Final Plan Attachment 8.1

Asset Management Plan

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1. Purpose of this Document

This Asset Management Plan (AMP) provides a consolidated view of network asset performance, asset condition, and operational issues relating to the Victoria and Albury Gas Company natural gas networks (the networks). The AMP is developed using historical and contemporary asset data, and draws on several other operational and technical plans.

The AMP is a component of Australian Gas Networks Limited's (AGN's) governance framework, which enables the prudent and efficient investment in and operation of the networks. The AMP presents (among other things) AGN's asset management objectives and approach, asset performance and condition, risk assessments, delivery capability, historical performance and investment drivers. The AMP is used in conjunction with operational plans, stakeholder feedback, business strategies, and other key reports to inform AGN's investment strategies and expenditure proposals.

This AMP contains the following sections:

1 **Purpose of this Document** – introduction to purpose and structure of this AMP;

2 **Executive Summary** – overall summary of asset management objectives, performance and growth;

3 **Background and Context** – overview of AGN, the Victoria and Albury networks, historical drivers, relevant standards and compliance framework;

4 **Asset Management Vision and Objectives** – asset management vision, objectives, and benefits to customers;

5 **Asset Management Approach** – description of asset management activities, risk assessment approach, internal monitoring activities and audit approach;

6 **Capacity Management** – overview of network capacity processes and demand profiles;

7 **Network Performance** – description of overall network performance; and

8 **Asset Life Cycle Strategies** – description of asset performance, asset condition, expected growth, and asset-specific maintenance and replacement strategies

1.1. Document Scope

This AMP covers network assets only. Management strategies for other assets, such as vehicle fleet, information systems, and facilities, are documented in specific asset class plans.

AGN owns regulated and unregulated networks in the Albury region. The regulated and unregulated networks are operated in the same way, using the same asset management principles and operational resources. Therefore, the information in this AMP applies to the regulated Victoria and the regulated and unregulated Albury networks. Specific data relating to the Albury regulated and/or regulated Victoria network are available in AGN's Final Plan and associated documents. Other network-specific data is available upon request.

2. Executive Summary

This AMP provides an overview of AGN's asset management approach, network performance and asset management activities over the next five-to-six years. The AMP is updated annually and is used to inform AGN's investment strategies and investment proposals. The AMP is a key component of AGN's network governance framework, and should be read in conjunction with other key documents such as the Distribution Mains and Services Integrity Plan, Meter Replacement Plan, and the Safety Case.

AGN's networks distribute natural gas to more than 600,000 customers in Victoria (predominantly Melbourne) and a further 53,000 customers in regional New South Wales. AGN is responsible for the strategic growth and development of all its networks, including prudent investment in and efficient operation of its assets. AGN outsources the day-to-day operation of the networks to APA Asset Management (APA).

AGN's asset management objectives are:

- **Ensuring network safety** – to maintain and operate assets so that the risks to employees, contractors and the public, are maintained as low as reasonably practicable;
- **Providing high quality service** – to provide customer service that is in the top quartile of gas distributor performance industry (e.g. reliability of gas supply);
- **Prudent and efficient operation and investment** – to ensure costs are prudent, efficient, consistent with accepted industry practices and necessary to achieve the lowest sustainable cost of providing gas distribution services in the long-term interest of customers;
- **Regulatory compliance** – to meet all regulatory requirements associated with the Gas Distribution Licence, Gas Reticulator Authorisation, Gas Act 1997 (Victoria), Gas Supply Act 1996 (New South Wales), National Gas Law, and other regulatory instruments; and
- **Environmental management** – to maintain and operate assets so that the risks to the environment are kept as low as reasonably practicable.

These objectives help ensure the ongoing investment in and operation of the networks is in the best interest of customers. Each of these objectives is factored into AGN's investment governance processes and decision making framework.

By achieving these objectives, AGN provides the following benefits to customers:

- a safe and reliable natural gas network;
- an affordable natural gas supply;
- confidence that natural gas remains a sustainable energy option; and
- minimal impact on the environment and community.

The following sections summarise current and forecast asset performance and network growth issues, and the replacement and network augmentation programs required over the next (2018 to 2022) Access Arrangement (AA) period.

Asset condition, performance and integrity

Asset condition and integrity is currently within acceptable levels, with all networks satisfactorily meeting peak day demand requirements. Ongoing maintenance schedules will be executed for each asset class as usual, however, there are several network issues that must be addressed through asset replacement and/or refurbishment over the next five years.

The highest network risk relates to distribution mains and services. The condition of cast iron (CI) and unprotected steel (UPS) mains in the network is poor, with these mains experiencing a relative high rate of leakage and failure[1]. Completion of the current Victoria mains replacement program is essential if the risk associated with these assets is to be reduced to low or as low as reasonably practicable (ALARP).

In addition, three major incidents on HDPE mains in South Australia over the last nine years, is driving effort to understand the behavior of this material and the risk across AGN's network. The Victoria network includes more than 3,000 kilometres of HDPE mains, and while broad replacement of this material is not forecast at this time, AGN will be removing small sections of the potentially highest risk HDPE mains. In summary, AGN will be undertaking the following action during the next five years:

- replacing all remaining cast iron and unprotected steel;
- removing the oldest seven kilometres of HDPE in the network; and
- sampling three kilometres of HDPE to assess its integrity and likely future risk profile.

Further actions relating to distribution mains and services are provided in section 8.2 of this document.

AGN will also undertake a program of city gate refurbishment, which will address:

- earthing and surge protection issues;
- service issues with old regulators, where the sourcing of spare parts is becoming problematic;
- water bath heater coil replacement;
- pipework condition; and
- required fencing and ancillary works.

Through the routine preventative maintenance program, AGN has identified four transmission isolation valves and three transmission pressure facility valves that require replacement. External coatings on several transmission pipelines have degraded to the extent there is a risk of corrosion. AGN will undertake a program of inline inspections, to determine the condition and integrity of these pipelines, as well as improving the level of cathodic corrosion protection (CP) through installing additional CP systems.

A number of network facilities are at the end of their useful lives with replacement spares no longer available. These include:

- district regulator facilities;
- industrial and commercial metering facilities; and
- SCADA field monitoring facilities.

A program of replacement will be undertaken to address the risk associated with these assets.

In addition, a number of industrial and commercial meter sets have maintenance and integrity issues, with a refurbishment program to be undertaken.

[1] Detailed information about CI and UPS mains condition and failure rates is provided in AGN's Distribution Mains and Services Integrity Plan for the Victoria Gas Network.

Network Performance, Growth and Development

Continued residential growth in several locations means network augmentation is required to maintain a safe and reliable supply to existing customers. AGN will undertake the following network augmentation projects during the next AA period:

- completing the duplication of the Dandenong to Crib Point (DCP) transmission pipeline;
- a number of separate but integrated augmentation projects in the Cranbourne high pressure network. The scope of work ranges from small to relatively large new mains, to a new gate station; and
- minor augmentation in the regional networks of Wallan, Moe and Echuca.

The Australian Energy Market Operator (AEMO) has recently advised AGN of its proposal to reduce the minimum supply pressure to AGN's Sale gate station. The pressure reduction is designed to avoid the need for significant augmentation of the upstream GasNet network; however, augmentation of AGN's downstream Sale to Maffra transmission pipeline will be required to maintain supply to existing customers. A full impact assessment has not been possible in time for this AMP. A detailed assessment expected early in 2017.

In addition to the above augmentations, as part of its bushfire risk mitigation program, AGN will install thermally activated isolation valves to customers' metering facilities located in bushfire prone areas. A program to improve remote pressure surveillance of district regulators and network fringe points will also be completed over the next AA period.

Deliverability

APA has reviewed the program of work for the next AA period. Based on capital works program delivery performance over the current period, and forecast capacity for the next AA period, APA has the capability to deliver the proposed works program in full. The program of work will be reviewed by AGN on an annual basis and adjusted as required to reflect new and emerging issues, and risks.

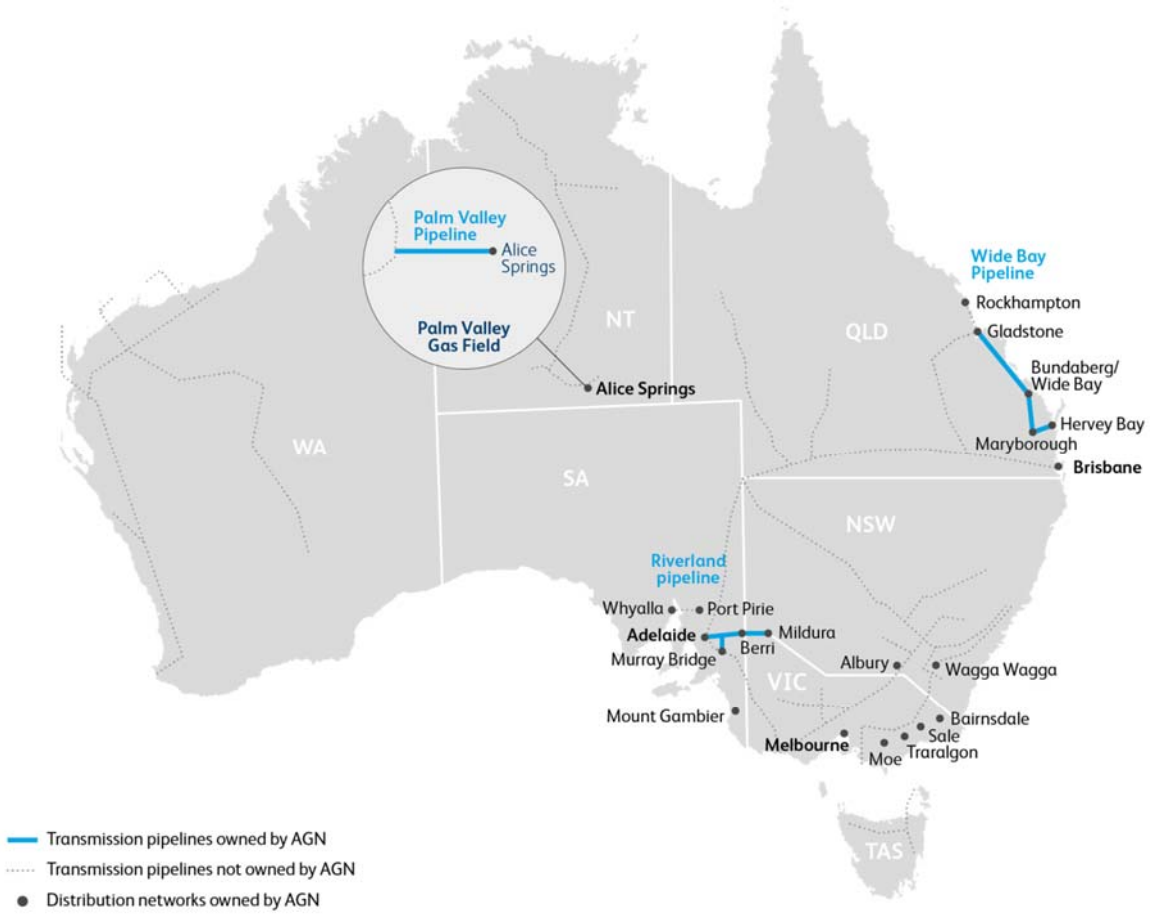
3. Background and Context

This chapter provides an overview of AGN, and its relationship with APA. It describes the AGN Victoria and Albury natural gas networks and the relevant standards, compliance requirements and investment drivers that apply to network asset management.

3.1. About AGN

AGN is one of the leading natural gas distribution businesses in Australia, serving around 1.2 million domestic, small business, and large industrial customers. AGN owns more than 23,000 kilometres of natural gas distribution networks and 1,100 kilometres of transmission pipelines in South Australia, Victoria, Queensland, New South Wales and the Northern Territory (see Figure 3.1).

Figure 3.1: Map of AGN's Networks



AGN's networks distribute natural gas to more than 627,000 customers in Victoria (predominantly Melbourne) and a further 26,000 customers in regional New South Wales (Albury and Murray Valley). This AMP provides detail of AGN's asset management approach and activities for the regulated Victoria network and the regulated and unregulated Albury networks.

3.1.1. Relationship with APA

AGN is responsible for the strategic growth and development of the Victoria and Albury networks, including prudent investment in and efficient operation of assets. AGN outsources the day-to-day operation of the networks to APA.

Under the terms of the Operating and Management Agreement with AGN, APA installs, operates and maintains the Victoria and Albury gas infrastructure assets. APA's services include:

- operating and maintaining each network;
- planning, designing and constructing network extensions;
- preparing and settling with AGN the budget for each financial year;
- providing AGN with regular information on financial and other management issues; and
- reading meters and billing retailers.

APA is responsible for operating networks in accordance with accepted industry standards and the conditions of AGN's gas distribution licence.

3.1.1.1. APA Delivery Capability

APA employs around 1,500 operational staff, operating approximately 27,000 kilometres of natural gas distribution networks across Australia, which service over 1.3 million customers. Annually, APA connects over 33,000 new customers, lays over 450 kilometres of new gas distribution mains and replaces over 400 kilometres of mains.

APA has operated the Victoria and Albury gas distribution networks since 2007.

