Jemena Gas Networks (NSW) Ltd

NETWORK PRESSURE MANAGEMENT PLAN

AA2025-30

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1. EXECUTIVE SUMMARY

1.1 OVERVIEW

The purpose of this Network Pressure Management Plan is to set out the expected infrastructure requirements to support customers and new connections over the 2025 to 2030 period. Specifically, the deeper assets that need to be installed such as new mains, regulators etc.[1]

The gas network is still growing with 112,000 new customers forecast over the next five-year period and with this we must ensure the network continues to provide a safe and reliable service to our customer base.

This outlook is based on the best information available, including projections from the NSW Government Department of Climate Change, Energy, the Environment and Water (DCCEEW), developers and local councils.

This document forms part of the 2025 Access Arrangement submission which sets out Jemena Gas Network's (JGN) proposed capacity augmentation plan for managing its NSW natural gas network from 1 July 2025 to 30 June 2030. It explains the activities and costs involved in delivering the safe and reliable gas supply that NSW households and businesses expect.

To develop our 2025 Capacity Augmentation Plan, we have:

- Considered and validated the safety and service levels our customers expect us to provide;
- Forecast the efficient level of costs required over this period to meet these safety and service levels;
- Ensured the benefit of adding new customers to the network outweighs the augmentation cost to ensure an affordable gas service.

1.2 FUTURE INFRASTRUCTURE

Capacity Augmentation expenditure covers augmentation and other works, generally deeper into the network, required to support an increase in gas demand. It does not include "connection costs" (mains, services and meters for an individual connection). **Table 1** below lists the planned Capacity Augmentation Projects for the 2025-2030 period.

[1] This plan does not include the cost of mains, services and meters required for each individual connection. These costs are covered by our connections program.

Table 1: Summary of planned projects

Planned projects cost estimate (million real $2023)								
Project name	**Project ID**	**RY25**	**RY26**	**RY27**	**RY28**	**RY29**	**RY30**	**Total**
Edmondson Park Soldiers Pde steel main	10057750	0.33	1.59	-	-	-	-	1.92
Auburn CDP	10065576	-	0.28	0.62	-	-	-	0.90
North Sydney CDP	10068856	-	-	-	-	0.39	1.14	1.53
Box Hill CDP	10068428	1.37	1.43	-	-	-	-	2.96
Woolwich Low Pressure CDP	10054437	-	-	-	0.41	0.32	-	0.73
Bayview Low Pressure CDP	10054436	-	-	-	0.08	0.11	-	0.19
Gymea Bay 210 KPA CDP	10000024	-	-	0.58	0.36	-	-	0.94
Campsie (Sydney South)	13033949	0.35	1.06	0.01				1.42
Umina Beach Low Pressure CDP	10068848	-	-	0.77	-	-	-	0.77
Goulburn 7kPa CDP	10069030	-	0.12	0.08	-	-	-	0.20
Figtree CDP - Stage 2	10068727	-	-	-	-	0.35	0.23	0.58
Blue Mountains Pressure Reduction Glenbrook-Springwood	10071182	-	0.10	0.44	-	-	-	0.54
Winter Gauging 5 Year Device Replacement	AA_GEA_3				0.78			0.78
Total		2.05	4.58	2.5	1.63	1.17	1.37	13.46

2. KEY CONSIDERATIONS

To develop and evaluate our Network Pressure Management Plan, we took into account many key considerations that were critical to ensuring an optimised program that is in the best interests of our customers. Over the last few years, several factors have impacted the management of our gas network. These include; the renewable energy transition, alignment to national gas rules, COVID-19 impacts, network customer growth and emissions reduction. Below, we describe how we considered these factors and their influence on our program below.

2.1 HOW THE UNCERTAIN FUTURE OF GAS AFFECTS OUR PLANNING TODAY

We plan and design the capacity augmentation infrastructure underpinning our network by looking forward. This is difficult as the future is not known.

There is a risk we build too little infrastructure requiring more expensive catch-up spend later on. This is particularly the case in greenfield areas where we have an opportunity to build before new suburbs develop. Building in established suburbs is expensive due to higher traffic management and restoration costs – and results in more disruption to our community.

There is a risk in building too much infrastructure. It may end up not being needed or being not quite the right solution. Delaying investments allows us to respond to new information and change our approach. Or, if the demand we forecast doesn’t eventuate, avoid incurring costs.

These risks are higher given the uncertainty of the gas network. It’s not clear how consumers will use energy as we move towards 2050. They may shift away from the gas network to other fuels, change how they use gas or continue to use gas with the availability of alternative gases such as biomethane and renewable hydrogen.

We recognise the uncertainty in the future of gas as Jemena looks to implement our Renewable Gas Strategy and have taken a conservative approach on how we should make these investment decisions. We have only included projects where the probability of impacting service to customers was high or when the revenue exceeds the cost to augment.

2.2 NATIONAL GAS RULES (**NGR**)

The implementation of the Capacity Augmentation Plan complies with the new capital expenditure criteria rules 79(1)(a) and 79(2)(c)(ii) & (iv).

The proposed projects in the plan are consistent with rule 79(1)(a) of the National Gas Rules :

> **Prudent** – Various options were considered to ensure continuity of gas supply to customers. This is consistent with what would be expected of a prudent operator.
>
> **Efficient** – The cost estimates for these projects were developed from actual costs of a similar project that followed the Jemena Procurement Policy.

Consistent with accepted and good industry practice – The proposed augmentation solutions are necessary to maintain asset integrity and compliance.

The proposed projects are also consistent with rule 79(2)(c)(ii) of the National Gas Rules: to maintain the integrity of service – we have only proposed projects that have a high probability of impacting customers if the augmentation was not to go ahead. As well as, maintain its capacity to supply existing services 79(2)(c)(iv) – The additional new developments connecting to the network will reduce the capacity of the existing services to a point where augmentation is required (timing of project), and hence required to maintain supply to its existing customer base.

2.3 FUTURE GAS NETWORK

We have developed our Renewable Gas Strategy that looks to use biomethane and hydrogen to decarbonise the gas network. Two projects funded by Jemena and ARENA have been completed to demonstrate to the market that Renewable Gases in Australia are feasible. These facilities include:

- Jemena Malabar Biomethane injection. In partnership with Sydney Water we have a facility that converts excess biogas into biomethane that can then be injected into our network without other modifications

- Western Sydney Hydrogen Hub. Renewable electricity is used to produced renewable hydrogen. The hydrogen is then injected into our distribution network as varying concentrations to inform how hydrogen can be used to decarbonise our network.

Although commercial injection of biomethane and renewable hydrogen has not been in effect in the Australian gas market, we anticipate that this will be available in the near term. We consider this when assessing our Network Pressure Management Plan and how to best ensure reliability of supply to customers.

2.3.1 HYDROGEN BLENDING

We have received significant interest from hydrogen project developers in injecting into our network. At this stage this typically relates to unfirmed small-scale grid-connect projects which aim to opportunistically blend into the wider gas stream when the electricity wholesale market prices are low.

Introducing hydrogen into existing natural gas networks involves careful consideration of the impact on network pressures. Hydrogen has different physical properties compared to methane, including a lower density, which can affect how it behaves within the pipeline system. As the proportion of hydrogen in the gas mix increases, it can lead to a reduction in the overall energy density of the gas and in turn reductions in network operating pressures.

The impact on pressure will be most pronounced at the extremities of our network. Moving to a blend of 10% by volume could reduce pressures at these locations and require the network to be augmented to maintain supply.

As no hydrogen injection projects are confirmed to go ahead, we have not incorporated this impact into our forecast assessment of pipeline pressures. However, this will require ongoing monitoring and may lead to increased levels of investment to manage pressures and avoid supply interruptions.

2.4 COVID

The COVID-19 pandemic, which led to widespread lockdowns and a surge in remote work, significantly changed gas usage patterns, in particular areas of our network. With more individuals working from home, there was a noticeable increase in peak demand and sustained demand. People who previously relied on workplace heating found themselves needing to keep their own homes warm throughout the day, leading to a higher heating loads.

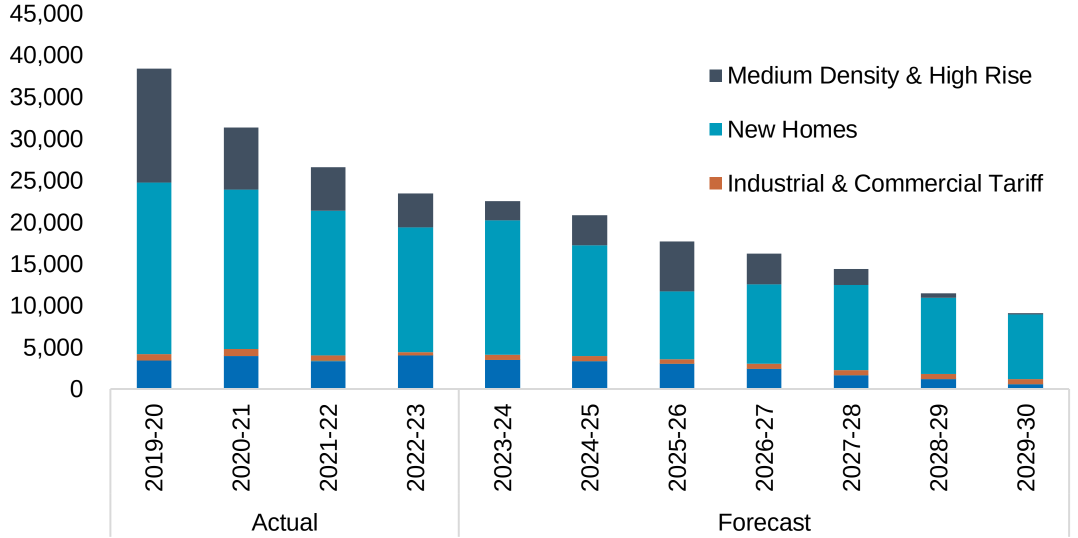
Given the unknown long-term impacts of COVID on peak demand, and the extent to which people will continue to work from home, we have taken a reactive approach and have continued to monitor network pressures in key affected areas. Given the shift towards hybrid work, peak demand will increasingly depend on whether a cold day occurs mid-week (when people tend to be in the office) or on a Monday or Friday when people tend to work from home.

2.5 CONNECTION GROWTH

Although the number of overall new connections in the RY26-RY30 period is lower than the current five-year period, the number of new connections that is forecast is not insignificant with respect to the operation of the gas network. Of the 112,000 new connections forecast:

- 74,000 new homes in new estate type areas. Although the bulk of the infrastructure to support these homes is included as part of the new estate planning, some of these homes will be in areas on the extremity of existing estates and be homes that have been delayed in existing estates. At times, additional infrastructure in the form of mains interconnections or reinforcement is required that was not in the original scope of the new estate plans.
- 16,000 customers in existing areas. The bulk of these new connections in existing areas are supplied through the existing infrastructure. However, where some of these new customers are aggregated on the extremity of a network, those segments of networks may require some additional reinforcement to support these new connections.
- 4,000 I&C customers. The bulk of these new connections in existing areas are supplied through the existing infrastructure. However, as the size of some of these industrial or commercial customers may have not been considered in network plans, or where these new customers are on the extremity of a network, those segments of networks may require some additional reinforcement to support these new connections.
- 18,000 for medium density high-rise of which 17,700 will be individual dwellings and 430 apartment buildings (with a single volume boundary connection). The bulk of these medium density customers will be in the form of 'clusters' close to transport hubs, such as railway stations. Subject to the ability of local infrastructure, as these developments occur, there may be a requirement for additional reinforcement to support these new connections.

Figure 1 Actual and forecast connection numbers



For projects that require augmentation due to a combination of new connections and increased network demand, we have evaluated the cost of augmentation against the revenue generated from connecting these customers. In order to accurately forecast the connection volume and customer mix, where possible, we have sourced the latest forecast data from Council and State government websites, as well as other forecasting tools like *Informed Decisions* demographic resource centre. Where forecasts were limited to only a 5 year period, we used data previously sourced from the Department of Planning.

2.6 NETWORK PRESSURE REDUCTION

We are developing a program in areas where the network pressure can be optimised in order to reduce emissions. The rate of leakage is proportional to the pressure in the mains, and thus a reduction in pressure will lead to a reduction in gas lost through leakage. Some areas have been deemed to have higher than average integrity issues where publicly reported leaks and levels of mains repairs are higher than other parts of the network (i.e. leading to higher emissions). The initial program includes a review of those systems with pressure higher than 210kPa, future phases will review the potential to reduce emissions through pressure management in those network segments with pressures of 210kPa or lower.

In the initial phase, the plan is to reduce those sections of the network where pressure is higher down to 210kPa, through small mains interconnections that will provide for a permanent reduction.

We are expanding this program, with the next phases to include:

- Implementation of minor mains interconnections that will enable season pressure reduction for 300kPa areas (down to 210kPa) i.e. applied seasonal during summer months with pressure re-increased in autumn required to maintain capacity during the winter period.

- Review of 210 kPa areas where pressure can be reduced to manage the level of fugitive emissions. We are in the process of identifying networks that can be reconfigured with minor interconnection to be-able to support the existing network supply with reduced pressure as part of the emission reduction strategy

The Picarro Emissions Program will support this initiative through:

- An initial survey, identifying those areas where the greatest benefit could be achieved;

- Validation surveys quantifying the benefits of the pressure reductions.

Interconnections to augment allocation will be required in order to ensure we can maintain existing level or network supply and reliability to existing customers/network. At this stage of the development of this project, an allocation has been included for this type of augmentation (refer to Minor Capital Works and Allocation – AA RY26-30). As we develop this program, subject to meeting business case requirements, there is the potential for additional projects to be considered.

An example of a recently identified project is the pressure reduction of the Glenbrook-Springwood network where it has been demonstrated that the pressure can be reduced from 300kPa to 210kPa through a series of works costing approximately $540,000, which includes installation of a secondary regulator and mains interconnection.

3. CAPACITY AUGMENTATION

When we review the reliability of our network, we use a framework to assess if and when augmentation is needed to improve the area's capacity and reduce the likelihood of a loss of supply event. To do this, we consider the area's requirements based on existing network configuration, the cost of potential options, and the overall timing for reinforcement.

This review is triggered by a set of capacity planning criteria that identifies areas at high risk of poor or loss of supply. The criteria are based on the overall network pressure, the type of customers in that location, and the peak flow rate.

3.1 REQUIREMENTS

Capacity Augmentation Projects (**CAP**s) arise as part of JGN's capacity planning cycle. Each year the Capacity Planning group assesses the level of utilisation of each sub-network to assess whether there are risks to gas supply. This is achieved by comparing annual gauging and telemetry information with the periodic validation of network models[2]. These models have load growth forecasts (i.e. peak loads as compared to annual loads) applied to them to predict when there is a risk that network pressures will drop, compromising supply to customers.

When a sub-network is reaching the stage where the risk of loss of supply is becoming material, network augmentation options that eliminate this risk are identified and the process of investment decision commences. As a general principle, timing of implementation is scheduled as late as possible, but not too late as to create an unacceptable risk of loss of supply. A structured risk assessment process, balancing considerations of Strategic, Financial, Safety, Operational, Regulatory Compliance and Reputational risk are undertaken in accordance with the Jemena Risk Manual.

There may be cases where CAP projects have additional imperatives, such as improving security of supply, mains rehabilitation or enabling the network pressure to be lowered for emissions benefits, as parallel benefits of a CAP, but growth in peak hour demand and consequent pressure decrement in the network is, generally, the primary driver. The peak demand growth that leads to CAPs, is either driven by demand growth from existing customers or connection of new customers.

The peak demand growth components that lead to CAPs are grouped into three categories :

- **Existing Customer Demand Growth** – This includes an increase in peak demand of existing customers, either as a result of more appliances being added, changing to higher capacity appliances, or household behavioural changes. This could result in increases in peak demand, but potentially involve reductions in annual demand. For instance – where high efficiency, high capacity appliances are installed, such as instantaneous hot water replace existing gas boilers. We have also seen behavioural changes after the covid pandemic where more people are working from home, which has resulted in an increased gas consumption and impacted the capacity in some areas. This is particularly the case for Woolwich, Bayview, Gymea Bay, Figtree, Umina Beach and Goulburn.

- **Medium Density and High Rise Developments** – These new developments are concentrated gas loads with single service connections and require assessment of the network's capacity to supply before proceeding with the connection. However, multiple connections in the same area, impact the capacity of the network such as the areas around developing rail corridors and train. These developments also have a commercial component which adds to the peak demand.

