WWCC's 10-year contract for operation of both the Narrung St WWTP and BISTF ends in approximately 2 years, after which WWCC have the option to extend the management for a 5-year period, and subsequently another 5-year period. This timing may align with the SAP and other growth to allow the overall treatment strategy to be optimized considering cost to WWCC and risk ownership
- Opportunity: Given the nature of development proposed for the SAP, there could be synergies and economic development opportunities for a waste-to-energy plant at the BISTF. The feasibility of such a project has not been investigated, however the following high-level considerations are noted:
  - This type of project typically is associated with larger scale plants and may not be economic for conventional domestic sewage. Hence, feasibility is likely to rely on there being sufficient organic waste loading available from customers in this catchment
  - The existing BISTF uses a sequencing batch reactor process, which is not suitable for energy generation, hence this opportunity relies on a new plant/process being added to the facility
  - Grant funding opportunities may exist associated with reducing greenhouse gas emissions from wastewater treatment processes

The following two possible treatment strategies are outlined for the SAP:

1. At Stage 1 of the SAP development, upgrade the common rising main system between Cartwrights Hill Area and Narrung St WWTP (4.7 km). The upgrade requirements and configuration are unknown and depend on broader planning however are likely to be similar (in extent and cost) to a 4.7 km long DN450-DN750 rising main with river crossing. The dedicated section rising main from the SAP area (SPS rising main described in Section 1.1.3) upstream of the common rising main is also required (2.5 km x DN600). An allowance for upgrade of the Narrung St WWTP should be made, however upgrade requirements and timing have not been investigated and there is expected to be some available capacity to cater for short-term growth (i.e. Stage 1 or part of Stage 1); OR
2. At Stage 1 of the SAP development, upgrade the BISTF to be a stand-alone WWTP with new discharge arrangement to the Murrumbidgee River. WWCC may choose to direct additional load from the Henwood residential area or other areas to this WWTP if feasible. SPS A within the SAP (described in Section 1.1.3) would not need to be sized to receive load from the

BISTF catchment and its rising main would be directed to the BISTF rather than into the common rising system running from Cartwight's Hill to the Narrung St WWTP

Either of these strategies will require significant investment at Stage 1 of the SAP and will require significant project development and delivery time, hence immediate development of WWCC's overall wastewater treatment planning strategy is strongly recommended to guide prudent investment.

For the purpose of this study, approach (a) has been assumed as this retains the existing network configuration and key items/projects can be more readily defined and costed at this stage.

In addition to the above proposed treatment strategy, and this SAP infrastructure study, WWCC are currently updating the *Development Servicing Plan, Sewer (DSP)*. This project is currently in progress and a draft of the updated DSP is expected to be completed late 2019. Inputs from the SAP Project and proposed treatment strategy will be relevant to the DSP and should be included/aligned as best possible.

4.2.3 WASTEWATER INFRASTRUCTURE REQUIREMENTS

The proposed wastewater servicing concept is shown in Figure 4.8 below. This is based on retaining the current treatment configuration where load from the BISTF, and other catchments in North Wagga Wagga, are ultimately conveyed to the Narrung St WWTP (i.e. treatment strategy 'a' described in the previous section).

A summary of the proposed new pump station and rising main infrastructure is provided in Table 4.9 and Table 4.10 .

Proposed new Sewage Pump Stations (SPS) and catchments have been developed based on topography and review of available WWCC's planning documents.

The proposed five catchments are:

- Catchment A represents most of the SAP area and receives load from other upstream catchments.
- Catchment B is located on the eastern side of the railway line and discharges (via the proposed SPS B) into Catchment A.
- Catchment C is the existing BISTF catchment servicing the East Bomen industrial area. Some extension to this catchment is proposed, where practical. Load from the BISTF (wither pre-treated or bypassing the treatment process, subject to treatment strategy) is to be directed by gravity into Catchment A.
- Catchment D is in the south-east part of the SAP which, due to topography, cannot be serviced from Catchment C by gravity. This load is to be directed (via the proposed SPS D) into Catchment C.
- Cartwright's Hill is an existing catchment with a Sewage Pump Station (SPS) located near Olympic Hwy. This currently receives pre-treated load from the BISTF, which will no longer be required, once the proposed SPS A is constructed. A small area in the south-west of the SAP can be serviced via the existing Cartwright's Hill network.

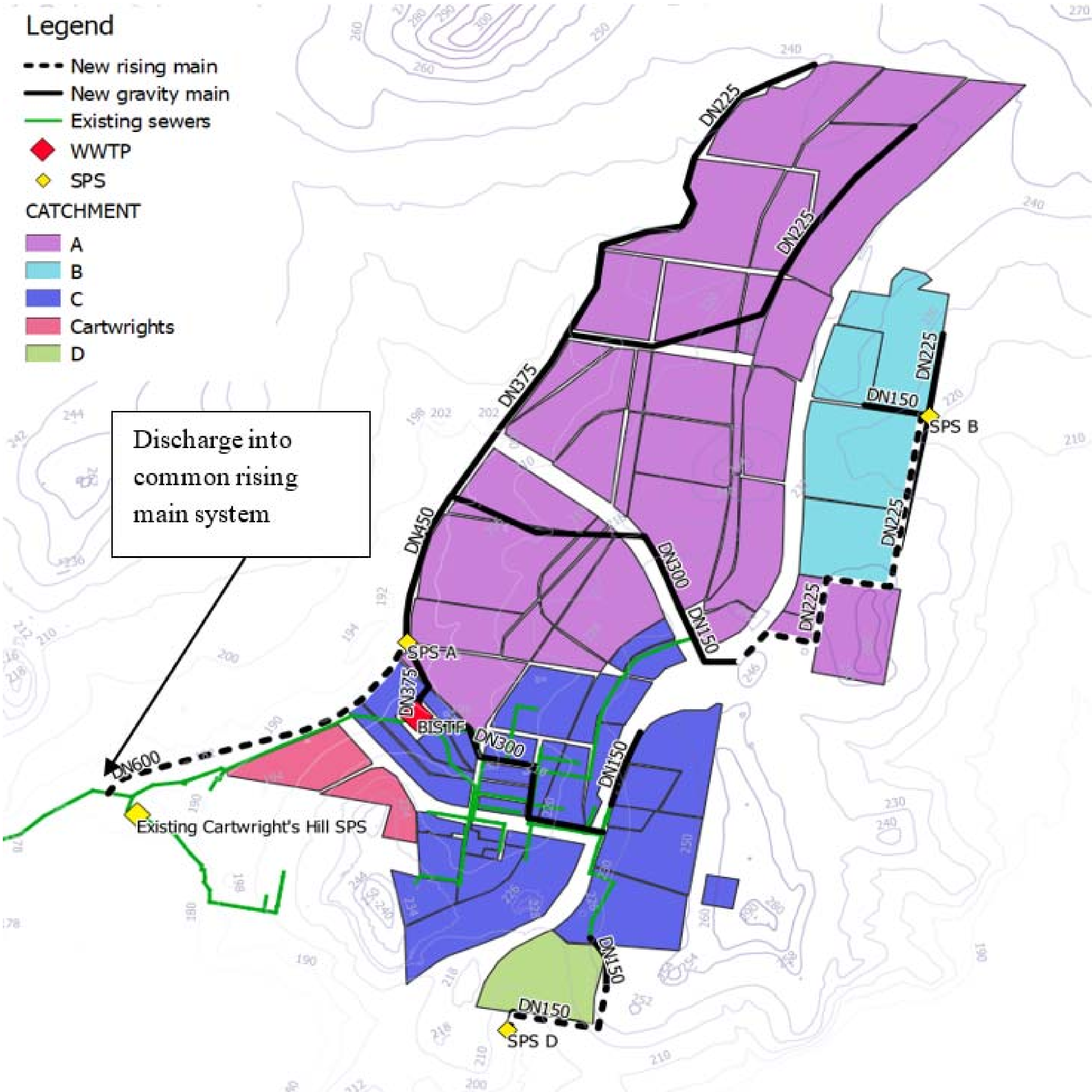


Figure 4.8 Wastewater Servicing Concept Layout

The proposed gravity mains form a trunk network which provides the hydraulic capacity to meet the adopted catchment loading. This includes both new gravity sewers mains and upsizing of existing mains. Local-level reticulation has not been included, which will connect to this spine network when land is sub-divided and developed. The sizing of gravity sewer mains is highly dependent on grade and as such will need to be revised during design and could change from the sizes nominated in this document.

Table 4.9 Sewage Pump Station (SPS) Requirements

DESCRIPTION	PWWF LOADING	INFRASTRUCTURE REQUIREMENTS	COMMENTS
SPS A	Stage 1: 251 L/s Stage 2: 306 L/s Stage 3: 387 L/s	New SPS with capacity 387 L/s @ 50 m head Assumed 3 submersible pumps with variable speed drives Assumed 6 m dia x 7 m deep wet-well (200 m^3 volume) Assumed no additional offline emergency storage structure Allow for 50 m x 50 m land acquisition and typical site civil works Allow for power supply to the site Allow for establishment of SCADA telemetry connection to the site	Main SPS servicing the SAP and receiving flow from BISTF Smaller pumps may be installed for Stage 1 and Stage 2 if desired Variable Speed Drives (VSD) assumed required for operation into the common rising main system Pump head assumed (subject to common rising main requirements)
SPS B	Stage 1: 57 L/s Stage 2: 57 L/s Stage 3: 57 L/s	New SPS with capacity 57 L/s @ 40 m head Assumed 2 submersible pumps Assumed 3 m dia x 6 m deep wet-well (40 m^3 volume) Assumed additional offline emergency storage structure required Allow for 25 m x 25 m land acquisition and typical site civil works Allow for power supply to the site Allow for establishment of SCADA telemetry connection to the site	Pump head assumed from topography and rising main length
SPS D	Stage 1: 17 L/s Stage 2: 17 L/s Stage 3: 17 L/s	New SPS with capacity 17 L/s @ 47 m head Assumed 2 submersible pumps Assumed 2 m dia x 6 m deep wet-well (20 m^3 volume) Assumed additional offline emergency storage structure required Allow for 25 m x 25 m land acquisition and typical site civil works Allow for power supply to the site Allow for establishment of SCADA telemetry connection to the site	Pump head assumed from topography and rising main length

Table 4.10 Rising Main Requirements

DESCRIPTION	ASSUMPTIONS FOR COSTING	COMMENTS
SPS A rising main	2,550 m length. DN600 or similar size	Assumes treatment strategy 'a' Pipe material subject to WWCC preference (potentially PE, MSCL or GRP)
Downstream common rising main system upgrade	Assumed details: — 4.7 km x DN600 rising main — Rising main crossing beneath river or via attachment to bridge	Pipe material subject to WWCC preference (potentially PE, MSCL or GRP)
SPS B rising main	2,740 m length. DN225 or similar size	Pipe material subject to WWCC preference (potentially PE or PVC)
SPS D rising main	1,030 m length. DN150 or similar size	Pipe material subject to WWCC preference (potentially PE or PVC)

4.2.4 WASTEWATER SERVICES CORRIDOR

The proposed three new SPS will each require a dedicated allotment. Subject to WWCC's treatment strategy, if the BISTF were to be upgraded to a stand-alone WWTP, additional site footprint is expected to be required. Allocating a similar size area to the existing plant would provide significant flexibility for future upgrades including for potential opportunities such as recycled water production or waste-to-energy generation. In addition to this, appropriate buffer distance should also be considered, subject to the nature/sensitivity of surrounding development.

Proposed gravity mains and rising mains have been aligned with roads and infrastructure corridors provided in the structure plan, where practical, to minimise easements required. These assets are constrained by topography however and in some instances easements or additional corridors will be required and are highlighted in Figure 4.9. This is not an exhaustive description of all easements which would be required to service the sub-precincts shown in the structure plan, which will include additional local-level reticulation sewers.

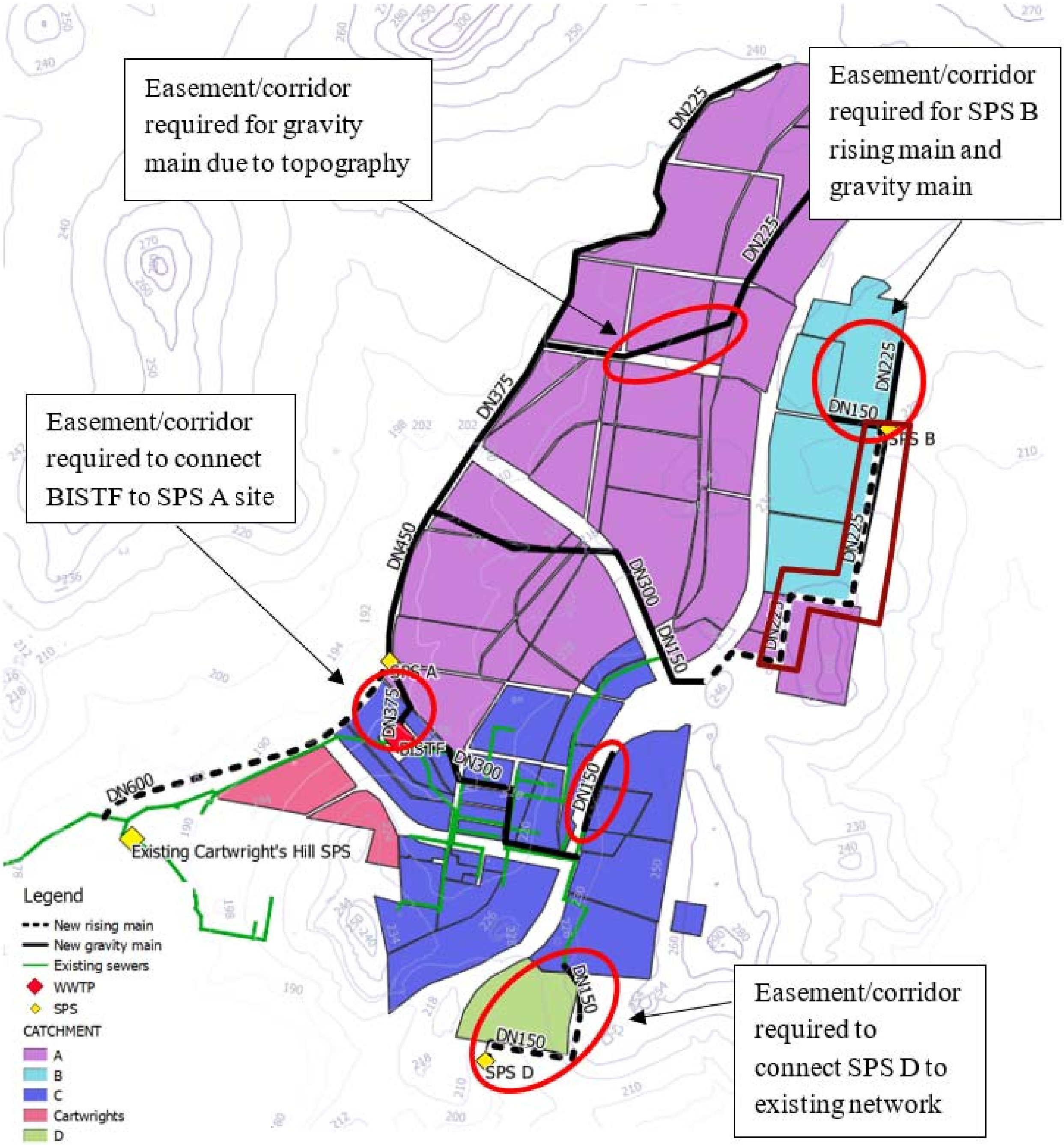


Figure 4.9 Wastewater easement/corridor requirements

4.2.5 INFRASTRUCTURE STAGING AND TIMELINE

The majority of the proposed infrastructure will be constructed at Stage 1 of the development, includes all three new SPS and associated rising mains. Additional infrastructure required at Stages 2 and Stage 3 is limited to new gravity mains near Olympic Highway that are connected to extent Catchment A to the north. Staging of wastewater network infrastructure is shown in Figure 4.10 below.

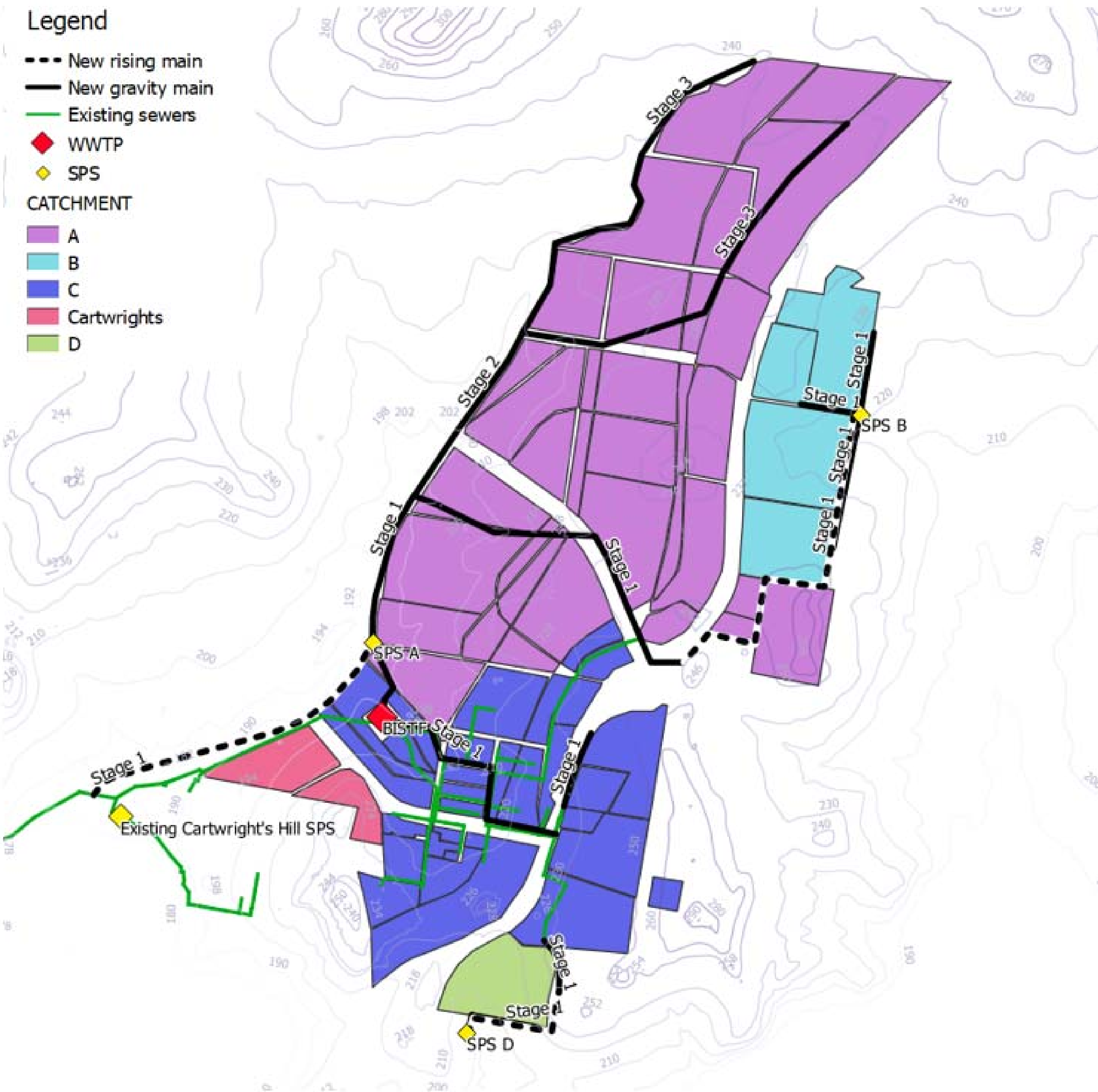


Figure 4.10 Wastewater infrastructure staging

Subject to the WWCC's treatment strategy, the major headworks items may be able to be staged, particularly treatment upgrades which could be triggered via monitoring of actual loading, however significant infrastructure upgrades are expected to be required at Stage 1 (i.e. the common rising main system upgrades).