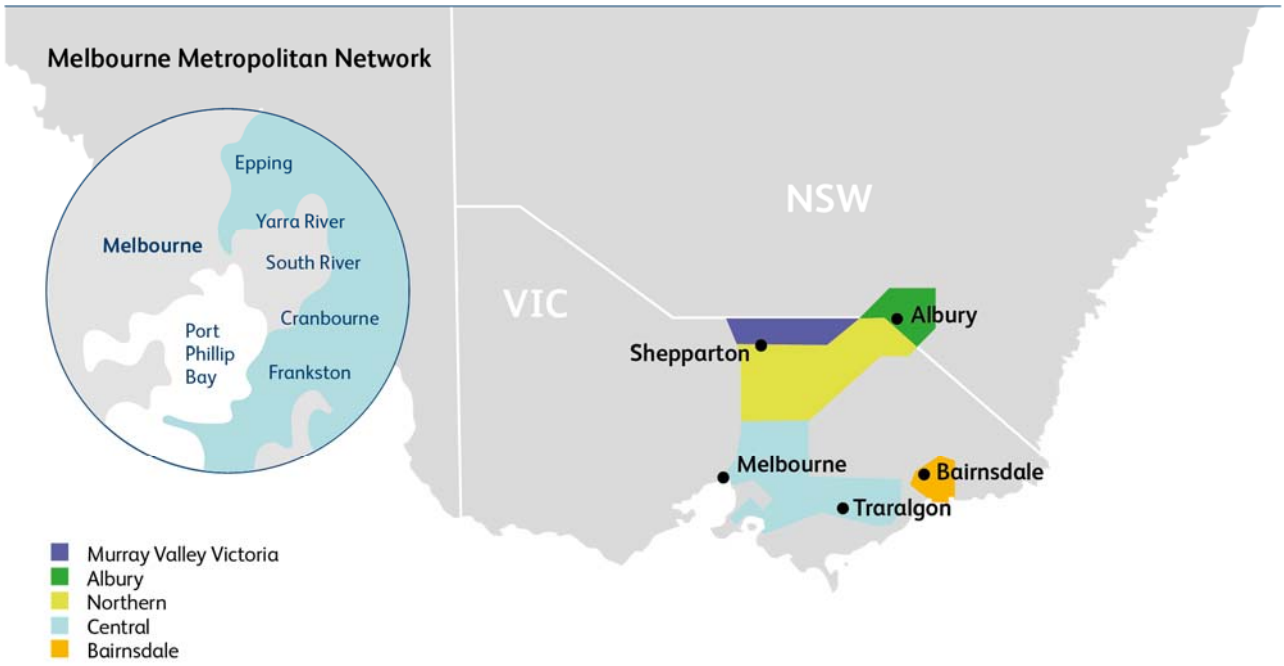
3.2. The Victoria and Albury Gas Networks

The Albury natural gas distribution is an extension of the Victoria network. The Albury network is located near the Victoria/New South Wales border, therefore it shares many of the maintenance crews and resources that work on the Victoria network.

Figure 3.2 illustrates the geographical area served by AGN's Victoria and Albury networks[2]. The Albury covered network is a subset of the Albury Gas Company network, the latter including a number of small towns north of the Victoria/ New South Wales border.

[2] More detailed maps of the Victoria and Albury networks are provided in Appendix A.

Figure 3.2: Area Covered by AGN's Victoria and Albury Covered Networks



The Victoria network is separated into four tariff zones; Murray Valley, Northern, Central, and Bairnsdale. The Albury covered network comprises a single tariff zone.

The Albury covered network serves the city of Albury and its surrounds, extending to Jindera to the north of Albury. It contains 400 kilometres of mains and delivers gas to nearly 22,000 customers.[3]

The Victoria network serves the northern, outer eastern and southern areas of Melbourne, the Mornington Peninsula, rural communities in northern, eastern and north-eastern Victoria, and south-eastern rural townships in the Gippsland. The Victoria network comprises more than 10,000 kilometres of mains, delivering natural gas to around 613,000 customers.

Table 3.1 summarises customer numbers and consumption in each of the Victoria and Albury tariff zones.

[3] Corowa, Mulwala and Howlong are also supplied via custody transfer stations in Victoria, from Rutherglen, Yarrawonga and Chiltern respectively. These form part of the unregulated Murray Valley (NSW) network. There are approximately 4,000 customers in the Murray Valley network.

Table 3.1: Customer Numbers and Consumption the Victoria and Albury Network Zones (Dec 2015)

Characteristic	Bairnsdale	Central	Northern	Murray Valley	Albury
Total customer numbers	3,917	538,551	75,926	7,712	21,936
Residential	3,809	518,043	72,611	7,469	20,964
Commercial	106	20,312	3,266	236	964
Tariff D	2	196	49	7	8
Total consumption (TJ)	281	45,147	9,510	1,800	2,742
Residential (TJ)	109	26,009	3,382	269	925
Commercial (TJ)	81	6,596	820	66	280
Tariff D (TJ)	91	12,542	5,308	1,465	1,537

Gas is delivered into AGN's networks via custody transfer meters owned by either APA GasNet or Jemena Gas Networks. Pressure regulation and associated facilities are owned by AGN. Table 3.2 provides an overview of the combined physical characteristics of the Victoria and Albury networks.

Table 3.2: Network Characteristics, December 2015

Characteristic	Value
Total length of mains (kilometres)	11,190
Physical gate points	57
Pressure regulating installations	122
Network isolation Valves	6,500
Inlet services	654,300
Meters	654,300

Gas mains in the networks are categorised into the five pressure regimes defined in Table 3.3.

Table 3.3 Maximum Allowable Operating Pressures (MAOP)

Pressure Regime	Definition
TP – Transmission Pressure	MAOP greater than 1050 kPa
HP1 – High Pressure	Networks with a MAOP between 140kPa and 500 kPa
HP2 – High Pressure	MAOP between 500 kPa and 1050 kPa
MP – Medium Pressure	MAOP between 7 kPa and 140 kPa
LP – Low Pressure	MAOP between up to 7 kPa

Networks are operated within the nominated maximum and minimum operating pressures. Emergency overpressure control is provided on all networks to ensure the maximum allowable operating pressure (MAOP) is not exceeded.

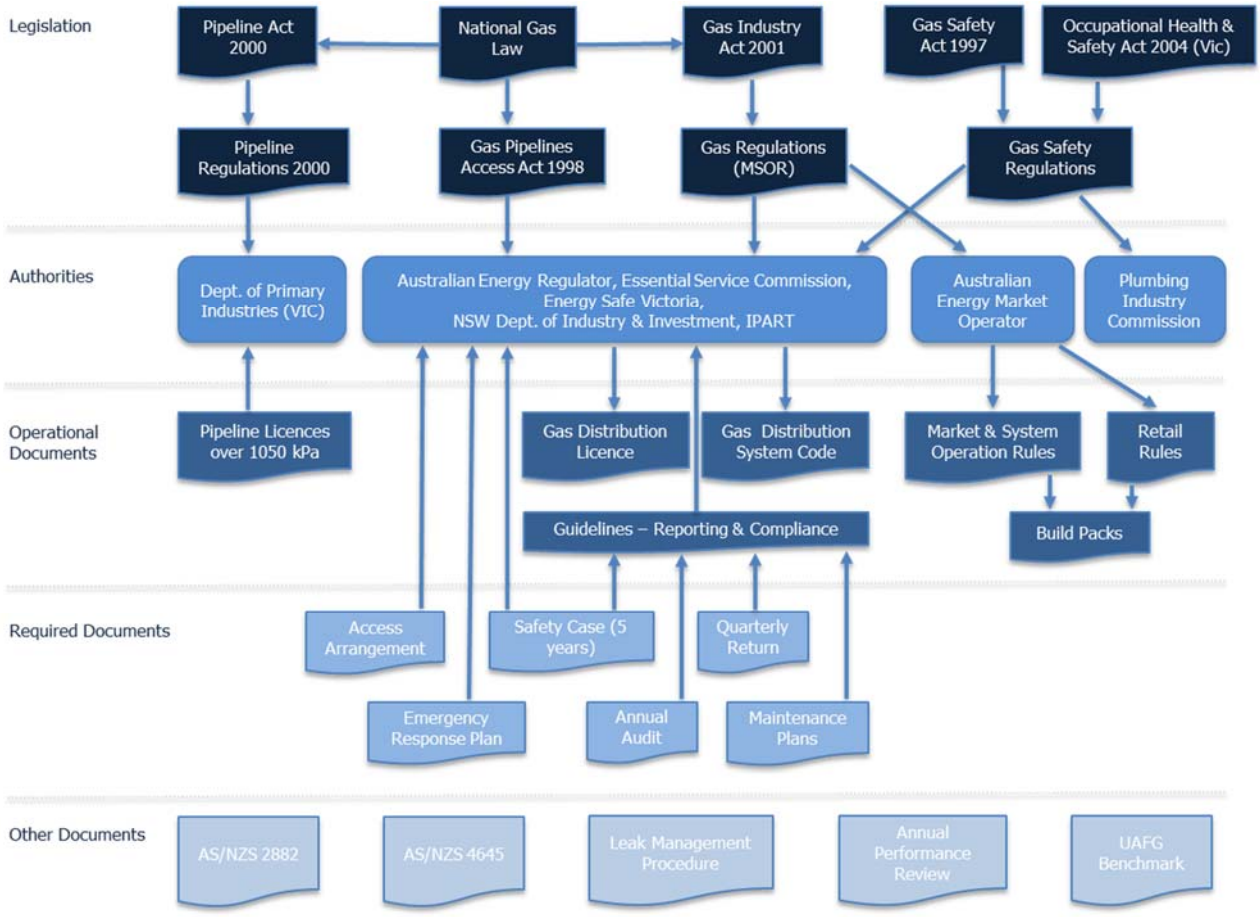
Each network has its own defined operating range depending on network configuration and capacity requirements. Operating pressures may vary depending on seasonal load demand.

3.3. Regulatory Framework and Standards

AGN's networks are managed and operated subject to regulatory frameworks and Australian Standards. These frameworks govern network safety, technical specifications, environmental requirements and efficient investment in the network.

Figure 3.3 provides an overview of the regulatory framework for the Victoria and Albury networks.

Figure 3.3: Regulatory Framework for the Victoria and Albury Networks[4]



[4] In New South Wales (NSW), rather than holding a Gas Distribution Licence, a natural gas operator must hold a Gas Reticulator Authorisation, granted by the Minister under the Gas Supply Act 1996 (NSW). The Gas Supply Act 1996 (NSW) is the equivalent of the Gas Safety Act 1997 in Victoria. The primary obligations for a network operator in NSW are in the Gas Supply (Safety and Network Management) Regulation 2013 (NSW).

The primary obligations relating to asset management and safety are contained in the following legislation:

- *Gas Safety Act 1997* (Vic) and accompanying regulations;
- *Gas Supply Act 1996* (NSW) and *Gas Supply (Safety and Network Management) Regulation 2013* (NSW); and
- *Occupational Health and Safety Act 2004* (Vic).

The National Gas Law (NGL) and National Gas Rules (NGR) also contain obligations relating to pipeline safety duty, as well as to ensure efficient investment, use, operation and management of assets and services.

In addition, AGN's approach to managing network risk is consistent with AS/NZS 4645 (specifically the risk framework and assessment contained in Appendix C), AS/NZ 2885, and AS/NZS ISO 31000. These standards provide guidance on expected risk management practices, and a framework for assessing and mitigating risk. Under the legislation and standards, AGN has an obligation to provide services in a manner that minimises hazards, and ensures the safety of its workers and the community. Key legislation, codes and standards are discussed further in the following section.

3.3.1. Legislation, Codes and Standards

3.3.1.1. National Gas Law

APA undertakes all asset management and investment activities in a manner that will or is likely to contribute to the achievement of the National Gas Objective (NGO), which is set out in Section 23 of the National Gas Law. The NGO is:

> *"... to promote efficient investment in, and efficient operation and use of, natural gas services for the long-term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas."*

The focus of the NGO is on the long-term interests of customers with respect to price, quality, safety, reliability and security of supply. The AMP facilitates this outcome by ensuring the approach to asset management identifies and mitigates risks in the most efficient way. Consideration of the NGO is built into all infrastructure investment decisions and is a key component of AGN's investment governance process.

Section 6 of the NGL also includes a *pipeline safety duty,* which is in turn defined in section 2 of the NGL as:

> *"pipeline safety duty means a duty or requirement under an Act of a participating jurisdiction, or any instrument made or issued under or for the purposes of that Act, relating to—*
>
> *(a) the safe haulage of natural gas in that jurisdiction; or*
>
> *(b) the safe operation of a pipeline in that jurisdiction;"*

Several pipeline safety duties arising from the *Gas Safety Act 1997, Gas Supply Act 1996 (NSW)* and the *Occupational Health and Safety Act 2004* require AGN to implement risk mitigation activities such as mains replacement. They are:

- Section 32 of the *Gas Safety Act 1997,* which requires AGN to operate and manage its facilities to minimise as far as is practicable hazards and risks to customers and the public and the property of customers and the public;

- Section 37 of the *Gas Safety Act 1997* and corresponding regulations 25, 26 and 30 of the *Gas Safety (Safety Case) Regulations,* which requires AGN to have certain management plans in place (as part of its safety case) to ensure the safe operation of its facilities;
- Part 2 Clause 6 of the *Gas Supply (Safety and Network Management) Regulation 2013* (NSW) under the *Gas Supply Act 1996* (NSW), requires AGN to develop, maintain and operate a safe gas network, while Part 3 Clause 11 details AGN must implement safety and operating plans; and
- the *Occupational Health and Safety Act 2004,* which requires AGN to ensure so far as is reasonably practicable that the health of workers, and any other person who may be affected by AGN's business undertaking, is not put at risk.

