Jemena Gas Networks (NSW) Ltd

Bankstown/Chullora/Greenacre 7kPa Rehabilitation

Table of Contents

1. Summary

This gas mains rehabilitation business case identifies options to address the ongoing decline of network integrity and performance in the Bankstown / Chullora / Greenacre (BCG) network. The preferred option is to replace all cast iron mains within the BCG network with new Polyethylene (PE) mains at a cost of $8.1M whilst maintaining network operating pressure at 7kPa.

The BCG network is supplied through 11 regulator sets, providing gas supply to approximately 13,000 customers. The total length of mains is approximately 230km, with a mixture of cast iron and unprotected steel mains being 23km and 20km respectively. The remaining 187km of mains within the network primarily consist of plastic.

The cast iron mains were laid from the 1920s through to the 1970s, with the majority being laid during the 1950s and 1960s. In the mid-1980s, a rehabilitation program was undertaken that replaced most of the cast iron mains in the network, however 23km still remains. Typical of the older ferrous gas mains in the industry, cast iron and unprotected steel mains in the network do not have effective protection measures such as coatings or cathodic protection (CP). As a result, the unprotected ferrous mains have gradually corroded over the past 70+ years. The figures below indicate the inefficiency of repairing corroded cast iron mains, as opposed to replacement of the main. The repair clamps currently used only address the localised leak, however adjacent areas of the main are likely to be equally corroded and are likely to fail in due course causing additional leaks:

Figure 1-1&2: Examples of corroded cast iron mains and a repair clamp used throughout JGN

All Australian gas distribution businesses are systematically removing, or have fully removed these types of older ferrous mains due to the increased safety, integrity and supply risks posed to the customers, general public and employees. Reduction in greenhouse gas emissions is a further driver for removing aged ferrous mains. There is a strong focus from customers and governments on emissions reduction, who expect energy providers to play their part in achieving greenhouse gas targets. The introduction of the Safeguard Mechanism[1], which requires industrial facilities (including gas networks) to reduce greenhouse gas emission by 4.9% per year, means it is essential the poorest condition mains are removed as soon as practicable.

Unaccounted for gas (UAG) is an indicator of network integrity and leaks, with JGN's overall network allowance being 2.9% of throughput. The UAG from the BCG network is significantly higher in comparison to the overall JGN network. These high leak rates, coupled with emissions reduction targets means the mains rehabilitation program should not be deferred further.

As part of our ongoing mains rehabilitation program, we will replace the cast iron mains within the BCG network as one project, with the first phase planned to start in 2025.

1.1 Business need

The primary drivers for undertaking the BCG network rehabilitation project are to:

- Ensure customers receive a reliable gas supply now and in the near future.

[1] See link.

- Reduce greenhouse gas emissions in alignment with Jemena's Emission Reduction Strategy.

Supporting benefits that further justify the need for delivering this project are to:

- Reduce the number and magnitude of gas leaks to improve personnel and public safety.
- Comply with Standards and Statutory Requirements.
- Reduce operational and UAG cost.
- Reduce emergency incidents and repairs.

1.2 Customer feedback

Customers have told us they value a safe and reliable gas supply, and expect Jemena to ensure the gas network remains safe and that gas is available when customers need it. In recent engagements, customers have indicated a preference for targeted investment in safety and reliability, encouraging JGN to proactively manage integrity issues with the aim of reducing ongoing maintenance costs. A strong theme that emerged from the customer engagement program is that while customers expect JGN to keep costs as low as practicable and encourage non-critical investments to be deferred where prudent to do so, safety must not be compromised.

Customers have suggested JGN should carefully consider the pace of investment, and take a considered approach to how the network may be used in the future. Customers would like JGN to consider affordability over the short and long term when making decisions. Customers expect Jemena to act now and plan for a net zero emissions future, rather than delaying investment. This includes looking at how new technology could be applied to improve asset management.

Reduction in greenhouse gas emissions is also valued by customers. Residential customers have expressed a preference for lower-emissions technology and support exploration of renewable gas technologies. Some larger customers have their own emissions reduction targets and expect their energy providers to play their part in facilitating a greenhouse gas decrease.