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[2] These network models exist in the Synergi Gas Software package and cannot be replicated in an excel model.

- **New Estate Growth Areas** - These areas are generally greenfield areas that have minimal or no gas infrastructure and require feeder mains and / or regulators to extend the gas network to service the proposed new estate. They require an assessment of the network's capacity to supply before proceeding with these connections.

When a network capacity assessment indicates a current or future constraint, requiring action, the following methodology is used in the development of solutions to identify network pressure risks and the following three variables are considered.

3.1.1 THE CONFIGURATION AND CONDITION OF THE EXISTING NETWORK

The existing network configuration, its topology, geography, location and physical state are critical considerations in the development of options. For example, crossing a river, railway line or major highway can prove to be difficult and costly and alternative routes assessed to minimise these types of crossings.

3.1.2 THE COST EFFECTIVENESS OF POTENTIAL OPTIONS

To ensure cost-effective options are chosen, the capacity assessment process requires the development of alternative options that balance the benefit to the number of customers with the cost of implementation.

3.1.3 THE TIMING OF IMPLEMENTATION

As part of the assessment process, the rule is that the augmentation project will be implemented as late as can be prudently managed, balancing the timing of loss of pressure with the project time to implement the option.

This is driven by the structure of network optimisation modelling, which in turn is driven by :

- Changes in demand as a result of a forecast rate of existing customers, which is derived from an analysis of historic growth in the network, the current rate of applications for new gas connections and recent pressure gauging results; and

- Changes in demand as a result of significant housing (new estates) or other customer developments in the network areas.

The data is entered into the network software[3] and simulations run to model peak network flows. The latest possible year, the year in which gas pressures are shown by modelling to decline significantly below the minimum pressures, is chosen as the year by which the project installation must be completed.

3.2 CAPACITY PLANNING CRITERIA

The following three main drivers are used in the Capacity Augmentation decision making process.

3.2.1 NETWORK PRESSURES

Capacity Augmentation is driven by increases in peak demand that are forecasted to reduce network pressures below critical thresholds. Increases in peak demand can stem from existing customers or new connections. Depending on the type of driver, the investment trigger threshold varies;

[3] Synergi Gas Software

1. **Existing Customer Demand Growth:** We set an investment trigger of 40-50 kPa[4], which aligns with the minimum operating pressure of our network for medium pressure networks (210 kPa). We use an investment trigger range, as it is subject to the extent of the potential poor supply area. This lower threshold is made feasible by our enhanced network visibility, following the upgrade of our monitoring systems from ~60 mechanical gauges to ~300 newer electronic gauges. These improvements allow us to monitor more locations with greater data granularity. Previously, this investment trigger was 70 kPa.

2. **Medium Density and High-Rise Growth**: For medium-pressure networks that are experiencing medium-density and high-rise growth, we also set an investment trigger of 40-50 kPa. This is due to the same enhanced network monitoring and visibility mentioned above. Additionally, these areas typically have a robust infrastructure foundation, making reinforcement solutions and ensuring supply reliability relatively straight forward.

3. **New Estate Growth:** New estate growth often requires substantial infrastructure to support new areas, including small estates or streets that are often built on the perimeter of larger estates and are not integrated into the suburbs master plan. These areas also experience significant growth, with connection volumes increasing by 10-30% per year. Due to this rapid growth, a higher investment threshold of 70 kPa is necessary to ensure reliable supply to customers.

We continually monitor all areas of our network to determine when they are forecasted to reach the minimum pressure threshold. When an area is anticipated to reach this minimum, we invest and reinforce our network to ensure continuous gas supply to our customers. These investment triggers are also continually under review to ensure we are investing at the right time, to balance reliability and affordability.

3.2.2 PEAK FLOW RATE

Capacity is measured as the peak flow rate the network can deliver if a particularly high winter peak demand occurs (forecast to a 1 in 10 probability of occurring). This '1 in 10' assessment is used rather than the annual, average or daily throughput, as it ensures the network is resilient and more likely to withstand cold conditions. Peak hourly flow rates are not recorded in metering equipment, so must be calculated from the available data that is captured.

A diversity factor is applied to the annual gas load to take into consideration the individual / local area peak flow patterns. The use of more efficient gas appliances, individual lifestyle patterns and geographical locations impact the daily and seasonal peak demand requirements, whereas hourly peak flow rates remain linear.

[4] This is only possible on a case-by-case basis depending on the location of our larger customers.

4. THE CURRENT NETWORK

In this section we introduce the networks that fall within the JGN footprint, define their geographical location, prospects for growth and areas of capacity concern. The networks encompass the following areas:

- Sydney North
- Sydney South
- Sydney West
- Wollongong
- Central Coast / Newcastle
- Country, Southern Highlands and Wollondilly

4.1 OVERVIEW

The JGN network has grown through a combination of extensions, new developments and acquisitions. It now provides gas to more than 1.6 million customers in Sydney, Newcastle, Wollongong, Central Coast and over 30 country centres including those within the Southern Highlands, Southern Tablelands, Central Tablelands, Central West and Riverina regions of NSW. Figure 2 below shows the extent of the Jemena NSW gas distribution network coverage.

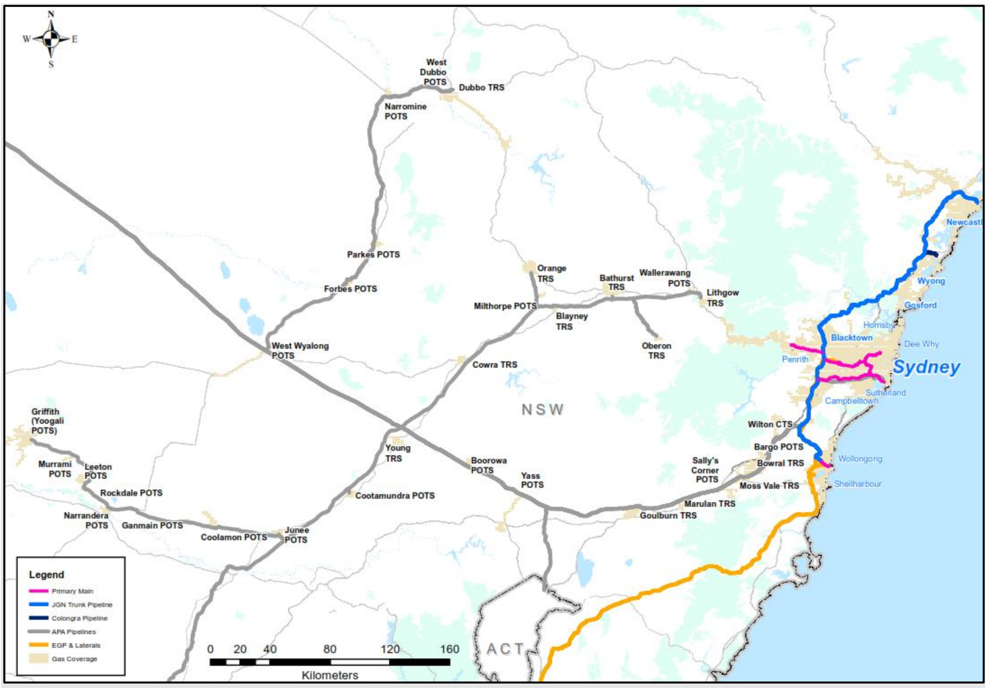


Figure 2: Overview of the Jemena NSW Gas Distribution Network

4.2 CURRENT CONFIGURATION

At present, gas is injected into the JGN Wilton network section (which provides gas to customers across Sydney, Newcastle, Wollongong and the Central Coast) at eight receipt points. Gas is sourced at these receipt points from[5]:

[5] The Western Sydney Hydrogen Hub (**WSGHH**), owned by Jemena is a research and development facility that injects renewable hydrogen into the distribution gas network. The volumes are small and does not contribute to supplying gas to customers on scale.

- the Moomba to Sydney Pipeline (**MSP**), owned by APA Group to JGN's Wilton receipt point;

- the Eastern Gas Pipeline (**EGP**), owned by Jemena to JGN's Albion Park, Port Kembla, Horsley Park and Wilton receipt points;

- the National Gas Storage Facility (**NGSF**), owned by AGL to JGN's Hexham and Tomago receipt points.

- Jemena Malabar Biomethane injection plan, owned by Jemena.

There are separate country receipt points (32 in all) for each of the country centres served by the JGN distribution network. All of those centres are connected to the MSP or Central West Pipeline (**CWP**), both of which are owned by APA Group.

The natural gas from these receipt points are then cascaded down to the relevant Trunk, Primary, Secondary, Medium and Low Pressure network systems. These network systems have a range of Maximum Allowable Operating Pressures (**MAOP**), ranging from 6,895kPa to 2kPa.

Figure 3 illustrates how the pressure steps down from 14,895kPa (Transmission Pipeline) to a minimum of 2kPa (Low Pressure Network) via a series of pressure regulating stations and regulator sets. The customers then receive gas via a meter at the appropriate pressure. Residential and small commercial customers are generally connected to the medium and low pressure mains, whilst larger commercial and industrial customers are connected at secondary pressures.

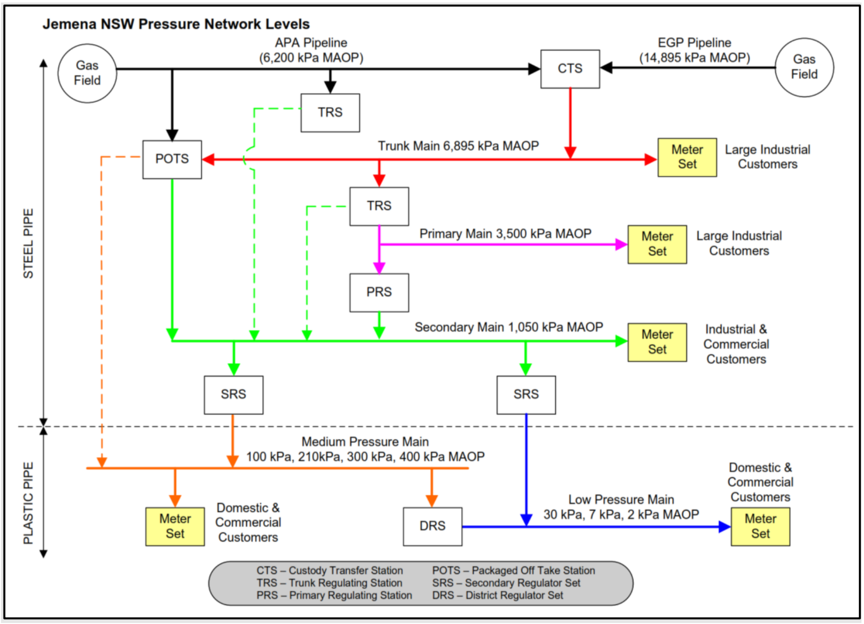


Figure 3: Jemena NSW pressure levels schematic

4.3 JEMENA STANDARD NETWORK OPERATING PRESSURES

The different network systems within JGN operate at various pressures, throughout the day and year, based on the network gas demand at any given time. Hence, the networks operate within these given operating envelopes as shown in Table 2 below. The pressure thresholds are an extract from Jemena's Capacity Specification Design Basis Manual[6].

The minimum operating system pressure for each of the relevant distribution networks are required to safely operate and ensure the downstream supply to the required customers and maintain the MAOP of each upstream network.

The minimum emergency system pressure is used for emergency scenario's for all existing customers connected to the network. We cannot operate below the emergency minimum pressures, as Jemena usually get an influx of poor supply complaints before we reach 15kPa and domestic gas regulators start to choke gas flows.

Table 2: NSW Distribution Operating Pressures

Network System	Jemena NSW Distribution						
	Trunk Network	Primary Networks	Secondary Networks	Medium Pressure Networks	Low Pressure Networks		
Maximum Allowable Operating Pressure (kPa)	6,895	3,500	1,050	400, 300, 210, 100	30	7	2
Minimum Operating System Pressure (kPa)	1,750	1,750	525	40	10	3.5	1.5
Minimum Emergency System Pressure (kPa)	1,500	1,500	400	15	5	2.8	1.4
Standard Metering Pressure (kPa)	Floating*	Floating*, 100kPa	100	35, 5, 2.75	5, 2.75, 1.38	2.75, 1.38	1.38

**Note : Floating pressure effectively means the customer receives the relevant network / pipeline pressure.*

6 Jemena Capacity Specification Design Basis Manual (GDN-1999-SP-DN-001).

4.4 CURRENT NETWORK CAPACITY & GROWTH

4.4.1 SYDNEY NORTH

The Sydney North gas network region lies within the local government areas (**LGAs**) of the Northern Beaches, Ku-ring-gai, Hornsby Shire, Hills Shire, City of Ryde, Hunters Hill, Lane Cove, North Sydney, Mosman, Willoughby and City of Parramatta and represents an area of approximately 550,000 hectares and services approximately 400,000 customers. Error! Reference source not found. shows the extent of the Sydney North r egion.

The Sydney North region is well established, predominantly filled with 210kPa networks with fairly good capacity.

The capacity constraints in the region are in the upstream secondary (1050kPa) and low pressure (7 kPa) network. The upstream secondary constraints are currently being managed through operational means such as; winter and summer regulator set points changes, use of valves to divert flow and additional monitoring of telemetry and gauges The North Sydney low pressure network services many high rise and commercial buildings and has experienced a lot of growth over the last 5 years. Work is needed to ensure continuity of supply and service of the area. The other constraints are in new estate growth areas in Sydney's North West due to greenfield areas with no gas infrastructure and require feeder mains to extend the gas network to the relevant developments such as Rouse Hill, Schofields, Tallawong and Box Hill.

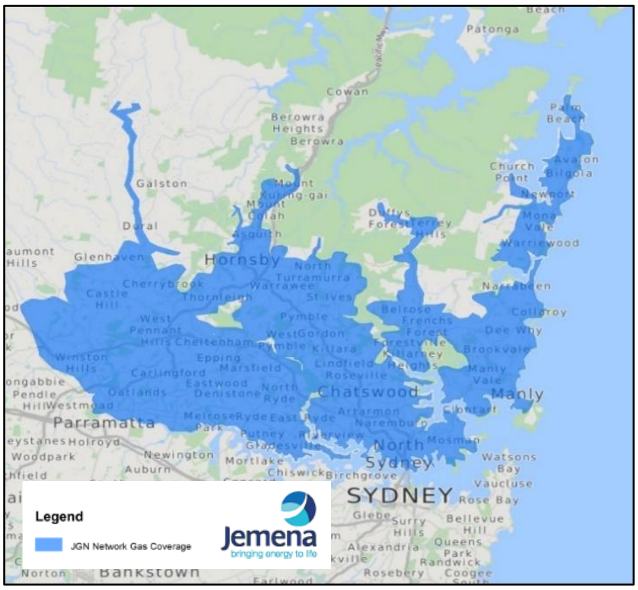
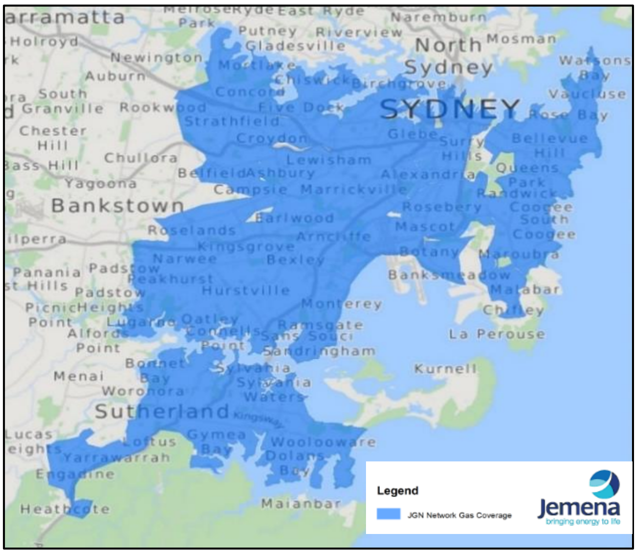


Figure 4: Sydney North Region Gas Network Coverage

4.4.2 SYDNEY SOUTH

The Sydney South gas network region lies within the LGAs of Woollahra, Waverley, Randwick, Burwood, Strathfield, Canada Bay, City of Sydney, Inner West, Bayside, Georges River, Cumberland, Canterbury-Bankstown and Sutherland Shire and represents an area of approximately 410,000 hectares and services approximately 470,000 customers. Error! Reference s ource not found. shows the extent of the Sydney South region.