These duties help inform AGN's risk management and investment activities.

3.3.1.2. National Gas Rules

The NGR impose requirements on a gas distribution business to ensure its asset management strategies and plans are efficient. To recover the efficient cost of providing services, the NGR provides for the AER to assess whether the expenditure required complies with the capital and operating expenditure criteria. Those criteria require that expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of delivering pipeline services[5]. In addition, capital expenditure must also be justified under NGR 79(2) as follows:

> *(a) the overall economic value of the expenditure is positive; or*
>
> *(b) the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or*
>
> *(c) the capital expenditure is necessary:*
>
> *(i) to maintain and improve the safety of services; or*
>
> *(ii) to maintain the integrity of services; or*
>
> *(iii) to comply with a regulatory obligation or requirement; or*
>
> *(iv) to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or*
>
> *(d) the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (c), and the former is justifiable under paragraph (b) and the latter under paragraph (c)."*

AGN's approach to asset management includes an assessment of options to manage risk and requires that the most efficient option is chosen and delivered at least cost. AGN adopts the framework of AS/NZ ISO 31000 to guide this process.

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5 NGR 78(1)(a) and NGR 91.

3.3.1.3. Gas Safety Act 1997 (Vic)

The *Gas Safety Act 1997* is the primary regulatory instrument in respect of AGN's obligations regarding gas safety in Victoria.

According to Section 1, the purpose of the *Gas Safety Act 1997*:

> *"...is to make provision for the safe conveyance, sale, supply, measurement, control and use of gas and to generally regulate gas safety."*

Under section 32, AGN has a general duty to

> *"... manage and operate each of its facilities to minimise as far as practicable –*
>
> *(a) the hazards and risks to the safety of the public and customers arising from gas; and*
>
> *(b) the hazards and risks of damage to property of the public and customers arising from gas; and*
>
> *(c) the hazards and risks to the safety of the public and customers arising from –*
>
> *(i) interruptions to the conveyance or supply of gas; and*
>
> *(ii) the reinstatement of an interrupted gas supply.*
>
> *Penalty: In the case of a natural person, 300 penalty units*
>
> *In the case of a body corporate, 1500 penalty units"*

What is practicable is defined in section 3 as:

> *"practicable in sections 32, 33, 61, 62 and 63 means practicable having regard to–*
>
> *(a) in sections 32, 61, 62 and 63 the severity of the hazard or risk in question; and*
>
> *...*
>
> *(c) the state of knowledge about the hazard or risk and any ways of removing or mitigating the hazard or risk; and*
>
> *(d) the availability and suitability of ways to remove or mitigate the hazard or risk; and*
>
> *(e) the cost of removing or mitigating the hazard or risk."*

Under section 37, AGN is required to provide a safety case with respect to its facilities. The Safety Case must be submitted to Energy Safe Victoria (ESV) for approval. The safety case outlines how AGN proposes to comply and demonstrate compliance with its obligations.

Section 37(2) requires that the safety case for a facility must –

> *"(a) be in writing; and*
>
> *(b) in accordance with the regulations, specify the safety management system being followed or to be followed by the gas company –*
>
> *(i) to comply with the gas company's duties under division 1; and*
>
> *(ii) in relation to any other matters relating to the safe conveyance, supply, sale, measurement or control of gas that are prescribed."*

If AGN fails to comply with its approved safety case, then AGN will be in breach of section 44(2) of the *Gas Safety Act 1997*. Such a breach exposes AGN to a substantial financial penalty. However, AGN's driver for compliance with the safety case is to ensure the safety of the community and its employees.

The prescribed content of a gas safety case is set out in the *Gas Safety (Safety Case) Regulations 2008*. Regulations 25 and 26 require a safety case to include a formal safety assessment and a safety management plan:

> *"25 Formal safety assessment*
>
> *(1) A safety case must contain a formal safety assessment.*
>
> *(2) The formal safety assessment for a facility must be consistent with the facility description for the facility and must provide—*
>
> *(a) a description of the methodology used and investigations undertaken for the formal safety assessment; and*
>
> *(b) an identification of hazards having the potential to cause a gas incident; and*
>
> *(c) a systematic assessment of risk, including the likelihood and consequences of a gas incident; and*
>
> *(d) a description of technical and other measures undertaken, or to be undertaken, to reduce that risk as far as practicable.*
>
> *26 Safety management system*
>
> *(1) A safety case must specify the safety management system followed or to be followed in relation to the facility.*
>
> *(2) The safety management system must contain the information specified in Division 5."*

Under regulation 30 of the *Gas Safety (Safety Case) Regulations 2008*, the safety management system must specify the procedures and the asset management plan that are used or to be used by the gas company to ensure that the design, construction, commissioning and installation, operation, maintenance and decommissioning of the facility and any modification of the facility:

> *"(a) is adequate for the safety and safe operation of the facility; and*
>
> *(b) is adequate for the safe and reliable conveyance and supply of gas; and*
>
> *(c) is adequate for ensuring the quality of gas conveyed or supplied;*
>
> *(d) takes into account the results of the formal safety assessment for the facility."*

In summary, the *Gas Safety Act 1997* and regulations under it create two principal duties relevant to managing the safety and supply risks associated with all network assets:

- first, to assess and manage the risks and the likelihood that a gas incident may result from the condition and utilisation of a main; and
- second, to do what is practicable to minimise hazards and risks to the public, customers and their property. This duty includes having a system in place to identify the most efficient and effective risk mitigation option including replacing any mains that cause a risk or hazard.

Failure to comply with the *Gas Safety Act 1997* can lead to the imposition of financial penalties.

In addition, clause 9 of AGN's Gas Distribution Licence issued under the *Gas Industry Act 2001* requires AGN to comply with all applicable laws (which include the *Gas Safety Act 1997*). Failure to comply with AGN's licence, if not remedied, could lead to revocation of that licence (see clause 3 of the Distribution Licence and section 53 of the *Essential Services Commission Act 2001*).

AGN's current safety case was submitted to Energy Safe Victoria in 2010. A revised safety case is to be submitted by the end of 2016.

3.3.1.4. Occupational Health and Safety Act 2004

AGN has obligations under the *Occupational Health and Safety Act 2004* to ensure the safety of its workers and the community.

Section 21(1) of the *Occupational Health and Safety Act 2004* provides:

> *"(1) An employer must, so far as is reasonably practicable, provide and maintain for employees of the employer a working environment that is safe and without risks to health.*
>
> *Penalty: 1800 penalty units for a natural person;*
>
> *9000 penalty units for a body corporate."*

AGN's approach to ensuring the safety of its workers (and the community) is outlined in its safety case, and incorporated in the procedures and practices adopted in operating and maintaining the network. These are captured in the Asset Management Plan and supporting plans and reports outlined in Figure 2.1.

While section 21(1) is limited in its scope to workers, section 23(1) imposes a general duty on an employer to ensure that persons other than an employer's employees are not exposed to risks to their health or safety arising from the conduct of the undertaking of the employer.

Section 23(1) provides:

> *"(1) An employer must ensure, so far as is reasonably practicable, that persons other than employees of the employer are not exposed to risks to their health or safety arising from the conduct of the undertaking of the employer.*
>
> *Penalty: 1800 penalty units for a natural person;*
>
> *9000 penalty units for a body corporate"*

Section 20 defines 'ensuring' health and safety and provides:

> *"(1) To avoid doubt, a duty imposed on a person by this Part or the regulations to ensure, so far as is reasonably practicable, health and safety requires the person—*
>
> *(a) to eliminate risks to health and safety so far as is reasonably practicable; and*
>
> *(b) if it is not reasonably practicable to eliminate risks to health and safety, to reduce those risks so far as is reasonably practicable.*
>
> *(2) To avoid doubt, for the purposes of this Part and the regulations, regard must be had to the following matters in determining what is (or was at a particular time) reasonably practicable in relation to ensuring health and safety—*
>
> *(a) the likelihood of the hazard or risk concerned eventuating;*
>
> *(b) the degree of harm that would result if the hazard or risk eventuated;*

(c) what the person concerned knows, or ought reasonably to know, about the hazard or risk and any ways of eliminating or reducing the hazard or risk;

(d) the availability and suitability of ways to eliminate or reduce the hazard or risk;

(e) the cost of eliminating or reducing the hazard or risk."

AGN's approach to identifying and managing safety risk is consistent with AS/NZS ISO 31000.

3.3.1.5. Gas Distribution System Code

The Gas Distribution System Code applies to gas distributors operating in Victoria. The Code was developed by the Victorian Essential Services Commission and applies to any organisation that holds a natural gas distribution licence. The Gas Distribution System Code sets out the minimum standards for the operation and use of the distribution system, which includes (among other things) minimum standards for connections and augmentations. Specific Gas Distribution System Code provisions relate to:

- operation of the distribution system;
- connection of a customer's supply address to the distribution system;
- disconnection and reconnection;
- illegal use of gas;
- curtailment and interruptions;
- emergencies and safety;
- customer dispute resolution;
- provision of metering installations;
- minimum standards of accuracy;
- metering installation testing;
- meter testing; and
- meter reading and data.

AGN is required by clause 4 of its Gas Distribution Licence to comply with the Code.

3.3.1.6. Gas Act 1997 – Section 55

AGN has a duty of care to ensure the safety and integrity of gas distribution network assets. Asset management activities and infrastructure investment (particularly safety-related investment) is guided by the Gas Act 1997. Section 55 of the *Gas Act 1997* provides:

"A person who owns or operates gas infrastructure or a gas installation must take reasonable steps to ensure that—

(a) the infrastructure or installation complies with, and is operated in accordance with, technical and safety requirements imposed under the regulations; and

(b) the infrastructure or installation is safe and safely operated."

With regard to safety, the relevant regulation is Regulation 37, which provides:

"For the purposes of section 55 of the Act—

(a) gas infrastructure must be designed, installed, operated and maintained to be safe for the gas service conditions and the physical environment in which it will operate and so as to comply with any applicable requirements of AS/NZS 4645, AS/NZS 1596 and AS/NZS 2885 or achieve, to the satisfaction of the Technical Regulator, the same or better safety and technical outcomes; and

(b) a gas installation must be designed, installed, operated and maintained to be safe for the gas service conditions and the physical environment in which it will operate and so as to comply with any applicable requirements of—

(i) in the case of a liquefied petroleum gas installation—AS/NZS 5601 and AS/NZS 1596;

(ii) in any other case—AS/NZS 5601."

Read together Section 55 and Regulation 37 require, amongst other matters, compliance with AS/NZS 4645 and AS/NZS 2885.

AS/NZS 4645 requires risks from a network which are 'High' or 'Extreme' to be reduced as soon as possible (if 'High') or immediately (if 'Extreme') to 'Low' or 'Negligible' and if this is not possible to as low as reasonably practicable (ALARP). Section C4 of AS/NZS 4645 provides: *"risks determined to be low or negligible or demonstrated to be as low as reasonably practicable (ALARP) are accepted risks"*

Page 3 of the standard provides: *"Risks associated with the network shall be at acceptable levels with respect to loss of any of supply of gas and any threats from escaping gas, throughout the life of the network."*

Clause 2.2 requires that all actions and activities shall not unduly expose personnel, the public or the environment to "unacceptable risks." Clause 2.3.1 provides: the primary principle in managing risk is to achieve an acceptable risk level.

Section C5 of Appendix C of the AS/NZS 4645 specifies treatment for addressing network risk and places an obligation on network operators to act immediately to reduce 'Extreme', 'High' and intermediate risks to ALARP.

AS/NZS 2885 is the overarching standard that applies to transmission pipelines. The standard relates to the design, construction, testing, operations and maintenance of gas and petroleum pipelines that operate at pressures more than 1050 kPa.

As required by the *Gas Act 1997* (and consistently with accepted good industry practice which would require compliance with applicable Australian Standards in the absence of any direction by safety legislation or a safety regulator to the contrary) AGN applies the AS/NZS 4645 and AS/NZS 2885 standards to assessing the risk associated with gas infrastructure assets. Asset maintenance and replacement programs are designed to achieve the maximum risk reduction possible given delivery capability, without imposing costs that are disproportionate to the risk reduction.

3.3.1.7. Gas Supply (Safety and Network Management) Regulation 2013

AGN has an obligation under the regulation to ensure that the gas network in New South Wales is designed, constructed, maintained and operated in a safe and reliable manner. Part 2 Clause 6 of the *Gas Supply (Safety and Network Management) Regulation 2013* states:

"Network operators to ensure safe gas supply

(1) A network operator must develop, maintain and operate a safe gas network.