Considering Macroplan's projected growth for stage 1 (35% for 2030), the SPS A and the rising mains are likely the immediate capital investment required for 2019–2030. Likewise, if the status-quo treatment option is chosen, the 4.7 km common rising main and reconfiguration of the BISTF discharge (to direct it to SPS A) would likely be required in the 2019–2030 period.

If the alternative treatment option were chosen, BISTF upgrade to be a stand-alone WWTP would likely be required in the 2018–2030 period (note this also impacts the SPS A pump station and rising main size and configuration)

The two smaller new SPS's and their rising mains will simply be required whenever development occurs in these local catchment areas. Stage 1 gravity mains may be able to be built proportionate to the development.

4.2.6 ASSUMPTIONS

LOADING CALCULATIONS

- The loading basis adopted for this study is based on standard theoretical parameters which have not been investigated in detail. This may not be an accurate estimate of actual loading for this development, which is of a significant geographic extent and is expected to include land-uses which can have extremely variable sewage generation rates.
- Loading assumptions should be revised in design as additional information regarding land-uses becomes available.

HEADWORKS

- Due to the scope of this study, treatment and headworks items have not been investigated in detail. Key items have been identified and assumptions made based on available information and preliminary engagement with WWCC.
- Additional wastewater treatment capacity is expected to be required for the SAP and other planned growth in North Wagga Wagga. The capacity and timing requirements for this have not been assessed.
- A long-term strategy for WWCC's overall wastewater treatment in Wagga Wagga is required to provide critical guidance for development of wastewater infrastructure for the SAP. For the purpose of this study, approach 'a', as has been assumed which retains the existing network configuration and allows key items/projects to be more readily defined and costed.
- Subject to the above strategy, the shared downstream network will require significant capacity upgrades to convey load from the SAP and other growth areas (Northern Growth Area located to the north west of the SAP project) to the Narrung St WWTP (i.e. 4.7 km common rising main system including river crossing). The requirements for this attributable to the SAP load only and have not been investigated in detail.

STAGING

- Timing of expenditure has been considered at a high-level only based on macroplan's estimates of development timing/progress within the overall Stage 1 area. In reality this rate of progress may differ at a local level which will influence expenditure timing/triggers, particularly regarding pipeline infrastructure which is highly dependent on the location of development.
- Remaining capacity of existing assets, to allow deferral of expenditure, has been assumed based on best available service authority information. Additional detailed investigations would be required to confirm remaining capacity for some existing assets.

NETWORK ANALYSIS

Gravity main capacity is subject to design grade and sizing has been estimated based on loading and a broad range of potential grades. Hence the exact sizing is subject to refinement in design.

Gravity main depth has a significant impact on cost be cannot be known with certainty without undertaking design development. A high-level assumption has been made that all gravity sewer sections will be:

- 50% less than 1.5 m depth,
- 25% between 1.5–3 m depth; and
- 25% between 3–4.5 m depth.

For all rising mains it is assumed construction will generally use conventional trenched excavation at 1 m typical depth.

Where ground conditions require, there may be additional cost for items such as rock excavation, trench stabilization, trench dewatering or pavement reinstatement. No investigations to determine the extent of these items have been undertaken and appropriate contingency allowances need to be made.

Where gravity mains or rising mains cross the railway corridor or Olympic Hwy, it is assumed that a 40 m length of steel enveloper pipe will need to be installed by trenchless methods.

4.3 STORMWATER

Stormwater Infrastructure requirements to support the Wagga Wagga SAP refined structure plan has been detailed in the Flooding and Water Quality Land Take Report (2019) prepared by Rhelm Pty Ltd. The following section of the report describes the key outcomes from the said report.

4.3.1 KEY ASSUMPTIONS

- The assumptions regarding the water quality is it sits at the base of the detention and is a bioretention basin with submerged (200 mm) and an upstream CDS unit. This includes a 300 mm extended detention depth. Then the detention basins begin above this and extends to the required volume. Outlets are controlled by the 20% AEP existing flood flows and the spillway sized to accommodate the 0.5% AEP event.
- Allowance for maintenance of the sites in addition to the water quality treatment and basins have been included.
- The detention basins have been amended to reduce the impact on developable land and incorporate those into riparian corridors.
- The basins are all at centralized locations, so they would need to be constructed prior to or alongside development. The structures can be refined with detailed design to better integrate into the space. The detention basin and water quality can sit adjacent to the riparian corridor and integrate with the outer 50% of this area if required.

4.3.2 STORMWATER INFRASTRUCTURE REQUIREMENTS AND STAGING

The proposed stormwater servicing concept is shown in Figure 4.11 and Figure 4.12 below. Rhelm Pty Ltd has noted during the time of preparation this report that the future infrastructure requirements are still being investigated further in detail and may be subjected to change in the final submission.

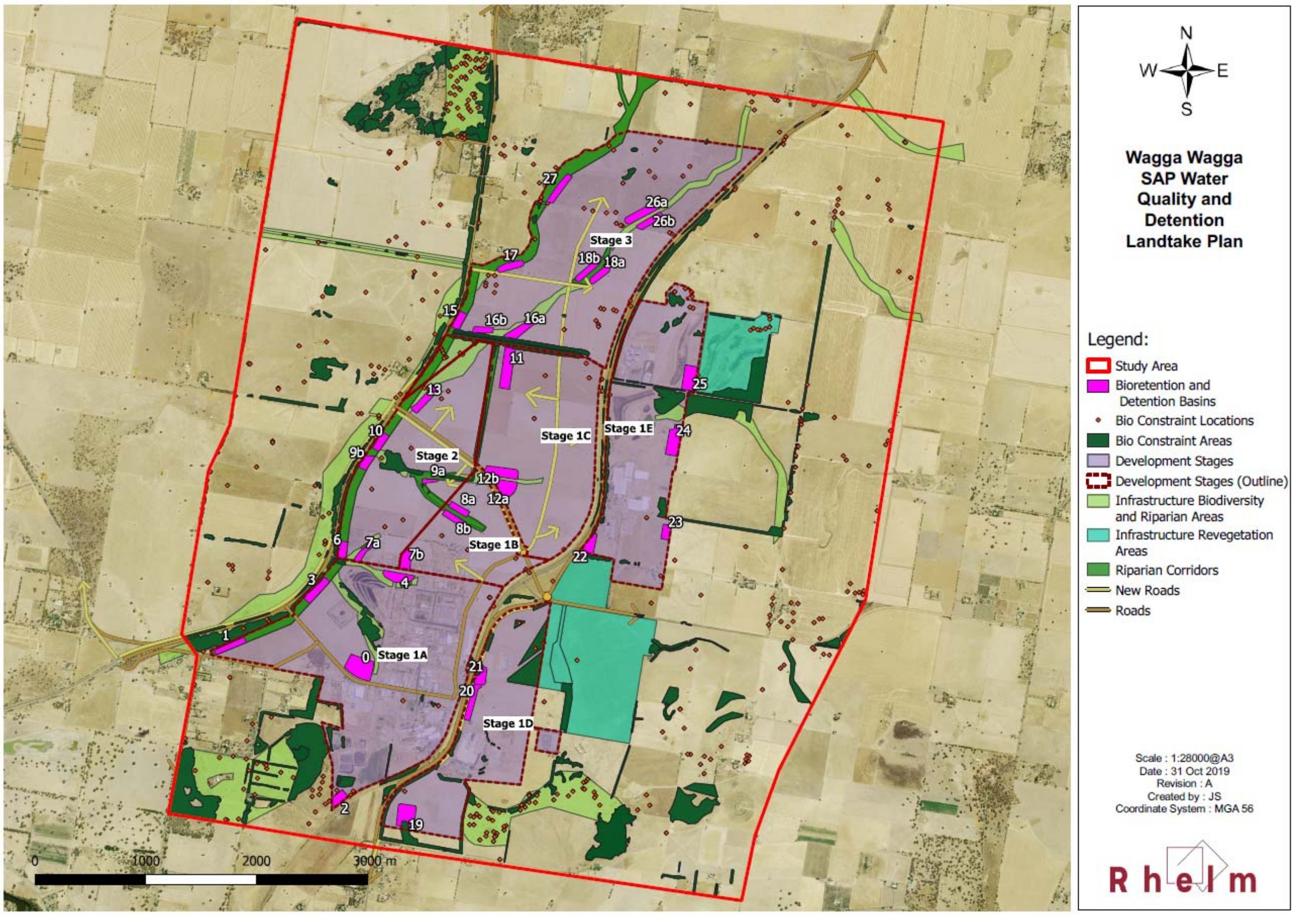
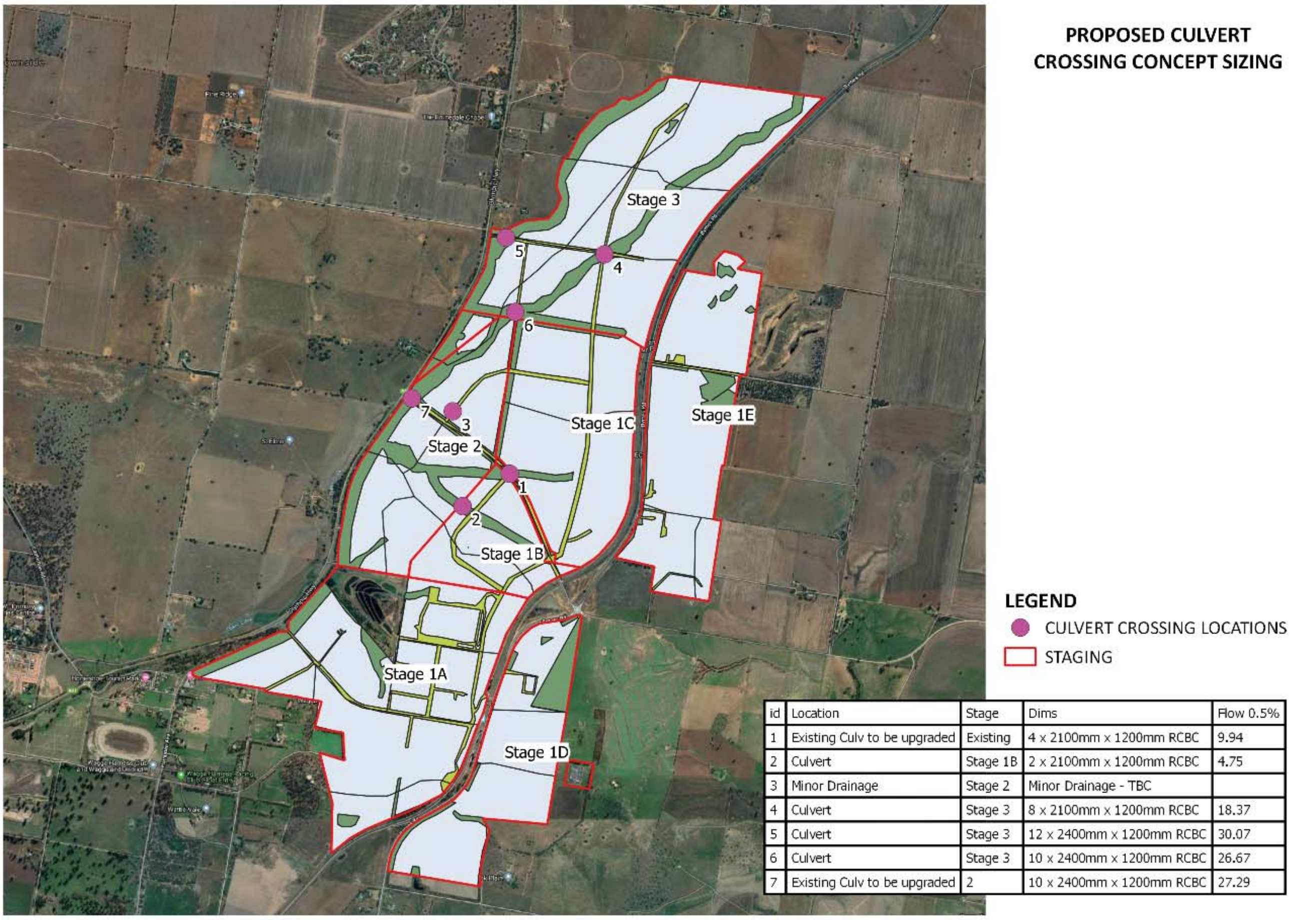


Figure 4.11 Stormwater detention basin and Water quality treatment land take



id	Location	Stage	Dims	Flow 0.5%
1	Existing Culv to be upgraded	Existing	4 x 2100mm x 1200mm RCBC	9.94
2	Culvert	Stage 1B	2 x 2100mm x 1200mm RCBC	4.75
3	Minor Drainage	Stage 2	Minor Drainage - TBC	
4	Culvert	Stage 3	8 x 2100mm x 1200mm RCBC	18.37
5	Culvert	Stage 3	12 x 2400mm x 1200mm RCBC	30.07
6	Culvert	Stage 3	10 x 2400mm x 1200mm RCBC	26.67
7	Existing Culv to be upgraded	2	10 x 2400mm x 1200mm RCBC	27.29

Figure 4.12 Stormwater culvert servicing concept

4.4 POWER

4.4.1 DEMAND ASSESSMENT

To enable power demand assessment for the final structure plan, the sub-precincts have been further divided according to various amenities to obtain pragmatic values for the energy intensity factors. Most of the assumptions used for power demands calculations are consistent with the scenario testing approach. Other assumptions include:

— GIS information received from Essential Energy assets shows that area within the proposed SAP have already access to distribution networks which are overhead in nature. Therefore, Installation of the required distribution upgrades will remain overhead unless specified by the relevant authority.

— The existing substations from Cartwrights Hill and Bomen have combined capacity to support the growth in some extent and will require both source and network upgrades to support the Wagga SAP.

— Provision of spare substations are not considered in the source upgrades. Noting that it is a design practice to include additional spare depending on the load patterns for each service area. This approach should be noted in designing the capacity of substation in the detail design stage.

— Detailed clearance checks for transmission cables are not considered due to information being Quality level – D (AS5488). In future design phases, clearances for A triple trucks should be considered.

— Easement applications for overhead poles are required when located on private land (not within road reserves or service corridors).

- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with Essential Energy is required.

The summary of power demands for the refined structure plan for Wagga SAP is summarised in the table below.

Table 4.11 Calculated power demands for the refined structure plan (Cumulative)

STAGE	AVERAGE LOAD DEMAND ESTIMATES (MVA)
1	114.4
2	131.8
3	163.9

4.4.2 POWER INFRASTRUCTURE REQUIREMENTS

Analysis of the existing capacity of Bomen, Cartwrights Hill distribution substation and Wagga North (132/66KV) transmission substation suggest that there are 2 major source upgrades required to support the revised structure plan

1. Upgrade the existing Wagga North Substation (132kV)
2. Construct a new distribution substation within Wagga Wagga SAP area

The summary of proposed power infrastructure to support the Wagga SAP refined structure plan are shown in Figure 4.13 and Table 4.12.

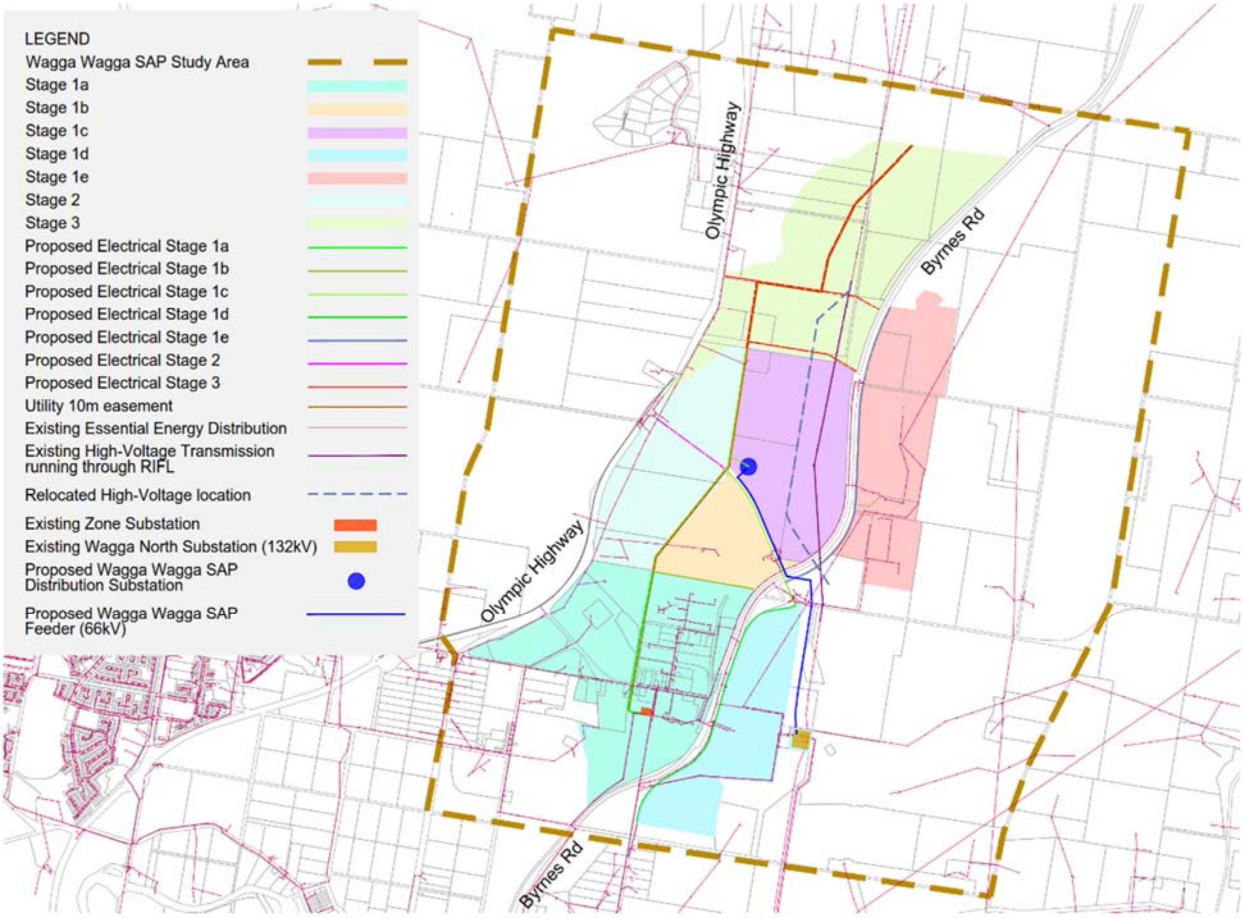


Figure 4.13 Summary of power servicing concept – refined structure plan

Table 4.12 Power source and network required for Wagga SAP refined structure plan

STAGE	NETWORK (LENGTH), KM	SOURCE UPGRADE REQUIRED
66kV feeder line from existing Wagga North Substation to Proposed Wagga SAP substation	2.80 km	— Proposed 70-MVA distribution substation within SAP area — Additional 60MVA substation capacity upgrade to existing Wagga North Substation
Stage 1a	1.4292 km	
Stage 1b	2.1077 km	
Stage 1c	2.7455 km	
Stage 1d	2.6477 km	
Stage 1e	2.1204 km	
Stage 1 (Sub-Total)	**11.10 km**	

Stage 2	0.780 km	— Extra 20 MVA transformer capacity upgrade required to cater for stage 2 load for the distribution substation within SAP area — Extra 20MVA substation capacity upgrade required to cater for stage 2 load for the existing Wagga North substation
Stage 3	4.78 km	— Extra 35 MVA transformer capacity upgrade required to cater for stage 3 load for the distribution substation within SAP area — Extra 35 MVA substation capacity upgrade required to cater for stage 3 load for the existing Wagga North substation
Total	**16.60 km**	

4.4.3 POWER SERVICES CORRIDOR

From the existing Wagga North substation (132kV) east of Bomen are, the proposed Wagga Wagga SAP Distribution Feeder (66kV) will run towards Bomen Intersection and crosses East Bomen Road where it will connect to the Proposed Wagga Wagga SAP Distribution Substation.