The Sydney South region is well established with next to no new estate growth but mainly driven by new medium and high density residential developments located throughout the Sydney City area. The region has a large amount of 210kPa networks with fairly good capacity, with the exception of Gymea Bay where recent pressure gauging has indicated a high risk of loss of supply.



The region does have a significant portion of JGN's 7kPa low pressure networks including Strathfield, Campsie, Bankstown, Burwood, Kings Cross and Sydney City and this where the network capacity constraints lie. Although, these networks are nearing capacity reinforcement, we are only forecasting Gymea Bay and Campsie as needing an increase in capacity. These low pressure networks have some of JGN's oldest unrehabilitated mains and is restricted to potential growth, predominantly along the planned rail corridor developments and road upgrades. Any planned medium and high density developments around the Sydney City 7kPa network can be serviced fairly easily due to the nearby secondary (1050kPa) mains which in turn supply the downstream 7kPa network through the abundant amount of regulators.

Figure 5: Sydney South Region Gas Network Coverage

4.4.3 SYDNEY WEST

The Sydney West gas network regions lies within the LGAs of the City of Blacktown, City of Penrith, City of Fairfield, City of Liverpool, City of Campbelltown, Camden, City of Hawkesbury and City of Blue Mountains and represents an area of approximately 850,000 hectares and service approximately 310,000 customers. Error! Reference source not found. shows t he extent of the Sydney West region.

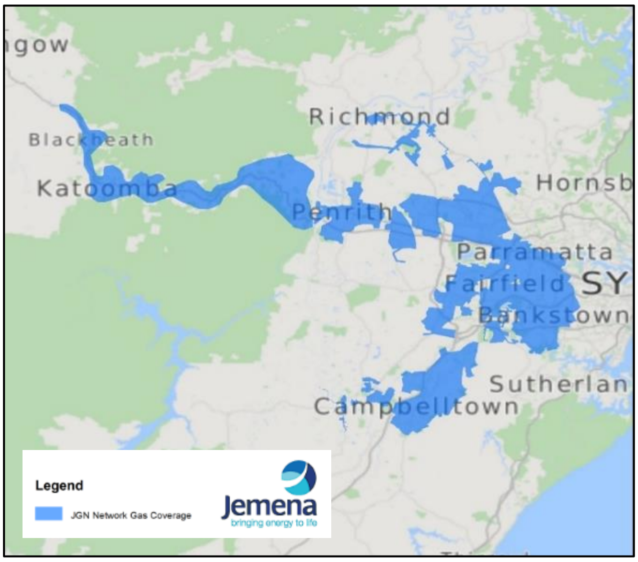


Figure 6: Sydney West Region Gas Network Coverage

Due to the size of the Sydney West region, there are areas that are well established but also the largest greenfield areas within the JGN network footprint.

The region also has a portion of JGN's 7kPa low pressure networks including Auburn, Lidcombe, Parramatta and Liverpool. These low pressure networks are restricted to potential growth, predominantly along the planned rail corridor developments and road upgrades but also due to the infrastructure landscape with many major roads and railways intersecting each other and isolating gas networks providing difficult and costly augmentation strategies.

Finally, the region does have pockets of 30kPa, 100kPa and 120kPa networks such as Camden, Elderslie and Minto. These areas currently have minimal growth, and capacity constraints are managed operationally through regulator set points and close monitoring of telemetry and gauging.

4.4.4 WOLLONGONG

The Wollongong gas network region lies within the LGAs of the City of Shellharbour, City of Wollongong and Municipality of Kiama and represents an area of approximately 180,000 hectares and services approximately 65,000 customers. Error! R eference source not found. shows the extent of the Wollongong region.

The Wollongong region is predominantly filled with 210kPa and 300kPa networks with sufficient capacity to cater for growth. The exception is Figtree where historically small mains have limited capacity in the area and has increased risk of loss supply to customers in the area.

Figure 7: Wollongong Region Gas Network Coverage

The region also has some 7kPa and 30kPa networks, predominantly in the Wollongong CBD area. Both the networks had some medium density and commercial growth. The networks had sufficient capacity to sustain the growth but if the growth continues, reinforcement options would need to considered.

4.4.5 CENTRAL COAST / NEWCASTLE

The Central Coast and Newcastle gas network regions lie within the LGAs of the Central Coast Council, City of Cessnock, City of Lake Macquarie, City of Maitland, City of Newcastle and Singleton Council and represent an area of approximately 375,000 hectares and services approximately 150,000 customers. Error! Reference source not found. s hows the extent of the Central Coast / Newcastle region.

The Central Coast region has one 300kPa network, with the rest of the area of 210kPa standard. There is minimal growth in this region and only a few new estate developments in Cooranbong and Warnervale areas. However, winter gauging pressure results have indicated a risk of loss of supply in Umina Beach and will require additional capacity to ensure reliability of supply.

The Newcastle CBD area mainly comprises of 30kPa and 210kPa network. The 30kPa network will be undergoing a rehabilitation program as the cast iron mains are towards the end of their life and the network has deteriorate significantly over the past few years.

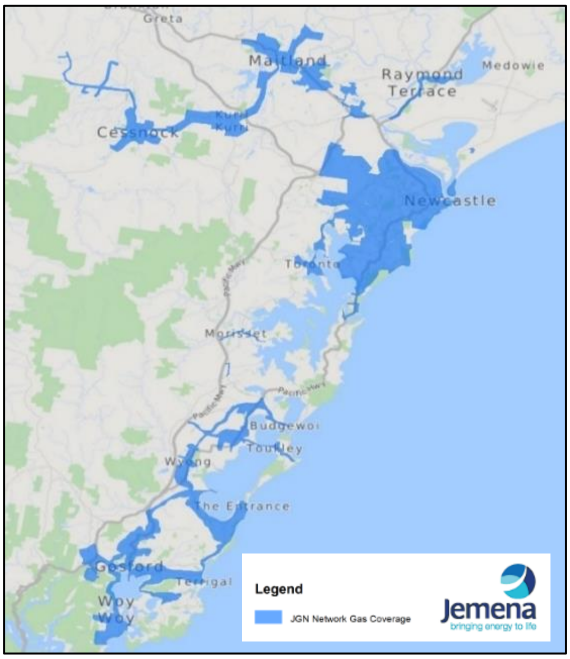


Figure 8: : Central Coast / Newcastle Region Gas Network Coverage

4.4.6 COUNTRY, SOUTHERN HIGHLANDS AND WOLLONDILLY

The Country and Southern Highlands gas network regions are supplied via the Moomba to Sydney Pipeline (MSP) or Central West Pipeline (CWP), while the Wollondilly gas network region is supplied via the Jemena Gas Network (JGN). These regions include the LGAs of Wollondilly, Wingecarribee, Goulburn Mulwaree, Upper Lachlan Shire, Hilltops, Bland, Forbes, Parkes, Narromine Wetlands, Dubbo Regional, Cootamundra-Gundagai Regional, Junee, Coolamon. Narrandera, Leeton, Griffith, Cowra, Blayney, Orange, Bathurst Regional, Oberon and Lithgow City.

Together, these gas network regions include 34 individual townships representing an area of approximately 440,000 hectares and services approximately 135,000 customers. The area has a variety of networks with different operating pressures such a 7kPa, 100kPa, 210kPa, 300kPa and 1050kPa with the majority being 210kPa and sufficient capacity for network growth depending on the topographical constraints such as the breadth of townships and required long length of feeder mains.

The growth opportunities are limited in the country and southern highland areas with the largest opportunities being driven by industrial and commercial markets including chicken farms, abattoirs, wineries and fruit dryers.

Some townships, such as Goulburn’s low pressure network have shown a risk of loss of supply and requires reinforcement.

5. FUTURE AUGMENTATION REQUIREMENTS

To develop and optimise our Network Pressure Management program, we have grouped the projects based on their main drivers. These drivers include existing customer demand, medium-density and high-rise development, new estate growth areas, network pressure reduction, and the winter gauging pressure program. The justification and reasoning for each project are described below.

5.1 EXISTING CUSTOMER DEMAND

Existing customer demand includes projects in areas that are already developed with housing and gas infrastructure. We have found that these areas typically need capacity reinforcement due to factors such as their location on the fringe of the network, limited feeder mains, and isolated pockets that are vulnerable to changes in gas demand. To assess each project, we have analysed winter gauging data, current customer usage and synergi modelling outcomes to determine the optimal solution and project timing.

5.1.1 WOOLWICH

Problem statement: Woolwich is located on a peninsula and is supplied by a single 110mm feeder gas main. The customers located at the end of the network are at risk of poor or loss of supply because of increased loads on the network and limited interconnected gas mains. Network reinforcement is required to prevent 400 customers from poor supply.

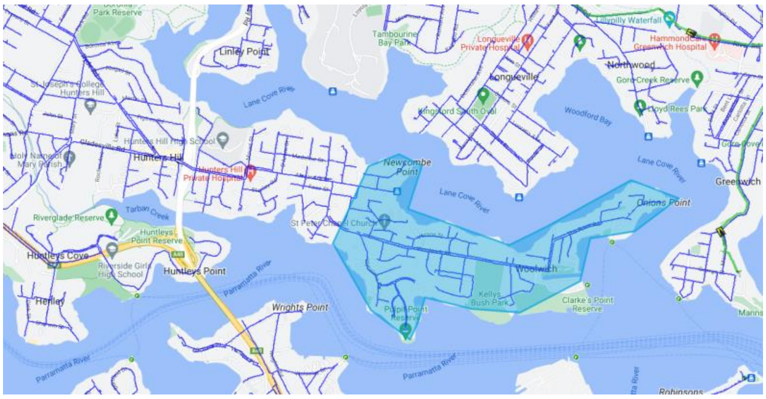


Figure 9: Woolwich customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of gas supply

	Options name	Description	Cost ($M)
	Do nothing	Poor supply to 400 customers in 2029	
1	Mains interconnections	Lay ~620m of 110mm PE along Paul Street and Mary Street interconnecting from the existing 110mm Nylon on Gladesville Rd and 110mm PE on Augustine St.	0.72
2	Reinforce feeder main	Lay ~900m of 110mm PE along Eltham St, Oxford, Percy, Gerrish and Cambridge St. Interconnect to the 110mm PE	1.10

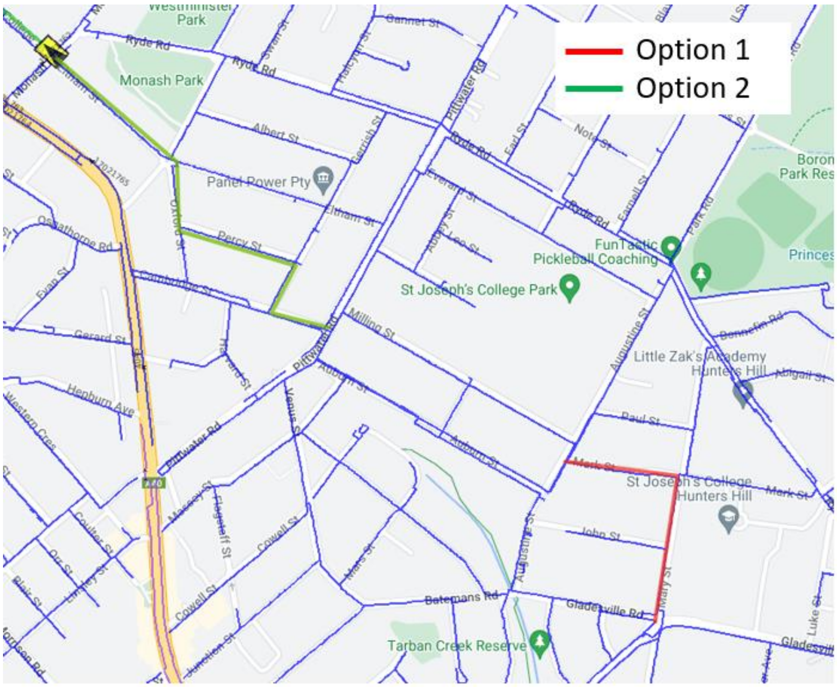


Figure 10: Reinforcement options for Woolwich

Analysis: Woolwich is located on a peninsula and has small feeder mains from a singular SDRS to the residential point. There are limited secondary mains in the area with the closest SDRS located 6km from Woolwich point. This puts a large limitation on ability to ensure reliability of supply.

Pressures over the last few years have deteriorated with the lowest pressure of 48 kPa measured in 2020 occurring during COVID when more people were working from home. Although more recent data has shown increased pressure results due to warmer weather the pandemic has introduced new ways of working which has continued and puts continued strain on the network to ensure reliable gas supply. Compounding this risk is the unique geographical location, and increasing the likelihood of loss of supply.

Synergi models have been used to assess the network capacity and determine the optimal solution. The first option includes laying 110mm PE to interconnect two existing 110mm PE feeder mains. This option increases the capacity in the area to above minimum operating pressure. The second option involves reinforcing the SDRS outlet with 110mm PE and extending the main to where the 110mm PE feeder starts (~900m). This option provides more capacity than option one but is more expensive due to the length of reinforcement and construction within built up areas.

Overall, the first option is recommended as it provides sufficient capacity to ensure reliability of supply while keeping costs down.

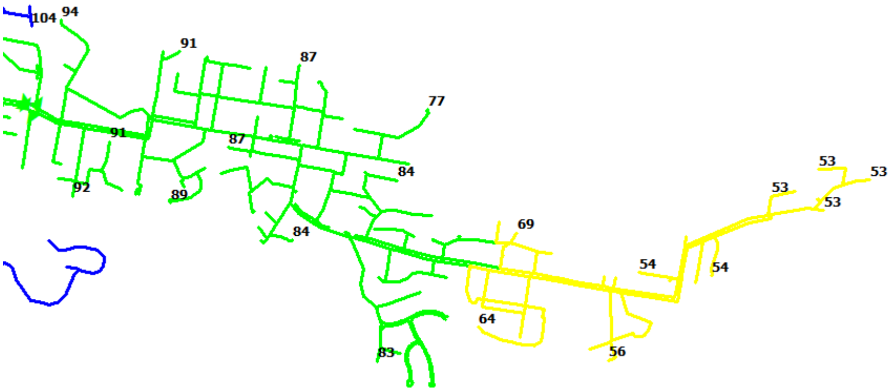


Figure 11: Woolwich network modelling in 2029 prior to reinforcement

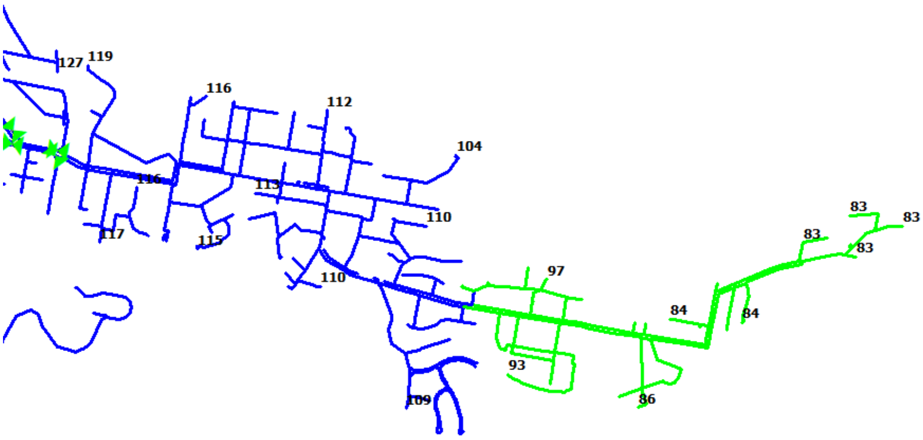


Figure 12: Woolwich network modelling in 2029 with preferred reinforcement option

Recommendation:

Network reinforcement is needed to reduce the likelihood of loss or poor supply to 400 customers in Woolwich. The first option is preferred as it is the lowest cost to increase capacity supply in the area.

Once this project has been completed the network will be assessed to determine whether the pressure can be decreased to reduce emissions.

5.1.2 BAYVIEW

Problem statement: Bayview is located on the fringe of the network. The winter peak pressure over the last three years has indicated poor capacity with pressures a low as 25 kPa. There is a pocket of 35 customers who are supplied by a 40mm nylon main and are already experiencing poor supply. Customer will experience decreased levels of service if reinforcement is not undertaken to increase capacity.