(2) A network operator must, when designing, constructing, operating or extending a gas network or any part of a gas network, take into account any standards (such as

codes, Australian Standards, guidelines or other requirements) that have been notified in writing to the network operator by the Director-General for the purposes of this subclause.

Maximum penalty: 100 penalty units (in the case of a corporation) and 25 penalty units (in any other case)."

Under Part 3 Clause 11, AGN is required to provide a safety and operating plans with respect to its network:

"Network operators to lodge and implement safety and operating plans

(1) A network operator must:

(a) lodge with the Director-General a safety and operating plan for its gas network that complies with the requirements of this Regulation, and

(b) implement that plan.

Maximum penalty: 100 penalty units (in the case of a corporation) and 25 penalty units (in any other case)."

The Safety and Operating Plans must be submitted to New South Wales Department of Industry for approval. The Safety and Operating Plans outline how AGN proposes to comply and demonstrate compliance with:

a NSW Gas Safety (Safety and Network Management) Regulations;

b AS/NZS 4645 Gas Distribution Network – Part 1 Network Management; and

c AS/NZS 2885 Pipelines – Gas and Liquid Petroleum (SAA Pipeline Code)

The Safety and Operating Plans describes the network, identify the risks inherent in operating a gas distribution network, and outline how these risks are being managed.

3.3.1.8. Australian Standards

AGN's networks are designed, constructed, operated and maintained in accordance with Australian Standards. The principal standards used those provided for in the *Gas Act 1997*, Regulation 10 – General Requirements for Gas Infrastructure:

- AS/NZS 4645-2005 Gas Distribution Network Management;
- AS/NZS 4568-2005 Preparation of a Safety and Operating Plan for Gas Networks;
- AS/NZS 2885.1-2007 Pipelines – Gas and liquid petroleum – Design and Construction;
- AS/NZS 2885.2-2007 Pipelines – Gas and liquid petroleum – Welding;
- AS/NZS 2885.3-2001 Pipelines – Gas and liquid petroleum – Operation and Maintenance;
- AS/NZS 2885.5-2003 Pipelines – Gas and liquid petroleum – Field Pressure Testing;
- AS/NZS 1697-2005 Installation and Maintenance of Steel Pipe Systems for Gas; and
- AS/NZS 3723-1989 Installation and Maintenance of Plastic Pipe Systems for Gas.

The following Australian Standards are also applied:

- AS/NZS 4130-2003 Polyethylene (PE) Pipes for Pressure Applications;
- AS/NZS 4041-2006 Pressure Piping; and
- AS/NZS 2832.1-2004 Cathodic Protection of Metals – Pipes and Cables.

3.3.2. Regulatory Reporting

AGN submits a series of operational and technical reports to ESV, which provide visibility of asset condition, performance and asset management practices.

The annual operational report provides information on:

- the quantity of each type of gas entering the distribution system from each source;
- the specifications of each type of gas entering the distribution system;
- a summary of the results of testing of metering accuracy;
- the total estimated amount of unaccounted for gas lost from the distribution system because of leakage;
- the condition and composition of the distribution system;
- the number of certificates of compliance received on connection of a gas installation to the distribution system;
- the quantity and type of gas distributed to small customers and other customers;
- the number of small and other customers connected to the distribution system;
- the number of connections and disconnections of customers to or from the distribution system;
- the number and type of complaints received in respect of gas odour, poor supply pressure, etc.;
- details of any failure to comply with the Act;
- performance indicators; and
- information on interruptions.

AGN also prepares a quarterly operational report and a monthly mains replacement report, which details asset management activities and performance.

In New South Wales, AGN submits a series of operational and technical reports to the Department of Industry – Resources and Energy (DRE). These reports provide visibility on key performance information and data.

The annual report provided to the DRE must contain the following:

1 Network asset information:
   a Total network pipe length – by pressure class;
   b Total quantity of gas entering each gas network system;
   c Total quantity of gas delivered to custody transfer points in each gas network; and
   d New regions/areas connected to gas supply.
2 Network integrity and safety information:
   a Total number of gas leaks reported to network operator by third parties (on network only) disaggregated by pressure class;
   b Total number of recorded mechanical damage incidents to gas networks, by type and source – by pressure class;
   c Number of emergency exercises or simulations conducted;

d Total kilometres of pipe subjected to leak surveys;

e Total number of leaks found during leaks surveys; and

f Number of calls the "One-Call" system received about work near the networks.

3 Network reliability and consumer-related matters:

a Total number of customers connected to the network;

b Total number of new customers connected to the network;

c Total number of customer hours of gas supply lost through unplanned losses of supply (when 5 or more customers were affected);

d Total number of unplanned losses of supply up to the meter – where 5 or more customers were affected;

e Total number of instances of poor supply pressure – recorded and confirmed;

f Total number of recorded instances of non-compliant gas entering the network;

g Total number of recorded instances of odorant level out of specification anywhere within network;

h Number of incidents/emergencies responded to; and

i Total number of incidents/emergencies that were not responded to within 60 minutes of receipt of notification.

As part of the Safety and Operating Plan process, AGN is also required to have an independent audit performed periodically (each year within 28 days of the anniversary of the date of lodgment of the Safety and Operating Plan or otherwise as directed by the DRE). The auditor is required to issue certificates of compliance for AGN, certifying that:

a the Safety and Operating Plan complies with Schedule 1 of the *Gas Supply (Safety and Network Management) Regulation 2013* (NSW);

b the measures implemented to prevent hazardous events identified in the plan from occurring, and intended to protect operating personnel, plant, equipment, the community and the environment should they occur, are being maintained;

c there are properly trained and equipped personnel available to maintain the plan;

d the plan is adequate and appropriate having regard to any changes in the gas network since a certificate was last issued by a nominated auditor; and

e any measures to rectify non-compliance with the plan detected in any previous audit have been undertaken and are effective.

3.3.3. Asset Performance Indicators

Table 3.4 presents a range of performance indicators used for various asset groups. Asset performance indicators are used by AGN's and APA's operating departments to determine the effectiveness of risk management and asset management activities. Associated key performance indicators (KPIs) are reported to senior management and the technical regulator.

Table 3.4 Asset Performance Indicators and KPIs

Asset Category	Asset Performance Indicators	KPIs (apply across all asset categories)
Transmission pipelines	• % of pipeline patrolled • Intelligent pigging survey results • Corrosion prevention survey readings • Coating survey results • Emergency exercises completed	• No. of 3rd party damages • No. of 3rd party damage near misses • No. of PM jobs scheduled but more than 1 month overdue • Mains leaks per kilometres of main • No. 3rd party damages • Supply outages to 5 or more customers • Supply outage average duration • No. of gas in building incidents • Onsite response to emergency within prescribed time • % of preventative maintenance jobs scheduled but more than 1 month overdue • Odourosity detectable < 20% LEL
Distribution mains and services	• No. leaks reported and repaired • No. of outstanding leaks • Poor supply incidents/outages • No. of over pressurisations • Corrosion prevention survey readings • Kilometres of mains laid • Kilometres of mains replaced • No. of services laid • No. of services replaced	
Distribution Facilities	• % preventative maintenance schedule complete • % of network protected by CP	
Customer Metering Facilities	• No. of inaccurate meters detected • No. of meter failures • No. of time-expired meters replaced • No. of meter leaks • % of preventative maintenance schedule complete	
SCADA Facilities	• Availability of telemetry systems • % preventative maintenance schedule complete	

3.4. Asset Management Drivers

Several factors influence the extension, replacement, modification or refurbishment of network assets. Such factors include:

- network growth;
- asset condition;
- safety;
- security of supply; and
- third party capital works programs.

These factors are known as asset management drivers, and are used in conjunction with asset performance indicators to determine the most prudent and efficient course of action to address ongoing network risk and capacity requirements.

3.4.1. Network Growth

Population growth, urban sprawl, and industrial growth creates a driver for the natural gas distribution network to expand into new areas. Such expansion requires the installation of new mains, inlets, telemetry systems and pressure control facilities. Demand growth also requires augmentation of existing assets to ensure sufficient network capacity.

Demand growth remains a key consideration in AGN's asset management strategies. Demand drivers include factors that impact the number of network connections, and factors that impact gas consumption. Connection drivers in the residential customer sector include population and housing growth, and building codes for homes. The key drivers of new industrial and commercial sector connections are prevailing economic conditions and delivered energy cost compared to the nearest alternative.

Residential sector consumption drivers include weather, retail gas price, microeconomic factors, appliance efficiency and alternative energy appliances. Drivers for commercial and industrial consumption include the retail gas price, micro- and macro-economic factors, and appliance efficiency. Consumption at some smaller commercial connections is also influenced by weather.

3.4.2. Safety

Ensuring the safety of the workforce and the community is a primary driver for asset management activities. AGN’s gas distribution network carries the inherent safety risks associated with transporting natural gas. Any crack, break or leak can pose a safety risk; however, the greatest risk occurs where mains break or crack, releasing gas into (or beneath) a building where it may collect, be ignited and cause an explosion.

Asset management activities are designed to increase the likelihood leaks being detected, and ideally repair or replace assets before a leak, crack or break occurs. A key indicator of asset condition can be age. However, asset condition is also heavily dependent on the material, location, and conditions under which the pipe was laid.

3.4.3. Asset Condition

Assets deteriorate as they age, and typically their performance declines over time. The rate of deterioration can vary dramatically depending on asset type, material, location and operating pressure. Though deterioration tends to be gradual, asset failure (particularly gas main failure) can be sudden, and the consequences severe.

As a result, asset condition is a critical driver of asset replacement. AGN aims to replace aged and poor condition assets before failure occurs. Asset condition is one of the most dynamic asset management drivers. This is because replacement and maintenance programs may have to accelerate or switch focus in response to asset performance indicators or safety incidents.

3.4.4. Security of Supply

Ensuring a safe and reliable natural gas supply is fundamental to AGN's asset management approach. As discussed in section 3.3.1.8, AGN manages its natural gas networks to Australian Standards, which provide guidance on acceptable levels of safety and reliability. In addition to these standards, AGN constantly monitors asset performance to ensure the network can meet the growing demands of customers. Changing consumption behaviours, new technology, and urban growth puts pressure on discrete sections of the network, and is an important driver in determining which parts of the network require augmentation, and whether existing asset solutions remain adequate.

3.4.5. Third Party Capital Works Programs

Capital works programs by other utilities and road authorities often require assets such as gas mains or service inlets to be moved, modified and/or replaced. The cost of such works is recouped from the requesting party.

3.4.6. Customer Expectations

AGN conducts market research and stakeholder engagement to understand customer perceptions. Engagement methods used include, but are not limited to, dedicated focus groups, telephone polls, and online surveys. At a high level, customers expect:

- a safe and reliable level of service;
- affordable pricing;
- responsive service;
- consistent service performance; and
- responsible environmental management.

These expectations are built into AGN’s asset management approach, and help inform asset management objectives.

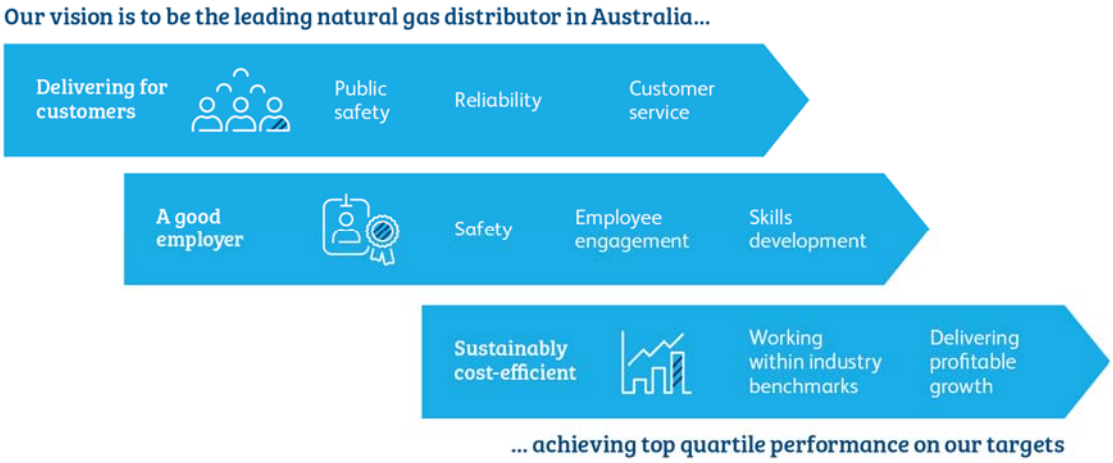
4. Asset Management Vision and Objectives

This section describes AGN's asset management vision and the objectives it seeks to achieve through its asset management strategy.

4.1. AGN Strategic Vision

AGN's strategic vision is summarised in Figure 4.1.

Figure 4.1: AGN Strategic Vision



AGN's asset management objective is to manage the networks in a manner that maintains a high level of safety, reliability and customer service. AGN will operate and invest in the network prudently and efficiently, in accordance with good industry practice and all applicable standards and regulatory requirements.