Customers continue to connect to the gas network. While growth in demand for natural gas services has slowed in recent years, new connections will continue during the next regulatory period, with growth expected in some pockets of the network. The distribution network is expected to continue to play a major role in NSW's energy future, as customers have told us that they value choice and diversity in their energy supply. Though there is a current trend towards electrification of industries, 85% of Sydney's customers agree that NSW needs a mix of energy sources – including solar, wind and gas – and that we should not 'put all energy eggs in one basket'. 78% of customers support having the choice of renewable gas options as part of the energy transition.[2]

Hundreds of thousands of customers remain dependent on the gas network, with many not being willing or able to switch away from gas as an energy supply. As such, while investment in network growth may be more conservative than compared to historical levels, it is important JGN continues to invest to sustain the network and ensure compliant pressures and uninterrupted supply.

1.3 Recommendation

In order to address the risks identified, five options have been considered.

Table 1–1: Summary of options

Option	Description	Total Capex	Risk
1	Reactive maintenance only	$0	Significant

[2] Redbridge, Sydney energy attitudes and sentiments, December 2023.

2	Reactive maintenance with minor capital works on ferrous mains	$5.6M (Total from 2024-2050)	Moderate
3	Replace cast irons mains with plastic mains and maintain network pressure at 7kPa	$8.1M	Low
4	Rehabilitate all ferrous mains and maintain network pressure at 7kPa	$15.4M	Low
5	Rehabilitate all mains and increase network pressure to 210kPa	$93.4M	Low

Option 3, which is to rehabilitate the cast iron mains and maintain network operating pressure at 7kPa is considered the most prudent option. This project will eliminate the risks of gas leaks, mains repairs and operational costs associated with cast iron main corrosion in the BCG network.

This option is consistent with customer feedback, in that it is a more targeted program than historical mains replacement initiatives and will focus solely on the cast iron mains.

1.4 Consistency with the National Gas Rules and National Gas Objective

When developing this business case, we have given regard to the requirements of the National Gas Rules (NGR) and the National Gas Objective (NGO).

NGR 79(1)

We submit that the proposed solution is prudent, efficient, consistent with good industry practice, and will achieve the lowest sustainable cost of providing services.

- **Prudent** – The expenditure is necessary in order to ensure the safety of the BCG network and the reliability of service to the thousands of customers who are dependent on the network's ongoing operation for gas supply. The work will reduce the current rated risk level to low.
- **Efficient** – Removing all the cast iron in the area as one project is the most cost effective option. Removal of the unprotected steel and other mains materials can be prudently deferred until such time that new technologies (such as Picarro) can inform future strategic replacement programs.
- **Consistent with accepted and good industry practice** – The removal of cast iron mains from distribution networks is consistent with accepted and good industry practice by other distribution companies across the country who are also on a pathway to removing, or have already removed all unprotected cast iron mains. The installation of PE that is capable of higher pressures is considered industry standard.
- **Achieve the lowest sustainable cost of delivering pipeline services** – A targeted cast iron replacement project that achieves the lowest sustainable cost of providing services, whilst being conscious of the changing landscape of gas and customer sentiment. It is prudent to invest now to remove cast iron throughout the network to assist keeping costs sustainable over the long term, as leaving in situ results in escalating maintenance, emissions and UAG costs, as well as unacceptable safety concerns.

NGR 79(2)

The proposed capex is justifiable under NGR 79(2)(c)(i) as it is necessary to maintain the safety of personnel and the public living and working around the ageing cast iron network. The rehabilitation works can also be justified under NGR 79(2)(c)(v) as removing these leaking cast iron mains will contribute to meeting emissions reduction targets.

NGR 74

Demand forecasts are based on 2023 data, and the cost estimate has been developed using a top-down approach, utilising information from similar projects that went through a competitive tender process. We therefore consider that this estimate has been developed on a reasonable basis and reflects the best information available at this time.

NGO

Removing the aged cast iron mains from the network also contributes to achieving the NGO, specifically with regard to emissions reduction. Leakage rates in the BCG network are significantly higher than the overall network. Replacing these leaking mains with fit-for-purpose plastic mains will significantly reduce the volume of UAG, and therefore the volume of methane potentially released into the atmosphere. This is likely to contribute towards achieving NSW emissions reduction targets and reducing Australia's greenhouse gas emissions.