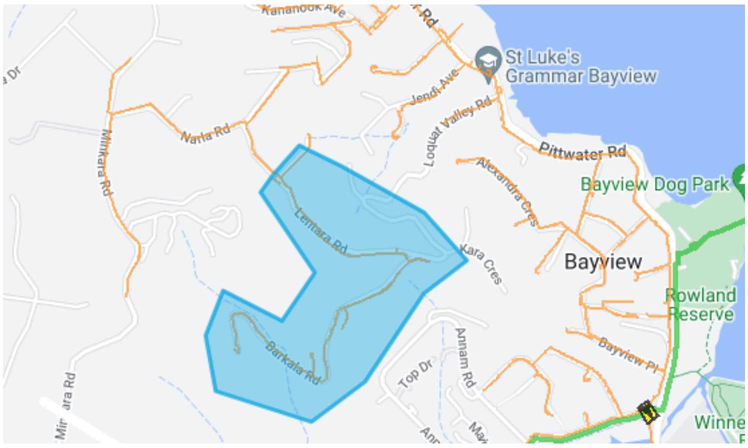


Figure 13: Bayview customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 25 customers and high risk of loss of supply to 10 customers in 2029	
1	Kananook interconnection (preferred)	• Lay ~75 m of 63mm PE main on Kananook Avenue interconnecting to Pittwater Road. • Lay ~52 m of 63mm PE main on Kananook Avenue at the corner of Taminga St.	0.19[7]
2	Pittwater interconnection	Lay ~450m of 63mm PE on Pittwater road to reinforce the section of 40mm NY	0.88
3	Ilya interconnection	Lay ~660m of 63mm PE on Kananook Ave, Taminga St and Ilya Ave to reinforce section of 40mm NY	0.99

[7] The file 'JGN - RIN - 4.3 - 10054436 - Bayview Low Pressure CDP - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

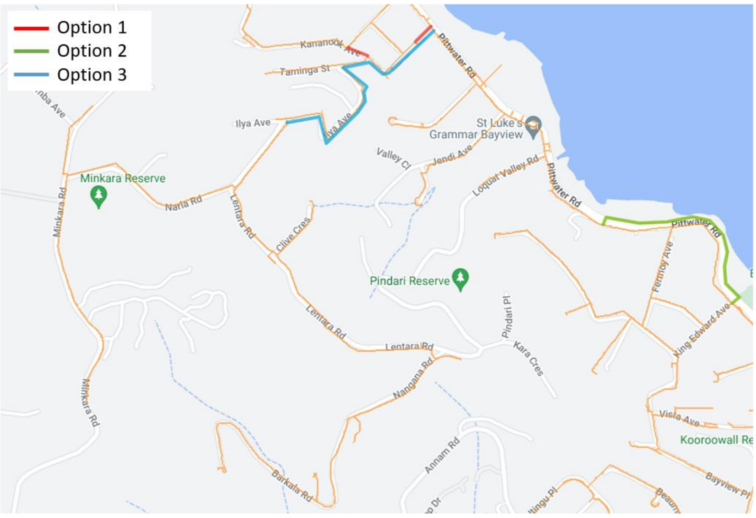


Figure 14: Reinforcement options for Bayview

Analysis: The 300 kPa Bayview network consists of small diameter feeder mains. This is because of a previous rehabilitation project where the existing large steel gas mains were inserted to prevent leaks. This configuration along with single feeds has resulted in reduced capacity in the area.

Network pressures over the last three years have deteriorated with pressures as low as 25 kPa, well below the network minimum pressure of 40 kPa.

Synergi models have been used to assess the network capacity and determine the most prudent and efficient option and project timing to ensure continuity of supply to customers. Figure 15, shows the network pressures for Bayview in 2029 when 35 customers are at risk of limited gas supply, 10 customers located on the red part of the network are at risk of loss of supply and 25 customers located on the yellow part of the network are at risk of poor supply. Figure 16, shows the pressure increase to adequately supply customers when the preferred option is installed.

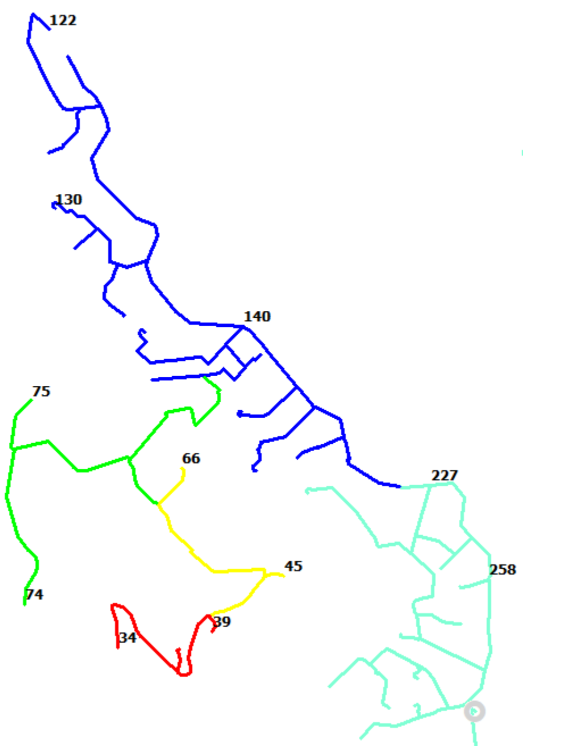


Figure 15: Bayview network modelling in 2029 prior to reinforcement

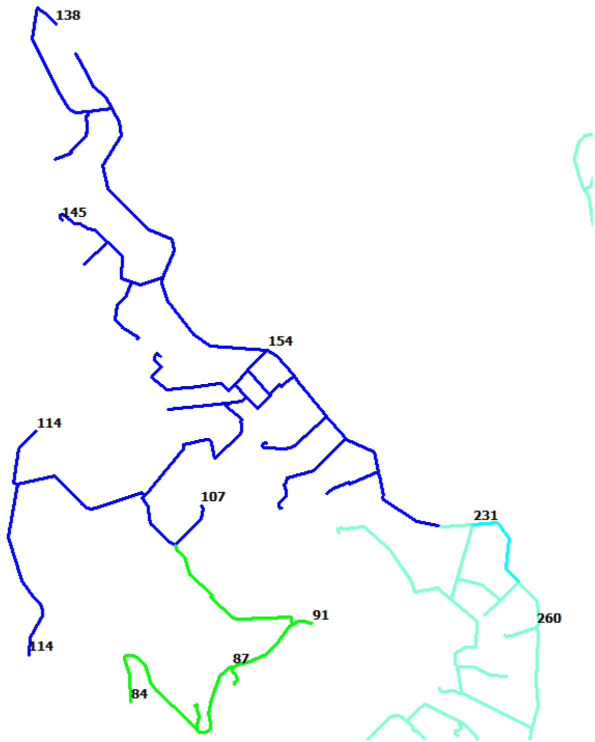


Figure 16: Bayview network modelling in 2029 with preferred reinforcement option

Recommendation: Network reinforcement is needed to reduce the likelihood of loss or poor supply to 35 customers in Bayview. Consideration and analysis of three options highlights the preferred option of Kananook interconnection is the most efficient as it is the lowest cost to bring the likelihood of the risk to low. This solution is also prudent as the expenditure is made shortly before a loss of supply event occurring.

Once this project has been completed the whole 300 kPa network will be assessed to determine whether the pressure can be decreased to reduce emissions.

5.1.3 GYMEA BAY

Problem statement: Gymea Bay is supplied by a one way, 75mm NY feeder main. The winter peak pressure over the last three years has indicated poor capacity. There are 270 customers who are at risk of poor or loss of supply if reinforcement is not completed to increase capacity in the area by 2028.

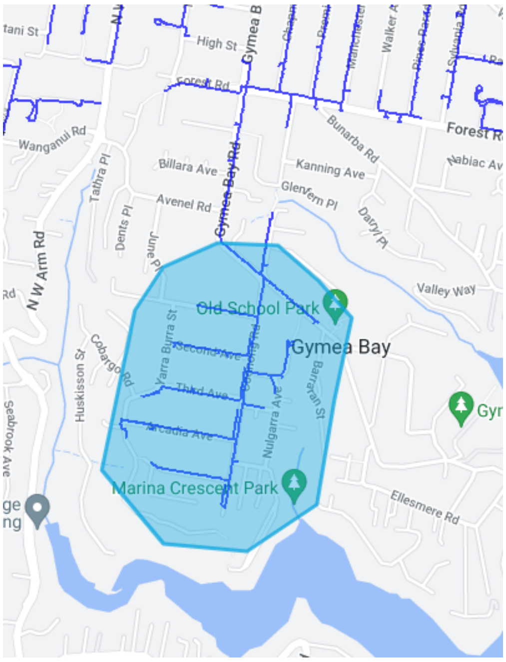


Figure 17: Gymea Bay customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 220 customers and high risk of loss of supply to 50 customers	
1	Forest Rd interconnection (preferred)	Lay ~700m mains reinforcement on Forest Rd and Gymea Bay Rd at a cost of approximately $0.7M.	0.93[8]
2	Gymea Bay interconnection	Lay ~415m mains reinforcement on Gymea Bay Rd	0.55
3	Manchester Rd interconnection	Lay approximately 1350m mains reinforcement on Manchester Rd, Forest Rd and Gymea Bay Rd.	1.80

[8] The file 'JGN - RIN - 4.3 - 10000024 - Gymea Bay 210 kPa CDP - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

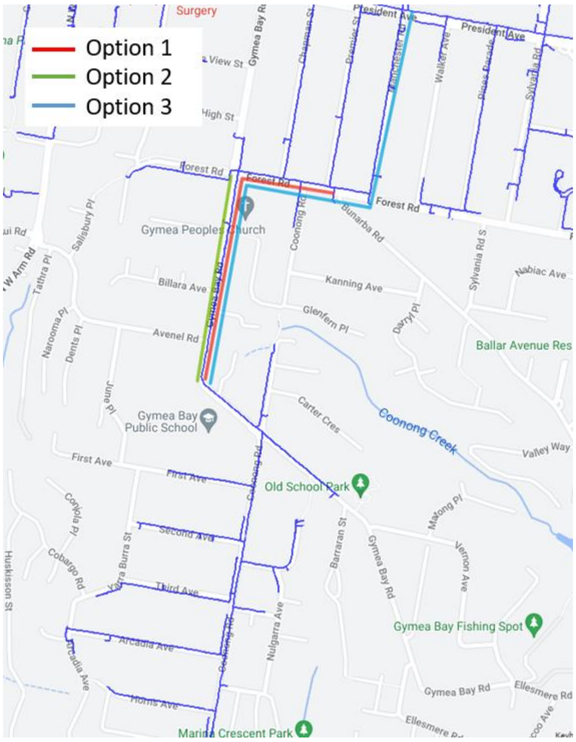


Figure 18: Reinforcement options for Gymea Bay

Analysis: The 210 kPa Gymea Bay network consists of a single 40mm and 75mm diameter feeder main. This main provides gas to over 300 customers and a respite aged care hospital. Gas is supplied north of the train line with two rail crossings and from the west across Princess highway. These limited points of gas entry into the area along with a single feeder main to Gymea Bay and considerable high-rise growth around the adjacent Kirrawee train station has contributed to the reduced capacity in the area.

Network pressures over the last three years have deteriorated with pressures expecting to reduce below our network minimum pressure of 40 kPa in 2028. This puts the customers in this area at high risk of poor or loss of supply.

Synergi models have been used to assess the network capacity and determine the most prudent and efficient option and project timing to ensure continuity of supply to customers. Figure 19, shows the network pressures for Gymea Bay in 2028 when 270 customers are at risk of limited gas supply, 50 customers located on the red part of the network are at risk of loss of supply and 270 customers located on the yellow part of the network are at risk of poor supply.

To ensure continuity of supply three options were considered. All three options increase gas supply by reinforcing the feeder main to Gymea Bay with each option scope varying by the length of reinforcement. The first option involves laying 700m of reinforcement that bridges the gap between a 50mm and 75mm diameter main and brings the overall capacity to 120 kPa. The second option involves a smaller length of reinforcement and still relies on gas flowing through a section of 40mm diameter main. Although this option is less expensive it only increases pressure slightly above minimum and increases the likelihood that reinforcement would have to be completed again in the short term. The third option includes the longest length of mains extension which is high cost and increases the pressure more than required.

Figure 20, shows the pressure increase to above 40 kPa when the preferred option is installed.

Figure 19: Gymea Bay network modelling in 2028 prior to reinforcement

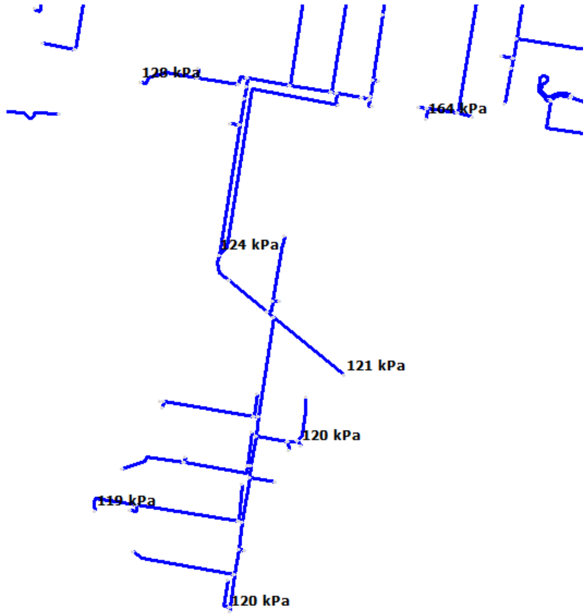


Figure 20: Bayview network modelling in 2029 with preferred reinforcement option

Recommendation: Network reinforcement is needed to reduce the likelihood of loss or poor supply to 270 customers in Gymea Bay. Analysis of the three options has deduced the first option as preferred. This solution is prudent as it is the lowest cost option to sufficiently increase pressures in the area and reduce the likelihood of loss of supply to low. This solution is also efficient as the expenditure is made shortly before a loss of supply event occurring.

This network will also be considered for pressure reduction post reinforcement, to reduce overall emissions. It would not be possible to consider this without addressing the low terminal pressure areas of the network.

5.1.4 FIGTREE

Problem statement: The Figtree network is located in the Wollongong Council area and operates at 210kPa. The network is fed by one SRS and does not have an alternate gas supply. The network also supplies a small 7kPa pocket and gas to approximately 7,400 customers. Over the last few years, pressures at multiple locations of the Figtree network have been consistently low. The pressures have dropped to less than 40 kPa during the last two winters and is below our minimum design operating pressures. Network reinforcement is required to increase capacity in the area and ensure reliability of supply to 210 customers.

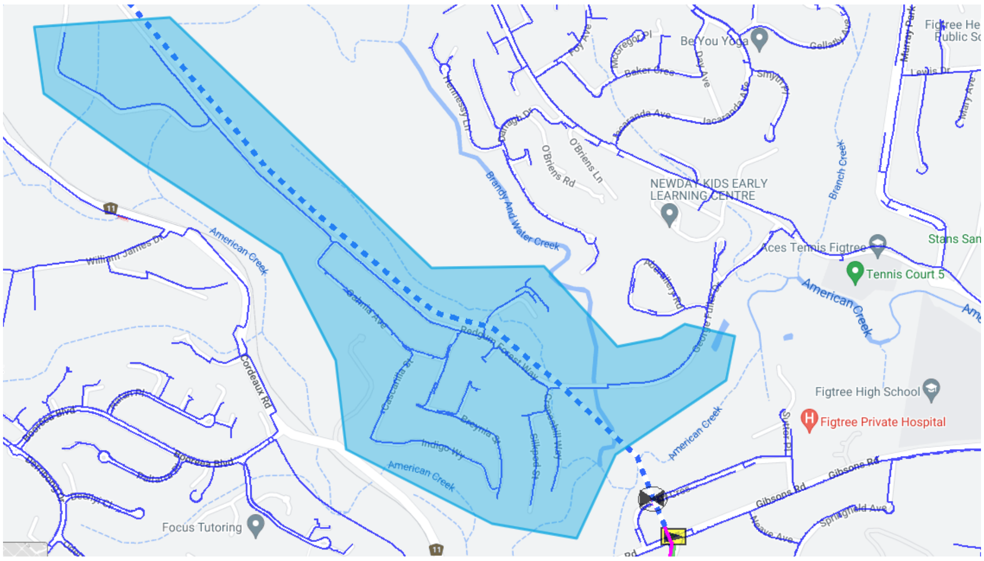


Figure 21: Figtree customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 10 customers and high risk of loss of supply to 200 customers in 2030	
1	Short mains extension on Gibbsons (preferred)	Lay ~ 780m of 110mm PE along Gibsons	0.57[9]
2	Long mains extension on Gibbsons	Lay ~ 980m of 110mm PE along Gibsons	0.72

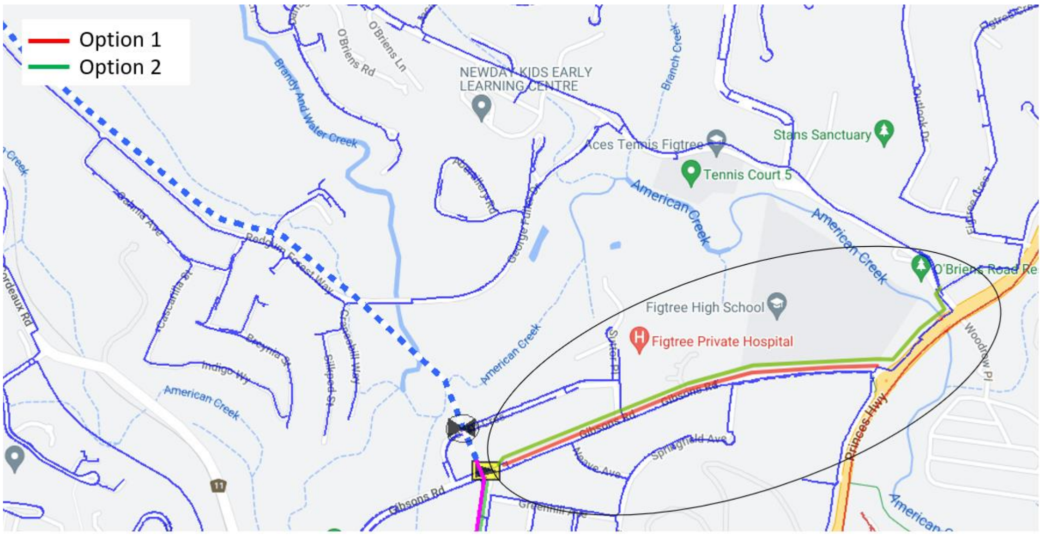


Figure 22: Reinforcement options for Figtree

The preferred solution is to be delivered in two stages, Figtree stage 1 will be delivered before winter 2024 and stage 2 is forecasted to be delivered in CY29-30.