Proposed electricity cables have generally been located within existing and future road reserves, including the Wagga Wagga SAP north-south infrastructure service corridor road within a 10-m easement nominated in the structure plan.

It has been assumed for the purpose of this study that the location of the proposed substation is around the "load centre" of stage 1 developments. The location of the future stage substation has not been fully determined and as shown in Table 4.13 Power infrastructure staging considering growth projections will not be required until approximately 2030. The final location and transmission line connection to be determined during concept and detailed design stages.

4.4.4 INFRASTRUCTURE STAGING AND TIMELINE

The proposed power servicing strategy shown in Figure 4.13 will accommodate different stages of Wagga Wagga SAP development assuming 100% growth for each stage is achieved. However, Macroplan's growth projection shows that 35% of the land in stage 1 will be developed by 2030, 87% by 2040 and 95% by 2060. Similarly, Stage 2 is not expected to grow until after 2040 and will be 80% developed by 2060. Stage 3 will not start until after 2060.

Table 4.13 summarises the power infrastructure staging considering the Macroplan series 2 growth scenario.

Table 4.13 Power infrastructure staging considering growth projections

STAGE	INFRASTRUCTURE STAGING 2019–2030	INFRASTRUCTURE STAGING 2030–2040	INFRASTRUCTURE STAGING 2040–2060	INFRASTRUCTURE STAGING POST 2060
Stage 1	Additional 60MVA substation upgrade to existing Wagga North substation			

STAGE	INFRASTRUCTURE STAGING 2019–2030	INFRASTRUCTURE STAGING 2030–2040	INFRASTRUCTURE STAGING 2040–2060	INFRASTRUCTURE STAGING POST 2060
Stage 1		66kV feeder from existing Wagga Wagga Substation to proposed Wagga Wagga SAP substation Proposed 70MVA substation in SAP		
Stage 1	Stage 1 Overhead cables (11 km in total)			
Stage 2			Extra 20MVA transformer & substation upgrade for Wagga North Sub	
Stage 2			Extra 20MVA transformer & substation upgrade for Wagga SAP substation	
Stage 2			Stage 2 Overhead cables (780 m in total)	
Stage 3				Extra 35MVA transformer & substation upgrade for Wagga SAP substation
Stage 3				Stage 3 Overhead cables (780 m in total)

The existing Wagga north substation upgrade is likely required in the 2018–2030 period as there is minimal spare capacity left and other external growth occurring which utilises this substation. The new 70MVA Wagga SAP substation as well as the 66kV feeder from the existing Wagga North substation can be deferred to 2030–40 to support 87% projected growth for stage 1. Proposed power reticulations are assumed to be built proportionate to the development of the land of the Wagga SAP area.

4.5 GAS

4.5.1 DEMAND ASSESSMENT AND ASSUMPTIONS

To enable gas demand assessment for the final structure plan, the sub-precincts have been further divided according to various amenities. Most of the assumptions used for gas demands calculations are consistent with the scenario testing approach and are summarised below:

- Concept strategy for gas services is limited to Wagga Wagga SAP areas that we assumed to generate future gas demands. Furthermore, the concept reticulation presented is within the distribution level only as APA noted during discussions that their supply is robust and can cater additional future demand. With this assumption, source augmentation is not investigated in this study.

- The provision of pumps, gas regulators and other appurtenances have not been considered in this study and are assumed to be designed as part of the distribution network upgrades.
- The assessed demand basis is conservative and when applied to an area of this size potentially excessive. Further review and refinement of these demands including benchmarking against similar developments and consultation with the relevant authority is recommended.
- The future gas demand assumptions considered heating requirements for employment, health, research, laboratory, general industry, space-heating, hot water consumption, cooking etc. for a total of 625 MJ/day (Regional Enterprise), and 56.40 MJ/day at 60% diversity factor (Commercial Gateway). Livestock processing and agriculture produce industry are assumed to have 8 and 2 GJ/sqm per annum of demand respectively. Furthermore, it is assumed that this demand will be spread across the entire precinct and not referring to any specific areas within the precinct itself.

The summary of gas demands for the refined structure plan for Wagga SAP is summarised in the table below.

Table 4.14 Summary of gas demands for each growth stage

STAGE	ESTIMATED FUTURE GAS DEMAND (TJ/DAY)
Stage 1	9.16
Stage 2	1.37
Stage 3	2.33

4.5.2 HEADWORKS

As noted in section 3.7.1 from the scenario testing section, APA has advised that there is a robust supply to support future growth from development within the Wagga SAP area and will be able to customise and augment to match demand requirements as they change. Notwithstanding, reticulation works are still required within the servicing areas of Wagga SAP.

4.5.3 GAS INFRASTRUCTURE REQUIREMENTS

The summary of proposed gas servicing concept is shown in Figure 4.14. A summary of the proposed new infrastructure for each stage is provided in Table 4.15

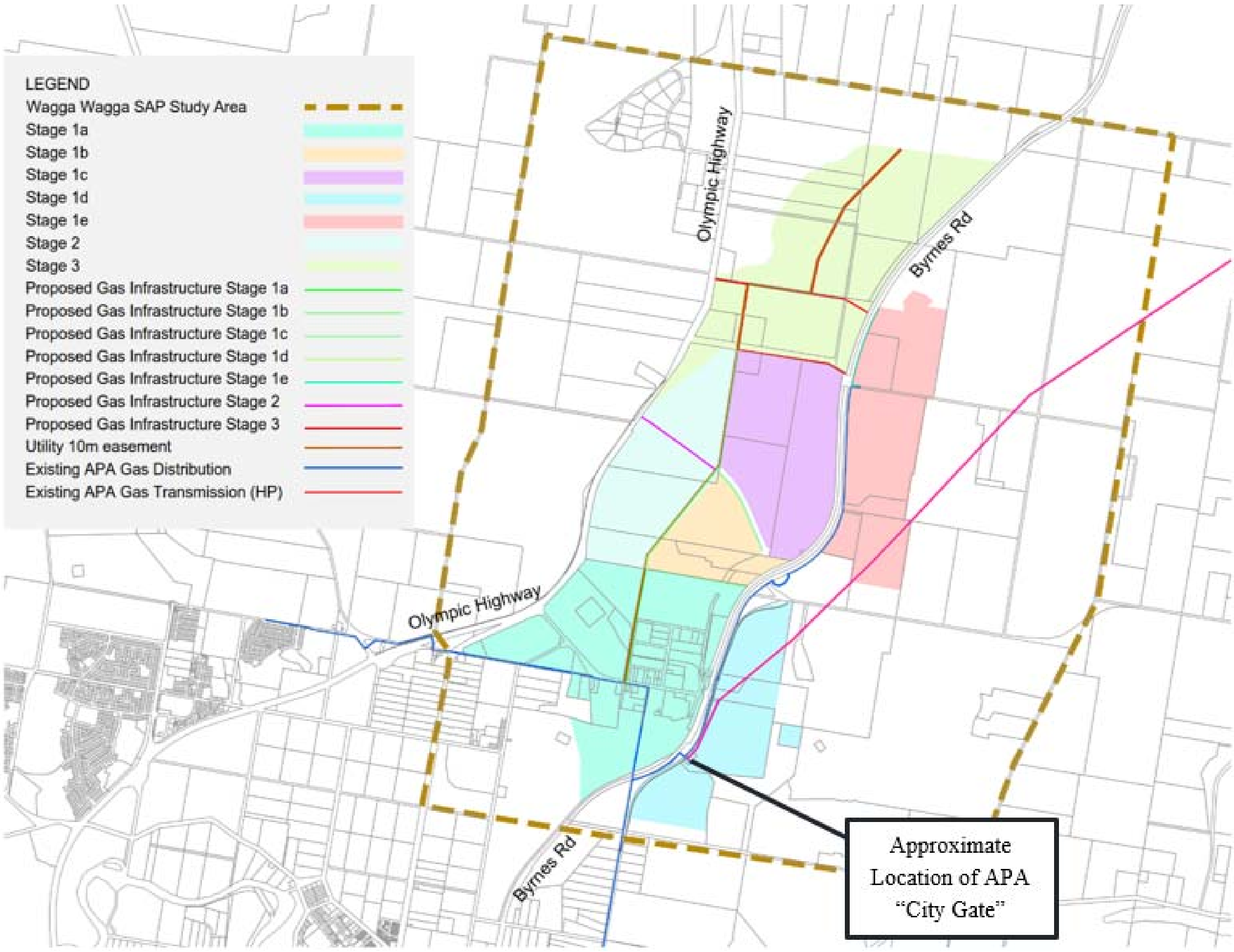


Figure 4.14 Summary of gas servicing concept – refined structure plan

4.5.4 GAS SERVICES CORRIDOR

Proposed gas mains have generally been located within existing and future road reserves, including the Wagga Wagga SAP north-south infrastructure service corridor road within a 10-m easement nominated in the structure plan.

Future gas infrastructure for stage 1 will connect to existing APA 100 mm gas line along Bomen Road and will run along the Wagga SAP utility corridor and stretches out to service the existing East Bomen Road, Byrnes Road and Merino Road. Stage 2 future gas infrastructure will run along East Bomen Road from the Stage 1 gas line at utility service corridor westward to Olympic Highway. Stage 3 future gas infrastructure will service the Trahairs Road west of Byrnes Road and will connect to the existing gas at the utility service corridor where it will run along it up to the edge of the Stage 3 Boundary.

4.5.5 INFRASTRUCTURE STAGING AND TIMELINE

The proposed gas servicing strategy shown in Figure 4.14 will accommodate different stages of Wagga Wagga SAP development assuming the growth for each stage achieves 100% potential. A breakdown of total reticulation required for gas for each stage growth is summarised in the table below.

Table 4.15 Summary of Gas reticulation for each stage – refined structure plan

STAGE	LENGTH (KM)
Stage 1a	1.08
Stage 1b	2.10
Stage 1c	2.11
Stage 1d	NA
Stage 1e	0.81
Stage 1 (Sub-Total)	6.01
Stage 2	0.85
Stage 3	4.75
Total	**11.61**

4.5.6 INVESTMENT TRIGGERS FOR GAS INFRASTRUCTURE

As summarised in the Table 4.6, it is noted that Macroplan's series 2 projection suggest that 35% of the land in stage 1 will be developed by 2030, 87% by 2040 and 95% by 2060. Similarly, Stage 2 is not expected to grow until after 2040 and will be 80% developed by 2060. Stage 3 will not start until after 2060. To align with this projection, proposed gas infrastructures are assumed to be built proportionate to the development of the land for each stage.

4.6 TELECOMMUNICATIONS AND DIGITAL CONNECTIVITY

Telecommunication and digital connectivity to the Wagga SAP area is reliant upon the NSW Regional Connectivity Program for which concept design from The Grex Group has been developed.

One of the key priority areas of the NSW Digital Connection Program is to improve digital connectivity to Wagga Wagga with the design of a Wagga Wagga data hub and fibre cables to make internet connectivity faster and more reliable to the region.

In consultation with Wagga Wagga City Council the location and design of the Wagga Wagga data hub is currently being considered.

There are currently two options being considered for the location of the Wagga Wagga Data Hub:

Option 1 – Wagga Wagga Data Hub located South of Wagga Wagga CBD area; or

Option 2 – Wagga Wagga Data Hub located within the Wagga Wagga SAP Study Area.

Option 2 is currently preferred option due to the increased flooding risk that Wagga Wagga CBD would pose.

4.6.1 ASSUMPTIONS

For the purposes of the preliminary digital infrastructure requirements we have made the following assumptions:

- If the location of the data hub is as per Option 1, a fibre backhaul will be required to connect between the Wagga Wagga Data Hub to the Wagga Wagga SAP area. The final location and arrangement (that is above or below ground) is to be confirmed. It will be assumed that this will terminate at a node within the SAP area co-located at commercial gateway location C1.

- If the location of the data hub is as per Option 2, we recommend that the data hub is co-located at commercial gateway location C1. A fibre backhaul will still be required to connect between the Wagga Wagga SAP area to a node within the Wagga Wagga CBD. The final location and arrangement (that is above or below ground) is to be confirmed.
- The fibre to the existing business within the Wagga Wagga SAP area will feed from location C1. This works for both data hub location options being considered.
- The fibre to the remaining areas of the Wagga Wagga SAP area will also feed from location C1.
- For the fibre backhaul and network installation, it is assumed construction will generally use conventional trenched excavation, 700–1000 mm typical depth and cable will generally be located in the shared services corridors within the Wagga SAP infrastructure corridor.

4.6.2 TELECOMMUNICATIONS INFRASTRUCTURE REQUIREMENTS

The summary of proposed communication infrastructure to support the Wagga SAP refined structure plan are shown in Figure 4.15 and Table 4.16.

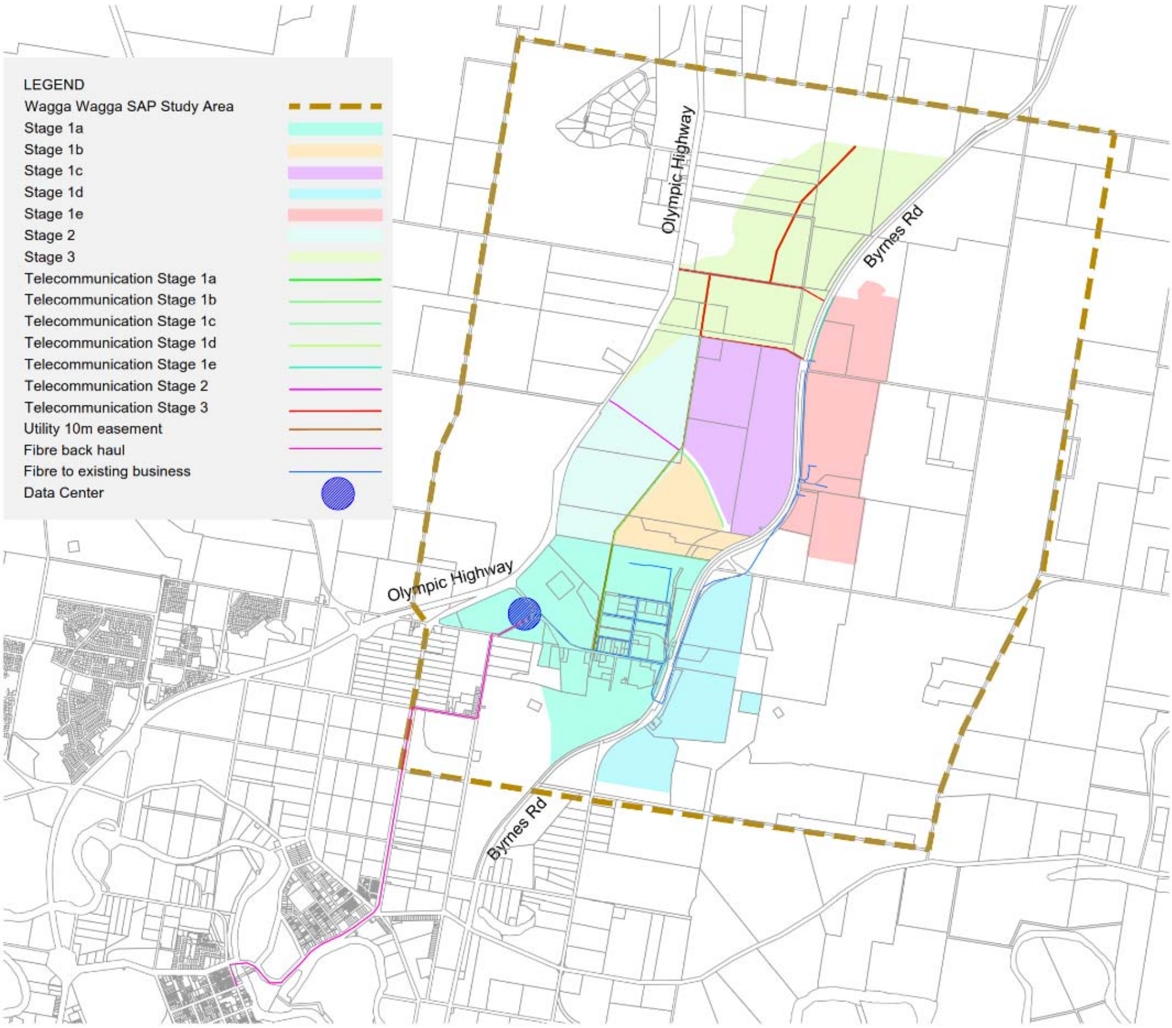


Figure 4.15 Summary of communication servicing concept – refined structure plan

Table 4.16 Summary of Communication Infrastructure required

STAGE	ITEM	DESCRIPTION
1 – Immediate investment through the NSW Digital Connectivity Program	Wagga Wagga Data Hub (If Option 1 – Provide a Node at Commercial Gateway location C1, if Option 2 – co-locate the Wagga Wagga Data hub at Commercial Gateway location C1).	Tier 2 Data Hub Data hub should be located within 2–3 km vicinity of electrical substation. Data to be provisioned for 250 kW IT load with 500 kW space (i.e. with an upgrade path to 500 kW Footprint of area required is 500–800 m2
1 – Immediate investment through the NSW Digital Connectivity Program	Fibre backhaul between the Data Centre and the Wagga Wagga SAP area (or between the Data Centre and Wagga Wagga CBD if option 2 is considered)	The final location and arrangement (that is above or below ground) is to be confirmed.
1 – Immediate investment through the NSW Digital Connectivity Program	10.12 km The fibre to the existing business within the Wagga Wagga SAP area	Will feed from location C1. Assumed construction will generally use conventional trenched excavation, 700–1000 mm typical depth and cable will generally be in the shared services corridors (Wagga SAP infrastructure corridor)
1A	1.10 km	
1B	2.10 km	
1C	2.05 km	
1D	NA	
1E	0.700 km	
2	0.850 km	
3	4.750 km	

4.6.3 COMMUNICATIONS SERVICES CORRIDOR

Proposed communication fibre conduits have generally been located within existing and future road reserves, including the Wagga Wagga SAP north-south infrastructure service corridor road within a 10-m easement nominated in the structure plan.