SAFEGUARD MECHANISM

The Safeguard Mechanism is the Australian Government's policy for reducing emissions at Australia's largest industrial facilities which includes mining, oil and gas industries, manufacturing, transport and waste facilities. The Safeguard Mechanism applies to facilities emitting more than 100,000 tonnes of carbon dioxide equivalent (tCO2-e) per year. There are legislated limits (also known as the "Baseline") on emissions which gradually decline (approximately by 4.9% yearly) over time to achieve emissions reduction targets. If emissions exceed the baseline target for the given year, the company will incur penalties as a result, and on the contrary to that, if emissions remain under baseline then they receive a credit. The greenhouse gas emission reduction target for NSW by 2030 is 50% below 2005 levels and approaching net zero by 2050. In 2022, JGN's emissions accounted to 336,260 tCO2e from which 98% was due to fugitive emissions from the medium pressure and low pressure networks. This ranks JGN within the top 100 emitters throughout Australia.

1.5 Financial information

The cost estimates for this project were benchmarked against similarly scoped projects that have undergone a competitive tender process as per Jemena's Project Management Methodology Summary of Costs.

Table 1–2: Summary Of Costs

Item	Project estimate ($000)
Jemena/Zinfra Labour & Materials	$301,167
Contractor	$4,157,644
Total Direct Costs	***$5,734,114***
Risk Allocation	$1,275,303
Overheads	$2,356,148
Total Project Estimation	***$8,090,262***

2. Background

The Bankstown/Chullora/Greenacre (BCG) network is currently operating at 7kPa with 11 Regulator Sets supplying gas to approximately 13,000 customers. This particular network consists of ~230km worth of mains of varying materials, with cast iron and steel mains making up 23km & 20km respectively. The remaining 187km of mains are plastic.

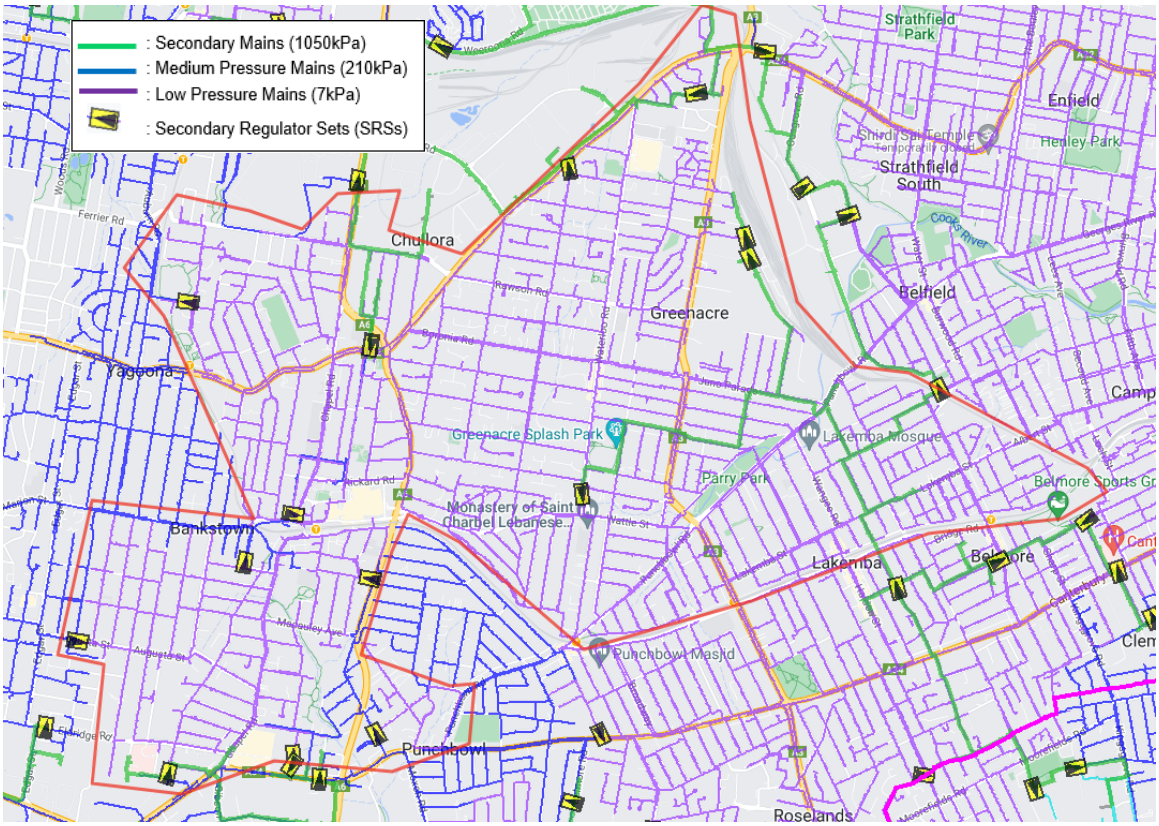
The cast iron mains were predominantly laid from 1920s through to the 1970s and are typically constructed of four and six inch mains. From the 1980s, the network has progressively been laid with plastic mains such as nylon and polyethylene. Over the past decade, the cast iron mains in the network have deteriorated to a point where the network consistently fails a number of performance indicators.