[9] The file 'JGN - RIN - 4.3 - 10068727 - Figtree CDP - Stage 2 - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

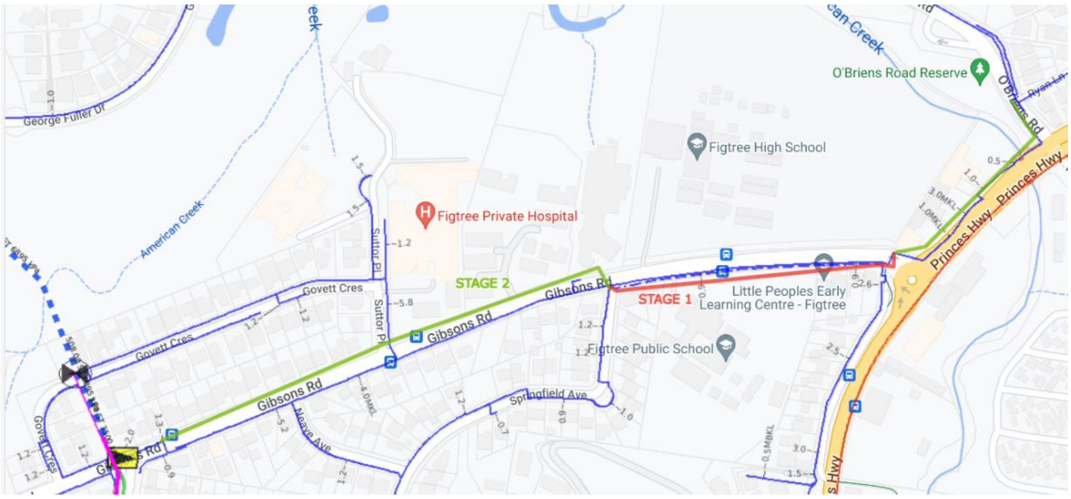


Figure 23: Preferred option for Figtree. Stage 1 (red) and Stage 2 (green) 780m of 110PE mains lay.

Analysis: Winter pressures over the last few years in Figtree have been below minimum design pressure with 38 kPa.

The limited capacity of the network is due to the small outlet of the SDRS located on Gibsons Rd with only a 75mm gas main installed in 1970. To increase the capacity and reduce the likelihood of loss of supply, the SDRS outlet requires reinforcement. Other options such as interconnections further downstream are not credible as they do not increase the pressure of the network. To improve the capacity in the area and ensure the most efficient solution we have broken down the project into two stages –

1. Stage 1 is currently being delivered in May 2024 and includes a section of reinforcement along Gibsons Road. Figure 24, shows the capacity of the network prior to installing Stage 1 and Figure 25, the capacity improve post reinforcement.

2. Stage 2 is required in 2030, as shown in Figure 26, when the network pressures reduce and put customers at risk of poor supply.

For stage 2, two options were considered. The first a shorter extension from the start of stage 1 to the SDRS and the second an continuation of this scope across Princes Highway and to Ryan Lane. Both options were modelled using synergi and increased capacity to Figtree. The first option is preferred as it is the lower cost option, to reduce the likelihood of poor or loss of supply to customers in the area, as seen by Figure 27.

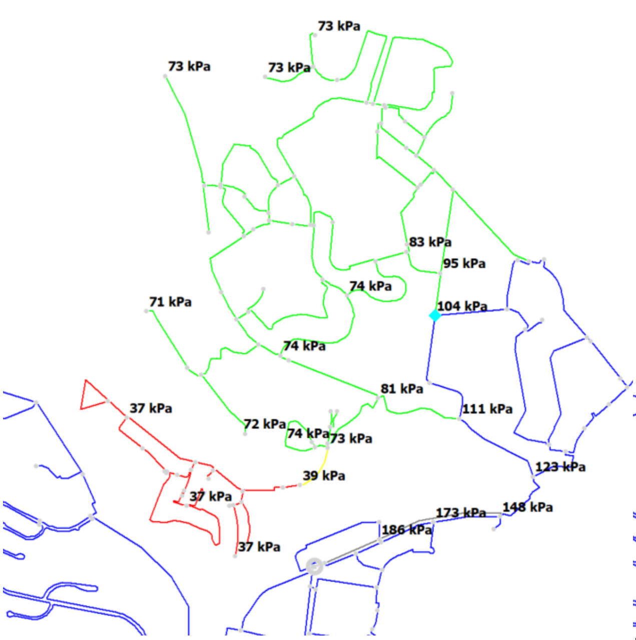


Figure 24: Figtree network modelling prior to reinforcement, in 2024

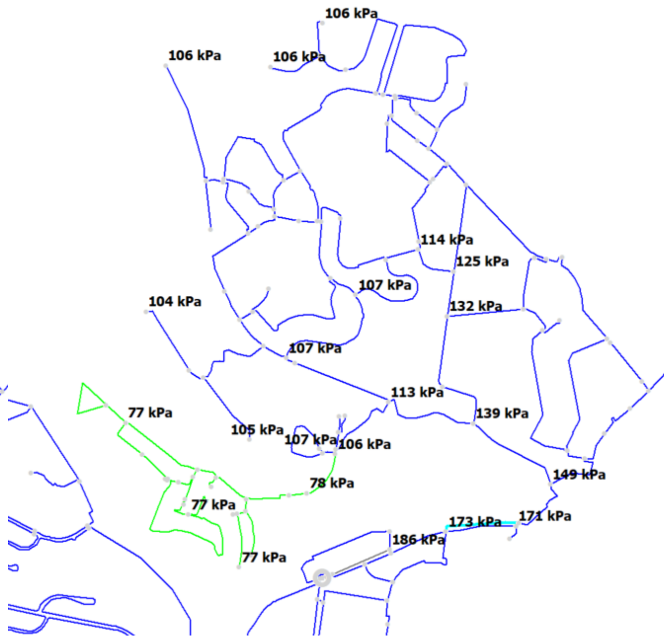


Figure 25: Figtree network modelling with Stage 1, May 2024

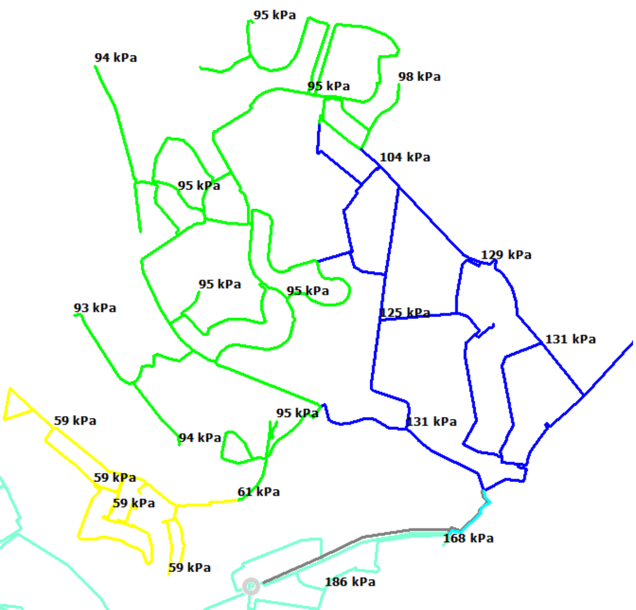


Figure 26: Figtree network modelling with Stage 1 and prior to stage 2 reinforcement in 2030

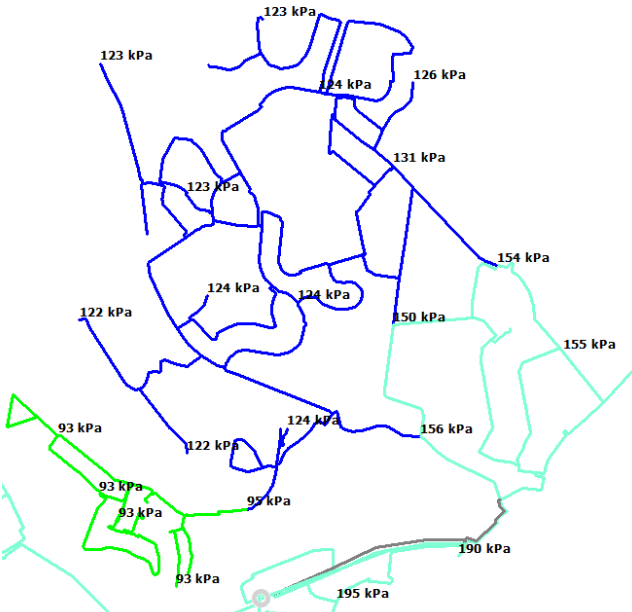


Figure 27: Figtree network modelling with Stage 2, in 2030

Recommendation: Network reinforcement is needed to reduce the likelihood of loss or poor supply to 210 customers in Figtree. The first option is preferred as it is the lowest cost to increase capacity supply in the area.

Once this project has been completed the network will be assessed to determine whether the pressure can be decreased to reduce emissions.

5.1.5 UMINA BEACH

Problem statement: Umina beach is on the Central Coast and is the terminal point of West Gosford and Woy Woy network region. The network operates at 210kPa and is supplied by one SRS located in West Gosford. In recent years, the winter gauging results have shown pressures as low as 29 kPa. Reinforcement is required to reduce the likelihood of poor or loss of supply to 2,000 customers.

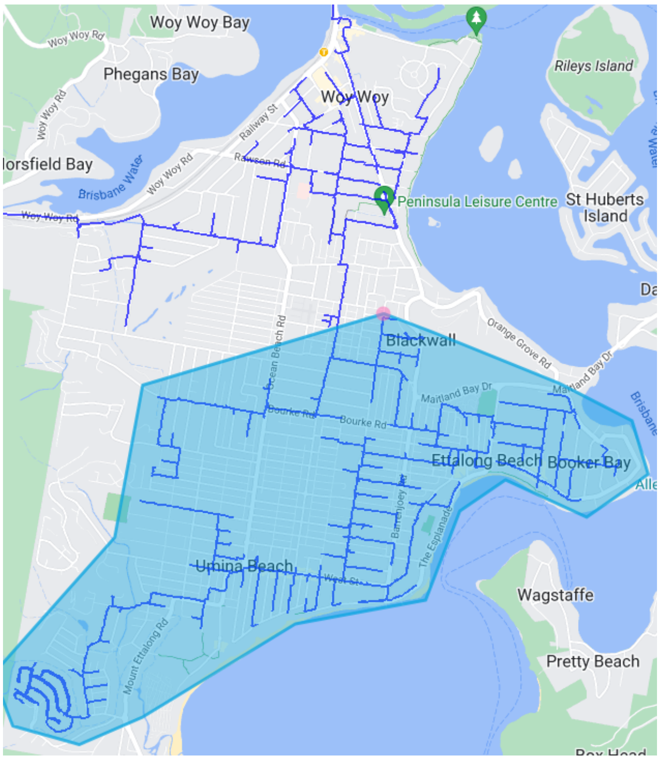


Figure 28: Umina Beach customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 2,000 customers and in 2027	
1	Three interconnections (preferred)	• Lay ~430 m of 110 mm PE main on Bourke Rd and Springwood St. • Lay ~880 m of 63 mm PE main connecting Hillview St with Ryans Rd • Lay ~215 m of 63 mm PE main on Bapaume Ave	0.76[10]
2	Brisbane Water connection	• Lay ~960m of 110mm PE main along Brisbane Water Drive	1.00

[10] The file 'JGN - RIN - 4.3 - 10068848 - Umina Beach Low Pressure CDP - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred options

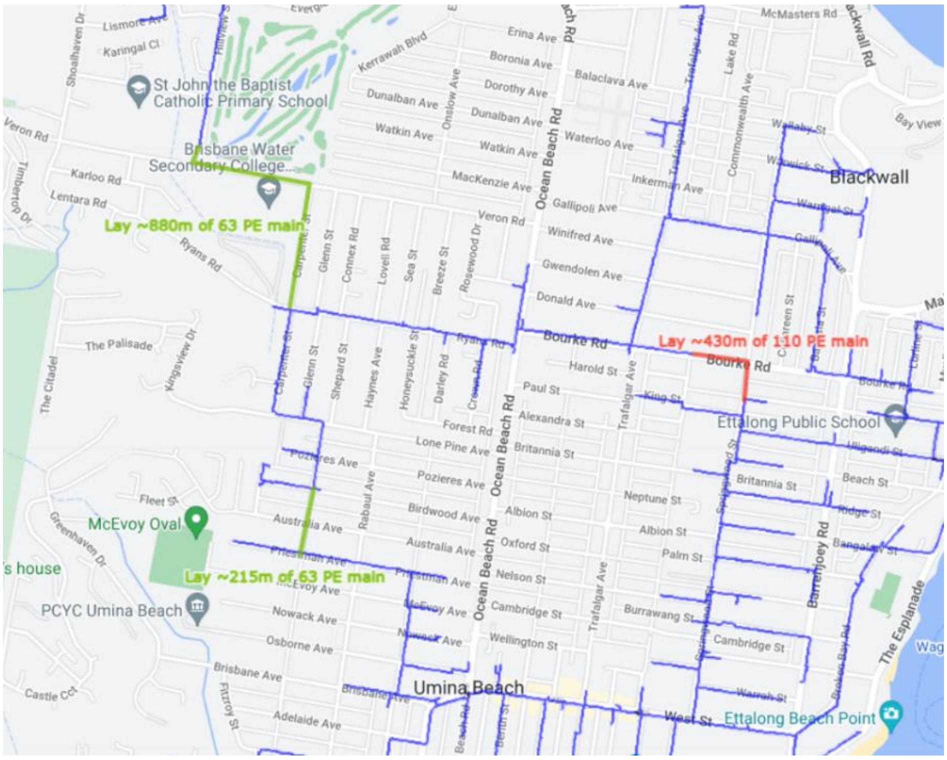


Figure 29: Preferred option for Umina beach project.

Analysis: Recent winter gauging data has shown that Umina beach and its surrounding suburbs are at risk of poor supply. The network area consists of a single feeder main with sporadic gas sections that do not interconnect and thus is not conducive to a reliable gas supply. There are around 2,000 customers who are at risk of poor supply if this network is not reinforced, this number is large due to medium density around Ettalong Beach. A higher investment trigger has been applied due to the large impact a poor supply event would incur with over 2,000 customers.

To address this risk a number of options were assessed with the preferred option to interconnect sections of the network accounting to total of 1.5km of mains lay. Interconnecting the proposed gas mains as shown in Figure 31: Umina network modelling with Stage 1, enables more capacity into Umina and Ettalong. Option 1 is preferred as it is the lowest cost option to decrease the risk of poor supply.