4.6.4 INFRASTRUCTURE STAGING AND TIMELINE

The proposed communication servicing strategy shown in Figure 4.15 will accommodate different stages of Wagga Wagga SAP development assuming full growth potential is achieved for each stage. However, considering Macroplan's projected growth for stage 1 (35% for 2030), It can be assumed that the proposed telecommunications upgrade from the existing business to Bomen can be built proportionate to the development of the land for each stage.

4.7 WASTE

4.7.1 DEMAND ASSESSMENT

To enable waste infrastructure assessment, future waste demands for the refined scenario of Wagga SAP has been calculated. Most of the assumptions used for waste demands calculations are consistent with the scenario testing approach and are summarised below:

- WWCC anticipates that waste generation from the LGA will increase between 1.5–3% depending on population growth over the next 10 years.
- Waste from Solar land use areas are excluded in the assessment due to lack of parameters available. It is noted that the usage life of solar panels is ranging from 15 to 25 years. Data from National Waste report 2018 suggests that About 1.1 Mt or 44 kg per capita of glass waste was generated in 2016–17 in Australia. It is noted that about 76–89% of the solar panels are made of plastics. These are present day estimates and it must further be assumed that with increased photovoltaic technology will lead to increased life expectancy the panels and recycling an reuse of panels will be of a greater efficiency and provide a lower impact on waste systems.
- Waste generation from the final structure plan shows that the management of waste from the Wagga Wagga SAP area in the future will not be efficient if it is managed as per the current state arrangements.
- Waste generated from regional enterprise was based from a 581kg/capita/year for 235 sq.m/capita factor (CIBSE). Additional livestock waste of 30 tons/year was included from projection of Wagga livestock marketing centre on top of the projected 664 kg/capita/year waste.

The summary of calculated waste demands is shown in Table 4.17 below.

Table 4.17 Summary of waste demands – refined structure plan

STAGE	ESTIMATED TOTAL WASTE GENERATION FOR BUILT AREA (TONNES/YEAR)
Stage 1	8,437
Stage 2	1,350
Stage 3	2,854
TOTAL	**12,641**

4.7.2 WASTE INFRASTRUCTURE REQUIREMENTS AND STAGING

In accordance with WWCC's vision to Improve resource recovery, optimise waste management costs and finances, improve access, amenity and environmental management of waste facilities and Plan infrastructure for the future, Wagga Wagga SAP area Waste Transfer and Recycling Centre is considered for development within the study area.

The size and capacity of this facility will vary depending on the stages shown in the Table 4.17. The waste transfer and recycling centre is proposed to be located between areas of Stage 1B and Stage 1C in close proximity of Merino Rd with an initial capacity of 8,500 Tons/year which can be expanded to a total capacity of 13,000 tons/year.

However, incorporating Macroplan's growth scenario (35% growth for stage 1 for 2030), the immediate capital investment for the waste transfer and recycling centre can be reduced to 4000 Tons/year with the remaining 4500 Tons/year upgrade to support stage 1 growth to be deferred to 2030–40 period as shown in the Table 4.18 below.

Table 4.18 Waste infrastructure staging considering growth projections

STAGE	INFRASTRUCTURE STAGING 2018–2030	INFRASTRUCTURE STAGING 2030–2040	INFRASTRUCTURE STAGING 2040–2060	INFRASTRUCTURE STAGING POST 2060
Stage 1	Initial 4500 Tons/year capacity	Additional 4000 Tons/year upgrade		
Stage 2			Additional 1400 Tons/year upgrade	
Stage 3				Additional 2900 Tons/year upgrade

The timing of providing the waste transfer and recycling centre should consider Wagga Wagga City Council's existing waste management contract and existing trade waste agreements.

5 CONCLUSIONS

This report assesses the Wagga Wagga SAP refined structure plan from the full EbD workshop from an infrastructure and services lenses as one input to the Wagga Wagga SAP masterplan. The following are the conclusions of this study:

SERVICE TYPE	SUMMARY OF INFRASTRUCTURE AND COSTS AND STAGING	RECOMMENDATIONS/NEXT STEPS
Water and Sewerage	Immediate Infrastructure investment for Water between 2019 - 2030: — North Wagga High Lift pump station (228 L/S @ 70 m) — Bomen Reservoir Upgrade, new 5 ML concrete tank — Water mains Immediate Infrastructure investment for Wastewater between 2019 - 2030: — SBS A 387 L/s @ 50 m head 6 m x 7 m wet well (200 m3) with 2.5Km rising mains — Upgrade the common rising main system between Cartwrights Hill Area and Narrung St WWTP (4.7 km) and reconfiguration of the BISTF discharge (to direct it to SPS A)	— The assessed demand basis is conservative and further review and refinement of these demands including benchmarking against similar developments and consultation with RWCC is recommended. — Further design development as well as refinement of assumptions is recommended before attempting to establish an estimated project cost/budget
Storm Water	Immediate Infrastructure investment for Storm Water between 2019 - 2030: — Culvert upgrades and detention basins within stage 1 growth areas	— Further design development as well as refinement of assumptions is recommended before attempting to establish an estimated project cost/budget
Power	Immediate Infrastructure investment for Power between 2019 - 2030: — Additional 60MVA substation upgrade to existing Wagga North substation and associated network connections.	— The Renewable Energy Opportunities and Constraints Report has identified a way in which the SAP can be 100% provided through renewable energy sources. However, to ensure power security, power network upgrades will be required, including the provision of substation and upgrades to existing Wagga North substation. — Provision of spare substations are not considered in the source upgrades. Noting that it is a design

SERVICE TYPE	SUMMARY OF INFRASTRUCTURE AND COSTS AND STAGING	RECOMMENDATIONS/NEXT STEPS
		practice to include additional spare depending on the load patterns for each service area. This approach should be noted in designing the capacity of substation in the detail design stage. — Further investigation and consultation with relevant utility authorities is recommended to better understand constraints surrounding proposed upgrades.
Gas	Immediate Infrastructure investment for Gas between 2019 - 2030: — Expansion of reticulation to support development of stage 1 areas	— APA has advised that there is a robust supply to support future growth from development within the SAP area and will be able to customise and augment to match demand requirements as they change. Therefore, no expected source upgrade is required to support the SAP expected gas demands. — The report covers a desktop assessment and does not include the detailed technical analysis and refinement of the gas loading assumptions is undertaken for the preferred scenario, with the aim of reducing the potentially excessive values presented in this document. This should include research and benchmarking of actual demand from AGN and APA.
Telecommunication and Digital Connectivity	Immediate Infrastructure investment for Gas between 2019 - 2030: — Provision of Wagga Wagga SAP data hub (with digital backhaul)	— Further discussions to relevant authorities are recommended to ensure Telecommunication and Digital Connectivity to Wagga SAP is realised through the NSW regional connectivity program.
Waste	Immediate Infrastructure investment for Waste Services between 2019 - 2030: Provision of a Waste Transfer and Recycling Centre with initial capacity of 4500 Tons/year	— Waste generation from the refined structure plan shows that the management of waste from the Wagga Wagga SAP area in the future will not be efficient if it is managed as per the current state arrangements. — For the refined structure plan, it is recommended that a further detailed business case considering the size and operation of the proposed Waste Transfer and Recycling Centre be explored in alignment with the Handbook for Design and Operation of Rural and Regional Transfer Stations – Department of Environment and Conservation NSW.

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APPENDIX A

FUTURE OPPORTUNITIES AND CONSTRAINTS IDENTIFIED FROM BASELINE ASSESSMENT

The future infrastructure and services opportunities and constraints identified in the Baseline Assessment has been included in Appendix A rather than the body of the final report as these were further developed through the scenario testing and final structure plan analysis that was completed. This appendix provides a record of the process that was followed to develop the final infrastructure and services plan.

1 FUTURE OPPORTUNITIES AND CONSTRAINTS IDENTIFIED FROM BASELINE ASSESSMENT

1.1 WATER, WASTEWATER AND STORMWATER

Based on the information collected during the desktop analysis about the existing utility infrastructure and services the following opportunities and constraints have been identified for the development of any future water, wastewater and stormwater utility infrastructure or expansion of additional services within the SAP investigation area.

1.1.1 WATER INFRASTRUCTURE

Significant growth is forecast in the North Wagga Wagga supply area including the SAP and the Estella residential area to the west of the SAP.

Riverina Water is currently undertaking planning around how best to meet the increased demand in the North Wagga Wagga system into the future. Options include:

Increasing the existing source/treatment/pumping system capacity.

Formalizing the transfer of water from the Wagga Wagga System across the river.

Removing the Estella Pressure Zone from the North Wagga Wagga System by supplying it from the Wagga Wagga System from across the river.

Increasing capacity of reservoir in Brucedale.

Install a local booster pump to service land within the SAP investigation which are at a high elevation preventing them to be serviced from the existing reservoirs. The best location for this pump would in the area around Bomen East Reservoirs. This installation would prevent the requirement for a lot of infrastructure to be built so these lands can become serviced from the Brucedale Zone, which is a long way away as well as having minimal existing capacity.

However, this type of configuration would only be acceptable where the reservoir is still able to provide a reduced/minimal level of pressure if the pump does not operate (i.e. power outage or other failure). Also, to be noted this alternative solution may not meet normal firefighting requirements for commercial/industrial areas and would likely require customers to install on-lot fire water tanks.

1.1.2 WASTEWATER INFRASTRUCTURE

Wagga Wagga City Council have identified a protentional future opportunity to upgrade the Bomen pre-treatment plant into a full WWTP with its own discharge arrangement to take this load from the Narrung St WWTP system. Council has indicated they have not studied or evaluated this opportunity in any detail and there is no planning work being undertaken around this at the present time.

Wagga Wagga City Council could also upgrade their recycled water system in future to treat to a higher quality and supply more customers. They are open to proposals for additional recycled water use although it is not currently supplied to any sites near the SAP investigation area.

While most of the SAP area west of the rail line can drain south along Olympic Hwy towards the existing Bomen industrial treatment plant, to service a large portion of the SAP area ultimately, this could include a trunk sewer running along the eastern side of Olympic Hwy to the treatment plant.

For most of the SAP area east of the rail line which is separated by a ridge which would need to drain to the east and be serviced by a new pump station located in the south-east part of the SAP. This would need to pump back to the west over the ridge and into the existing network (or new/upgraded network) draining to the treatment plant.

1.1.3 STORMWATER INFRASTRUCTURE

There are many individual catchments and topography within and around the SAP investigation area. For this reason, any stormwater management measures developed for the SAP investigation area would need to consider each catchment separately.

The existing Bomen Industrial area would be assumed to have an associated high impervious area ratio due to be an industrial area. This would result in greater runoff volumes and an increase in the amount of pollutant matter. Therefore, if there is an increase in land set aside for future industrial use, consideration should be given to existing downstream drainage systems and their capacity to receive changed runoff volumes, quality management and patterns from the site, while maintaining existing flows to support habitats. Additionally, any future method to capture or intercept stormwater for reuse will need to contemplate the impact upon the recharge ability of the Murrumbidgee river. Other stormwater constraints are presented in Table 1.1.

Table 1.1 Overall stormwater management constraints to ensure existing flows are maintained, while minimising the effects of excessive runoff rates and volumes

	CONSTRAINTS
1	A lot-based stormwater impact assessment should be provided at development application phase for each lot.
2	Provide local level quantity and quality management systems to control runoff from roadways and other communal lands.
3	Local level quantity management structures (i.e. detention basins) are to be sized and located to offset the effects of development. As a guide, a typical detention of 260 m^3/ha may be required.
4	Rainwater re-use where stormwater is collected to provide an alternative water source. Water can then be used for various potable and non-potable uses depending on the level of treatment. The provision of rainwater re- use systems can have significant positive impacts on the quality of stormwater runoff.
5	Reduction of impervious areas to reduce the volume and rate of stormwater runoff. Optimisation of pervious/impervious ratios may include the limiting of paved surfaces.
6	Water Sensitive Urban Design (WSUD) principles that control the quality of stormwater discharged from the Bomen Urban Land Release Area are to be incorporated (as outlined in the GHD report for Bomen).
7	Water quality targets shall be determined in accordance with the Engineering Guidelines for Subdivisions and Developments, Part 3 Guidelines for Drainage Design.
8	Provide drainage corridors to manage concentrated surface trunk drainage flow within catchments. The drainage corridors would follow an alignment like the “Blue Line” water courses/ riparian corridors.
9	Analysis of existing culverts/ existing stormwater drainage systems to confirm capacity and determine the impact of backwater effects (if any).
10	Consider containment of “dirty” stormwater within the Bomen Urban Land Release Area.

Source: Wagga Wagga City Council

1.2 ELECTRICITY AND GAS SUPPLY

Based on the information collected during the desktop analysis about the existing utility infrastructure and services the following opportunities and constraints have been identified for the development of any future gas and electrical utility infrastructure or expansion of additional services within the SAP investigation area.

1.2.1 ELECTRICITY INFRASTRUCTURE

RETICULATION EXPANSION

If the available network capacity mentioned in Section **Error! Reference source not found.** is not adequate to supply future growth within the SAP investigation area, then an investment into the creation of new electrical infrastructure such as towers, power lines, substations will be required.

VIRTUAL POWER NETWORK

Depending on the number of developments in the Wagga Wagga SAP investigation area, the option of Virtual Power Plant (VPP) could be investigated in the future. A VPP consists of distributed power generating components such as wind farms, solar parks, and battery storage systems. The interconnected components are controlled centrally via the Virtual Power Plant but nonetheless remain independent in their operation and ownership.

The objective of a Virtual Power Plant is to relieve the load on a traditional power grid by intelligently distributing the power generated by each of the individual components during periods of peak load. Additionally, the combined power generation and power consumption of the networked components in the Virtual Power Plant could be traded on the energy exchange.

The most recently example of the implementation of this technology was in Australia was in Adelaide, South Australia. A large number of solar battery storage systems are working together to generate and store energy, and feed energy into the grid for across 1,000 residential and business premises.

Energy from the installed solar and battery storage system provides electricity for each development on which it is installed. Any energy generated by the system and not used by a development will be transmitted back into the grid. The transmitted energy will be centrally controlled to support the needs of the grid, providing additional energy to the rest of the state when it is needed. This provides every participating development with an energy system installed, a potential reduction in power bills. Also, participating developments will have access to other power sources during network outages.

At full scale the VPP could make electricity more affordable and reliable across the SAP investigation area by introducing competition to the market, adding new sources of power supply, and boosting the security of the network.

1.2.2 RENEWABLE ENERGY

BIO ENERGY

The Teys Australia meat processing plant within the SAP is an example of the above concept – methane rich gas is already captured from Covered Anaerobic Lagoons forming part of the waste water treatment plant. The Riverina Oils canola crushing, and refining plant located within the SAP is another example (The facility processes approximately half of the NSW Canola crop).

AGRICULTURAL RESIDUES

Several developers have made early plans for second generation cellulosic ethanol facilities within Australia utilising cereal straw as feedstock, but these plans have generally stalled once the realistic cost of cereal straw is understood. In summary, use of agricultural residues is challenging unless these residues are concentrated in a central location as a result of the primary processing activities.

SOLAR ENERGY

The NSW Riverina-Murray is a key region for the Australian utility scale solar sector, and currently hosts a significant number of operational, under-construction and under-development utility scale solar PV farms. Operational projects include Coleambally (150 MWac) and Griffith (30 MWac). Under-construction projects include Darlington Point (275 MWac), Sunraysia (200 MWac), Limondale (250 MWac), Hillston (115 MWac), and Finley (130 MWac), and most locally Bomen (120 MWac). Many more gigawatts of utility scale solar projects are under-development in the Riverina-Murray Region.

However, with respect to applicability to the Special Activation Precinct, there are several noteworthy features of utility scale solar projects:

1 Land use – modern utility scale solar projects require indicatively 2–3 hectares per MWac of capacity. i.e. they require lots of land. Further development of solar directly within the SAP area may not be the preferred use of the finite SAP land.

1 The materials and equipment for utility scale solar projects are predominantly imported (this includes PV modules, mounting structures, inverters, DC and high voltage cable, and often extending to transformers and other HV equipment).

2 Solar projects offer a brief period of "peaky" construction labour requirements, which specifically are required on the site for a typical period of 6–12 months. For example, below is the labour resource profile of a real project (between 100 and 200 MW) built in NSW. Once transitioning to operation, it may be expected that full-time employment during solar would be on the order of 1 person per 30 MW, plus contractors brought in for more significant maintenance and overhaul tasks.

3 It may be possible that once peak solar installations are achieved in the region, that specific solar-industry suppliers may consider the SAP an ideal location for a service centre (hosting spare equipment and components warehousing, repair and servicing, training and engineering and technical support). Key candidate suppliers with a large volume of equipment entering the region include inverter suppliers SMA and Ingeteam, and single axis tracker suppliers ATI and Nextracker.

WIND ENERGY

WSP notes that the wind speeds reported at 100 m at the Project area is significantly lower than the reported wind speeds at the operational and prospective sites (approximately 25% on average). This indicates that the Project area may not benefit from similar wind regimes as the other regions in New South Wales While most of the turbines currently on the market will operate at the wind speeds reported at the Project area, there is still an elevated risk associated with the development of a wind asset in the Wagga Wagga SAP.

HYDRO ENERGY

For conventional hydropower, a combination of volume flow (i.e. river flow) and elevation difference is needed. The main waterway in the region is the Murrumbidgee River. The Murrumbidgee is already a heavily regulated and utilised waterway for hydropower in the steeper part of its catchment, with Burrinjuck 28 MW and further upstream its headwaters are diverted to the Tumut scheme (forming part of the Snowy Scheme).

For pumped hydro energy storage, elevation difference is required, and ideally either an existing reservoir (e.g. proposed Baroota pumped hydro in South Australia using the existing Baroota reservoir as the lower reservoir), or multiple existing reservoir (e.g. the nearby Snowy 2.0) are available. Greenfield sites are possible, but then the cost effectiveness of the reservoir is dependent on suitable topography, and elevation difference between reservoirs remains the key ingredient.

GEOTHERMAL ENERGY

A high-level feasibility assessment based on the data reviewed and based on key factors of heat, fluid and permeability covered above, is that the geothermal resources available to the Wagga Wagga SAP are not likely to support utilization for electricity generation or direct heat use. The temperatures that would be expected to be found if further detailed exploration and data gathering were to be undertaken, would be in the range of circa 23°C at depths of 300 m. These temperatures would be considered too low for electricity generation or direct heat use applications, and too low to support other options such as bathing purposes – as utilized in other areas of NSW including Moree, Pilliga and Lightning Ridge (which have average temperatures of circa 40°C, and where commercial bathing facilities have been established).

1.3 GAS INFRASTRUCTURE

HYDROGEN AND METHANE PRODUCTION

APA Group has expressed interest in the development of a hydrogen production and distribution facility. The power to gas facility could produce hydrogen from renewable electricity, which could then be injected into the local gas distribution network.

WWCC are keen to consider the capture and use of methane gas.

SENSITIVE USES

APA seeks to limit sensitive uses from establishing within the pipeline Measurement Length to retain a high level of compliance with applicable safety standards. AS2885 defines a sensitive use as one which may increase the consequences of failure due to its use by members of the community who may be unable to protect themselves from the consequences of a pipeline failure.