4.2. Asset Management Objectives

AGN's asset management objectives are:

- **Ensuring network safety** – to maintain and operate assets so that the risks to employees, contractors and the public, are maintained as low as reasonably practicable;
- **Providing high quality service** – to provide customer service that is in the top quartile of gas distributor performance industry (e.g. reliability of gas supply);
- **Prudent and efficient operation and investment** – to ensure costs are prudent, efficient, consistent with accepted industry practices and necessary to achieve the lowest sustainable cost of providing gas distribution services in the long-term interest of customers;
- **Regulatory compliance** – to meet all regulatory requirements associated with the Gas Distribution Licence, Gas Reticulator Authorisation, Gas Act 1997 (Victoria), Gas Supply Act 1996 (New South Wales), National Gas Law, and other regulatory instruments; and
- **Environmental management** – to maintain and operate assets so that the risks to the environment are kept as low as reasonably practicable.

These objectives ensure the ongoing investment in and operation of the networks is in the best interest of customers. Each of these objectives are factored into AGN's investment governance processes and decision making framework.

The asset performance indicators and KPIs described in Section 3.3.3 provide guidance on whether these objectives are being satisfied, and help inform ongoing asset maintenance and replacement programs.

By achieving these objectives, AGN provides the following benefits to customers:

- a safe and reliable natural gas network;
- an affordable natural gas supply;
- confidence that natural gas remains a sustainable energy option; and
- minimal impact on the environment and community.

5. Asset Management Approach

This section describes AGN and APA's approach to asset management, the risk assessment framework used to inform asset strategies, and the asset life cycle process. It also describes the process of internal and external monitoring and audit undertaken to ensure the agreed asset management approach is being adhered to.

5.1. Asset Management Cycle

Maximising asset utilisation and minimising life cycle costs, balanced against safety and quality standards, is fundamental to achieving the NGO. The AMP is designed to demonstrate the suitability of network assets to deliver service levels and performance targets, which informs network maintenance and capital investment programs.

The AMP documents the asset management practices for each network asset class and is part of an overall asset lifecycle management strategy.

Through the AMP development process AGN:

- identifies the levels of service required for the network;
- outlines activities, action plans and works programs, optimised and prioritised by risk, to deliver the objectives and targets;
- describes risk management practices for the ongoing identification and assessment of asset management related risks and to identify and implement appropriate control measures;
- ensures investment in lifecycle activities are prudent and efficient based on a whole of life approach; and
- monitors the performance and condition of the assets.

APA's asset management approach follows a Plan, Do, Check, Act cycle, supported by a continuous improvement culture. This is in line with good asset management practice as defined in ISO 55000 – Asset Management.

Figure 5.1: AGN's Asset Management Cycle

Table 5.1 Asset Management Cycle Description

Asset Management Cycle	Description
Plan	• Annual and five-year capital and expenditure plans are developed based on assessment of performance, reliability, condition, risk and cost
Do	• Projects and programs of work are executed in accordance with approved budgets and controlled and monitored using formal project management methodology
Check	• Key safety, financial, regulatory, reliability, condition and service indicators are reviewed monthly by senior AGN/APA management
Act	• Asset management issues and risks are assessed and prioritised to inform the scope of projects and programs for the development of the next iteration of the AMP

This AMP provides a five-year outlook, and has regard to where assets are within their life cycle. The AMP informs the necessary asset maintenance and replacement/refurbish programs. However, new projects and delivery rates may change in line with demand growth, updated asset condition information, and new obligations during the five-year period.

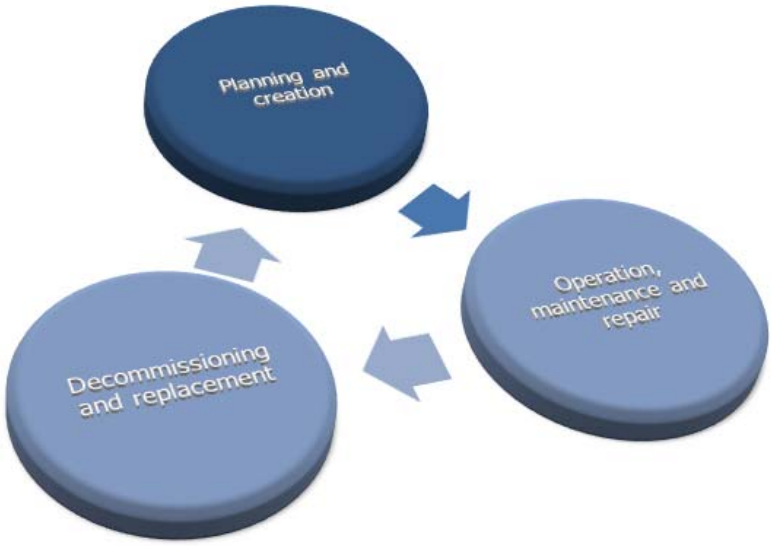
For each asset, APA identifies the life and management approach to optimise the asset life. Consistent with AS/NZS 4645, the asset life cycle has three stages:

1 planning and creation;

2 operation, maintenance and repair; and

3 decommissioning and replacement.

Figure 5.2: Asset Life Cycle



AGN takes a systematic approach to each stage of the asset life cycle, with discrete processes for each asset class. The following sections describe the asset life cycle stages.

5.1.1. Planning and Creation

Planning and creation processes look at current and future demand trends, asset performance, and map these against potential asset maintenance, replacement or refurbishment solutions.

5.1.1.1. Planning Horizons

AGN has an annual rolling five-year plan for assets. Year one of the plan represents firm requirements for the next financial year. Subsequent yearly forecasts are indicative, and reflect estimated connections growth and utilisation rates, network performance and asset condition.

Mains replacement is based on a long-term outlook/assessment of risk, performance and condition/integrity. This includes a quantitative and qualitative analysis of risks, and a robust cost options assessment. Major network augmentation projects are evaluated on a horizon consistent with the reliability of forecast information. Each year, the plan is updated for latest performance and asset condition data.

5.1.1.2. Investment Governance

AGN has robust planning and approval processes to ensure capital expenditure is prudent, efficient and consistent with good industry practice. Network asset creation is subject to appropriate cost controls. The following financial controls ensure creation of assets only occurs in accordance with established prudent approval processes:

- all capital expenditure projects are subject to the preparation of a formal business case/justification requiring senior APA management approval;
- projects valued less than $500k are approved by APA management in accordance with determined approval limits, provided the projects are in the approved annual budget and satisfy required rate of return criteria;
- projects valued more than $5 million require AGN Board approval; and
- APA reports to AGN monthly on progress against capital budget and progress for major capital projects.

While specific investment programs are developed using a ‘bottom-up’ approach, the overarching asset creation, maintenance and decommissioning/replacement are subject to rigorous ‘top-down’ review. The top-down investment governance approach provides that:

- forecasts are based on the considerable expertise of AGN and its contractor, APA;
- forecasts are based on robust business cases that have been subject to thorough review as to their compliance with the relevant requirements of the NGL and NGR;
- where possible, forecasts have been based on the most recent actual information available, which information reflects revealed efficient expenditure/outcomes;
- all different options and relevant drivers of a forecast have been considered and explained in the business cases, including by providing any data used to derive a forecast;
- relevant industry stakeholders have been consulted, where appropriate, in deriving a forecast, plan and/or estimate;
- all capital expenditure, from design through to implementation, is required to pass through a series of internal delegations, including through the AGN Board depending on the materiality of the project;
- network modelling is undertaken to ensure there is sufficient capacity to meet demand and maintain minimum supply pressures in all parts of the network;

- capital works are timed, wherever possible, to coincide with works undertaken by road authorities and other utilities to minimise the cost and disruption to the public; and
- financial modelling is undertaken to ensure investment passes the economic test under Rule 79(2)(b).

5.1.2. Operation, Maintenance and Repair

The operation, maintenance and repair stage of the asset life cycle involves three principle processes:

- surveillance and monitoring;
- preventative maintenance; and

corrective maintenance.

Table 5.2 presents the activities conducted during each process.

Table 5.2: Operation and Maintenance Processes

Maintenance Process	Activities
Surveillance and monitoring	• Telemetry pressure point monitoring and demand customer monitoring of pressure at delivery points • Pressure monitoring at various field locations using chart recording • Pipeline patrol and inspection • Cathodic protection monitoring • Coating survey • Leak survey • Inspection of special crossings • Odorant monitoring • Gas quality monitoring
Preventative maintenance	• Regulator maintenance • Valve maintenance • Cathodic protection maintenance • Telemetry system maintenance • Meter maintenance • Periodic meter changes
Corrective maintenance	• Repairing leaks • Repairing third party damages • Clearing water ingress and system blockages • Resolving metering problems/failures • Repairing cathodic protection system faults • Repairing pipe coating failures/faults • Fault-finding on pressure regulating installations

Maintenance is undertaken to ensure assets continue to meet their intended performance levels within their expected life time. Maintenance processes and frequencies take into account:

- asset type and age;
- location and operating environment;
- importance of function;
- manufacturer's recommendations;
- asset history;
- industry experience; and
- condition monitoring.

APA operating procedure manuals detail minimum requirements for the maintenance and condition monitoring of:

- transmission pressure pipelines;
- high pressure mains and services;
- medium and low pressure mains and services;
- gate stations;
- pressure reducing stations; and
- meter stations.

Operating procedure manuals detail the frequency and scope of work to be carried out, and are used in conjunction with relevant codes of practice and equipment manufacturer's instructions. The operating procedures defined in the manuals include:

- monitoring the condition of pipeline easements, signage, and above ground facilities;
- identifying threats to the safety of a pipeline and its ongoing reliable operation;
- controlling corrosion in accordance with applicable standards;
- monitoring the condition of coatings for both buried and aboveground pipe work and structures;
- identifying leaks;
- ensuring accuracy and reliability of instrumentation associated with measurement of gas flow and monitoring of pipeline conditions;
- ensuring reliable operation of pressure control and pressure relief equipment, emergency shut down and slam shut valves, isolation valves, heaters, filters and other ancillary equipment to design specifications;
- testing the effective operation of electrical protection equipment and the adequacy and condition of electrical earthing systems;
- inspecting pressure vessels and pig traps for both internal and external corrosion and defects, and the condition of quick acting closure mechanisms and seals; and
- carrying out special inspections of underwater pipelines, tunnels, casings, foreign crossings, and special zones identified as requiring specific inspection and monitoring.

Maintenance practices are audited by AGN's external auditors and by ESV, as well as by APA internal auditors for compliance with distribution licence conditions, AS/NZS 2885.3 and AS/NZS 4645 requirements.

5.1.3. Decommissioning and Replacement

Assets that are approaching the end of their useful life, or those that experience accelerated deterioration, are identified for replacement. Where feasible (and safe to do so), refurbishment is considered as an option to extend the asset's useful life. The option to replace or refurbish is typically considered as part of the business case process.

The asset replacement decision is driven by the prudent balance between avoiding future costs of maintenance, current replacement cost, risk, regulatory compliance and levels of service. Where replacement is identified as the prudent option, the asset replacement program takes into account the efficient allocation of resources.

AGN monitors trends in maintenance requirements, which provides a good indication of forecast replacement rates. Long-life assets such as pipelines usually deteriorate slowly. This allows time to identify priorities and undertake replacement in a prudent and efficient manner.

The following controls are associated with refurbishing/replacing assets:

- annual integrity and performance reviews;
- a project proposal/business case approved for each major asset refurbishment/replacement; and
- production of an annual Distribution Mains and Services Integrity Plan (DMSIP) with AGN approval of annual budgets and award of major contracts.

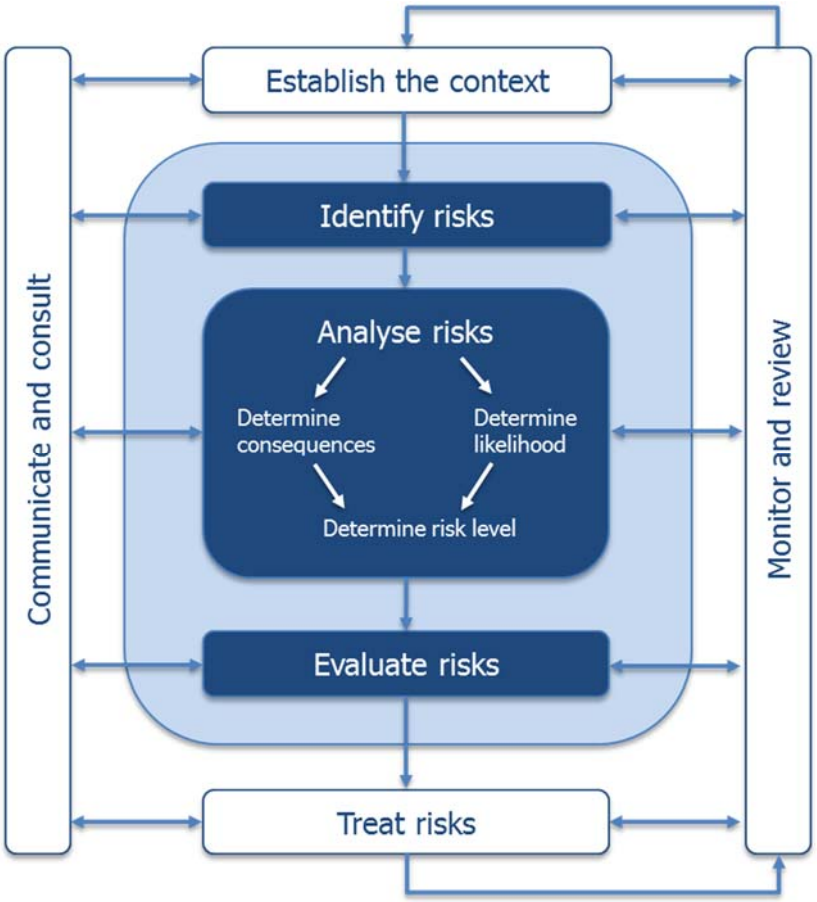
Where an asset has reached the end of its useful life (and cannot be refurbished), it is decommissioned. Like the commissioning process, AGN's decommissioning process is guided by AS/NZS 4645 (for distribution assets) and AS/NZS 2885 (for transmission assets).