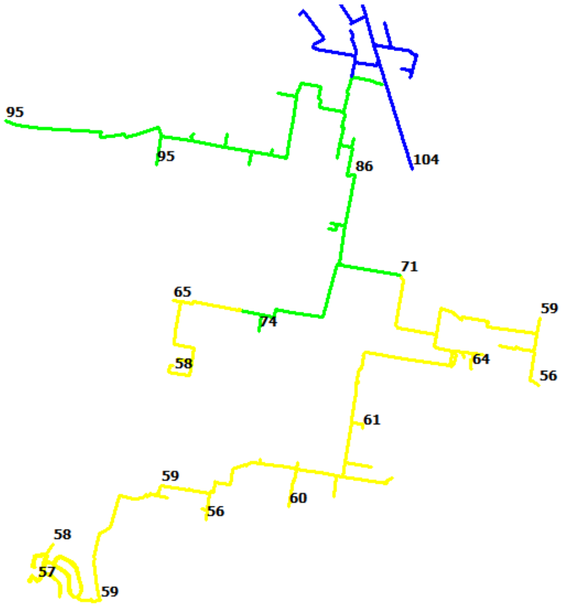


Figure 30: Umina network modelling prior to reinforcement

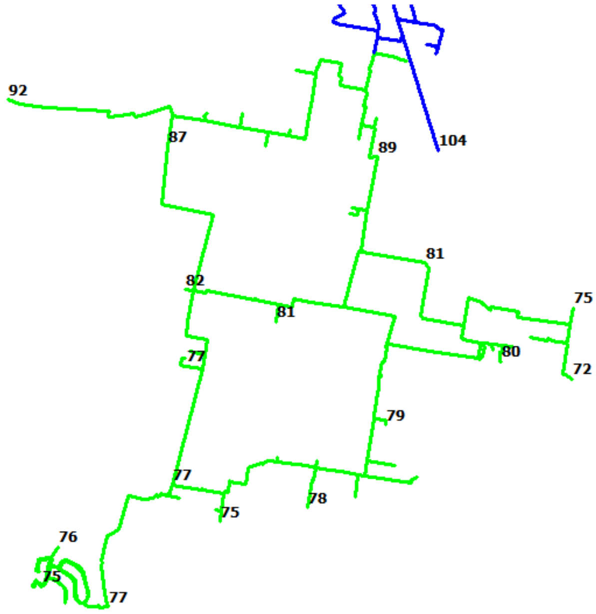


Figure 31: Umina network modelling with Stage 1

Recommendation: Network reinforcement is needed to reduce the likelihood of poor supply to 2,000 customers in Umina Beach. The first option is preferred as it is the lowest cost to increase capacity in the area.

This network will also be considered for pressure reduction post reinforcement, to reduce overall emissions. It would not be possible to consider this without addressing the low terminal pressure areas of the network.

5.1.6 GOULBURN

Problem statement: Goulburn has a low pressure network of 7 kPa that services the town's commercial areas. The last few years have shown a deterioration of gas supply, putting over 800 customers at risk of either poor or loss of supply. This area is critical due to the location of a nearby hospital. Figure 32, provides an overview of the area where customers are at risk of loss of supply.

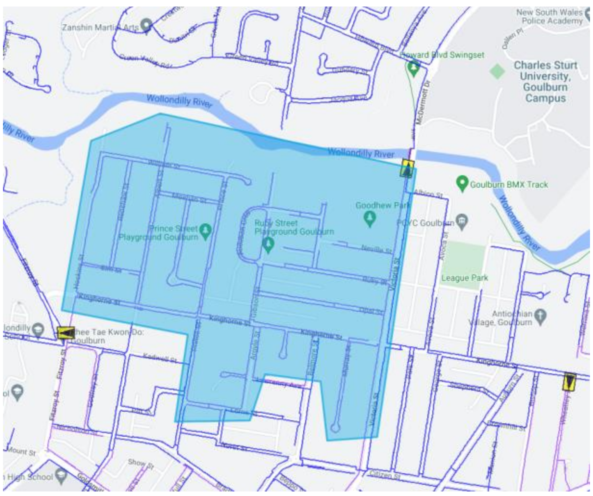


Figure 32: Goulburn customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 250 customers and high risk of loss of supply to 550 customers in 2027	
1	Victoria interconnection (preferred)	Lay ~95m of 110mm PE from the DRS outlet along Victoria St	0.20[11]
2	Hoskins interconnection	Install SDRS on intersection between Prince and Kinghorne St	0.60

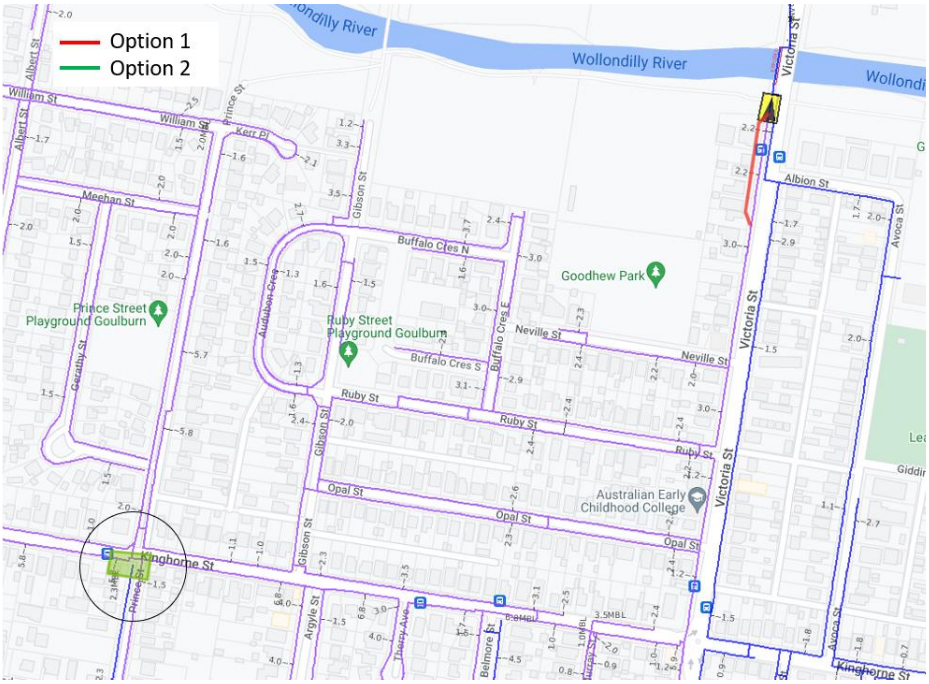


Figure 33: Reinforcement options for Goulburn

Analysis: There are three sections of low (7 kPa) networks in the Goulburn town centre. These sections were downgraded as part of rehabilitation works. The northern low pressure network has two medium pressure SDRS feeding the network and have consistently shown poor capacity. In the last few years network pressure as low as 1.89 kPa have been recorded which is well below the network emergency limit of 2.8 kPa. If the network was to be left with no reinforcement than 800 customers are at risk of poor or loss of supply.

Synergi models have been used to assess the network capacity and determine the most prudent and efficient option. Figure 34, shows the network pressures for Goulburn in 2027. To ensure continuity of supply two options were considered. The first is to increase the feeder main from the northern SDRS by laying 110mm PE and the second to install another SDRS to increase overall gas supply. The first option is considered the most prudent and efficient as it is lowest cost and returns the capacity of the area to above minimum operating pressure. Figure 35, shows the peak pressure results once option 1 is installed.

[11] The file JGN - RIN - 4.3 - 10069030 - Goulburn 7kPa CDP - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

Figure 34: Goulburn network modelling prior to reinforcement

Figure 35: Goulburn network modelling with reinforcement

Recommendation: Network reinforcement is needed to reduce the likelihood of poor supply to 800 customers in Goulburn. The first option is preferred as it is the lowest cost to increase capacity in the area.

5.2 MEDIUM DENSITY AND HIGH RISE DEVELOPMENTS

Medium density and high-rise developments include projects in low pressure (7 kPa) areas and designated as major housing and community hubs. For these projects, we have conducted a cost benefit analysis to determine if the revenue generated from the connections exceeds the cost of augmentation. Additionally, we have considered other critical factors, such as winter gauging data and Synergi modelling outcomes.

5.2.1 AUBURN

Problem statement: In recent years we have received many applications for medium density/high rise building connections in a localised pocket of the Auburn 7kPa network. This area is within close proximity to the Auburn train station and network modelling forecasts that no new customers will be able to connect and the existing customers throughout this pocket of the network will be at risk of poor supply. Reinforcement is required to minimise the risk of 900 customers experiencing poor or loss of supply.

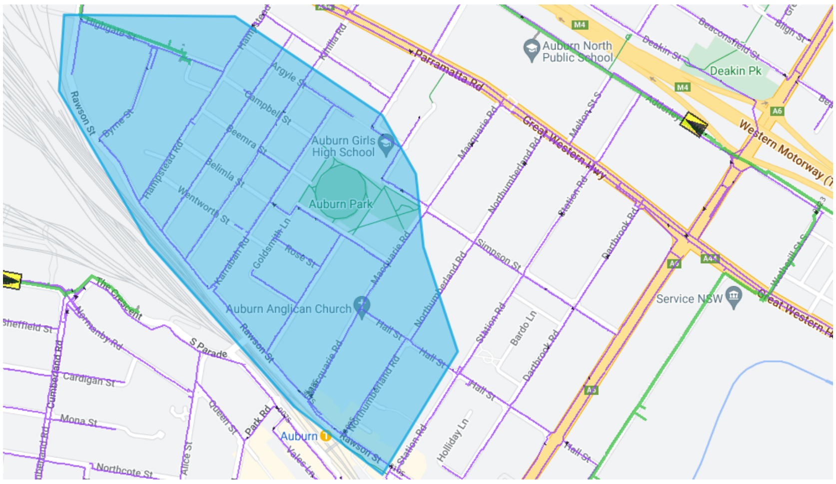


Figure 36: Auburn customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or loss of gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 800 customers and high risk of loss of supply to 100 customers in 2026	
1	Highgate St (preferred)	• Install a SDRS on Highgate St to provide supply to a low pressure network. • Lay ~140m of main to reinforce Hall St	0.88[12]
2	Skarratt St	• Install a SDRS on Skarratt St to provide supply to a low pressure network • Lay ~140m of main to reinforce Hall St	1.00

[12] The file 'JGN - RIN - 4.3 - 10065576 - Auburn CDP - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

Figure 37: Auburn scope map of the preferred option

Analysis: Auburn is a suburb located on a large low (7kPa) pressure network that had undergone mains rehabilitation in the early 90's. The area has experienced a large amount of redevelopment resulting in increased density. Recent gauging data has shown capacity in the area has deteriorated with pressures as low as 2.56 kPa. This is well below the minimum emergency pressure limit of 2.8 kPa.

The area around Auburn train station has been undergoing redevelopment and in particular Northumberland Road has had four large high-rise and commercial buildings that have contributed to a decrease in capacity. This growth is expected to continue and reinforcement is required to connect new customers and prevent 900 customers from losing supply.

Capacity modelling: Synergi models have been used to assess the network capacity and determine the most prudent and efficient option. Figure 38, shows the network pressure for Auburn in 2026 where 900 customers are at risk of limited gas supply. To improve the capacity in the area a new supply point needs to be introduced. This is only possible with a SDRS from the secondary main to low pressure. There are only two credible options available, one involving an SDRS on Highgate St or the other requiring an SDRS on Skarratt St. Both options increase the capacity in the area to the same level however, vary in cost due to the location. A SDRS on Skaratt St is more costly due to higher traffic management costs and night construction. It is for these reasons that option 1 is preferred.

The preferred reinforcement involves installation of a SDRS fed from the 1050kPa network on Highgate St. The outlet of the regulator set supplying at 7kPa will be tied into the existing low pressure network to create an additional source of supply to the area north of the Auburn train station. An interconnection of 160mm PE along Hall St is also be required to increase supply to the localised pocket of customers impacted by upcoming high rise loads.

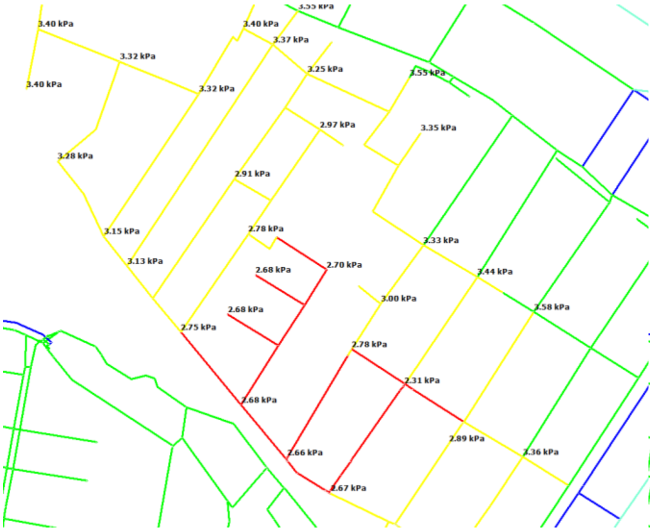


Figure 38: Auburn network modelling prior to reinforcement

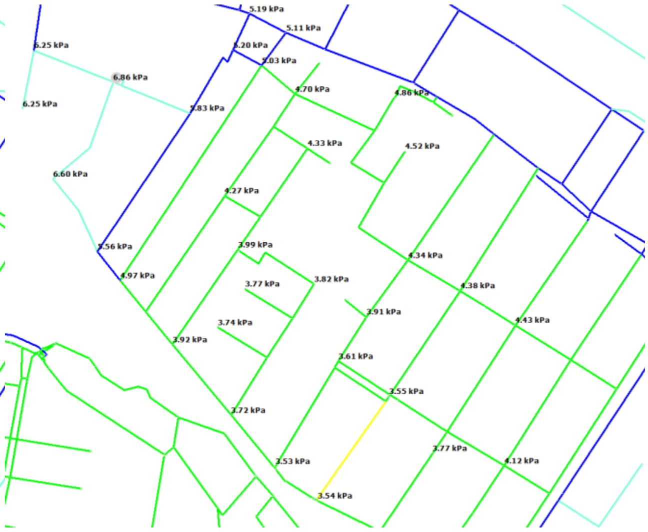


Figure 39: Auburn network modelling with preferred reinforcement option

Cost benefit analysis: The Costs and Benefits Analysis Model was used to assess the cost of augmentation against revenue generated by connecting new customers. Auburn is forecasted for high-rise and medium density development. Refer to file 'JGN - RIN - 4.3 - 10065576 - Auburn CDP - CBAM - 20240628 - Public', which present the cost benefit summary, showing Highgate St option as the recommended option due to the benefits outweighing the overall cost of the project.

Recommendation: Network reinforcement is needed to ensure customers can continue to connect and reduce the likelihood of loss of or poor supply to 900 customers in Auburn. The first option is preferred as it is the lowest cost to increase capacity supply in the area and the revenue is higher than the cost of augmentation.

5.2.2 CAMPSIE

Problem statement: Campsie is a high density suburb located in the middle of a low pressure network where the nearest gas supply point is over a kilometre away. The area around Campsie train station has been zoned for medium to high density and the existing network will be unable to support these connections. There are approximately 430 customers that are at risk of poor or loss of supply in 2026.