There have been multiple instances where the mains in this network have failed, causing gas leaks and risks to the public and community, also necessitating road closures and evacuations for repairs to occur. Leak rates in this area are higher than the network overall average, resulting in poor emissions performance. This network has been earmarked for replacement for some time. We have been able to defer cast iron replacement for several years, however the network has continued to deteriorate during this time. Current leakage rates and the associated safety, supply, and emissions concerns means it would not be prudent to defer these works further.

The BCG network is connected to the neighbouring Haberfield / Strathfield / Campsie 7kPa network, which is also experiencing the same network degradation issues as all the mains were installed at a similar time in similar conditions.

The Bankstown/Chullora/Greenacre network map is shown below.

Figure 2–1: Bankstown / Chullora / Greenacre 7kPa Network Map



2.1 Risk analysis

The current network performance gives rise to serious safety and operational risks, as well as a financial risk in paying penalties due to emissions exceeding baseline targets in relation to the Safeguard Mechanism. Unless action to mitigate risks is taken, gas release leading to serious harm, significant disruption to customer supply, or causing JGN to exceed its Safeguard Mechanism legislated limit will all be risks of a higher likelihood. The risk level for this project is therefore assessed as 'significant'. Under JGN's risk framework, any risks deemed significant (or higher) must be addressed to reduce the risk to low, or as low as reasonably practicable (ALARP).

A risk assessment was conducted to determine the extent of the untreated risk. The risk assessment was undertaken in accordance with the Group Risk Management Manual JAA MA 0050 Revision 10.

Table 2–1: Risk rating

Contributing Factors/ Scenario	Strategic	Financial	Safety	Operational	Regulatory & Compliance	Reputation	Consequence (Highest Impact)	Likelihood	Risk level
Degradation of pipe and fittings causing gas release	Minor	Minor	Serious	Serious	Serious	Minor	Serious	Likely	Significant

Table 2–2: Untreated risk summary

Risk type	Consequence	Likelihood	Untreated risk summary	Risk Level
Strategic	Minor	Likely	• To not complete the works would not be in alignment with JGN's Networks Asset Class Strategy. • Jemena emission reduction strategy would be impacted as this network has a high leakage (UAG 36% vs 2.9% benchmark).	Moderate
Financial	Minor	Possible	• Jemena incurs higher operating costs to purchase gas to replace the gas lost through leakage. • If the ageing and corroding cast iron remains in situ, operating costs will continue escalating as unplanned and emergency repairs will increase. • Jemena will also be liable to pay penalties for failing to reduce emissions below baseline targets as per the Safeguard Mechanism.	Moderate
Safety	Serious	Possible	• Leakage from corrosion of the pipe and fittings could cause fire and gas incidents that lead to injury to the public and Jemena employees. • Environmental damage due to higher leakage rates from emitted UAG.	Moderate
Operational	Serious	Likely	• Supply to customers would likely be affected in the event of emergency repairs. • Continuity of supply and level of service to customers cannot be assured when operating a network which requires continual maintenance and repair.	Significant
Regulatory	Serious	Possible	• High rates of leakage have the potential to cause adverse publicity. In larger incidents, reports may be requested by the technical regulator.	Moderate

			• Jemena will also be liable to pay penalties for failing to reduce emissions below baseline targets as per the Safeguard Mechanism.	
Reputation	Minor	Unlikely	• Responding to a high level of emergency incidents and repairs has required the use of the fire brigade and the police to ensure public safety. This is a drain on this resource to attend gas emergencies, as this also affects their availability to the community • Constant customer complaints and being unsatisfied with the service may lead to higher disconnections and adverse media attention, which would negatively impact the reputation of Jemena.	Low

2.2 Consistency with asset class strategy and plans

As described in JGN's Networks Asset Class Strategy, our assets are necessary for the safe distribution of gas, while ensuring the correct pressures and volumes are available to all of our customers at all times. In addition to keeping the network safe and reliable, understanding and minimising our fugitive emissions is critical to help achieve net zero greenhouse gas emissions and comply with JGN's legislative requirements.