To this end, APA's preferred position is that all land uses listed below be located outside of the ML:

Table 1.2 Examples of sensitive land uses.

Child care centres	**Place of worship**
Detention facility	**Residential care facility**
Educational facility	**Retirement facility**
Function facility	**Service station**
Health care services	**Shop**
Hospital	**Shopping centre**
Hotel	**Theatre**

Source: APA Transmission

EASEMENT MANAGEMENT

APA is the beneficiary of several pipeline easements for the three (3) HPGTPs detailed in Error! Reference source not found. above that run through the Wagga Wagga SAP area. To ensure compliance with the safety requirements of AS2885, APA needs to ensure easement is managed to an appropriate standard. This includes:

- ensuring the easement is maintained free of inappropriate vegetation and structures.
- place warning signs at various mandated points along the pipeline route, including any change in property description/boundaries.
- maintain a constant line of sight between warning signs.
- undertake physical patrols and inspections of the easement.

APA will not accept outcomes that do not enable safety responsibilities to the surrounding community.

Crossing of the pipeline should be minimised as much as possible. Any proposed developments will require the extension of services to the proposed industrial lots, and it is possible that these may need to cross the HPGTP.

Any works within the easement must be approved by APA through their Third-Party Works Authorisation process. This process will ensure all works are undertaken in a safe manner that does not physically impact on the pipeline.

PREFERRED TREATMENT OF EASEMENT – INDUSTRIAL AREAS

The preferred treatment of pipelines in industrial areas is for the pipeline and easement to be located within linear open space or within the frontage of lots so that APA maintains access rights and can easily perform visual checks on the pipeline easement. Where located in the frontage of an industrial lot the easement could be utilised as a landscape setback or car parking but not for permanent storage of materials.

1.4 TELECOMMUNICATIONS AND INTERNET SERVICES

1.4.1 TELECOMMUNICATIONS INFRASTRUCTURE

An increase in demand for data and call services in the SAP area will place additional loading on the existing mobile communications infrastructure in and around Wagga Wagga. Generally, it will fall to the individual telecommunication carriers to accommodate an increased demand for services by either upgrading existing facilities or by building new base stations should they be required. This is typically a reactive process on the carrier's behalf, with increased demand being placed on facilities triggering a process of either upgrade or infill to accommodate the new load. The upgrading of existing facilities in the area would depend on a range of factors including tenure, structural capacity, coverage objective of a carrier and the level of demand being placed on the network at the time

In addition, the rollout of 5G mobile coverage has begun in regional NSW, with Telstra and Optus both committing to the technology becoming increasingly available from 2019 onwards. The demand for this service will likely push other service providers to follow with customers and business users expecting stable and super-fast mobile internet connections. The capacity of this service to handle large amounts of data will mean some users may rely solely on a mobile data connection for certain aspects of business. The provision of a purpose-built facility (monopole or lattice tower) within the SAP, would allow for carriers wishing to provide 5G coverage to the area, a simple option upon which to locate equipment. Connection into a fibre network would be made possible through the nearby fibre networks.

1.4.2 INTERNET INFRASTRUCTURE

The early engagement between Wagga Wagga City Council and the NBN on the provisioning of fibre to the SAP, will be necessary to allow for business and industry to take advantage of the fixed line network. NBN will ultimately need to review the business case for the provisioning however support indicated by Wagga Wagga City Council and a committed funding to assist in the deployment of services should expedite and support this.

1.4.3 REGIONAL DIGITAL CONNECTIVITY PROGRAM

The Regional Digital Connectivity program aims to bring faster, more reliable, widespread digital coverage to regional NSW and confirms the NSW Government's commitment to deliver transformative investment under the $4.2 billion Snowy Hydro Legacy Fund.

The Regional Digital Connectivity Program will investigate how to close the divide between metropolitan and regional NSW. It will provide digital infrastructure to support growing economies and communities from country to coast.

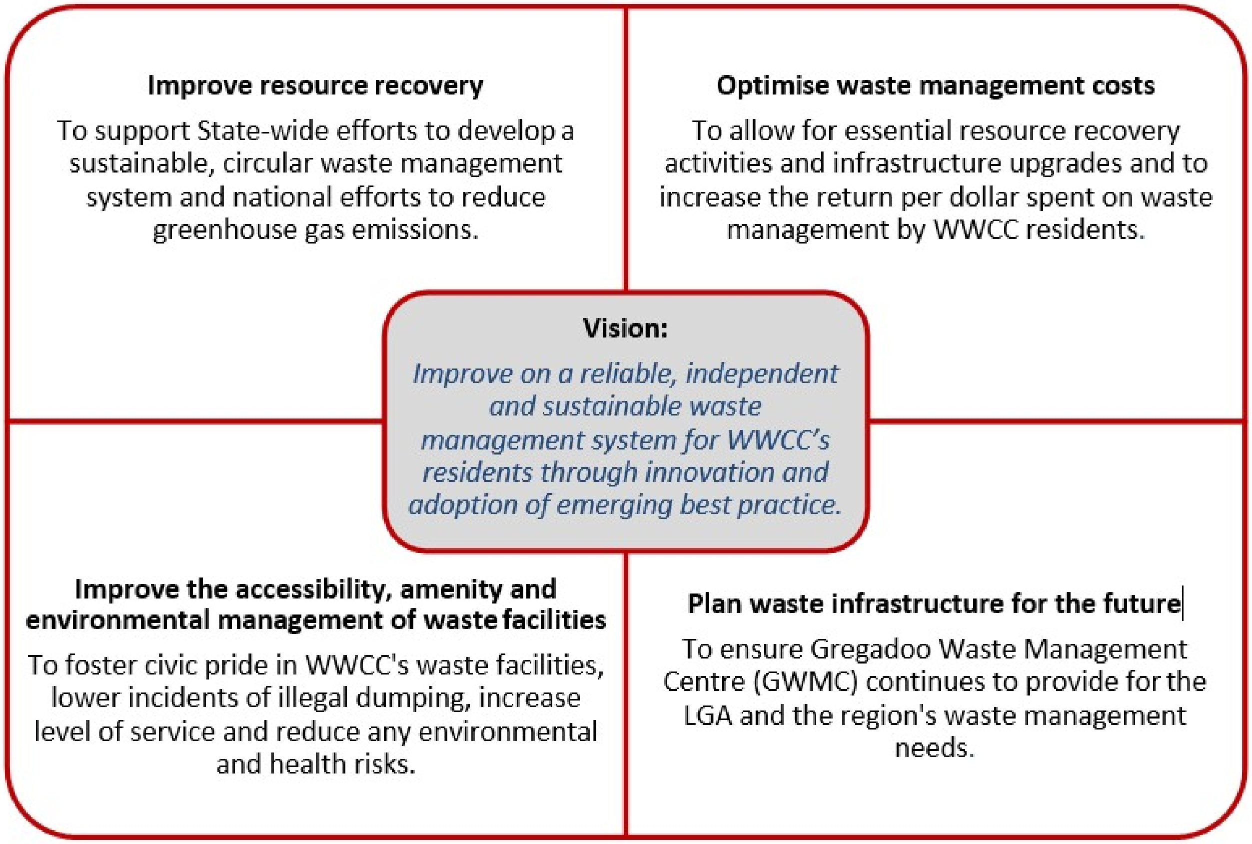
The NSW Government is looking at Dubbo and Wagga Wagga, and the surrounding areas, as case study locations to design a better-connected regional NSW. Technical consultants have commenced discussions with Council and key stakeholders to investigate example designs in and around Wagga Wagga. These designs will work out where investment is implemented and they will be shaped by regional communities and businesses from the beginning, ensuring specific needs are met now and into the future.

1.5 WASTE AND RESOURCES RECOVERY

WWCC has a vision for the next 10-year period which fall under four themes are envisioned:

- Improve resource recovery;
- Optimise waste management costs and finances;
- Improve access, amenity and environmental management of waste facilities; and
- Plan infrastructure for the future.

The themes are presented in Figure 1.1, describe the vision and what it would mean for four key areas of the waste management system.



Source: Wagga Wagga City Council

Figure 1.1 WWCC waste vision and themes

To reflect these waste vision and themes WWCC is currently interested in the future exploration of methane reuse technologies due a stockpile of this gas being produced by the LMC. WWCC is also considering the use of solar technologies to power their facilities. WWCC also has a desire about reducing the transportation of waste to other parts of the state by increasing the utilisation or upgrade of GWMC.

Another future opportunity raised by WWCC that might be feasible in terms of the SAP is an additional transfer station specific to meeting the waste needs of the future businesses in the SAP could be provided.

1.6 EXISTING/FUTURE BUSINESSES

There are several existing businesses within or around the SAP investigation area which rely upon provision of exiting utility infrastructure and services to function effectively. The infrastructure and service needs of these businesses have been captured during a public consultation process completed in July 2019.

1.6.1 EXISTING

TEYS

Teys Australia is the second largest meat processor and exporter in Australia. Teys Wagga Wagga employs 800–900 FTE but this can be increased to 1,100 when required. Currently the facility can process 1,115 head of cattle a day with a maximum capacity 1,300 predicted to be reached in the next 2 years. Teys exports 350 ton of processed meat
pre-packaged for off the shelf sales to Aldi and Woolworths. Products are shipped via Qube transport with either rail or truck. Teys maintains that there is no wastage with all products created from all of the cattle.

Around 40% of water used in boilers is recycled from ponds with use of biofilter. Wastewater offsite is expensive, but some is provided on farms. Utilities cost approximately $35 per head from mostly water and gas requirements used for the operational process. However, their power requirements for chilling and freezing products while gas is used for hot water and steam production. There is dedicated communication service for the facility.

ROBE

Riverina Oils and Bio Energy Pty Ltd (ROBE) is an oilseed crushing and refining plant built in 2013.

It has a crushing capacity of 500 tonnes of oilseed per day. Each day the factory has the potential to produce over 200 tonnes of high-quality refined vegetable oil for the food industry and 300 tonnes of premium vegetable protein meal each day for the poultry, dairy and animal feed industries. There are approximately 40 employees working at the plant.

ROBE is the highest consumer of gas in the area which it uses for its boiler to generate steam and heating part of the production process. Steam is also associated with a high amount of water and power use, but the waste water is removed in the steam process.

AUSTRAK

Austrak is factory which designs and produces sleepers. It has approximately 30 employees. The factory operates by contract which means products are made to order and are not stockpiled. All contracts to domestic market. When there are no contracts the site will shut down during such periods. Site is expected to be have high amount of production over the next 10 years due to the large amount of rail projects in NSW. Trains export product approximately every two weeks by a private siding but there are also slip trains available to carry large loads. However, trucks for smaller delivery. Cement and fly ash are delivered everyday

Utilities mostly include water and power as part of the operational process. There is a gas connection but its use does not include any steaming or heating utilisation. There is possibility future or new technology could require steam curing and therefore this connection will remain. Wastewater is mostly generated from concrete waste which is then recycled into their process. Any excess concrete is sent to a nearby recycling facility.

GREAT SOUTHERN ELECTRICAL

Great Southern Electrical provides high and low voltage reticulation networks, including transformers, powerlines, subdivisions for properties, industries or farms. Great Southern Electrical is accredited to perform contestable works within the Essential Energy network. It operates across Southern NSW.

Communication services are a reported issue due to slow speeds which prevents engineering programs from working efficiently without good connection speeds. There is a remote office and staff working around rural areas, but current communication services are not capable of communicating their technological needs.

Water for the production of power for pumps). There is an in interest in solar technology including being a supplier of solar products. The lot next door is vacant and there are talks of expanding to include a data centre or fuel station.

It was reported that there are private communications networks throughout Bomen, however Great Southern Electrical has found it hard to obtain connection agreements.

FULTON HOGAN

Fulton Hogan is an infrastructure construction company. It produces 55–60,000 ton of asphalt produced a year. Recycle materials are used in the operational process. The company is investigating into increasing the additions of more recycled martials including for example glass. Currently does not produce hot mix storage on its site but Fulton Hogan has indicated this could become a possibility if work continues to grow. This would require additional gas to deliver. Electrical use has a large draw on the current system at start up but there is an option to use diesel to run burners.

PROWAY

ProWay designs and builds livestock handling products and facilities. This include works such as the design, maintenance and installation of cattle and sheep yards, livestock equipment and sheering sheds. Around 50% of products are exported locally within 5 hours. International exports include to the USA, UK, New Zealand markets. Digital connectivity speed is critical for this business to function efficiently. Supply of steel for product creation comes from Southern Steel Supplies, a next-door neighbour.

1.6.2 FUTURE

RIFL

Riverina Intermodal Freight and Logistics (RiFL) Hub project is planned to be built at Bomen industrial park, north-east of Wagga Wagga. The site was strategically chosen due to being located close to the midpoint of the current Melbourne-Sydney interstate rail line operated by Australian Rail Track Corporation (ARTC).

The RiFL Hub is intended to drive opportunity for the regions industry and the freight and logistics industry in and around Wagga Wagga by creating greater opportunity to achieve efficiencies in the movement of containerised freight. Freight would be transported by road, and then onto rail, making Riverina produce more cost-competitive, whilst also providing economic diversification in Wagga Wagga.

There are a range of stakeholders including potential users of the RiFL Hub such as Visy, ROBE, GrainCorp and other large freight handlers and rail operators. To service this hub, existing and new utility assets will need to be modified and built to service competently including new telecommunications, wastewater, electrical and water assets.

Source: Wagga Wagga Integrated Transport Strategy and Implementation Plan 2040 (WWCC, August 2017)

Figure 1.2 Wagga Wagga and it's rail and road connections with Australia's major cities

Source: Wagga Wagga City Council

Figure 1.3 Layout of Riverina Intermodal Freight and Logistics (RIFL) Hub

APPENDIX B

INFRASTRUCTURE AND SERVICES SWOT ANALYSIS

The infrastructure and services SWOT analysis was completed as part of the Scenario Testing completed to inform the Full Enquiry by Design Workshop.

WAGGA WAGGA SAP: SCENARIO TESTING INFRASTRUCTURE

POWER RISKS AND OPPORTUNITIES

Significant power infrastructure upgrades required if in-house power generation is not included

Circular economy opportunity through embedded Virtual Power Plant concept

In house power generation is in surplus to estimated load demands

GAS RISKS AND OPPORTUNITIES

Robust gas supply and access to city gate (network distribution point)

Reluctance of gas provider to invest in infrastructure before customers are present

Gas supply might trigger change to high pressure main measured length

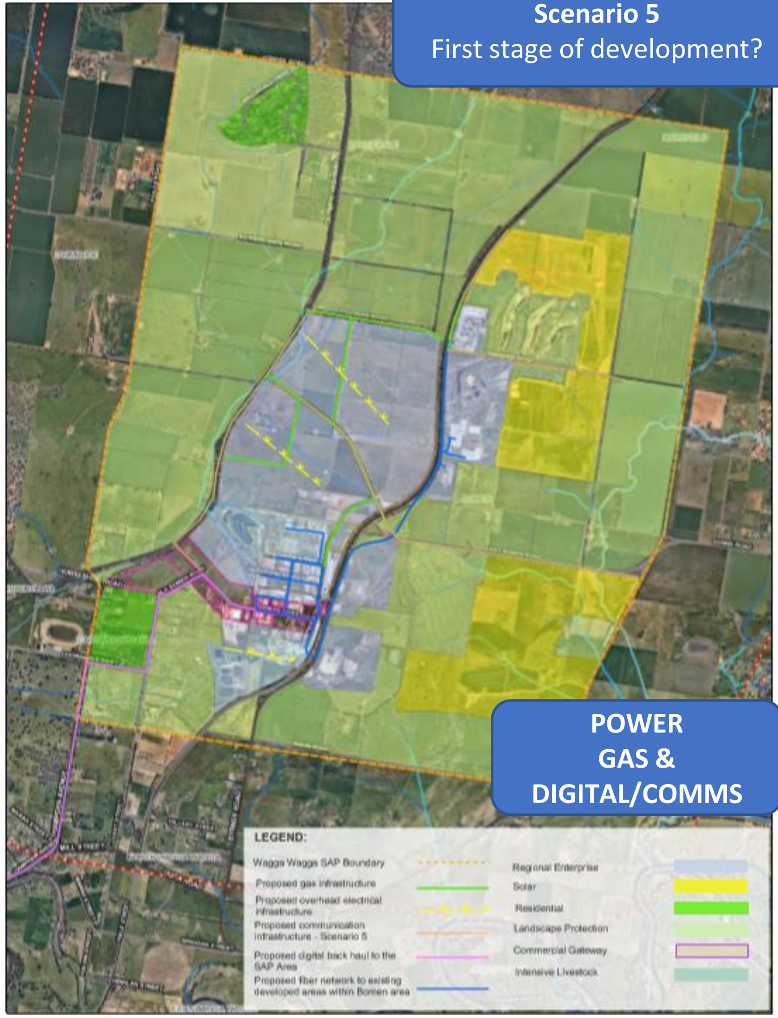
DIGITAL/COMMUNICATIONS CONNECTIVITY

Leverage the NSW Regional Digital Connectivity Program

Fiber connection from Wagga Wagga data hub to SAP area. Option to provide the data hub in the SAP area?

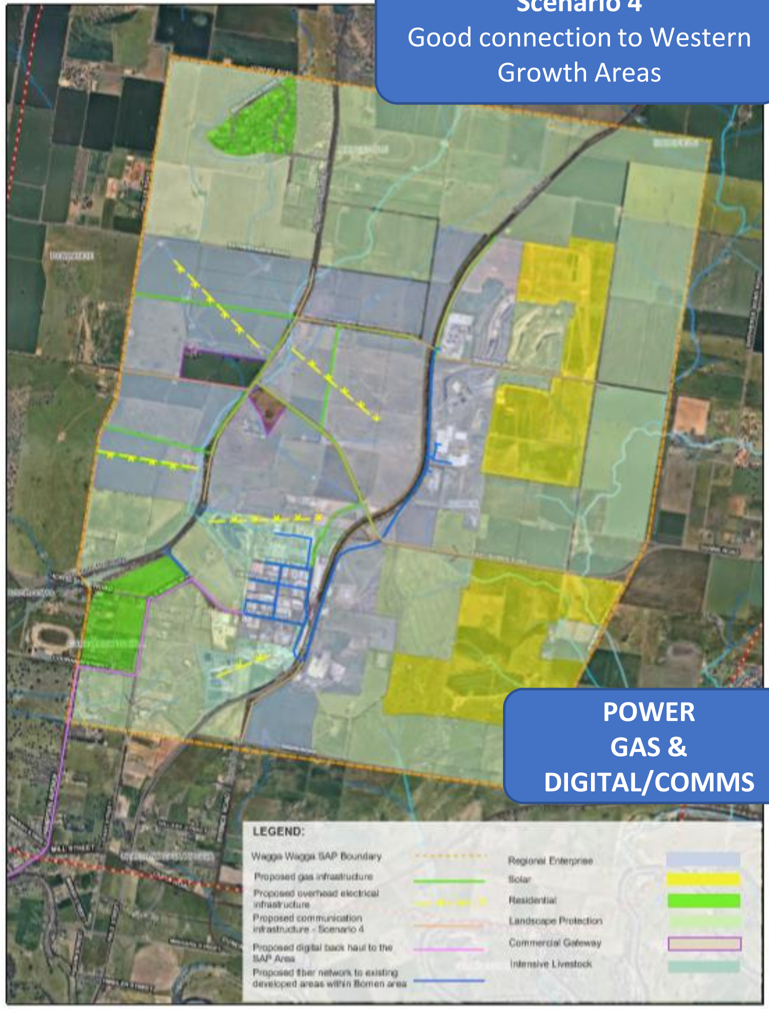
Fast tracks solution to improve connectivity to existing businesses, can subsequently connect to future areas

Scenario 5
First stage of development?