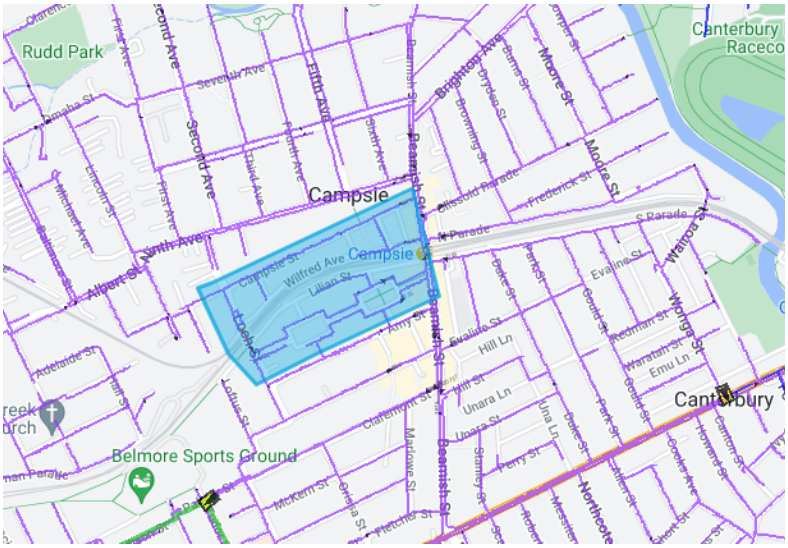


Figure 40: Campsie customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 430 customers in 2026	
1	Rehabilitate low pressure main (preferred)	• Rehabilitate ~700m of low pressure main to medium pressure and install SDRS • Interconnect low pressure mains at Byron and Cowper St intersection. • Lay ~40m of main from the outlet of SDRS and tie into Beamish St.	1.42[13]
2	Claremont interconnection	• Lay ~750m of secondary main in Claremont St. • Install a SDRS, tie in outlet of SRS to 160mm PE main in Claremont St.	2.00

[13] The file 'JGN - RIN - 4.3 - 13033949 - Campsie (Sydney South) - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

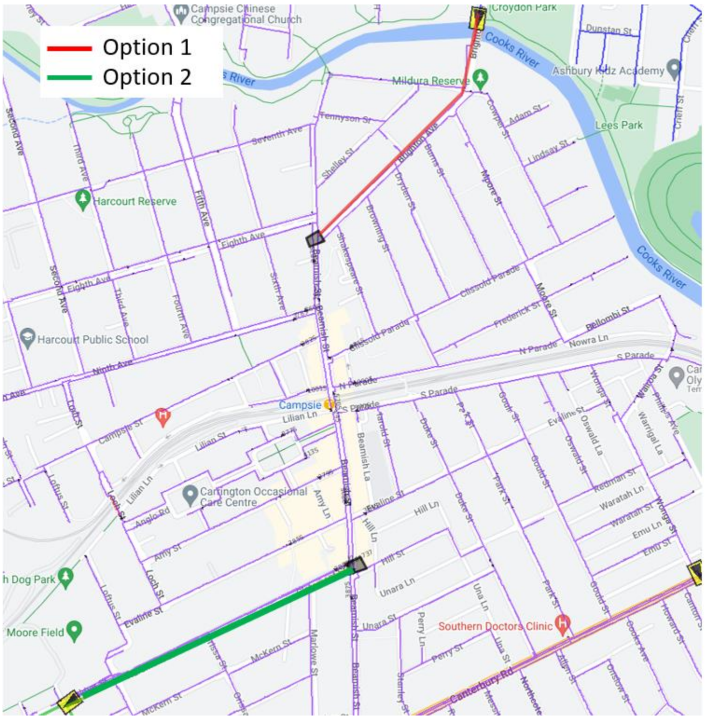


Figure 41: Reinforcement options for Campsie

Analysis: Campsie is a suburb located on a large low (7kPa) pressure network that had undergone mains rehabilitation in the early 90's. The suburb includes a large amount of high density living suburbs such as; Strathfield, Burwood, Canterbury, Campsie, Punchbowl, Bankstown and Lakemba. Many of these suburbs have train stations and have undergone significant residential and commercial growth. This is particularly the case for Campsie where a section around the train station is at risk of poor or loss of supply due to the growth seen around the area to date.

Network pressures over the last three years have deteriorated with pressures expected to reduce below our network minimum pressure of 3.5 kPa in 2026. This puts 430 customers in this area at high risk of poor or loss of supply.

Capacity modelling: Synergi models have been used to assess the network capacity and determine the most prudent and efficient option, as well as the project timing to ensure continuity of supply to customers. Figure 42, shows the network pressures for Campsie in 2026 when 430 customers are at risk of limited gas supply.

To ensure continuity of supply two options were considered. All options include introducing more gas supply into the area through SDRS. These are the only credible options as the network is already well interconnected and reinforced, meaning that options that consider further interconnections would not be effective is addressing the gas supply constraint.

The first option involves rehabilitating a section of the existing low pressure network and upgrading it to medium pressure. A new SDRS can then be installed that provides a new gas supply point from the medium to low pressure. The second option includes extending the secondary pressure mains and using this as a supply point into the low pressure network with the use of an SDRS. Both options provide similar improvements to the capacity of the area with the first being the lowest cost and hence the preferred option.

Figure 43, shows the pressure increase to above 3.5 kPa when the preferred option is installed.

Figure 42: Campsie network modelling in 2026 prior to reinforcement

Figure 43: Campsie network modelling in 2026 with preferred reinforcement option

Cost benefit analysis: The Costs and Benefits Analysis Model was used to assess the cost of augmentation against revenue generated by connecting new customers. Campsie is being upgraded with as a new Sydney metro station and with this a high forecast for high-rise and medium density development. Refer to file 'JGN - RIN - 4.3 - 13033949 - Campsie (Sydney South) - CBAM - 20240628 - Public' presents the cost benefit summary, showing the rehabilitate low pressure mains option as the recommended option due to the benefits outweighing the overall cost of the project.

Recommendation: Network reinforcement is needed to ensure customers can continue to connect to the network and reduce the likelihood of loss or poor supply to 430 customers in Campsie. The first option is preferred as it is the lowest cost to increase capacity supply in the area.

5.2.3 NORTH SYDNEY

Problem statement: The low pressure (7 kPa) network in North Sydney has experienced significant high rise and commercial development limiting the capacity in the area. Network reinforcement is required to prevent 420 customers from poor or loss of supply.

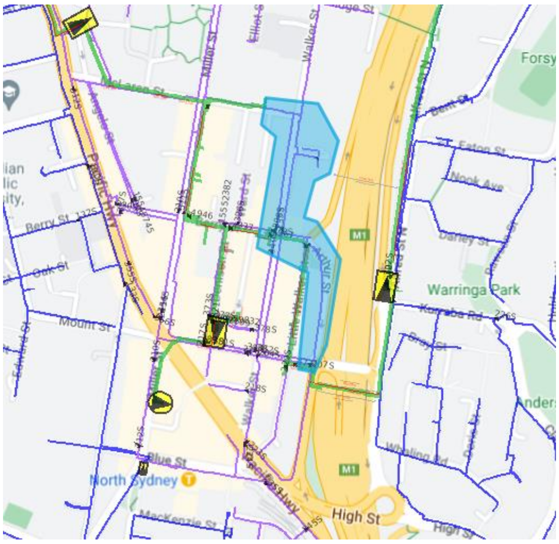


Figure 44: North Sydney customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	Poor or loss of supply to 420 customers	
1	Install new SDRS	Install new SDRS on Walker Street, on the corner of Walker and Berry St. This will bring in a new gas supply to the 7kPa area.	1.51[14]
2	Mount St interconnection	Lay 170m of 110mm PE from the outlet of the SDRS, along Mount St and tie into 75mm NY on Little Walker	0.60

[14] The file 'JGN - RIN - 4.3 - 10068856 - North Sydney CDP - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

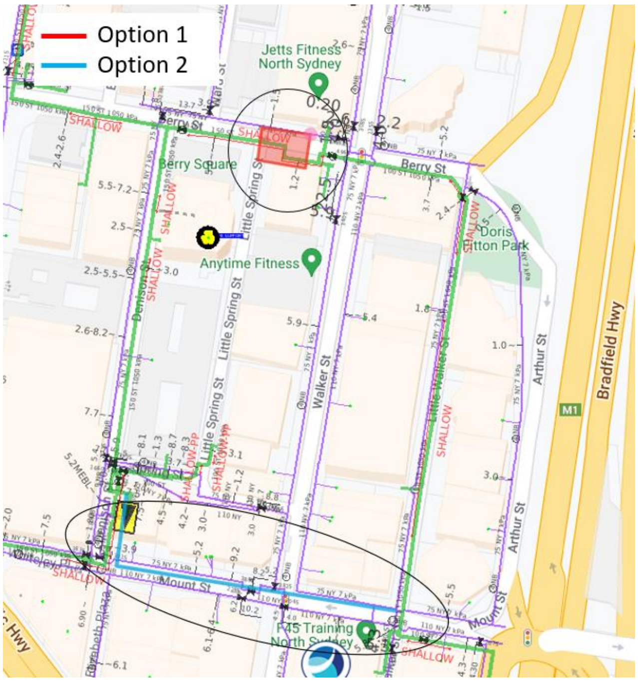


Figure 45: Reinforcement options for North Sydney

Analysis: The North Sydney area is supplied by a series of interconnecting low pressure and secondary pressure networks. There is a preference to connect new customers off the low pressure instead of the secondary in order to reduce the number of weak points in the secondary steel that may pose a leak or incident risk. Over the last few years new connections have been recommended off the secondary due to capacity limitations on the low pressure network. We are now at a point where no additional secondary connections are recommended and reinforcement is required to increase capacity on the low pressure network.

Recently, North Sydney has experienced considerable high-rise growth, limiting the capacity on the low pressure network and the ability to connect new customers. Synergi modelling shows that 420 customers are at risk of poor or loss of supply and reinforcement is required to increase capacity in the area in 2029.

Two options were assessed, the first is to install a new SDRS and enable more gas supply into the low pressure network. The secondary option was to reinforce a feeder main from one of the SDRS and extend the main to a street of limited capacity. This option only provides a limited amount of additional capacity and reinforcement would be required again in the short term.

Overall, Option 1 is preferred as it adequately addresses the risk of loss of supply.

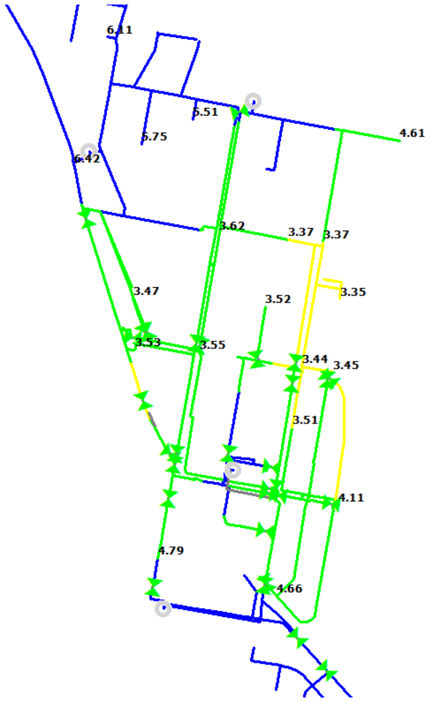


Figure 46: North Sydney network modelling in 2029 prior to reinforcement

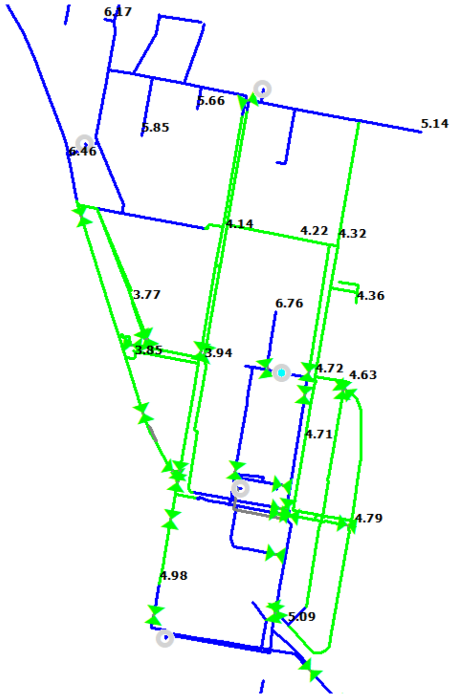


Figure 47: North Sydney network modelling in 2029 with preferred reinforcement option

Cost benefit analysis: North Sydney is a classified as a Central Business District (CBD) and has many high-rise and skyscraper buildings. With the addition of Victoria Cross metro station the area will continue to be developed and new large and high-rise buildings will be built. It is for this reason that the assumption for average revenue per volume boundary connection has been adjusted and the following assumptions have been applied:

- The average revenue per volume boundary connection has been increased by 1.5 times the standard revenue cost of ~$8,000 per annum. This is because the average high-rise building in North Sydney will be greater than the standard Sydney area. North Sydney Council typically have approved apartment buildings of 16 floors while the average building size across Sydney is 11 floors. This has been used as the basis for revenue increase.
- In May 2024 the Minn's government announced a rebalancing of housing across Sydney with North Sydney flagged as an area of growth. It is forecasted that 5,900 dwelling will be developed in the next five years.
- Four commercial developments like restaurants, cafes and business buildings will be built per annum.

Overall, the revenue is greater than the overall cost to augment. Refer to file 'JGN - RIN - 4.3 - 10068856 - North Sydney CDP - CBAM - 20240628 - Public'.

Recommendation: Network reinforcement is needed to continue connecting customers post 2029 and to reduce the likelihood of poor supply to 420 customers in North Sydney. The first option is preferred as it increases the capacity sufficiently enough in the area that reinforcement would not be needed again in the short term.

5.3 NEW ESTATE GROWTH AREAS

The areas in Sydney experiencing significant new estate growth are the North West and South West of regions. In these regions, additional infrastructure is required to support new connections. Similar to the medium density and high-rise development projects, we have conducted cost benefit analysis assessments to ensure the revenue generated from the connections exceeds the cost of augmentation. We have also reviewed the area's growth and assessed project options using Synergi modelling.

5.3.1 BOX HILL

The total cost for this project is > $2M, and an Options Analysis report has been created, see BAB-DAA-000100- Box Hill CDP.

5.3.2 EDMONDSON PARK

Problem statement: There is an opportunity to complete the final of a three stage project, involving connecting two sections of secondary pressure mains to ensure reliability of supply to Edmondson Park. This area has gone through considerable new estate growth and long term planning has enabled the supply of gas into the area. The final stage is forecast to occur in 2025-26 due to developer construction windows.

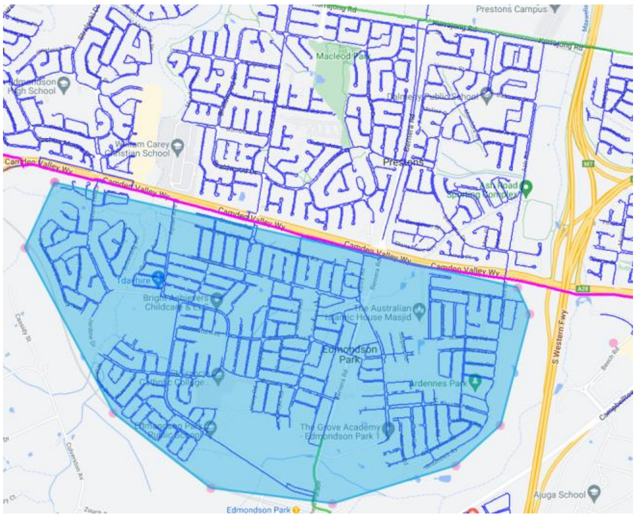


Figure 48: Edmondson Park customers who are at risk of poor or loss of supply

Options: The following options were considered to address the risk of poor or gas supply

	Options name	Description	Cost ($M)
	Do nothing	High risk of poor supply to 3,500 customers	
1	Secondary main and SDRS	Lay 500m of secondary pressure main and install an SDRS	1.42[15]
2	Camden Valley interconnection	Horizontal directional drill 125m of gas main across Camden Valley Way highway	0.80

[15] The file 'JGN - RIN - 4.3 - 10057750 - Edmondson Park Soldiers Pde Steel Main - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

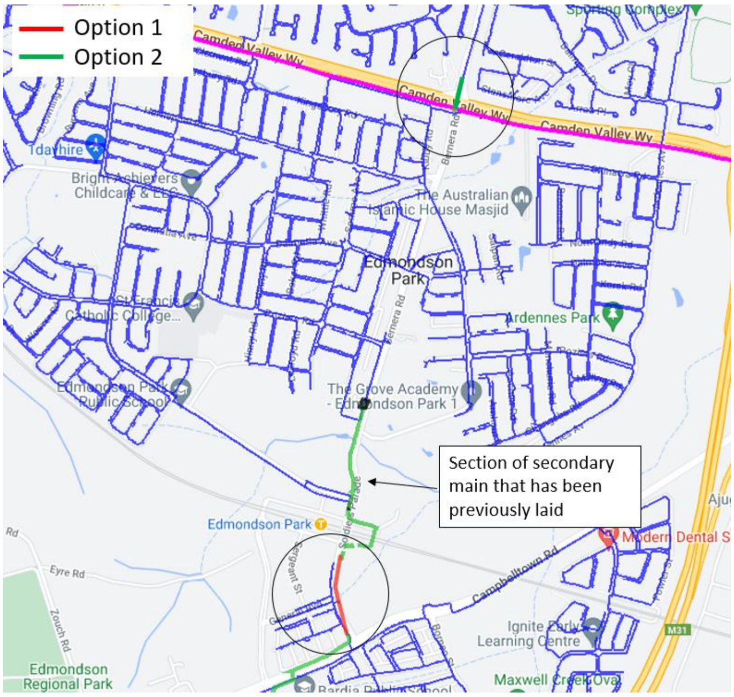


Figure 49: Edmondson Park scope map

Analysis: Edmondson Park has been an ongoing project delivered in stages from 2013. The first two stages of the overall project occurred in 2012, by constructing a portion of the secondary steel feeder main under the Edmondson Park railway line. This was a rare opportunity for Jemena to reduce construction costs at the time of the building the railway station which opened in 2015. A second stage involved laying ~200m of secondary steel was completed in 2019 during the RMS road widening works. This was again an important opportunity to extend our secondary network when road works were already being undertaken and in turn saving on construction costs.