Investment in the networks asset class is largely driven by the installation of new mains to service new areas, as well as the timely replacement of existing mains and services. The replacement of mains, services and pressure reducing facilities is optimised to achieve a balance of targeted risk reduction, whilst still maximising economies of scale where possible. Once network assets are in service, as prudent asset managers it must be ensured that these assets continue to function safely, and remain fit for purpose, replacing or refurbishing them in a timely manner. Our aim is to manage our network assets for the lowest practicably sustainable cost.

Our key considerations are:

- **Safety** – It is vital our network assets remain safe and compliant. We replace network assets when they pose an unacceptable safety risk. This may be due to deterioration in asset performance, or a change in the local environment that increases the risk associated with asset failure and/or unacceptable gas leaks. It is also important that our networks are constructed in compliance with AS/NZS 4645: Gas Distribution Management and its relevant parts, and that our network activities and asset management align with ISO 55001. This enables us to demonstrate to ourselves, our customers, external stakeholders and business partners that we maintain good industry practice, whilst managing our risk to as low as reasonably practicable.
- **Reliable service** - It is vital our network assets continue to provide the required levels of service. Our networks and flow stopping activities are designed such that third party damage incidents as well as planned and reactive maintenance is such that it does not interrupt the supply to residential, commercial or industrial customers where possible. Hydraulic modelling and network design ensure that network pressures and capacity are carefully balanced to remain above the minimum allowable limits, whilst also being mindful that higher pressures result in increased fugitive emissions.
- **Enable net zero** – We have a responsibility under the Safeguard Mechanism and the Government's Net Zero 2050 targets to reduce our greenhouse gas emissions, and to use our network assets to help customers reduce theirs. The largest source of greenhouse gas emissions from our network is fugitive gas. Therefore, where there is an opportunity to modify our network assets to reduce or better measure our greenhouse gas emissions we will consider investment. Similarly, where renewable or lower- emissions gasses are introduced into the gas distribution system, we must also invest in the appropriate network assets to ensure they remain safe and that gas volumes can be measured accurately.

Jemena's Emissions Reduction Plan is to reduce CO_2 emissions to Net Zero by 2050. The Federal Government is also mandating via the Safeguard Mechanism to reduce 4.9% of CO_2 emissions every year from mid-2024 to 2030. In Jemena Gas Networks (JGN) the biggest contributor to CO_2 emissions is in the form of methane from fugitive emissions on gas assets, namely mains, services and meters.

The key pillars of the Emissions Reduction Plan for JGN are:

- Pressure reduction (both permanent and seasonal)
- Targeted network repair and replacement, and
- System use gas reduction.

The replacement of the cast iron mains in the BCG network aligns to the strategies presented in the JGN Network Asset Class Strategy 2023 such as safety, reliability and reducing fugitive emissions.

3. Options

Option costs & benefits

The following options were identified:

- **Option 1**: Reactive maintenance only
- **Option 2**: Reactive maintenance with minor capital works on ferrous mains
- **Option 3**: Replace cast iron mains with plastic mains and maintain network pressure at 7kPa
- **Option 4**: Rehabilitate all ferrous mains and maintain network pressure at 7kPa
- **Option 5**: Rehabilitate all mains and increase network pressure to 210kPa

3.1 Option 1: Reactive maintenance only

This option considers reactively responding to network maintenance as it continues to deteriorate over time, with no planned or proactive maintenance to be conducted. The risk profile will continue to escalate with more corrective maintenance occurring in an attempt to maintain an acceptable level of safety and reliability, thus rendering this option infeasible.

There are increasing costs associated with responding to larger and more frequent publicly reported leaks, as well as increasing operational costs for UAG, and ongoing penalties for failing to reduce emissions below legislated limits in accordance with the safeguard mechanism. This option does not support the transition to 'Net Zero by 2050'.

This option would result in a starting operating cost of ~$870k in 2024, and progressively increases up to ~$1.42M p.a. by 2050.

3.1.1 Benefits

There would be no immediate capital investment in the network, therefore this is a less capital-intensive option and would have a lower impact on network tariffs in the short term. However, reactive operational maintenance costs would escalate significantly over time given that no proactive maintenance will be completed.