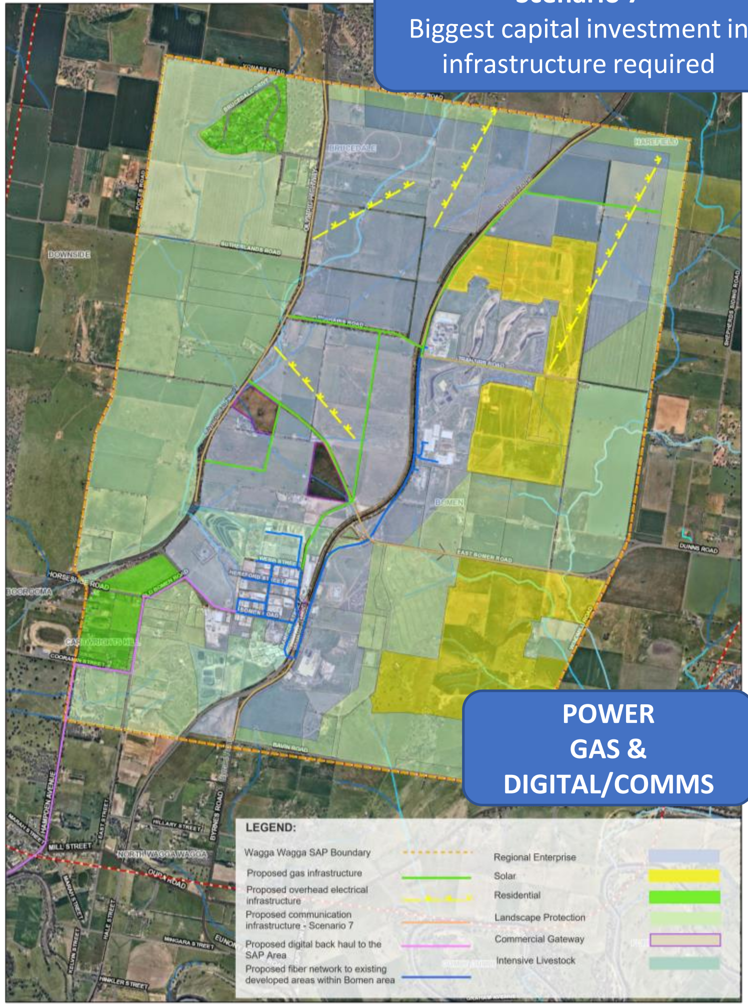
POWER GAS & DIGITAL/COMMS

Scenario 4
Good connection to Western Growth Areas



POWER GAS & DIGITAL/COMMS

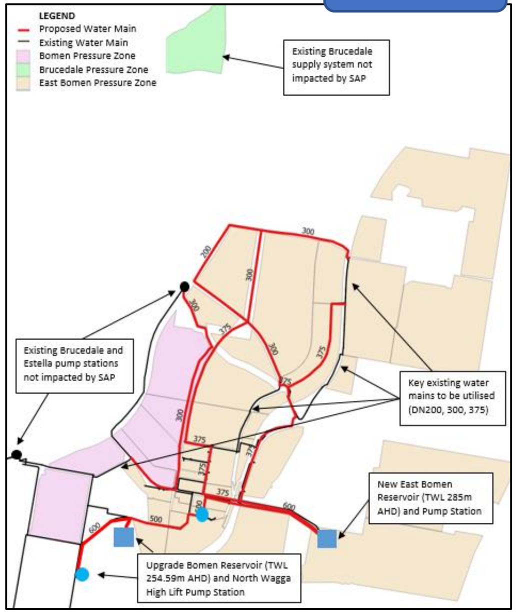
Scenario 7
Biggest capital investment in infrastructure required

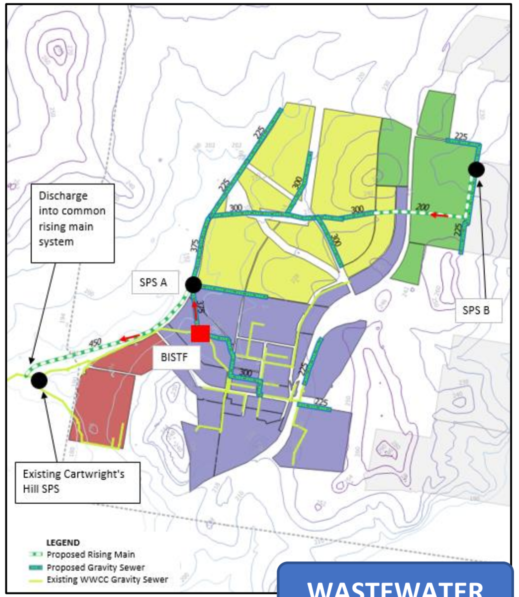


POWER GAS & DIGITAL/COMMS

WAGGA WAGGA SAP: SCENARIO TESTING INFRASTRUCTURE

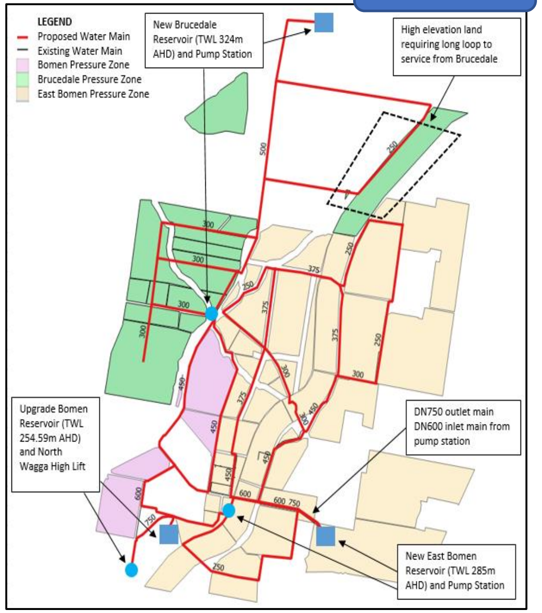
WATER SUPPLY — **Scenario 5**

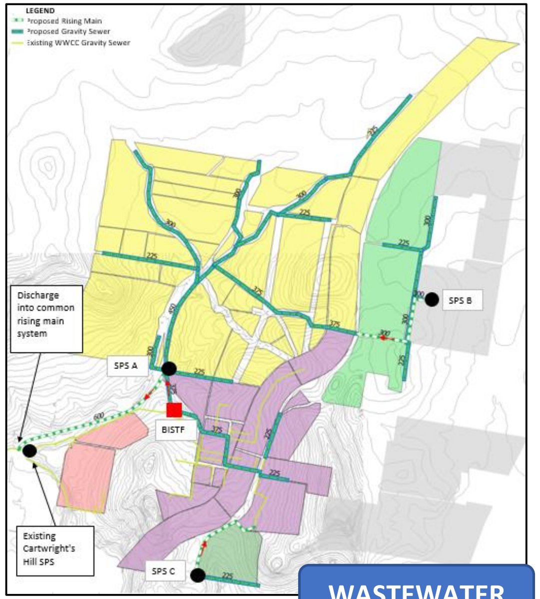




WASTEWATER

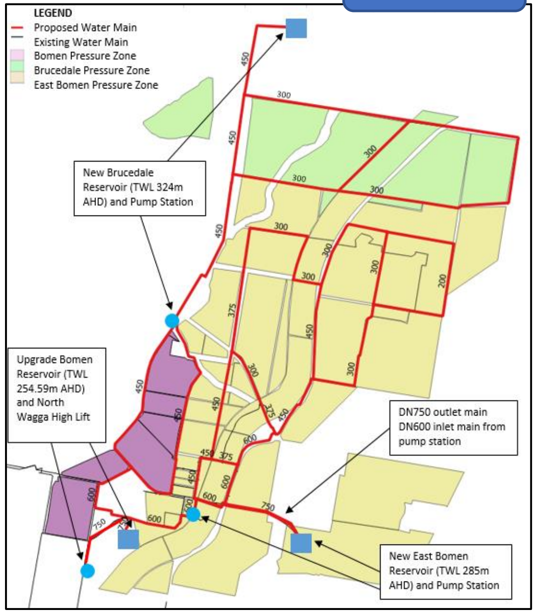
WATER SUPPLY — **Scenario 4**

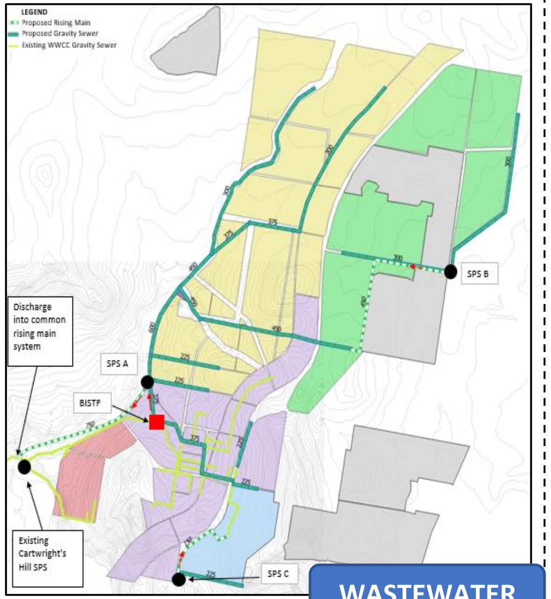




WASTEWATER

WATER SUPPLY — **Scenario 7**

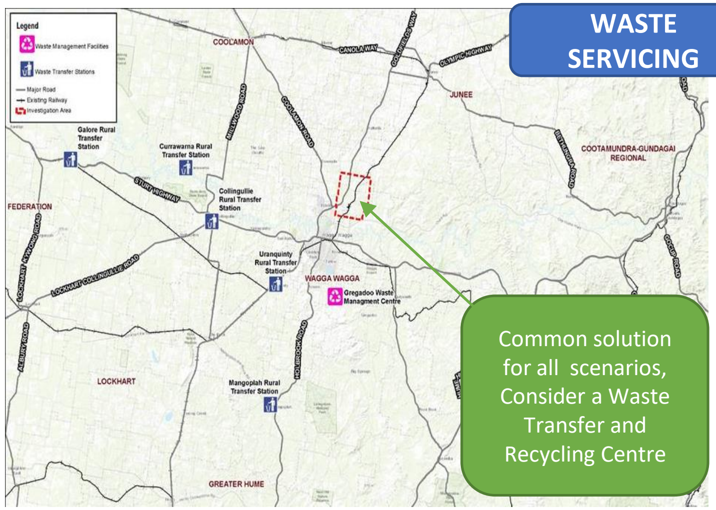




WASTEWATER

WATER SUPPLY RISKS AND OPPORTUNITIES	Consider seeking separate water allocation for SAP (i.e. separate from Wagga Wagga, existing RWCC allocations)
Significant additional water allocation required	significant source/upstream upgrades required
Invitation to contribute to Riverina Water ICWM Process (Sept 2019)	
WASTEWATER RISKS AND OPPORTUNITIES	most of the SAP naturally falls to the SW, reducing no of catchments and sewage pump stations
potential upgrades to existing STP and downstream system required	BISFT condition/capacity not adequate (less than expected)
WASTE SERVICING RISKS AND OPPORTUNITES	Waste Transfer and Recycling Centre – circular economy opportunity
Existing landfill site is approximately 20km away from the study area	commercial drivers do not currently influence the behavior of customers to recycle

WASTE SERVICING



Common solution for all scenarios, Consider a Waste Transfer and Recycling Centre

SWOT ANALYSIS – GAS

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
common to all options	Robust access to gas supply with the City Gate being located within the SAP area.	Typically, the provision of gas infrastructure is not based on future demand analysis rather on a requirement basis, therefore there may be a reluctance from the service provider to invest in gas distribution infrastructure until development and customers are in place.	Potential opportunity to add a hydrogen mix to the gas supply to provide an alternative form of energy supply.	Restrictions on developments within the measured length of the transmission lines (see baseline report)
Scenario 4	Gas interconnection to City Gate likely to only require one crossing of the railway which can be achieved through available corridors	Gas supply required may trigger a change in the pressure of the gas transmission line which might increase the measured length of the main, restricting development within the revised measured length of the transmission line.		More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
Scenario 5	Gas interconnection to City Gate likely to only require one crossing of the railway which can be achieved through available corridors		Scenario 5 could be considered the first stage that would support the future development of the other two scenarios	
Scenario 7		Gas supply required may trigger a change in the pressure of the gas transmission line which might increase the measured length of the main, restricting development within the revised measured length of the transmission line.	Under bore construction methodologies to minimise impact to railway operations	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
		Gas interconnection to the city gate will likely require additional crossing points across the railway corridor.		

SWOT ANALYSIS – WATER

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
common to all options	services significant development	significant infrastructure required	invitation to participate in RWCC planning process that is currently reviewing their Integrated Water Cycle Management (IWCM), therefore aligning the Wagga Wagga SAP requirements to RWCC planning processes	Development occurs more slowly (less) than expected, or planning/design based on conservative loading, resulting in higher operational costs than what is required
	existing land use (rural/ind) favourable re constructability, exist services, etc.	significant additional water allocation needed	do not service solar farms, reducing infrastructure requirements	additional water allocation not available (significant threat)
	improves reliability of Brucedale system by upgrading looping/network upstream of the pump station	significant source/upstream upgrades required	Challenge per ha/per capita demand parameters to size infrastructure requirements more appropriately	reliance on existing infrastructure. (capacity/condition may be less than expected)
	separate inlet to East Bomen Res improves WQ and operational flexibility		use recycled water to substitute some industrial potable demands	industrial development near existing bore fields - contamination/WQ threat?
			staging of infrastructure upgrades	approvals (heritage, env.) for necessary infrastructure and corridors unable to be obtained

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
			Challenge levels of service required to reduce infrastructure requirements	Land/corridors not allocated for necessary infrastructure
			Consider seeking separate water allocation for SAP (i.e. separate from Wagga Wagga, existing RWCC allocations)	Ground conditions (rock) impact constructability/cost
				Service authorities unwilling to take on new infrastructure
Scenario 4	improves reliability of Brucedale system from present state	large capacity upgrades for Brucedale system needed	Upgrade/modernise/add reliability to Brucedale system	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
		includes pockets of high EL land near East Bomen (and2km north) which would require local booster zones/pumping to service	consider trimming north part of rail terminals from serviced area	
		Servicing north extent of Rail Terminals requires a long loop of mains from Brucedale zone. Uneconomical and poor WQ outcome	do not service northern extent of rail terminal area	

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
Scenario 5	no need to upgrade Brucedale system infrastructure	proportionally more construction in built-up area	defer significant capital spend through staging and utilisation of exiting inf.	
	better able to stage as more focussed around existing network		Upgrade/modernise/add reliability to Brucedale system	
	likely more economical per ha / per conn. Than other options (due to focussed area)			
Scenario 7	improves reliability of Brucedale system from present state	large capacity upgrades for Brucedale system needed	use Estella zone to the west to supply areas at appropriate EL within SAP	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
		varying elevation of land west of Olympic. Hwy difficult to service from a single pressure zone	extend East Bomen Zone west of Olympic. Hwy and use local booster PS	
			use PRV's from Brucedale zone to manage high pressure area west of Olympic. Hwy	

SWOT ANALYSIS – SEWERAGE

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
common to all options	services significant development	significant infrastructure reqd.	Utilise spare capacity at BISTF	BISFT condition/capacity not adequate (less than expected)
	most of the SAP naturally falls to the SW, reducing no of catchments/SPS	potential upgrade to existing STP	Utilise spare capacity in exist network/staging	existing network asset condition/capacity not adequate (less than expected). Note AC mains, note uncertainty
	Depth of groundwater in are is significant, limiting infiltration to sewage network	potential upgrade to downstream network	Renewal/management of existing network assets as development occurs	Development occurs more slowly (less) than expected, or planning/design based on conservative loading, resulting in operation and asset issues
	existing land use (rural/ind) favourable re constructability, exist services, etc.	potential discharge license issues/constraints	Commercial opportunities re: trade waste (i.e. council treatment vs private treatment and types of development/waste allowed). Waste-to-energy power generation	approvals (heritage, env) for necessary infrastructure and corridors unable to be obtained
		high strength sewage may reduce asset life of existing and new infrastructure	Create separate high strength and study systems to manage trade waste opportunities	Land/corridors not allocated for necessary infrastructure
			staging of infrastructure	
			Optimize network/planning re: other growth (Estella). Particularly re: common rising main system	Ground conditions (rock) impact constructability/cost

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
			Challenge per ha/per capita loading parameters to size inf. More appropriately	Service authorities unwilling to take on new infrastructure
			use pressure sewer or private pump stations to service uneconomical area	
			Challenge levels of service required to reduce infrastructure requirements	
Scenario 4	development west of Olympic Hwy able to be serviced by gravity	residential development proposed close to BISTF (buffer distance issues?)	consider trimming southern part of rail terminals from serviced area	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
		southern extent of rail terminals difficult to service due to low elevation		
		likely less economical per ha / per conn. Than option 5 (which has a more focussed area)		
		requires large infrastructure, potentially beyond what is standard in Wagga Wagga network		

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
		includes pockets of high EL land near East Bomen (and2km north) which would require local booster zones/pumping to service		
Scenario 5	SPS C not required	limits area/extent of development possible	More suitable for staged development given growth focussed around existing infrastructure/serviced area	
	SPS B small	development proposed close to BISTF (buffer distance issues?)		
	smaller size of all infrastructure	less ability to stage infrastructure		
	smaller impact on downstream network	proportionally more construction in built-up area		
	Does not include rail terminal land which is far north and south of the core network			
	likely more economical per ha / per conn. Than other options (due to focussed area)			

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
Scenario 7		southern extent of rail terminals difficult to service due to low elevation	consider trimming southern part of rail terminals from serviced area	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
		likely less economical per ha / per conn. than option 5 (which has a more focussed area)	as catchment will be in the vicinity, opportunity to sewer service existing Brucedale Res area if desired	
		Large catchment east of Rail Line requires large SPS B and receiving infrastructure		
		requires large infrastructure, potentially beyond what is standard in Wagga Wagga network		

SWOT ANALYSIS – POWER

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
common to all options	total power generation from in-house renewable energy sources is in surplus of estimated total load demand for all the scenarios	High cost of distribution network infrastructure	provide in-house power generation from renewable energy sources such as Solar, Battery Energy Storage Systems (BESS) and Biogas generation	If in-house power generation is not adopted all scenarios will require significant infrastructure upgrades to ensure capacity demands are met
			Installation of overheads to reduce the overall capital investment required	The provision of a Virtual Power Plant may not be supported by the current Australian Energy Regulator and may not be supported by the current energy provider
Scenario 4	Access to existing distribution network allows for staged expansion across the precinct as the development occurs	Electrical energy generation from Biogas is same as Scenario 5, although the total area of development is more than double	Current trend of declining solar PV module and energy storage system costs.	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
	8% higher coverage of annual electricity consumption of SAP through renewable electrical energy than Scenario 5	Higher infrastructure cost than scenario 5	Circular economy through VPP- Embedded network concept	Scenario results may change due to continuous technological advancements in renewable energy sector
	Higher excess power available for energy storage than Scenario 5		Large scale BESS to store excess power during peak generation hours	