We have now come to the final stage of the project, connecting the two secondary pipelines to ensure reliability of gas supply to customers in Edmondson Park. This involves laying 500m of 150mm ST and a district regulator set. This project originally proposed in 2023 has been delayed until 2025-26 due to ongoing liaison with the developer.

Area Growth: Edmondson Park has been rapidly growing in the last 5 years. The Enterprise Asset Management (EAM) tool has been used to review the growth and below is a summary of the last five years of customer numbers, consumption and revenue. The area has almost doubled in all metrics in the last five years and will continue to grow.

Table 6: Edmondson Park growth data

Year	2019	2020	2021	2022	2023
Customer numbers	2,826	3,137	3,484	3,726	4,029
Consumption (GJ)	40,512	50,755	63,472	70,228	74,770

Network pressure has deteriorated over the last few years with readings as low as 63 kPa. It is forecasted with the connection of village commercial centres and medium and high density around the train station, pressures will approach minimum and put customers at risk of poor or loss of supply.

Capacity modelling: Synergi modelling has been used to assess the options available to ensure reliability of supply. Figure 50, shows the network area at risk of poor supply if nothing was done to address the capacity constraints. There are 3,500 customers at risk of poor supply. The second option increases the pressure marginally (40 kPa) and reinforcement would be likely in the short term. Comparatively, option 1 increases the pressure to meet the growing demand as seen in Figure 51. Overall, option 1 is preferred from a modelling and cost perspective

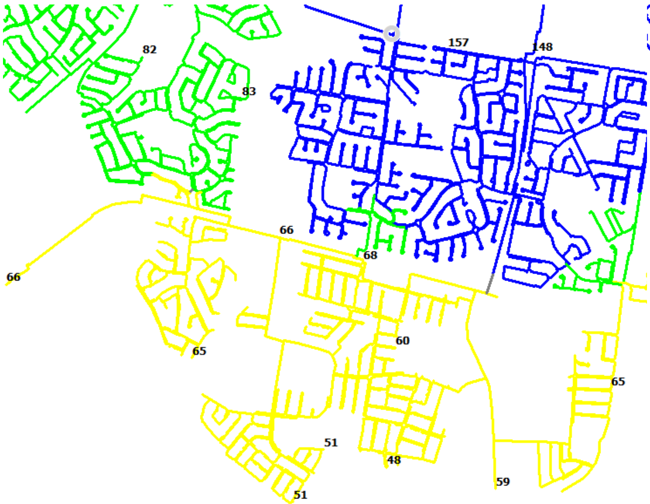


Figure 50: Edmondson network modelling prior to reinforcement

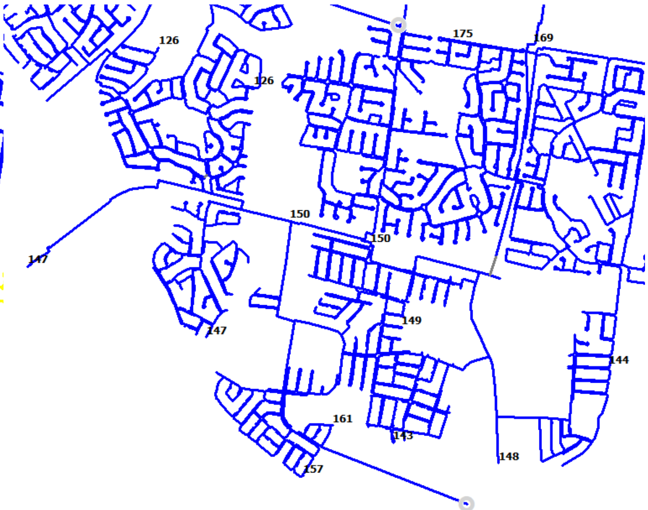


Figure 51: Edmondson network modelling with preferred reinforcement option

Cost benefit analysis: The Costs and Benefits Analysis Model was used to assess the cost of augmentation against revenue generated by connecting new customers. Edmondson park is a high growth new estate area and is forecasted to have over 2,300 dwellings over the next 10 years. The file 'JGN - RIN - 4.3 - 10057750 - Edmondson Park Soldiers Pde Steel Main - CBAM - 20240628 - Public', presents the cost benefit summary, showing the secondary main and SDRS option as the recommended option due to the benefits outweighing the overall cost of the project.

Recommendation: Network reinforcement is needed to ensure customers can continue to connect to the network and reduce the likelihood of poor supply to 3,500 customers in Edmondson. The first option is preferred as it is adequately increases the pressure of the network to support new estate growth and commercial development.

5.4 NETWORK PRESSURE REDUCTIONS

As part of our network pressure reduction program, the Blue Mountains has been identified as one of the initial network areas to be lowered from 300 kPa to 210 kPa.

5.4.1 BLUE MOUNTAINS PRESSURE REDUCTION

Problem statement: Network pressure reduction is a key component of JGN's emissions reduction strategy. The Blue Mountains currently operates at 300 kPa and has been identified as an area that could be reduced to 210 kPa with the addition of reinforcements.

Options: The following options were considered to enable the network pressure to be decreased

	Options name	Description	Cost ($M)
	Do nothing		
1	Install new SDRS	• Lay ~10m of 50mm ST crossing Waratah Rd. • Install SDRS. • Lay ~100m of 110mm PE in Waratah Rd and tie in to 50mm NY.	0.54[16]
2	Highway interconnection	• Lay 570m of 110mm PE main in Layton Ave, across Greater Western Highway. Tie in to 50mm NY in Hope St and 32mm NY in Layton Ave.	0.85

Analysis: Network reinforcement is required to reduce the pressure of the network, as seen in Figure 52. Simply downgrading the pressure as the network is today will result in loss of supply to over 1200 customers. To restore the pressure to above minimum, many options were considered with two being credible. The first is to install a new gas supply point with an SDRS and the second is the carry out a long interconnection across an RMS road. Both options provide similar amounts of capacity, so the lower cost option was preferred. In this instance the SDRS option was lower cost due to the high costs of crossing the Great Western Highway in the second option.

[16] The file 'JGN - RIN - 4.3 - 10071182 - Blue Mountain Pressure Reduction Glenbrook-Springwood - PEMO - 20240628 - Public' contains details on the cost build-up for the preferred option.

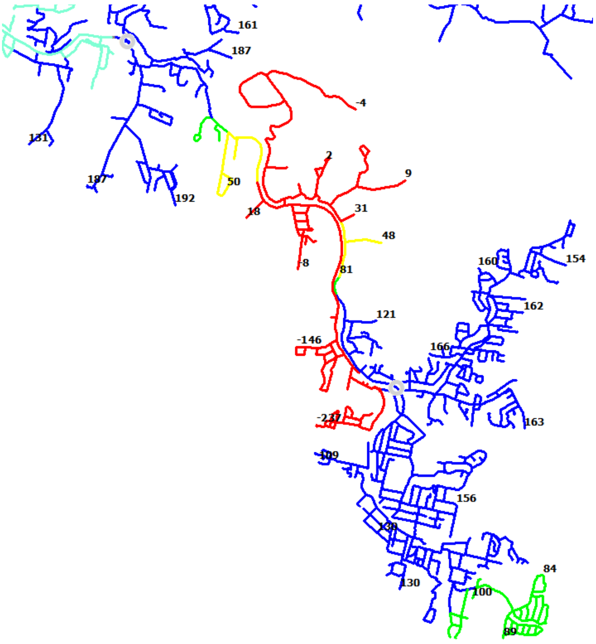


Figure 52: Blue Mountains network modelling with network downgrade to 210 kPa prior to reinforcement

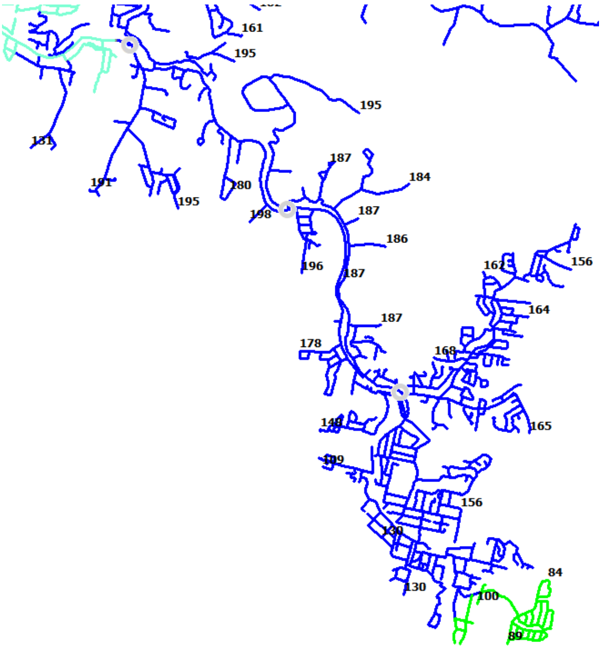


Figure 53: Blue Mountains network modelling with network downgrade to 210 kPa and with preferred reinforcement option

Recommendation: Network reinforcement is needed to enable the network MAOP to be reduced from 300 kPa to 210 kPa. This decrease will result in emissions reduction.

5.5 WINTER GAUGING PRESSURE MONITORING

Winter gauging is an annual program carried out to ensure the reliability of gas supply through winter pressure monitoring. This monitoring enables the identification of network improvement areas, allowing for timely recommendations in terms of network reinforcements that reduce the risk of poor or loss of supply to customers.

During the winter peak period (June - September), we use pressure data logging devices known as pressure gauges in the network to monitor pressure in each of the gas networks. The data from the winter gauging program is then used to validate the network modelling (Synergi) and identify locations with supply issues that require reinforcements.

We use 300 pressure gauges to monitor the network pressure. These devices typically have a lifecycle of five years. In 2020, many data loggers had past their product lifecycle, and a significant number had exceeded their battery life expectancy, with more than half failing in the year prior. These gauges also relied on 3G telecommunications technology, which was forecasted to be obsolete by June 2024. A project was initiated to implement the procurement of new pressure gauges in 2021, and 300 new gauges with enhanced technology were procured. The business case was approved for $780,000 in $Real 2021.Table 8 shows the historic expenditure for winter gauging $ Real 2023.

Table 8: Historic expenditure for winter gauging

Project	Project ID	RY21	RY22	RY23	Total Project Actuals
Winter Gauging 5 Year Device Replacement	R-GEAW	$832,900	(491)	0	$832,409

The pressure gauges procured in 2021 have an expected lifecycle of five years, but can be extended for an additional two years if necessary. Therefore, the timing for replacement of these devices is scheduled seven years later in 2028 (RY28). The replacement volume is planned to be 300 units, with a cost estimate of $780,000 which was based on the prior business case approved value, Table 9.

It is required to replace the pressure gauges when they reach the end of their lifecycles based on the following reasons.

1. **Customers:** If we are unable to monitor the network capacity, there is a potential for customers to lose supply. This may result in loss of supply, relights and inconvenience to customers.

2. **Operational Cost**: In efforts supporting the failing gauges, Service Technicians are required to make frequent trips to these gauge locations to reset the gauges in efforts to bring them back to life from a low-battery level or swap them with a working gauge from another site. This additional operational cost will continue to worsen.

3. **Investment trigger increase**: It is because of our investment in monitoring equipment that we were able to reduce the investment trigger for existing demand and medium density / high-rise areas. If we are unable to continue this investment the trigger would need to be lifted, as the network visibility would be severely reduced.

Table 9: Winter gauging requirement

Project	Project ID	RY28 Forecast Requirement
Winter Gauging 5 Year Device Replacement	R-GEAW	$780,000

6. RECOMMENDED PROJECTS

A summary of our recommended projects and the costing method applied is described below.

6.1 SCHEDULED PROJECTS FOR 2025-2030

The following projects are recommended to ensure continuity of supply to JGNs customers. Projects have only been proposed where the risk of loss of supply is high and networks will be continually monitored to ensure the reinforcement is installed at the right time.

Table 10: Overview of Planned Capacity Driven Projects

Planned projects cost estimate (million real $2023)								
Project name	**Project ID**	**RY25**	**RY26**	**RY27**	**RY28**	**RY29**	**RY30**	**Total**
Edmondson Park Soldiers Pde steel main	10057750	0.33	1.59	-	-	-	-	1.92
Auburn CDP	10065576	-	0.28	0.62	-	-	-	0.90
North Sydney CDP	10068856	-	-	-	-	0.39	1.14	1.53
Box Hill CDP	10068428	1.37	1.43	-	-	-	-	2.96
Woolwich Low Pressure CDP	10054437	-	-	-	0.41	0.32	-	0.73
Bayview Low Pressure CDP	10054436	-	-	-	0.08	0.11	-	0.19
Gymea Bay 210 KPA CDP	10000024	-	-	0.58	0.36	-	-	0.94
Campsie (Sydney South)	13033949	0.35	1.06	0.01				1.42
Umina Beach Low Pressure CDP	10068848	-	-	0.77	-	-	-	0.77
Goulburn 7kPa CDP	10069030	-	0.12	0.08	-	-	-	0.20
Figtree CDP - Stage 2	10068727	-	-	-	-	0.35	0.23	0.58
Blue Mountains Pressure Reduction Glenbrook-Springwood	10071182	-	0.10	0.44	-	-	-	0.54
Winter Gauging 5 Year Device Replacement	R-GEAW				0.78			0.78
Total		2.05	4.58	2.5	1.63	1.17	1.37	13.40

6.2 PROJECT COSTS

All proposed projects have followed Jemena's Project Management Methodology (**PMM**) by identifying issues or opportunities on the network through Opportunity Brief's as part of the normal Business-as-usual (**BAU**) process.

Cost estimations for the proposed augmentation projects were obtained using the Project Estimation Model (**PEM**), in accordance with JEM PR 2542 Jemena Infrastructure Cost Estimation Procedure. Those projects that fell outside the current normal Capital and Operational Work Plan (**COWP**), post year 2030, were estimated using recent historical project actuals with similar scopes, and scaling the proposed projects with the correct lengths, materials and regulators.

7. TERMS AND DEFINITIONS

Term	Definition
AA	Access Arrangement
APA	Australian Pipeline Association
BAU	Business As Usual
CAP	Capacity Augmentation Project
CBD	Central Business District
COWP	Capital and Operating Work Plan
CWP	Central West Pipeline
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EGP	Eastern Gas Pipeline
HRVB	High Rise Volume Boundary
HRVI	High Rise Volume Individual
JGN	Jemena Gas Networks
kPa	Kilopascals
LGA	Local Government Area
MAOP	Maximum Allowable Operating Pressure
MD	Medium Density
MSP	Moomba to Sydney Pipeline
NGR	National Gas Rules
NGSF	Natural Gas Storage Facility
NPV	Net Present Value
PE	Polyethylene
PEM	Project Estimation Methodology
PMM	Project Management Methodology
Scmh	Standard Cubic Metres per Hour
ST	Steel
VB	Volume Boundary
VI	Volume Individual
WACC	Weighted Average
WSA	Western Sydney Airport
WSHH	Western Sydney Hydrogen Hub

8. REFERENCES

8.1 INTERNAL

Document No.	Revision	Title	ECMS Link
GDN-1999-SP-DN-001	0	Capacity Design Specification Manual	http://ecms/otcs/cs.exe/link/309709655
GAS-199-RP-DN-002	0	Flow Diversity Monitoring Project	http://ecms/otcs/cs.exe/link/314096426
JAA MA 0050	8	Jemena Group Risk Management Manual	http://ecms/otcs/cs.exe/link/295482907
JEM PR 2542		Jemena Infrastructure Cost Estimation Procedure	

8.2 EXTERNAL

Document No.	Revision	Title	WEB Link
AS / NZS 4645	2018	Gas Distribution Network Management	(Refer SAI Global Website)