3.1.2 Limitations

- If no proactive work is undertaken, the regression analysis demonstrates publicly reported leaks will increase further in the following years. The likelihood of an incident that may cause injury would therefore increase with a higher frequency of publicly reported leaks. This option fails to improve safety to customers.
- Continuity of supply cannot be assured when operating a network that requires continual maintenance and repair. Hence, this option fails to improve reliability of supply for customers.
- This option also fails to improve efficiency and affordability to customers, as operational costs will continue to increase due to recurring operating and maintenance activities, increased UAG, lost revenue from current customers and reputational damage to Jemena.
- This option will also involve ongoing penalties for failing to reduce emissions below legislated limits in accordance with the safeguard mechanism.

- This option limits our ability to reduce emissions from gas leaks and enable a comparison of the emissions using the Picarro technology of pre and post repair. Hence, this option does not support the transition to 'Net Zero by 2050' and Jemena's emissions reduction strategy.

3.2 Option 2: Reactive maintenance with minor capital works on ferrous mains

Under this option, we would deliver a program of minor capital works, with any other works undertaken on a reactive basis. This option considers reactively responding to network maintenance as it continues to deteriorate over time, along with minor capital targeted rehabilitation activities. The priority of mains to be rehabilitated is based on the risk level of individual sections of mains, relative to each other.

The capital cost for this option is approximately $200k per year with annual operating costs starting from $870k in 2024 increasing up to $931k in 2050.

3.2.1 Benefits

- This option would allow JGN to address the most urgent risks first, with the remainder of issues managed on a reactive basis.
- According to the priority and level of deterioration of the mains within the network, individual sections will be replaced to reduce the ongoing leaks and associated repairs this would ensure customers receive a reliable gas supply.

3.2.2 Limitations

- This option would require capacity development projects to ensure adequate pressure is maintained in all parts of the network. Additionally, as the network deteriorates at an increasing rate, opex would likely never reduce, hence the option fails to improve efficiency of the network and affordability to customer.
- The success of this option requires JGN's minor works program to keep pace with the deterioration of the ferrous mains network. There is a risk under this option that the volume of ongoing reactive works would increase as further integrity issues are discovered.
- This option limits our ability to reduce emissions from gas leaks and enable a comparison of the emissions using the Picarro technology of pre and post repair. Hence, this option does not support the transition to 'Net Zero by 2050' and Jemena's emissions reduction strategy.
- This option is not consistent with long-established good practice of the industry to proactively remove aged cast iron mains from gas distribution networks.
- This option will still involve ongoing penalties for failing to reduce emissions below legislated limits in accordance with the safeguard mechanism.

3.3 Option 3: Replace cast iron mains with plastic mains and maintain network pressure at 7kPa

This option replaces all the remaining cast iron mains (23km) in the BCG network. The scope involves insertion of new PE mains into cast iron mains, with the project to be completed in 2027. The performance of the network's plastic mains is considered satisfactory.

It is historical practice that once a network area is rehabilitated, operating pressures are increased as part of the same project. However, network modelling demonstrates that with a minor reinforcement and an additional regulator set, the existing 7kPa network will meet the capacity demands of customers for the short-to-medium term. Therefore, any pressure increase is not required until such time that capacity constraints determine it must be done.

Based on the bottom-up costing for this rehabilitation, the forecast capex is $8.1M ($2023). Ongoing operational costs after the completed works are estimated to be $35K per year, until 2050. This project is expected to

commence in 2025, as the deferral of cast iron mains replacement poses an unacceptable risk, because of poor integrity, high leakage rates of 36% which in turn causes safety and supply issues. Customers have also expressed the high importance of emissions reduction. Our plan to target a network with high UAG aligns with customer expectations.

Reduction of emissions, and reliability of supply are the strongest drivers of this mains replacement project. Considering the ongoing operational and maintenance costs, as well as the cost of UAG is initially ~$870K p.a. prior to commencing the project, we are planning to mobilise construction in 2025.

3.3.1 Benefits

- Cast iron mains account for the greatest number of leaks and repairs in the BCG network. The mains rehabilitation project will further improve safety to customers by reducing the number and frequency of publicly reported leaks, as well as undetected leaks. Consequently, it will reduce the risk and potential harm to our customers, the public and Jemena personnel.
- Less reactive maintenance would practically eliminate network supply interruptions derived from publicly reported leaks, ensuring customers receive a reliable gas supply.
- Rehabilitating the cast iron mains will significantly reduce emissions in the form of UAG, as well as its associated cost such as penalties from non-compliance with the Safeguard Mechanism. It would also enable us to reach Jemena's emission reduction target of 'Net Zero by 2050'.
- A proactive cast iron mains replacement is the most efficient manner to remove the risks with significantly lower costs than a mains repair or a piecemeal reactive mains replacement. This is because the fixed costs associated with replacing mains are spread over a greater volume and using the insertion technique is a cost-effective replacement methodology. Also, the project can be designed such that minor network capacity upgrades can be achieved when replacements are done.
- Operating costs will be reduced significantly after the rehabilitation project, making the network more affordable to customers over the longer term.