5.2. Risk Management

There is an inherent risk associated with gas mains and services. Whenever a gas main leaks, cracks, or breaks there is the potential for the community and employees to be seriously injured, or for supply to be disrupted. The risk can vary depending on the location, material type, pressure and age of each gas main or service inlet. AGN reviews the performance indicators of mains to assess the potential risk associated with deterioration in condition.

AGN manages network integrity by regularly updating risk assessments to reflect new information on asset condition. A rigorous risk assessment and risk rating guides the actions and activities that ensure network safety and compliance is maintained as efficiently and effectively as possible. AGN's risk management cycle is summarised in Figure 5.3.

Figure 5.3: Risk Management Cycle



AGN's risk management framework is based on AS/NZS ISO 31000 Risk Management – Principles and Guidelines, and the requirements of AS/NZS 2885 Pipelines-Gas and Liquid Petroleum and AS/NZS 4645 Gas Distribution Network Management. AGN is required to comply with AS/NZS 2885 and AS/NZS 4645 as a regulatory requirement by the Gas Act.

AS/NZS 4645 (which provides the overarching standard for distribution mains and services) requires that all actions and activities not unduly expose personnel, the public or the environment to unacceptable risks. Measures to mitigate those risks are to be identified, reviewed and documented. The areas to be considered include:

- safety of the public (including customers);
- safety of personnel working on the gas distribution network;
- integrity of the network;
- minimisation of environmental impacts; and
- protection of property.

In accordance with Appendix C of AS/NZS 4645, for each risk event AGN considers the consequence and likelihood of that event occurring. Combining these produces the level of risk assessed (risk rating). Once the level of risk has been defined, AGN considers risk treatment options (guided by AS/NSZ 4645) and consider the effectiveness and cost of those options for remediating the risk.

The costs are considered against the inherent risk, the level of risk reduction, and the residual risk, to determine a prudent and efficient course of action. Where assets are rated 'extreme' or 'high' risk under AS/NZ 4645, AGN assesses the most effective way to reduce the risk to 'low' or 'negligible' and the efficient cost of doing so. Where assets are rated as 'intermediate', AGN assesses whether the risk can be reduced to 'low' or 'negligible' and how that might be achieved.

If the risk cannot be reduced to 'low' or negligible, or the cost of doing so is disproportionate to the risk reduction, AGN takes action to reduce the threat to the extent practicable and demonstrate the risk is as low as reasonably practicable (ALARP). For some assets, the only way to reduce the risk is to replace them.

This framework provides for circumstances where the cost of mitigating risk is disproportionate to the impact on the risk when a risk is rated as 'intermediate'. Where this occurs, a business can consider the risk to be ALARP.

5.3. Monitoring and Review

To ensure risk management and asset life cycle processes are robust and being adhered to by the business, AGN has a suite of internal and external reporting and audit processes (see Table 5.3). These processes help AGN evaluate the effectiveness of the overall asset management approach, as well as the skills and competencies of personnel.

Table 5.3: AGN Internal and External Monitoring Processes

Monitoring Process	Activity
Audit	• Internal audit • External audit
Reporting	• Operational and KPI reporting • Expenditure against budget
Review	• Asset condition and KPI trends • Training needs/Skills and competencies assessments • Site and activity management planning • Procedural controls / operating manuals • Records management processes

5.3.1. Audit Processes

Auditing ensures all activities and processes comply with required industry standards. The results of internal and external audits are reported to APA management, and are provided to AGN twice yearly.

Internal audits include:

- **supervisor monitoring audits** – to ensure field activities are performed in accordance with internal requirements and relevant legislation;
- **verification audits** – conducted by trained quality and safety auditors, independent to the operating function. The purpose of these audits is to verify that the audits of task related activities provide credible and consistent results;

- **technical facility audits** – performed by trained quality and safety auditors, since the level of exposure of the business tends to be greater with critical gas facilities; and
- **HSE management system audits** – to provide evidence that the APA HSE system is effective. These audits are conducted by trained safety auditors.

External audits include:

- **AGN audits** – performed on an 'as required' basis to provide confidence that APA is conducting the operational function with due diligence, and in compliance with legal requirements;
- **regulatory audits –** conducted by applicable government safety and commercial regulators as a means of ensuring that activities performed within APA conform to legislative requirements; and
- **safety plan audits –** external auditors may be engaged by APA to conduct audits on aspects of safety or operating plans.

APA tracks all audits through to completion using its Management of Audits, Regulatory Compliance and Incidents System (MARCIS).

5.3.2. Reporting Processes

AGN undertakes internal and external reporting to measure the effectiveness of asset management processes and compliance with the asset management approach. Business reporting is largely hierarchical in nature and is designed to monitor whether the business is meeting its objectives. Reports may be categorised as compliance reports, operational reports, exception reports and financial reports. The vertical reporting structure has the following levels:

- **Corporate Governance Compliance Report** is a high-level acknowledgement that activities and functions provided by the business conform to all legislative and industry expectations. The report is produced six-monthly for AGN's Board and audit committee;
- **AGN Operational Report** is produced monthly and draws together key operating criteria, system performance, Health Safety & Environment (HSE) performance, financial measures, internal and external audits, and other predictive measures into a single document;
- **departmental reports** are produced monthly for APA management and provide key operational performance information and HSE performance;
- **section reports** are also produced monthly, and keep departmental managers informed of the activities under their control; and
- **HSE Committee reports** are produced by each operating unit to keep all staff informed of the issues that affect their area of operation and control.

In some situations, the vertical reporting structure is augmented by horizontal reporting methods. Examples include hazard alerts, technical bulletins, management presentations, emails, notice boards, etc. Budget planning and monitoring is undertaken to ensure planned work is performed efficiently and within economic constraints. Detailed budgets are prepared annually and monitored monthly.

In addition to business reporting, a quarterly report is provided to ESV. The quarterly report includes data on:

- number of leak repairs;
- loss of supply;
- mains damages;
- emergency response;
- guaranteed service levels;
- complaints; and
- mains replacement progress.

5.3.3. Review Processes

Formal and informal reviews are a vital input into asset planning and management processes. Table 5.4 summarises some of APA's key review processes.

Table 5.4: APA Review Processes

Review Process	Description
Asset condition and KPIs	Asset KPIs are the primary measures of asset performance, condition and integrity. These are reviewed in the APA monthly operating and management report and the annual Distribution System Performance Review. Generally, gas distribution networks are stable with well-established underlying trends. This allows corrective actions or required changes to be planned well in advance of failure points.
Skills and competencies of personnel	Skills and competencies of staff and contractors are critical to the effective management of the assets. Business activities are risk-assessed, and where ranked as critical, are managed through a robust method of individual certification. Critical activities may only be performed by operators who can demonstrate their competence to nationally registered assessors and have been issued with an 'authorisation to operate'. Staff and contractor competency is reassessed every two years via scheduled refresher training courses and reaccreditation processes.
Procedural controls / operating manuals	APA has a suite of procedural control and operating manuals, which include: • work instructions; • operating procedures; • competency standards; and • training programs. These documents are reviewed to ensure the contents reflect changing regulatory requirements, risk mitigation strategies and industry best practice.

6. Capacity Management

This section summarises the capacity management process and the drivers for network augmentation.

6.1. Capacity Management Process

Network capacity is managed by:

- monitoring network performance;
- assessing forecast demand; and
- assessing threats to supply.

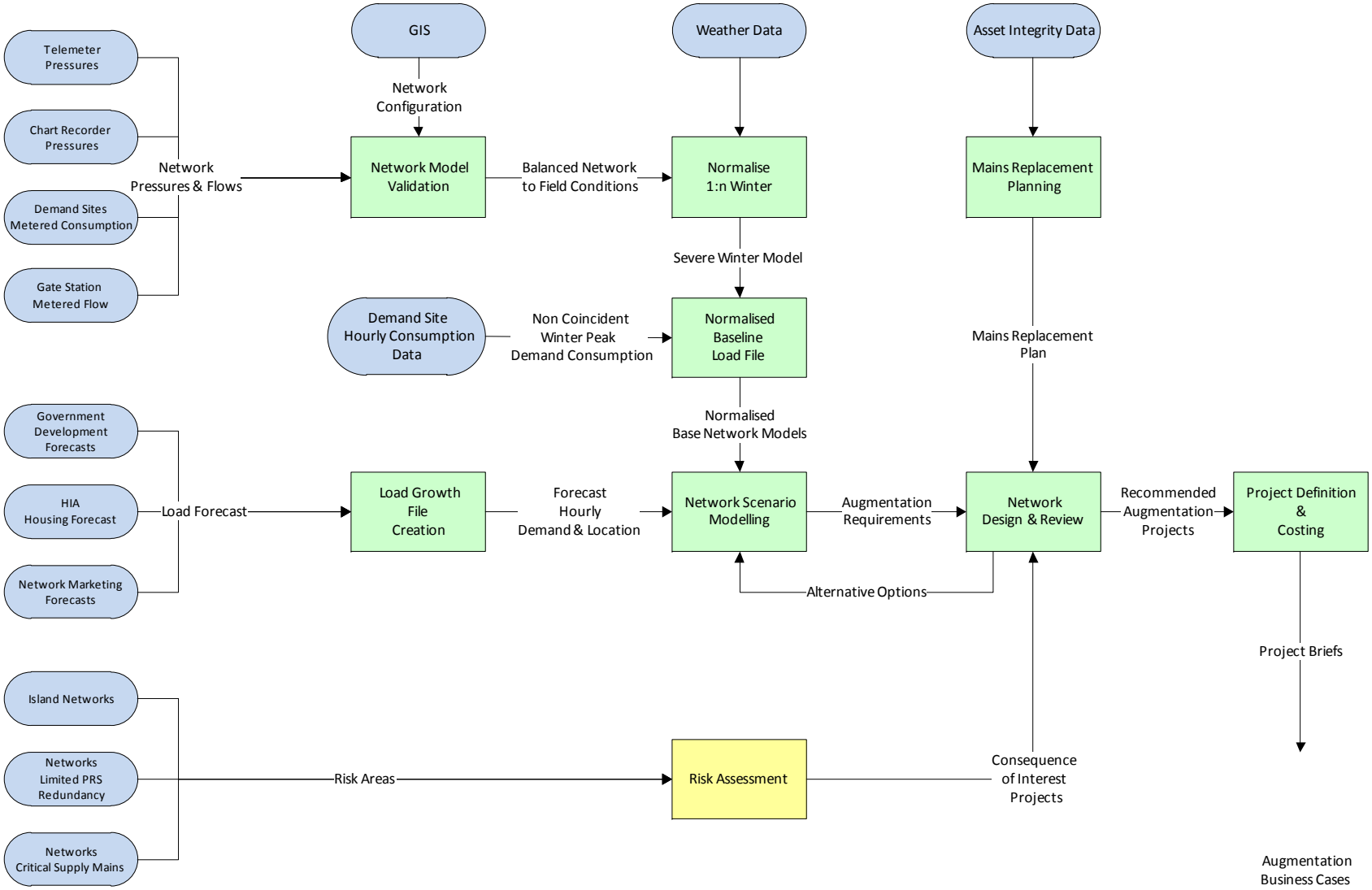
Network capacity issues are addressed in accordance with the risk they present, and undertaken subject to qualitative and quantitative analysis of costs and benefits.

The network requires augmentation when:

- the minimum pressure in a network falls, or is forecast to fall, below the recommended minimum end of main pressure during design load conditions; or
- there is insufficient redundancy within the network, which adversely affects the security of supply to a large number of customers.

AGN's capacity management process is presented in Figure 6.1 the following page.

Figure 6.1: AGN Capacity Management Process



The capacity management process involves the following key activities:

- **maintaining baseline capacity models** – meter-to-main connectivity configuration is maintained within the Geographic Information System (GIS). Network configurations are exported into capacity modelling software (Synergee). Network models are validated against actual field conditions using gate station inputs, large volume customer hourly demand, system pressures and derived Tariff R and Tariff C loads. Computer models are iteratively balanced so that modelled pressures match those from the field;
- **design load assessment** – Tariff R and C design loads are derived from the validated baseline network load, corrected to allow for additional consumption consistent with a one-in-two probability winter's day. Tariff D customer load is normalised based on variation in consumption during the daily peak hour period throughout winter. In each case the design load is based on a peak hourly load (as opposed to peak day or monthly average) as this is the important parameter for maintaining supply to the network;
- **forecasting load growth** – a range of sources, including the Melbourne Planning Authority publications, precinct structure plans, publicly available documentation from forecast.id and HIA statistics, as well as internal marketing trend analysis and expert projections, are used to forecast the number and location of new residential connections.