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
Scenario 5	Most cost-effective solution given the smaller distribution expansion required	8% lower coverage of annual electricity consumption of SAP through renewable electrical energy than Scenarios 4 and 7.	Current trend of declining solar PV module and energy storage system costs.	Scenario results may change due to continuous technological advancements in renewable energy sector
	Energy yield from Biogas is the same despite being smaller development area than Scenarios 4 and 7	Lower excess power available for energy storage than Scenarios 4 and 7	Circular economy through VPP- Embedded network concept	
			Large scale BESS to store excess power during peak generation hours	
Scenario 7	Access to existing distribution network allows for staged expansion across the precinct as the development occurs	May require the upgrade of substation infrastructure to ensure that the power generation from renewable energy sources can be distributed back into the grid	Current trend of declining solar PV module and energy storage system costs.	More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5
	8% higher coverage of annual electricity consumption of SAP through renewable electrical energy than Scenario 5	Electrical energy generation from Biogas is same as Scenario 5, although the total area of development is more than double	Circular economy through VPP- Embedded network concept	Scenario results may change due to continuous technological advancements in renewable energy sector

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
	Higher excess power available for energy storage than Scenario 5	Highest infrastructure cost compared to scenario 4 and 5	Large scale BESS to store excess power during peak generation hours	

SWOT ANALYSIS – WASTE

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
common to all options	provision of a future transfer and recycling facility provides improved efficiencies in the transportation of landfill and opportunities to recycle materials generated from waste sources	Existing landfill site is approximately 20km away from the study area	Provision of a Wagga Wagga SAP Waste Transfer and Recycling facility	Current commercial waste agreements (that is commercial rate to dispose of waste) does not currently influence the behaviour of customers to recycle and manage their waste more efficiently
		Location of future Wagga Wagga SAP Transfer and Recycling facility not currently considered.		
		Waste from Solar industries is unknown		
Scenario 4				More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
Scenario 5				
Scenario 7				More vulnerable to common threat "Development occurs more slowly (less) than expected…" compared to Scenario 5

APPENDIX C

WAGGA SAP FUTURE DEMAND CALCULATIONS

Summary of Water Demand and Sewerage Loading Parameters Proposed for Wagga Wagga SAP - Based on Land-use Information Provided 26 Aug 2019 - Updated for preferred scenario 14 Oct

Sub Precinct Type	Anticipated Land Uses (from Concept Workshop)	Comments / Assumptions	Proposed water demand rate	Proposed sewer loading rate
Regional Enterprise	_ 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 off-site air, noise and odour impacts) _ Emergency Services facility _ General Industry (e.g. advanced manufacturing of non-agricultural products) _ 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 Centre _ Customs inspection facility	Assume these areas are to be water and wastewater serviced. Demand/loading as per Authority standards (for light industrial land use)	**10.5ET/ha.** This is based on *Section 64 Determination of ET Guidelines* Standard ET (15ET/ha for Future Unknown Industry - Light) x 0.7 Local Factor. **18.9kL/d per ha Peak Day Demand** (based on RWCC standard rate of 1.8kL/ET)	**10ET/ha.** This is based on Council's Development Service Plan. **5.46kL/ha/d ADWF (0.063L/s per ha).** This is based on the above ET/ha rate and flow parameters in Council's Development Servicing Plan Wet Weather flow parameters: PWWF = PDWF + GWI + IIF (to be calculated based on WSA02 method as stated in Council's Development Servicing Plan, which also replaces IIF with 0.029 x Cumulative ET)
Intensive Livestock Agriculture	_ ~~Extensive agriculture (e.g. irrigated pastures, irrigated fodder cropping)~~ (these uses excluded) _ ~~Intensive livestock agriculture (e.g. feed lots, piggeries, poultry farms)~~ (these uses excluded) _ Biosolids Treatment facility (e.g. related to Intensive livestock agriculture) _ Depot facility _ Electricity Generating Works (e.g. anaerobic digester related to Intensive livestock agriculture) _ Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants) _ Roads	Assume these areas are to be water and sewer serviced. <u>Important Note</u> - these anticipated land-uses may have non-standard demands which could easily exceed the assumed demand/loading rates at a local/development level - however (given approx 110ha of this land use is proposed) the proposed (standard) rates are considered reasonable as an overall/average allowance	**21.0ET/ha.** This is based on *Section 64 Determination of ET Guidelines* Standard ET (30ET/ha for Future Unknown Industry - Heavy) x 0.7 Local Factor. **37.8kL/d per ha Peak Day Demand** (based on RWCC standard rate of 1.8kL/ET)	**10ET/ha.** This is based on Council's Development Service Plan. **5.46kL/ha/d ADWF (0.063L/s per ha).** This is based on the above ET/ha rate and flow parameters in Council's Development Servicing Plan Wet Weather flow parameters: PWWF = PDWF + GWI + IIF (to be calculated based on WSA02 method as stated in Council's Development Servicing Plan, which also replaces IIF with 0.029 x Cumulative ET)
Commercial Gateway	_ Highway service centre (fuel, food, etc.) _ Industrial training facility _ Information and education facility _ Kiosk and Visitor Information _ Recreation area/park _ Roads _ Public domain lighting, markers and entry statements.	Assume these areas are to be water and wastewater serviced. Note - there is insufficient detail regarding floor areas, buidling occupacy, etc is available to apply the Section 64 Determination of ET Guidelines Standard ET requirements for commercial land uses. Hence, the same rate as for Future Unknown Industry - Light has been adopted. These land uses have near-equivalent demand in Sydney Water's Water System Planning Guideline, supporting this approach	**10.5ET/ha.** **18.9kL/d per ha Peak Day Demand** (based on RWCC standard rate of 1.8kL/ET)	10ET/ha. This is based on Council's Development Service Plan. 5.46kL/ha/d ADWF (0.063L/s per ha). This is based on the above ET/ha rate and flow parameters in Council's Development Servicing Plan Wet Weather flow parameters: PWWF = PDWF + GWI + IIF (to be calculated based on WSA02 method as stated in Council's Development Servicing Plan, which also replaces IIF with 0.029 x Cumulative ET)
Solar	_ Solar farm _ Associated infrastructure (including battery storage) _ Roads	It is assumed these areas are to be water serviced, where practical/adjacent to network, but with minimal water demand. It is assumed there is no wastewater generation from these areas	**0.25EP/ha**. **0.45kL/d per ha Peak Day Demand** (based on RWCC standard rate of 1.8kL/ET)	Nil
Landscape Protection	_ Agriculture _ Rural industries _ Recreation areas _ Environmental protection works	It is assumed there is no potable water demand or wastewater generation for these areas	Nil	Nil
Residential	_ Dwellings	N/A	N/A	N/A
Overlay Type				
Green infrastructure	_ n/a	It is assumed there is no potable water demand or wastewater generation for these areas	Nil	Nil
Rail terminals	_ 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) _ 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)	It is assumed these areas are to be water serviced, where practical/adjacent to network, but with minimal water demand. It is assumed there is no wastewater generation from these areas	**0.25EP/ha**. **0.45kL/d per ha Peak Day Demand** (based on RWCC standard rate of 1.8kL/ET)	Nil

General Notes:

All areas above are gross area (incl. allowance for road reserves) not net area (sum of lot areas only)

For other purposes (i.e. WSUD/ESD consideration). Average Day Demand (potable water) could be assumed to be approx. half of the Peak Day Demand figures given above

WATER DEMAND ESTIMATE

Wagga Wagga SAP					WATER					
Development Type	Comments	Stage	Pressure Zone	Area ID	Area (ha)	Rate (ET/ha)	ET	PDD (kL/d/ET)	PDD (kL/d)	PDD (L/s)
Regional Enterprise		2	Bomen	RE12	25.6	10.5	268	1.8	483	5.6
Regional Enterprise		2	Bomen	RE13	43.3	10.5	455	1.8	819	9.5
Regional Enterprise		2	Bomen	RE14	17.7	10.5	186	1.8	334	3.9
Regional Enterprise		1	Bomen	RE28	14.1	10.5	148	1.8	266	3.1
Regional Enterprise		1	Bomen	RE29	6.7	10.5	70	1.8	127	1.5
Regional Enterprise		1	Bomen	RE30	4.0	10.5	42	1.8	76	0.9
Regional Enterprise		1	Bomen	RE31	11.0	10.5	116	1.8	208	2.4
Regional Enterprise		1	Bomen	RE32	20.7	10.5	218	1.8	392	4.5
Regional Enterprise		3	Bomen	RE9	7.9	10.5	83	1.8	149	1.7
Regional Enterprise		2	Bomen	RE10	25.5	10.5	268	1.8	482	5.6
Regional Enterprise		2	Bomen	RE11	14.4	10.5	151	1.8	271	3.1
Industrial Livestock		1	Bomen	IL1	22.8	21	478	1.8	861	10.0
	Sub-total				213.7		2,483		4,469	52
Regional Enterprise		3	Brucedale	RE1	35.6	10.5	374	1.8	674	7.8
Regional Enterprise		3	Brucedale	RE2	18.6	10.5	195	1.8	351	4.1
Regional Enterprise		3	Brucedale	RE3	20.9	10.5	220	1.8	396	4.6
Rail Terminal		3	Brucedale	RT1	52.5	0.25	13	1.8	24	0.3
	Sub-total				127.6		802		1,443.9	16.7
Regional Enterprise		3	East Bomen	RE4	36.2	10.5	380	1.8	684	7.9
Regional Enterprise		3	East Bomen	RE5	16.2	10.5	171	1.8	307	3.6
Regional Enterprise		3	East Bomen	RE6	21.3	10.5	224	1.8	403	4.7
Regional Enterprise		3	East Bomen	RE7	26.3	10.5	276	1.8	497	5.7
Regional Enterprise		3	East Bomen	RE8	8.2	10.5	23	1.8	41	0.5
Regional Enterprise		2	East Bomen	RE15	4.9	10.5	51	1.8	93	1.1
Regional Enterprise		1	East Bomen	RE16	3.7	10.5	39	1.8	70	0.8
Regional Enterprise		1	East Bomen	RE17	21.2	10.5	222	1.8	400	4.6
Regional Enterprise		1	East Bomen	RE18	5.7	10.5	60	1.8	108	1.3
Regional Enterprise		1	East Bomen	RE19	22.5	10.5	237	1.8	426	4.9
Regional Enterprise		1	East Bomen	RE20	34.9	10.5	366	1.8	659	7.6
Regional Enterprise		1	East Bomen	RE21	4.7	10.5	49	1.8	88	1.0
Regional Enterprise		1	East Bomen	RE22	6.1	10.5	64	1.8	116	1.3
Regional Enterprise		1	East Bomen	RE23	8.0	10.5	84	1.8	150	1.7
Regional Enterprise		1	East Bomen	RE24	28.9	10.5	303	1.8	546	6.3
Regional Enterprise		1	East Bomen	RE25	6.6	10.5	70	1.8	125	1.5
Regional Enterprise		1	East Bomen	RE26	6.6	10.5	69	1.8	124	1.4
Regional Enterprise		1	East Bomen	RE33	12.2	10.5	128	1.8	231	2.7
Regional Enterprise		1	East Bomen	RE34	38.0	10.5	399	1.8	718	8.3
Regional Enterprise		1	East Bomen	RE35	42.3	10.5	445	1.8	800	9.3
Regional Enterprise		1	East Bomen	RE36	4.4	10.5	47	1.8	84	1.0
Regional Enterprise		1	East Bomen	RE37	24.2	10.5	254	1.8	457	5.3
Regional Enterprise		1	East Bomen	RE38	23.5	10.5	246	1.8	443	5.1
Regional Enterprise		1	East Bomen	RE39	32.9	10.5	345	1.8	621	7.2
Industrial Livestock		1	East Bomen	IL2	19.7	21	413	1.8	743	8.6
Industrial Livestock		1	East Bomen	IL3	9.0	21	190	1.8	342	4.0
Industrial Livestock		1	East Bomen	IL4	8.9	21	186	1.8	335	3.9
Regional Enterprise		1	East Bomen	RE40	2.1	10.5	22	1.8	40	0.5
Regional Enterprise		1	East Bomen	RE41	1.3	10.5	14	1.8	24	0.3
Solar Farm		1	East Bomen	SL1	25.6	0.25	6	1.8	12	0.1
Solar Farm		1	East Bomen	SL2	96.3	0.25	24	1.8	43	0.5
Solar Farm		1	East Bomen	SL3	111.1	0.25	28	1.8	50	0.6
Solar Farm		1	East Bomen	SL4	122.0	0.25	30	1.8	55	0.6
Solar Farm		1	East Bomen	SL5	105.8	0.25	26	1.8	48	0.6
Solar Farm		1	East Bomen	SL6	39.3	0.25	10	1.8	18	0.2
Regional Enterprise _ Existing		1	East Bomen	RE_EX_1	16.7	10.5	175	1.8	316	3.7
Regional Enterprise _ Existing		1	East Bomen	RE_EX_2	30.1	10.5	316	1.8	569	6.6
Regional Enterprise _ Existing		1	East Bomen	RE_EX_3	28.5	10.5	300	1.8	539	6.2
Regional Enterprise _ Existing		1	East Bomen	RE_EX_4	5.2	10.5	55	1.8	99	1.1
Regional Enterprise _ Existing		1	East Bomen	RE_EX_5	8.3	10.5	87	1.8	156	1.8
Regional Enterprise _ Existing		1	East Bomen	RE_EX_6	3.3	10.5	35	1.8	63	0.7
Regional Enterprise _ Existing		1	East Bomen	RE_EX_7	3.8	10.5	40	1.8	72	0.8
Regional Enterprise _ Existing		1	East Bomen	RE_EX_8	29.5	10.5	310	1.8	557	6.4
Regional Enterprise _ Existing		1	East Bomen	RE_EX_9	3.1	10.5	33	1.8	59	0.7
Regional Enterprise _ Existing		1	East Bomen	RE_EX_10	7.5	10.5	79	1.8	142	1.6
Regional Enterprise _ Existing		1	East Bomen	RE_EX_11	1.4	10.5	15	1.8	26	0.3
Regional Enterprise _ Existing		1	East Bomen	RE_EX_12	0.5	10.5	5	1.8	10	0.1
Regional Enterprise _ Existing		1	East Bomen	RE_EX_13	5.5	10.5	58	1.8	104	1.2
Regional Enterprise _ Existing		1	East Bomen	RE_EX_14	3.3	10.5	34	1.8	62	0.7
Regional Enterprise _ Existing		1	East Bomen	RE_EX_15	2.6	10.5	28	1.8	50	0.6
Regional Enterprise _ Existing		1	East Bomen	RE_EX_16	2.6	10.5	27	1.8	49	0.6
Regional Enterprise _ Existing		1	East Bomen	RE_EX_17	5.0	10.5	53	1.8	95	1.1
Rail Terminal		3	East Bomen	RT2	19.6	0.25	5	1.8	9	0.1
Rail Terminal		1	East Bomen	RT3	20.1	0.25	5	1.8	9	0.1
Rail Terminal		1	East Bomen	RT4	24.0	0.25	6	1.8	11	0.1
Rail Terminal		1	East Bomen	RT5	6.5	0.25	2	1.8	3	0.0
Rail Terminal		1	East Bomen	RT6	4.8	0.25	1	1.8	2	0.0
Rail Terminal		1	East Bomen	RT7	5.6	0.25	1	1.8	3	0.0
Rail Terminal		1	East Bomen	RT8	6.1	0.25	2	1.8	3	0.0
Rail Terminal		1	East Bomen	RT9	5.8	0.25	1	1.8	3	0.0
Rail Terminal		1	East Bomen	RT10	7.0	0.25	2	1.8	3	0.0
Rail Terminal		1	East Bomen	RT11	10.5	0.25	3	1.8	5	0.1
Rail Terminal		1	East Bomen	RT12	39.0	0.25	10	1.8	18	0.2
	Sub-total				1,286.4		7,188		12,938	150
	TOTAL				**1,628**		**10,472**		**18,850**	**218**

Standards Used:

NSW Water Directorate Section 64 Determination of ET Guidelines Standard ET

RWCC standard parameter of 3.8kL/d perET

INFRASTRUCTURE SERVICING ASSUMPTIONS AND COMMENTS

The following basis has been used for conceptual sizing of infrastructure. Wherever possible this has incorporated the requirements of the relevant service authorities. In some cases, due to limited available information and time for development of a project specific design basis, other sources and/or general assumptions based on other Australian guidelines and authorities have been adopted.