3.3.2 Limitations

- The older plastic mains will still have levels of leakage. However, the repair of plastic mains is less complex than for ferrous mains while the magnitude of leakage is also typically lower.

3.4 Option 4: Rehabilitate all ferrous mains and maintain network pressure at 7kPa

Under this option, we would replace all 43km of remaining ferrous mains (cast iron and steel) in the network. The method of replacement is by inserting new PE mains into the old ferrous mains, with the project taking 3 years to complete from 2025 to 2027.

Network modelling demonstrates that with a minor reinforcement and an additional regulator set, the existing 7kPa network will meet the capacity demands of customers for the short-to-medium term. Therefore, any pressure increase is not required until such time that capacity constraints determine it must be done.

The capital cost for this option is $15.4M ($ 2023) with an initial annual operational cost of $870K prior to the commencement of rehabilitation.

3.4.1.1 Benefits

- Along with cast iron, unprotected steel mains also account for higher than average leakage rates. Rehabilitating both the unprotected steel and cast iron mains will improve safety to customers by reducing the probability, magnitude and frequency of leaks. It will therefore reduce the likelihood of harm to our customers, the public and our employees.
- Removing all ferrous mains would significantly reduce ongoing maintenance costs and minimise the likelihood of supply interruptions due to publicly reported leaks. This ensures customers will receive a reliable gas supply.
- A proactive ferrous mains replacement is the most efficient manner to remove the risks with significantly lower costs than a mains repair or a piecemeal reactive mains replacement. This is because the fixed costs associated with replacing mains are spread over a greater volume and using the insertion technique is a cost-effective replacement methodology. Also, the project can be designed such that minor network capacity upgrades can be achieved when replacements are done.
- Rehabilitating the ferrous mains will significantly reduce emissions in the form of UAG, as well as its associated cost such as penalties from non-compliance with the Safeguard Mechanism. It would also enable us to reach Jemena's emission reduction target of 'Net Zero by 2050'.
- Operating costs are reduced significantly after the rehabilitation project, making the network more affordable for customers.

3.4.1.2 Limitations

- The older plastic mains will still have levels of leakage, however the repair of plastic mains is less complex than for ferrous mains.
- Although all the cast iron must be removed, this option foregoes the opportunity to prudently defer steel mains replacement while we deploy improved leak detection technology (Picarro), which will help us optimise our asset management strategies.

3.5 Option 5: Rehabilitate all the mains in the network and increase network pressure to 210kpa

This option replaces the entire 230km network through either insertion or direct lay to remove cast iron, steel and older plastic mains over three years from 2025 to 2027. On completion, the network pressure will be upgraded to 210kPa.

The capital cost for this option is $93.4M ($ 2023) with an initial annual operational cost of $870K prior to the commencement of rehabilitation.

3.5.1.1 Benefits

- The mains rehabilitation project will improve safety to customers by significantly reducing the probability and frequency of publicly reported leaks. Consequently, it will significantly reduce the likelihood of harm to our customers, the public and our employees.
- It would ensure customers receive a reliable gas supply as opposed to continuing with the current repair process in the area which often requires isolating sections of gas mains. Repairing only provides a temporary and ad-hoc solution to a network that is progressively deteriorating.
- Rehabilitating the ferrous mains will significantly reduce emissions in the form of UAG, as well as its associated cost such as penalties from non-compliance with the Safeguard Mechanism. It would also enable us to reach Jemena's emission reduction target of 'Net Zero by 2050'.

3.5.2 Limitations

- Not all mains in the network have integrity or supply issues and hence replacing all mains is not cost effective.
- While growth in demand for natural gas services has slowed in recent years, the number of connections continues to increase. However, it may not be necessary to upgrade the network to 210kPa at this point in time, as maintaining pressures at 7kPa should meet demand in the short to medium term.
- This option incurs the highest capital expenditure compared to the other options.