  Market trend analysis is used to determine the rate of new connections for industrial and commercial, and demand market sectors. The additional connections are converted to an expected hourly demand at specific locations within the network. The output of this process is an annual load growth profile that is superimposed on the network model to identify future capacity constraints;
- **network scenario modelling** – Synergee is used to evaluate various load scenarios and augmentation options. Capacity shortfalls are identified and solutions modelled to confirm augmentation requirements;
- **mains replacement planning** – the identification of mains for replacement involves assessing key operating data (leaks, supply pressures, gas outages, risk analysis). Priority areas are identified, from which detailed replacement strategies are formulated. The output of this process is combined with capacity and security of supply issues to optimise the location and size of principal supply mains within the network;
- **project initiation** – the various capacity, replacement and security of supply issues are reviewed and options considered. A recommended solution is defined and submitted for inclusion into a five-year augmentation plan. The plan is reviewed annually to confirm the timing and scope of proposed projects; and
- **project business cases** – a business case is prepared for augmentation projects identified for implementation within the budget year, and approved in line with the appropriate delegation of authority.

  Each business case addresses:

  - scope, cost and timing;
  - background to the project;
  - options considered;
  - economic analysis;
  - risk assessment;

- compliance with regulatory conforming expenditure requirements; and
- cost breakdown.

6.1.1. Network augmentation drivers and risk assessment approach

Network augmentation is the addition of gas network infrastructure (mains, gate station, and pressure facilities), aimed at providing adequate capacity to maintain a safe and reliable supply of gas to customers. The risk of inadequate network capacity is assessed using the APA Risk Matrix, applying APA's risk likelihood and consequence criteria across safety, environmental, operational, compliance, customer, reputational and financial consequence categories. APA's risk matrix is aligned with the risk framework provided for in Appendix C of AS/NZS 4645.

Networks are augmented to:

- **maintain a safe supply of gas to customers –** poor network pressures could, in some circumstances, lead to a momentary loss of supply to an appliance. Should a 'flame out' occur and remain unnoticed, this could lead to a gas in building incident, which in turn could result in serious injuries and/or fatality through a gas explosion or asphyxiation. While the likelihood of this is low the consequences could be major;
- **maintain supply reliability to existing customers** – growth within and at the extremity of networks can decrease network capacity (as measured by extremity pressures) to the extent that supply reliability to existing customers may be compromised resulting in a gas outage. Supply interruption to customers can pose significant operational, compliance and reputational issues. AGN is obligated under the Gas Distribution System Code to maintain system pressures above nominated minimums that are deemed to maintain a safe and reliable supply of gas. Failure to maintain adequate system pressures could result in fines or in extreme circumstances cancellation of the distribution license. In addition, there is an obligation for AGN to achieve guaranteed service levels within its Victoria network. Failure to do so results in compensation payments to customers of up to $300 per customer (depending on the extent and duration of supply loss); and
- **avoid a major gas outage caused by a single point failure** – a single point of failure (third party damage, major mains leak, pressure regulating facility failure) could pose significant operational, compliance and reputational issues. There are several controls (dial before you dig, pipeline route surveys, SCADA monitoring, preventative maintenance programs, and design redundancy) that aim to mitigate this risk. However, there is still a possibility, albeit small, that could give rise to an unacceptable risk. In these circumstances, additional network infrastructure may be considered to reduce the risk to low or negligible, and if not ALARP.

Network augmentation projects are assessed on the highest risk event associated with either:

- insufficient network pressure cause by incremental growth, which leads to a loss of supply to existing customers; or
- a single point of failure of the network that results in insufficient network pressure, which leads to a loss of supply to existing customers.

Table 6.1 summarises the consequences associated with not maintaining adequate system pressure.

Table 6.1: Consequences of System Pressure Failure

Consequence Category	Description
Health and Safety	A momentary loss of supply could result in a 'gas in building' event that could result in serious injuries to occupants if it remains undetected and allowed to accumulate.
Environmental	Any loss of supply has no material impact on the environment.
Operational	Operational impacts include; managing customer complaints; effecting safe turn-off and turn-on of customers' appliances; and incurring Guaranteed Service Level (GSL) payments. The higher the incidence of events and customers impacted, the higher impact on the business.
Customers	Customers value reliability of supply to the extent that if there is a reliability issue within an area they are likely to choose or be directed to alternative energy supply sources.
Reputation	Negative media exposure could influence the public's perception that the network is not being maintained in safe and reliable manner. This in turn could impact the fuel of choice by the community, resulting in a long-term 'decay' in network utilisation.
Compliance	As part of AGN's obligations under its Gas Distribution Licence it is required to maintain a safe and reliable supply of gas to customers. This obligation is defined by the Gas Distribution code, which details minimum network pressures to be maintained. Failure to do so could result in fines being imposed or in an extreme situation cancellation of the asset owners.
Financial	Significant gas outage events could materially impact on the cost to the business in terms of GSL payments, cost of relights, injury compensation and or building costs in event of a 'gas in building' incident.

6.2. Peak Hour Demand

This section provides an overview of trends in customer demand used to inform network augmentation strategies.

6.2.1. Demand drivers

Demand drivers that influence the residential, commercial and industrial market segments fall into two categories:

1 new connections drivers, and

2 customer consumption drivers.

Drivers for new residential connections include population and associated housing growth, interest rates, and building codes for homes. The primary driver for new industrial and commercial connections is delivered energy cost compared to the nearest alternative.

Residential consumption drivers include weather, retail gas price, microeconomic factors, appliance efficiency and alternative energy appliances. Drivers for commercial and industrial consumption include the retail gas price, micro- and macro-economic factors, and appliance efficiency. Table 6.2 shows the different drivers that influence customer connections and consumption, by sector.

Table 6.2: Natural Gas Demand Drivers

Sector	Natural Gas New Connections Drivers	Natural Gas Consumption Drivers
Residential	Population and housing growth	Weather
	Interest rates	Retail gas price
	Building codes	Microeconomic factors
	Appliance obsolescence	Gas appliance efficiency
		Alternative energy appliances
Industrial and commercial	Connection cost	Retail gas price
	Network proximity	Micro and macroeconomic factors
	Alternative energy price and accessibility	Appliance efficiency
	Technology developments (e.g. gas-powered air conditioning)	Production process technology improvements
	Energy security	Weather

Like many natural gas utilities worldwide, AGN is experiencing a decline in average consumption per customer. The decline in average consumption is partly due to customers choosing alternative energy sources, especially electricity. The shift towards electricity is influenced by the following factors:

- greater focus by retailers on electricity marketing rather than gas, with many retailers offering both products; and
- erosion of the natural gas space heating market share and benefits of gas given the penetration of reverse cycle air conditioners in the residential market.

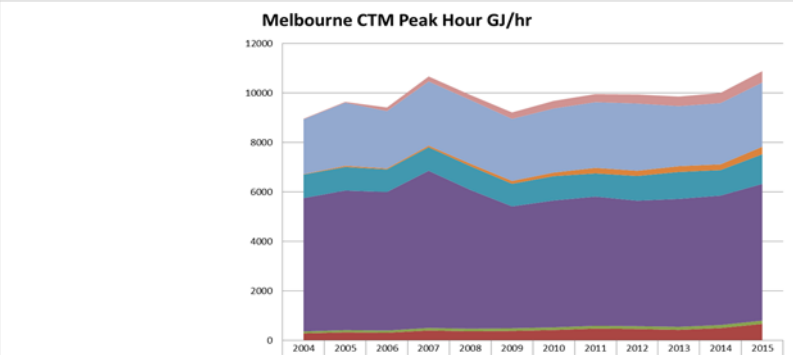
Improvements in gas appliance efficiency and other technological improvements are also eroding average consumption.

While average consumption may be declining the network peak hour consumption has been steadily increasing, driven primarily by residential growth and the use of high instantaneous demand appliances (instantaneous hot water and central/space heating).

6.2.2. Historical and forecast demand

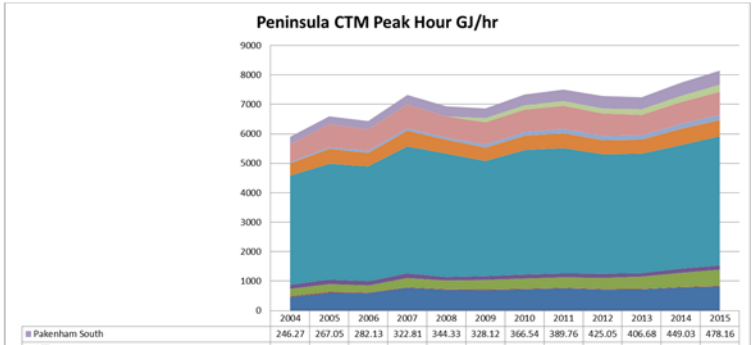
The following graphs consolidate the observed historical peak hour load at each custody transfer point within the Victoria and Albury networks, grouped by tariff zones.

Figure 6.2: Melbourne CTM Peak Hour



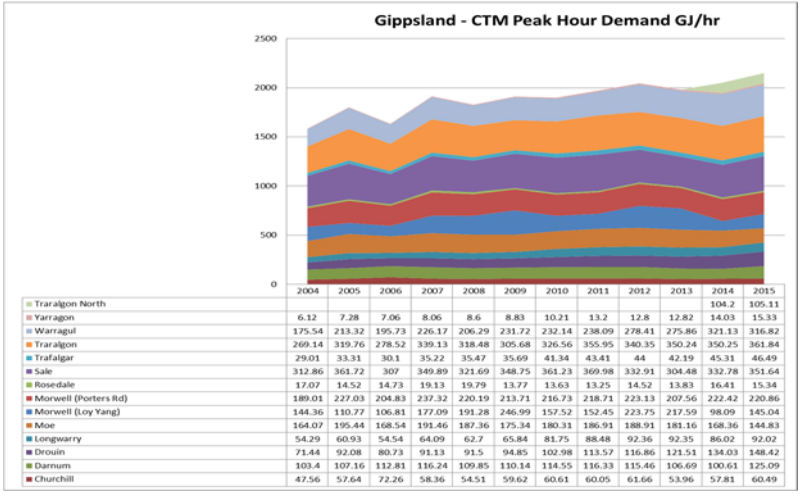
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Whittlesea	20.95	33.78	145.35	202.59	200.58	259.17	307.53	326.99	365.26	386.04	410.27	458.84
W.Melbourne	2216.51	2548.35	2315.24	2593.21	2576.52	2507.99	2589.33	2654.52	2717.87	2425.24	2475.18	2594
Laurimar Park	16.47	48.42	40.66	64.51	99.31	116.55	145.42	224.98	209.86	233.43	233.02	305.92
Melbourne (QWR)	950.32	950.62	913.03	950.45	959.34	911.03	981.69	935.58	996.98	1087.93	1028.86	1196.1
Keon Park East	5386.42	5639.2	5597.25	6347.8	5606.59	4921.93	5125.35	5218.31	5069.04	5168.34	5229.41	5522.5
Healesville	77.28	88.11	88.11	104.17	105.47	107.78	108.4	113.35	115.1	123.36	122.75	131.55
Epping	293.71	335.54	317.41	408.16	375.49	389.8	403.8	483.06	447.98	420.35	489.64	656.87
Beveridge						2.64	23.32	2.64	20.93	12.45	16.98	19.08

Figure 6.3: Peninsula CTM Peak Hour



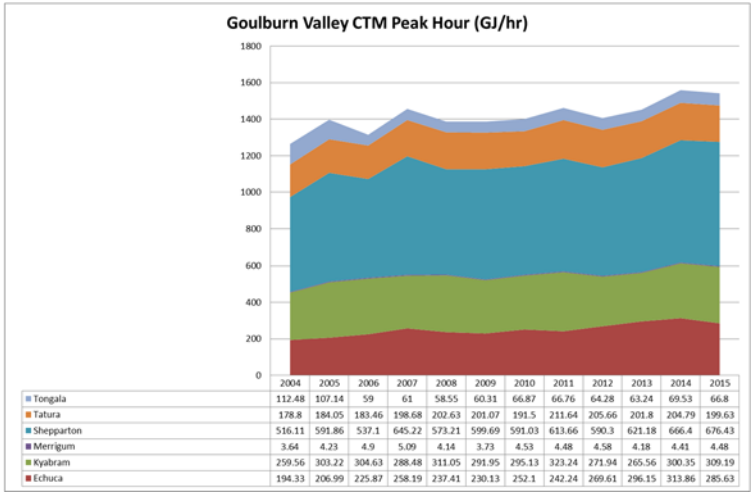
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pakenham South	246.27	267.05	282.13	322.81	344.33	328.12	366.54	389.76	425.05	406.68	449.03	478.16
Officer						141.13	145.57	159.59	167.9	189.45	207.08	242.13
Narre Warren	614.05	778.13	727.18	805.32	710.3	758.12	760.72	779.91	763.33	693.02	743.52	779.03
Lyndhurst	45.73	59.69	72.51	85.23	80.2	104.59	127.83	153.04	145.65	147.51	162.8	182.17
Hampton Park	413.98	504.18	456.07	534.45	472.18	453.85	486.17	507.73	476.07	478.9	557.2	550.09
Dandenong	3704.2	3926.48	3901.25	4304.93	4186.85	3901.55	4220.08	4245.42	4050.33	4051.96	4185.5	4379.02
Cranbourne (West)	139.95	160.05	143.12	163.32	120.41	133.51	141.93	138.68	149.97	121.61	148.2	149.04
Cranbourne (East)	246.2	263.7	240.61	311.32	294.3	325.79	345.51	354.47	377.98	416.89	476.23	551.49
Clyde North	31.69	32.11	17.84	18.44	21.37	20.98	19.38	17.61	17.65	16.65	16.37	16.11
Berwick	458.65	603.22	595.13	776.36	706.5	696.1	722.76	758.19	713.15	720.29	788.42	821.93