RESERVOIR SIZING

— Sized based on RWCC formula (O+E+F). Operating and emergency storage considers a typical non-residential diurnal pattern (with peak of 1.5 spread generally over business hours)

— Bomen zone sizing is for the SAP demand component only from this zone (not the throughflow to other zones)

Table A1. Example reservoir sizing calculation

Example Reservoir	
14	PD Demand (ML)
3.17	Operating Storage (ML)
6.85	Emergency Storage (ML)
0.216	Fire Storage (ML)
10.2	Reservoir Capacity (ML)

PUMP STATION SIZING

— Sized to equal Peak Day Demand (i.e. over 24hours)

— Pump head based hydraulic model

WATER MAIN SIZING

— Sized based on hydraulic modelling analysis considering minimum pressure 20m and maximum peak hour headloss gradient 5m/km

— Fire flows to commercial/industrial land assumed to be 15L/s during 2/3 x Peak Hour demand. On this basis, water main sizing is not driven by fire flows (i.e. peak hour performance is the critical scenario)

SEWERAGE PUMP STATION SIZING

— SPS sizing based on local catchment PWWF plus upstream (pumped catchment) PWWF. This approach assumes no buffering of peak flows at the BISTF (or upstream SPS)

RISING MAIN SIZING

— Rising main sizing based on velocity at SPS design flowrate. 2.5m/s maximum allowable, 1-1.5m/s desirable

GRAVITY SEWER GRADE AND CAPACITY

— Capacity (pipe full) determined for a range of potential grades using WSA02 Sewer Pipe Sizing Calculator with standard parameters (as per table below)

— This range has been used as a guide for indicative pipe sizing (in conjunction with calculated PWWF and site topography). Actual gravity sewer size may differ subject to design alignment, actual grade, location of loading, etc

Table A2. Summary of capacity range used for indicative gravity sewer sizing

Diameter	Assumed minimum grade	Full pipe capacity at min grade (L/s)	Full pipe capacity at 1% grade (L/s)	Minimum grade comment/basis
DN225	0.33%	26	46	WSA02 standard min grade
DN300	0.25%	49	98	WSA02 standard min grade
DN375	0.25%	88	177	Assumed min grade - subject to water authority requirements
DN450	0.25%	143	287	Assumed min grade - subject to water authority requirements
DN600	0.25%	306	614	Assumed min grade - subject to water authority requirements

Stage	1

% of built area avail	Area require/MW	Annual Generation (kWh/MW)
75%	8000	1520000

Stage	1	2	3
Low Amenities	41%	41%	41%
Medium Amenities	25%	25%	25%
High Amenities	33%	33%	33%

Stage
1
2
3

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	%Portion of land area assigned to each sub land use	Land Use Area for subland use (ha)	Land Use Area (m2)	Ratio of Built Area to Land Use Area (m2)	Built Area Estimate (m2)	Area Available for PV (m2)	PV Array Size (MW)	PV Annual Generation (kWh/yr)	PV Annual Generation (MWh/Yr)	Energy Intensity (Building) (kWh/m2/yr)/ Built Area	Energy Consumption Estimates for Built Area (kWh/yr)	Energy Consumption Estimates (MWh/yr)	Assumed no. of hours in operation (Hrs/Yr)	Remarks	Power Factor	Average Load Demand Estimates (MVA)
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan					Assumed Built Area Roof available for PV	8000SqMtr/MW							Assumed number of hours based on the BCA 2016 occupancy and operation profiles of the class of building below		
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	483	41%	199	1,987,532	30%	596,259	447,195	55.90	84,966,976	84,966.98	151	89,886,117	89,886.12	2,860	Class 7	0.9	34.9
	MAI1	Medium Amenity Industry		25%	123	1,225,103	30%	367,531	275,648	34.46	52,373,154	52,373.15	173	63,729,859	63,729.86	2,860	Class 8	0.9	24.8
	HAI1	High Amenity Industry		33%	161	1,613,964	30%	484,189	363,142	45.39	68,996,980	68,996.98	172	83,215,651	83,215.65	6,188	Class 6,7,9a	0.9	14.9
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	106	45%	47.7	477,000	6%	28,620	21,465	2.68	4,078,350	4,078.35	1100	31,482,000	31,482.00	2,860	Class 8	0.9	12.2
	ILA2	_Biosolids Treatment facility (e.g. related to Intensive livestock agriculture) _Depot Facility		55%	58.3	583,000	17%	99,110	74,333	9.29	14,123,175	14,123.18	660	65,412,600	65,412.60	2,860	Class 8	0.9	25.4
Rail Terminal	RT/FT		149	100%	149	1,490,000	6%	89,400	67,050	8.38	12,739,500	12,739.50	62	5,551,740	5,551.74	2,860	Class 8	0.9	2.2

Total PV Array Size (AC) 129.01

	Total Average Load Demand	**114.4**
Distribution Network	Available D/S Capacity	44.5
	Distribution Substation Requires (SAP)	**69.9**
Transmission Netwrok	Available T/S Capacity at Wagga North S/S (132/66kV)	**60.0**
	Additional Capacity to be accomodated Wagga North S/S (132/66kV)	54.4
	Transmission S/S additional capacity requires (with 1.1 as factory of safety) Wagga North S/S (132/	**59.9**
	Transmission line	Wagga North to D/S 66kV

Notes:

Note: 8000 Sqmtr/MW area of the roofs are considered for roof top solar PV installation (to be confirm with Miranda/Ellie to be consistent with Parkes Assumption)

Note: POA iradiance=2093.8kWh/sqmtr/annum, Estimated Energy 1520 MWh/MW/Annum (Tilt=20Degree, East-West Orientation)

Note: Estimated Energy for existing solar farm is 2099MWh/MW/Annum (SAT)

References:

Freight Terminal:Land Use Rato: WSP projects: Lion and Rhino Rack, Ceva and Toll sitesEnergy Demand: Moorebank Intermodal

Regional Enterprise: Jensen Plus Report: Structure Plan Preliminaries Report   Updated 3 scenarios for technical testing

Regional Enterprise (Distribution): Big W + Coles

Regional Enterprise (adv manufacturing): Inghams Enterprises + No.1 1 to No.6 Edinburgh SA

Regional Enterprise (mining, hazardous waste): WSP Project, Lion

Regional Enterprise (customs house, small enterprise/office): WSP Project, Lion

Intensive Livestock Agriculture: Jensen Plus Report: Structure Plan Preliminaries Report   Updated 3 scenarios for technical testing

Protected Cropping: Simplot Feeds

Stage	2

% of built area availa	Area require/MW	Annual Generation (kWh/MW)
75%	8000	1520000

Stage	1	2	3
Low Amenities	41%	41%	41%
Medium Amenities	25%	25%	25%
High Amenities	33%	33%	33%

Stage
1
2
3

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Land Use Area for subland use (ha)	Land Use Area (m2)	Ratio of Built Area to Land Use Area (m2)	Built Area Estimate (m2)	Area Available for PV (m2)	PV Array Size (MW)	PV Annual Generation (kWh/yr)	PV Annual Generation (MWh/Yr)	Energy Intensity (Building) (kWh/m2/yr)/ Built Area	Energy Consumption Estimates for Built Area (kWh/yr)	Energy Consumption Estimates (MWh/yr)	Assumed no. of hours in operation (Hrs/Yr)	Remarks	Power Factor	Average Load Demand Estimates (MVA)
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan					Assumed Built Area Roof available for PV	8000SqMtr/ MW							Assumed number of hours based on the BCA 2016 occupancy and operation profiles of the class of building below		
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	595	41%	245	2,450,333	30%	735,100	551,325	68.92	104,751,741	104,751.74	151	110,816,315	110,816.32	2,860	Class 7	0.9	43.1
	MAI1	Medium Amenity Industry		25%	151	1,510,371	30%	453,111	339,834	42.48	64,568,369	64,568.37	173	78,569,510	78,569.51	2,860	Class 8	0.9	30.5
	HAI1	High Amenity Industry		33%	199	1,989,780	30%	596,934	447,700	55.96	85,063,093	85,063.09	172	102,592,615	102,592.62	6,188	Class 6,7,9a	0.9	18.4
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	106	45%	47.7	477,000	6%	28,620	21,465	2.68	4,078,350	4,078.35	1100	31,482,000	31,482.00	2,860	Class 8	0.9	12.2
	ILA2	_Biosolids Treatment facility (e.g. related to Intensive livestock agriculture) Depot Facility		55%	58.3	583,000	17%	99,110	74,333	9.29	14,123,175	14,123.18	660	65,412,600	65,412.60	2,860	Class 8	0.9	25.4
Rail Terminal	RT/FT		149	100%	149	1,490,000	6%	89,400	67,050	8.38	12,739,500	12,739.50	62	5,551,740	5,551.74	2,860	Class 8	0.9	2.2
									Total PV Array Size (AC)	155.13								**Total Average Load Demand**	**131.8**
																		Capacity increase from Stage 1	**17.4**

Additional upgrade from stage 1	**calculated**
Transformers to cater for (SAP)	17.4
Transformer capacity required at Wagga Nor	19.1

Notes:
Note: 8000 Sqmtr/MW area of the roofs are considered for roof top solar PV installation (to be confirm with Miranda/Ellie to be consistent with Parkes Assumption)
Note: POA iradiance=2093.8kWh/sqmtr/annum, Estimated Energy 1520 MWh/MW/Annum (Tilt=20Degree, East-West Orientation)
Note: Estimated Energy for existing solar farm is 2099MWh/MW/Annum (SAT)

References:
Freight Terminal:Land Use Rato: WSP projects: Lion and Rhino Rack, Ceva and Toll sitesEnergy Demand: Moorebank Intermodal
Regional Enterprise: Jensen Plus Report: Structure Plan Preliminaries Report _ Updated 3 scenarios for technical testing
Regional Enterprise (Distribution): Big W + Coles
Regional Enterprise (adv manufacturing): Inghams Enterprises + No.1 1 to No.6 Edinburgh SA
Regional Enterprise (mining, hazardous waste): WSP Project, Lion
Regional Enterprise (customs house, small enterprise/office): WSP Project, Lion
Intensive Livestock Agriculture: Jensen Plus Report: Structure Plan Preliminaries Report _ Updated 3 scenarios for technical testing
Protected Cropping: Simplot Feeds

Stage	3

% of built area availa	Area require/MW	Annual Generation (kWh/MW)
75%	8000	1520000

Stage	1	2	3
Low Amenities	41%	41%	41%
Medium Amenities	25%	25%	25%
High Amenities	33%	33%	33%

Stage
1
2
3

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Land Use Area for subland use (ha)	Land Use Area (m2)	Ratio of Built Area to Land Use Area (m2)	Built Area Estimate (m2)	Area Available for PV (m2)	PV Array Size (MW)	PV Annual Generation (kWh/yr)	PV Annual Generation (MWh/Yr)	Energy Intensity (Building) (kWh/m2/yr)/ Built Area	Energy Consumption Estimates for Built Area (kWh/yr)	Energy Consumption Estimates (MWh/yr)	Assumed no. of hours in operation (Hrs/Yr)	Remarks	Power Factor	Average Load Demand Estimates (MVA)
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan					Assumed Built Area Roof available for PV	8000SqMtr/ MW							Assumed number of hours based on the BCA 2016 occupancy and operation profiles of the class of building below		
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	800	41%	329	3,294,488	30%	988,347	741,260	92.66	140,839,377	140,839.38	151	148,993,236	148,993.24	2,860	Class 7	0.9	57.9
	MAI1	Medium Amenity Industry		25%	203	2,030,704	30%	609,211	456,908	57.11	86,812,580	86,812.58	173	105,637,202	105,637.20	2,860	Class 8	0.9	41.0
	HAI1	High Amenity Industry		33%	268	2,675,272	30%	802,582	601,936	75.24	114,367,866	114,367.87	172	137,936,420	137,936.42	6,188	Class 6,7,9a	0.9	24.8
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	106	45%	47.7	477,000	6%	28,620	21,465	2.68	4,078,350	4,078.35	1100	31,482,000	31,482.00	2,860	Class 8	0.9	12.2
	ILA2	_Biosolids Treatment facility (e.g. related to Intensive livestock agriculture) Depot Facility		55%	58.3	583,000	17%	99,110	74,333	9.29	14,123,175	14,123.18	660	65,412,600	65,412.60	2,860	Class 8	0.9	25.4
Rail Terminal	RT/FT		179	100%	179	1,790,000	6%	107,400	80,550	10.07	15,304,500	15,304.50	62	6,669,540	6,669.54	2,860	Class 8	0.9	2.6
									Total PV Array Size (AC)	204.18								Total Average Load Demand	163.9
																		Capacity increase from Stage 2	32.1

Additional upgrade from stage 2	**calculated**
Transformers to cater for (SAP)	32.1
Transformer at Wagga North	35.3

Notes:

Note: 8000 Sqmtr/MW area of the roofs are considered for roof top solar PV installation (to be confirm with Miranda/Ellie to be consistent with Parkes Assumption)

Note: POA iradiance=2093.8kWh/sqmtr/annum, Estimated Energy 1520 MWh/MW/Annum (Tilt=20Degree, East-West Orientation)

Note: Estimated Energy for existing solar farm is 2099MWh/MW/Annum (SAT)

References:

Freight Terminal:Land Use Rato: WSP projects: Lion and Rhino Rack, Ceva and Toll sitesEnergy Demand: Moorebank Intermodal

Regional Enterprise: Jensen Plus Report: Structure Plan Preliminaries Report _ Updated 3 scenarios for technical testing

Regional Enterprise (Distribution): Big W + Coles

Regional Enterprise (adv manufacturing): Inghams Enterprises + No.1 1 to No.6 Edinburgh SA

Regional Enterprise (mining, hazardous waste): WSP Project, Lion

Regional Enterprise (customs house, small enterprise/office): WSP Project, Lion

Intensive Livestock Agriculture: Jensen Plus Report: Structure Plan Preliminaries Report _ Updated 3 scenarios for technical testing

Protected Cropping: Simplot Feeds

Stage	1

Stage	1	2	3
Low Amenities	41%	41%	41%
Medium Amenities	25%	25%	25%
High Amenities	33%	33%	33%

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Ratio of Built Area to Land Use Area (m2) - Max 30% per .3.A Concept Scenario Options (incorporating Short EbD Workshop Summary)	Land Use Area for subland use (ha)	Land Use Area (m2)	GAS DEMAND (GJ/m2/annum)	GAS DEMAND (GJ/day/annum)	GAS DEMAND for Built Area, (GJ/day)	GAS DEMAND for Built Area, (TJ/day)
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan							
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	489	41%	30%	60	603,672	2.0535	0.00562613	3,396.33	3.40
	MAI1	Medium Amenity Industry		25%	30%	37	372,100	1.4598	0.00399954	1,488.23	1.49
	HAI1	High Amenity Industry		33%	30%	49	490,208	0.8510	0.00233154	1,142.94	1.14
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	106	45%	30%	14.31	143,100	8.0000	0.02191781	3,136.44	3.14
	ILA2	Livestock Management Facility (Stockyards)		55%	30%	17.4	174,000	-	-	-	-
Rail Terminal	RT/FT		149	100%	30%	44.7	447,000	Nil	Nil	Nil	Nil

Stage	2

Stage	1	2	3
Low Amenities	41%	41%	41%
Medium Amenities	25%	25%	25%
High Amenities	33%	33%	33%

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Ratio of Built Area to Land Use Area (m2) - Max 30% per .3.A Concept Scenario Options (incorporating Short EbD Workshop Summary)	Land Use Area for subland use (ha)	Land Use Area (m2)	GAS DEMAND (GJ/m2/annum)	GAS DEMAND (GJ/day/annum)	GAS DEMAND for Built Area, (GJ/day)	GAS DEMAND for Built Area, (TJ/day)
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan							
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	111	41%	30%	14	137,655	2.0535	0.00562613	774.46	0.77
	MAI1	Medium Amenity Industry		25%	30%	8	84,849	1.4598	0.00399954	339.36	0.34
	HAI1	High Amenity Industry		33%	30%	11	111,782	0.8510	0.00233154	260.62	0.26
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	0	45%	30%	0	-	8.0000	0.02191781	-	-
	ILA2	Livestock Management Facility (Stockyards)		55%	30%	0	-	-	-	-	-
Rail Terminal	RT/FT		0	100%	30%	0	-	Nil	Nil	Nil	Nil

Stage	3

Stage	1	2	3
Low Amenities	41%	41%	41%
Medium Amenities	25%	25%	25%
High Amenities	33%	33%	33%

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Ratio of Built Area to Land Use Area (m2) - Max 30% per .3.A Concept Scenario Options (incorporating Short EbD Workshop Summary)	Land Use Area for subland use (ha)	Land Use Area (m2)	GAS DEMAND (GJ/m2/annum)	GAS DEMAND (GJ/day/annum)	GAS DEMAND for Built Area, (GJ/day)	GAS DEMAND for Built Area, (TJ/day)
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan							
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	189	41%	30%	23	233,481	2.0535	0.00562613	1,313.59	1.31
	MAI1	Medium Amenity Industry		25%	30%	14	143,916	1.4598	0.00399954	575.60	0.58
	HAI1	High Amenity Industry		33%	30%	19	189,597	0.8510	0.00233154	442.05	0.44
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	0	45%	30%	0	-	8.0000	0.02191781	-	-
	ILA2	Livestock Management Facility (Stockyards)		55%	30%	0	-	-	-	-	-
Rail Terminal	RT/FT		30	100%	30%	9	90,000	Nil	Nil	Nil	Nil

Stage	1

Stage	1			2	3
Low Amenities	41%			41%	41%
Medium Amenities	25%			25%	25%
High Amenities	33%			33%	33%

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Ratio of Built Area to Land Use Area (m2) - Max 30% per .3.A Concept Scenario Options (incorporating Short EbD Workshop Summary)	Land Use Area for subland use (ha)	Land Use Area (m2)	Waste Generated,	Waste Generated			Waste Generated for Built Area,Tonnes/Year	
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan					Factor 1	Factor 2			
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	628	41%	30%	78	775,280	581 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	1,950.09	
	MAI1	Medium Amenity Industry		25%	30%	48	477,878	582 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	1,202.03	
	HAI1	High Amenity Industry		33%	30%	63	629,562	583 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	1,583.56	
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	106	45%	30%	14.31	143,100	664 kg per capita non core organic waste 43 kg / ha Assume 235 sqm/capita	2.82553191	0.04300000	kg/sqm/year	410.49	939.61
	ILA2	Livestock Management Facility (Stockyards)		55%	30%	17.4	174,000					499.12	
Commercial	HA1		10.08659906	100%	30%	3.025979717	30,260	Assume 50L/100 sqm per day at 500Kg/m3 density		0.09125	Tonnes/Yr/sq.m	2,761.21	

Stage	Waste Generated Tonnes/Year
1	8437
2	1350
3	2854
Total	**12641**

Stage	2

Stage	1			2	3
Low Amenities	41%			41%	41%
Medium Amenities	25%			25%	25%
High Amenities	33%			33%	33%

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Ratio of Built Area to Land Use Area (m2) - Max 30% per .3.A Concept Scenario Options (incorporating Short EbD Workshop Summary)	Land Use Area for subland use (ha)	Land Use Area (m2)	Waste Generated,	Waste Generated			Waste Generated for Built Area,Tonnes/Year	
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan					Factor 1	Factor 2			
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	110	41%	30%	14	135,438	581 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	340.67	
	MAI1	Medium Amenity Industry		25%	30%	8	83,483	582 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	209.99	
	HAI1	High Amenity Industry		33%	30%	11	109,982	583 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	276.64	
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	0	45%	30%	0	-	664 kg per capita non core organic waste 43 kg / ha Assume 235 sqm/capita	2.82553191	0.04300000	kg/sqm/year	-	30.00
	ILA2	Livestock Management Facility (Stockyards)		55%	30%	0	-					-	
Commercial	HA1		1.794285203	100%	30%	0.538285561	5,383	Assume 50L/100 sqm per day at 500Kg/m3 density		0.09125	Tonnes/Yr/sq.m	491.19	

Stage	Waste Generated Tonnes/Year
1	8437
2	1350
3	2854
Total	**12641**

Stage	3

Stage	1			2	3
Low Amenities	41%			41%	41%
Medium Amenities	25%			25%	25%
High Amenities	33%			33%	33%

Wagga Wagga SAP PV Calculator - Distributed Generation			Total land Area (ha)	% Portion of land area assigned to each sub land use	Ratio of Built Area to Land Use Area (m2) - Max 30% per .3.A Concept Scenario Options (incorporating Short EbD Workshop Summary)	Land Use Area for subland use (ha)	Land Use Area (m2)	Waste Generated,	Waste Generated			Waste Generated for Built Area,Tonnes/Year	
Land Uses as described in Prelim Report				Assumption based on Final Structure Plan					Factor 1	Factor 2			
Regional Enterprise (New+Existing)	LAI1	Low Amenity Industry	215	41%	30%	27	265,106	581 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	666.83	
	MAI1	Medium Amenity Industry		25%	30%	16	163,410	582 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	411.03	
	HAI1	High Amenity Industry		33%	30%	22	215,278	583 KG/Capita/Year 43 Kg/ha/year Assume 235 sqm/capita	2.47234043	0.04300000	kg/sqm/year	541.50	
Intensive Livestock Agriculture SubPrecinct	ILA1	Livestock Processing Industry (e.g. abattoirs, knackeries, tanneries, woolscours, and rendering plants)	0	45%	30%	0	-	664 kg per capita non core organic waste 43 kg / ha Assume 235 sqm/capita	2.82553191	0.04300000	kg/sqm/year	-	30.00
	ILA2	Livestock Management Facility (Stockyards)		55%	30%	0	-					-	
Commercial	HA1		4.399979435	100%	30%	1.319993831	13,200	Assume 50L/100 sqm per day at 500Kg/m3 density		0.09125	Tonnes/Yr/sq.m	1,204.49	

Stage	Waste Generated Tonnes/Year
1	8437
2	1350
3	2854
Total	**12641**

ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With 43,600 talented people in more than 550 offices across 40 countries, we engineer projects that will help societies grow for lifetimes to come.