3.6 Options analysis

Criteria	Option 1	Option 2	Option 3	Option 4	Option 5
Option Description	Reactive maintenance only	Reactive maintenance with minor capital works on ferrous mains	Replace cast irons mains with plastic mains and maintain network pressure at 7kPa.	Rehabilitate all ferrous mains and maintain network pressure at 7kPa.	Rehabilitate all mains and increase network pressure to 210kPa
Option Drivers	• No upfront capital	• This option would allow JGN to address the most urgent risks first. • Addresses highest risk in minor capital works.	• Lower upfront capital than options 4 and 5. • Provides a safer network for the public and employees. • Eliminates the risk of complex repairs on leaking cast iron mains for Jemena personnel. • Improve efficiency and affordability of the network through reducing operational costs. • Contributes to emission and UAG reduction targets. • Reduces ongoing opex costs.	• Provides a safer network for the public and employees. • Eliminates the risk of complex repairs on leaking cast iron mains for Jemena personnel. • Improve efficiency and affordability of the network through reducing operational costs. • Contributes to emission and UAG reduction targets. • Reduces ongoing opex costs	• Provides a safer network for the public and employees. • Eliminates the risk of complex repairs on leaking cast iron mains for Jemena personnel. • Improve efficiency and affordability of the network through reducing operational costs. • Contributes to emission and UAG reduction targets. • Accounts for future growth and standardises the network to 210kPa. • Reduces ongoing opex costs
Treated Risk Ranking	Significant	Moderate	Low	Low	Low
Total Capex Cost (Nominal $)	-	$5.6M	$8.1M	$15.4M	$93.4M$_{2023\ EST.}$
Total Opex Cost (Nominal $)	$42.8M	$34M	$4.5M	$4.5M	$4.4M
Totex Cost (Nominal $)	$42.8M	$39.6M	$12.6M	$19.9M	$97.8M
Relative NPV to ‘Status Quo’	-	$2.3M	$27.2M	$21M	-$48M
Option Analysis	Does not address the issue	Partially address the issue	Fully addresses the issue	Fully addresses the issue	Fully addresses the issue
Recommendation	Not recommended	Not recommended	Recommended	Not recommended	Not recommended

4. Recommendation

Option 3 is recommended to be the most prudent option for this project. Replace cast irons mains with plastic mains and maintain the network pressure at 7kPa.

The proposed solution addresses safety of the public, customers and our employees, but also delivers a cost-effective solution in the medium term. In addition to primary drivers, this option will significantly reduce our fugitive emissions and UAG, whilst enabling JGN the time to utilise new technologies in development of future replacement strategies for other network materials.

This option addresses the project drivers and aligns with Jemena's business plan, customer expectations, the NGO, the NGR, as well as accepted industry practice.

4.1 Economic analysis [PEM investment framework]

Please refer to Investment Framework file name 'JGN - RIN - 4.3 - 10022734 - Bankstown Chullora Greenacre 7kPa Rehabilitation - CBAM - 20240628 - Public'. For Project Estimation Model, please refer to 'JGN - RIN - 4.3 - 10022734 - Bankstown Chullora Greenacre 7kPa Rehabilitation - PEMO - 20240628 - Public'.

4.2 Risk outcomes for the preferred option showing how risks is mitigated / reduced.

While options 3, 4 and 5 have the same treated risk level, option 3 was deemed to be the most prudent due to the cost effectiveness to address the untreated risk in comparison to the other options.

The treated risk in implementing Option 3 to rehabilitate the cast iron mains is reduced from 'Significant' to 'Low'.

Table 4–1: Summary of preferred option

PREFERRED OPTION – Risk assessment summary				Treated risk summary		
Preferred Option/Treated risk	**Capex Cost**	**Benefits**	**Key mitigations**	**Consequence**	**Likelihood**	**Risk level**
Option 3 Replace cast irons mains with plastic mains and maintain network pressure at 7kPa.	$8.1M	- Eliminates all the corrosion issues and reduces opex cost associated with cast iron mains - Reduction in emissions and UAG - Provides a safer network for the public and employees. - Improve efficiency and affordability of the network through reducing operational costs.	- Eliminates the risk of complex repairs on leaking cast iron mains for Jemena personnel - Complies with the Gas Supply Act 1996; No 38 (3), due to the ferrous mains being rehabilitated and condition of plastic mains being addressed on an as required basis	Minor	Unlikely	Low

PREFERRED OPTION – Risk assessment summary				Treated risk summary		
			- Reduced penalties incurred by the Safeguard Mechanism as a result reducing emissions.			