Figure 6.4: Gippsland CTM Peak Hour



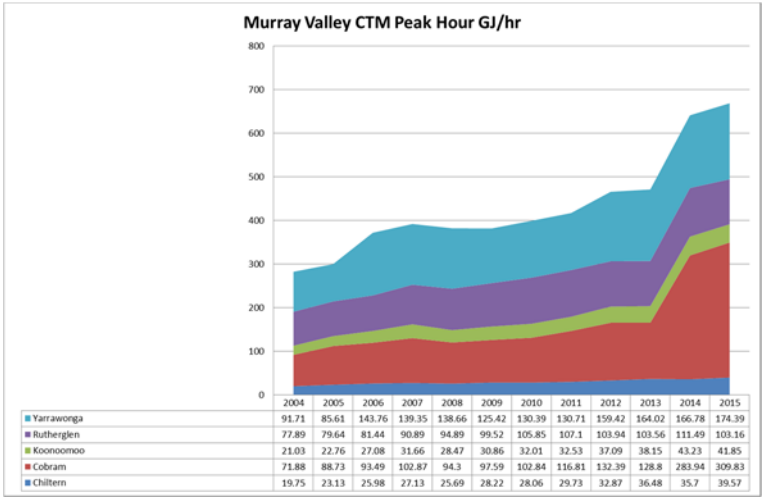
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Traralgon North											104.2	105.11
Yarragon	6.12	7.28	7.06	8.06	8.6	8.83	10.21	13.2	12.8	12.82	14.03	15.33
Warragul	175.54	213.32	195.73	226.17	206.29	231.72	232.14	238.09	278.41	275.86	321.13	316.82
Traralgon	269.14	319.76	278.52	339.13	318.48	305.68	326.56	355.95	340.35	350.24	350.25	361.84
Trafalgar	29.01	33.31	30.1	35.22	35.47	35.69	41.34	43.41	44	42.19	45.31	46.49
Sale	312.86	361.72	307	349.89	321.69	348.75	361.23	369.98	332.91	304.48	332.78	351.64
Rosedale	17.07	14.52	14.73	19.13	19.79	13.77	13.63	13.25	14.52	13.83	16.41	15.34
Morwell (Porters Rd)	189.01	227.03	204.83	237.32	220.19	213.71	216.73	218.71	223.13	207.56	222.42	220.86
Morwell (Loy Yang)	144.36	110.77	106.81	177.09	191.28	246.99	157.52	152.45	223.75	217.59	98.09	145.04
Moe	164.07	195.44	168.54	191.46	187.36	175.34	180.31	186.91	188.91	181.16	168.36	144.83
Longwarry	54.29	60.93	54.54	64.09	62.7	65.84	81.75	88.48	92.36	92.35	86.02	92.02
Drouin	71.44	92.08	80.73	91.13	91.5	94.85	102.98	113.57	116.86	121.51	134.03	148.42
Darnum	103.4	107.16	112.81	116.24	109.85	110.14	114.55	116.33	115.46	106.69	100.61	125.09
Churchill	47.56	57.64	72.26	58.36	54.51	59.62	60.61	60.05	61.66	53.96	57.81	60.49

Figure 6.5: Goulburn CTM Peak Hour



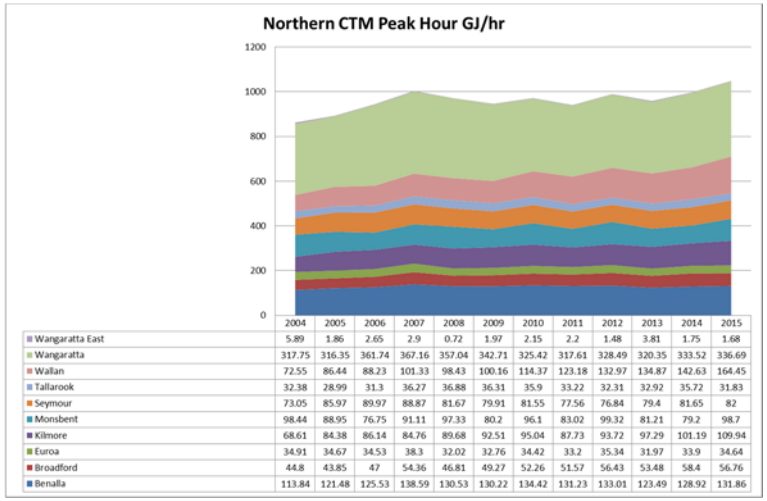
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Tongala	112.48	107.14	59	61	58.55	60.31	66.87	66.76	64.28	63.24	69.53	66.8
Tatura	178.8	184.05	183.46	198.68	202.63	201.07	191.5	211.64	205.66	201.8	204.79	199.63
Shepparton	516.11	591.86	537.1	645.22	573.21	599.69	591.03	613.66	590.3	621.18	666.4	676.43
Merrigum	3.64	4.23	4.9	5.09	4.14	3.73	4.53	4.48	4.58	4.18	4.41	4.48
Kyabram	259.56	303.22	304.63	288.48	311.05	291.95	295.13	323.24	271.94	265.56	300.35	309.19
Echuca	194.33	206.99	225.87	258.19	237.41	230.13	252.1	242.24	269.61	296.15	313.86	285.63

Figure 6.6: Murray Valley CTM Peak Hour



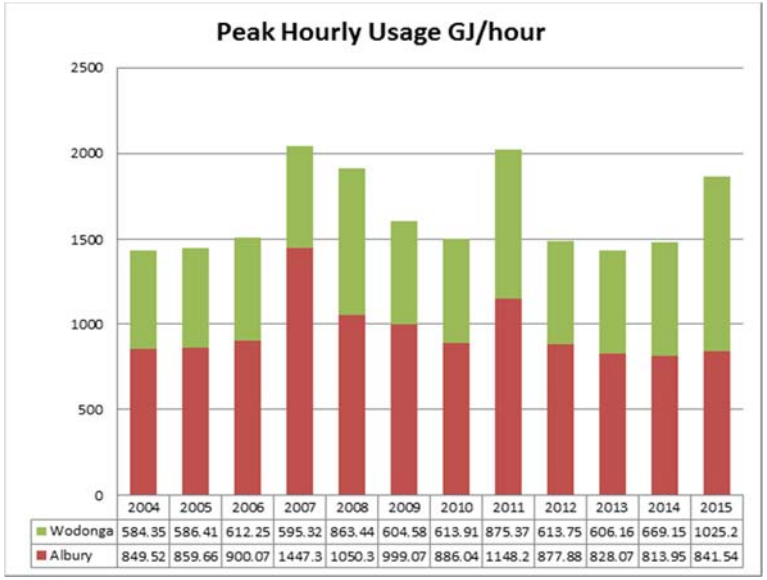
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Yarrawonga	91.71	85.61	143.76	139.35	138.66	125.42	130.39	130.71	159.42	164.02	166.78	174.39
Rutherglen	77.89	79.64	81.44	90.89	94.89	99.52	105.85	107.1	103.94	103.56	111.49	103.16
Koonoomoo	21.03	22.76	27.08	31.66	28.47	30.86	32.01	32.53	37.09	38.15	43.23	41.85
Cobram	71.88	88.73	93.49	102.87	94.3	97.59	102.84	116.81	132.39	128.8	283.94	309.83
Chiltern	19.75	23.13	25.98	27.13	25.69	28.22	28.06	29.73	32.87	36.48	35.7	39.57

Figure 6.7: Northern CTM Peak Hour



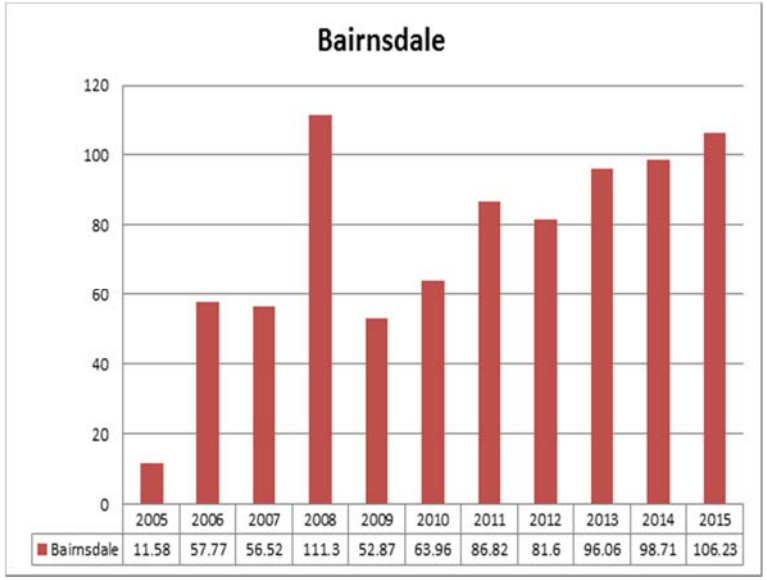
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Wangaratta East	5.89	1.86	2.65	2.9	0.72	1.97	2.15	2.2	1.48	3.81	1.75	1.68
Wangaratta	317.75	316.35	361.74	367.16	357.04	342.71	325.42	317.61	328.49	320.35	333.52	336.69
Wallan	72.55	86.44	88.23	101.33	98.43	100.16	114.37	123.18	132.97	134.87	142.63	164.45
Tallarook	32.38	28.99	31.3	36.27	36.88	36.31	35.9	33.22	32.31	32.92	35.72	31.83
Seymour	73.05	85.97	89.97	88.87	81.67	79.91	81.55	77.56	76.84	79.4	81.65	82
Monsbent	98.44	88.95	76.75	91.11	97.33	80.2	96.1	83.02	99.32	81.21	79.2	98.7
Kilmore	68.61	84.38	86.14	84.76	89.68	92.51	95.04	87.73	93.72	97.29	101.19	109.94
Euroa	34.91	34.67	34.53	38.3	32.02	32.76	34.42	33.2	35.34	31.97	33.9	34.64
Broadford	44.8	43.85	47	54.36	46.81	49.27	52.26	51.57	56.43	53.48	58.4	56.76
Benalla	113.84	121.48	125.53	138.59	130.53	130.22	134.42	131.23	133.01	123.49	128.92	131.86

Figure 6.8: Albury Wodonga CTM Peak Hour



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Wodonga	584.35	586.41	612.25	595.32	863.44	604.58	613.91	875.37	613.75	606.16	669.15	1025.2
Albury	849.52	859.66	900.07	1447.3	1050.3	999.07	886.04	1148.2	877.88	828.07	813.95	841.54

Figure 6.9: Bairnsdale CTM Peak Hour



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bairnsdale	11.58	57.77	56.52	111.3	52.87	63.96	86.82	81.6	96.06	98.71	106.23

Key observations in peak hour demand are:

- peak hour demand in most tariff zones are steadily increasing;
- demand in the Melbourne and Peninsula zone has been growing at almost 3% since the end of the Global Financial Crisis ended in 2009. These zones combined, represent about 75% of customers within the Victoria and Albury networks;
- demand in the Peninsula zone has increased by about 30% since 2004, primarily driven by residential growth around Cranbourne, Berwick and Packenham;
- Gippsland demand growth is primarily driven by growth in Warrgula and Taralgon; and
- the significant increase in Murray Valley demand in 2014 was driven by a large customer addition in Cobram.

7. Network Performance

This section describes the overall network performance and service levels for the Victoria and Albury networks. It presents information on overarching network performance such as reliability of supply, network incidents and level of UAFG.

Asset condition and overall network performance data is used to determine the replacement and maintenance strategies for each asset class, which in turn informs operating and capital expenditure forecasts. Details of asset condition, replacement and maintenance strategies are provided in Section 8 of this AMP.

7.1. Reliability of Supply

The reliability of supply is a good indicator of asset condition. Reliability of supply is related to gas incidents and interruptions to supply. AGN looks at the outcomes of asset management policies, processes and plans in terms of:

- reliability (gas interruptions);
- condition/integrity (leaks, gas in building, third party damage UAFG); and
- emergency leak response.

As discussed in section 3.3.3 of this AMP, AGN monitors a suite of KPIs and asset performance indicators to measure network performance. The most critical indicators are:

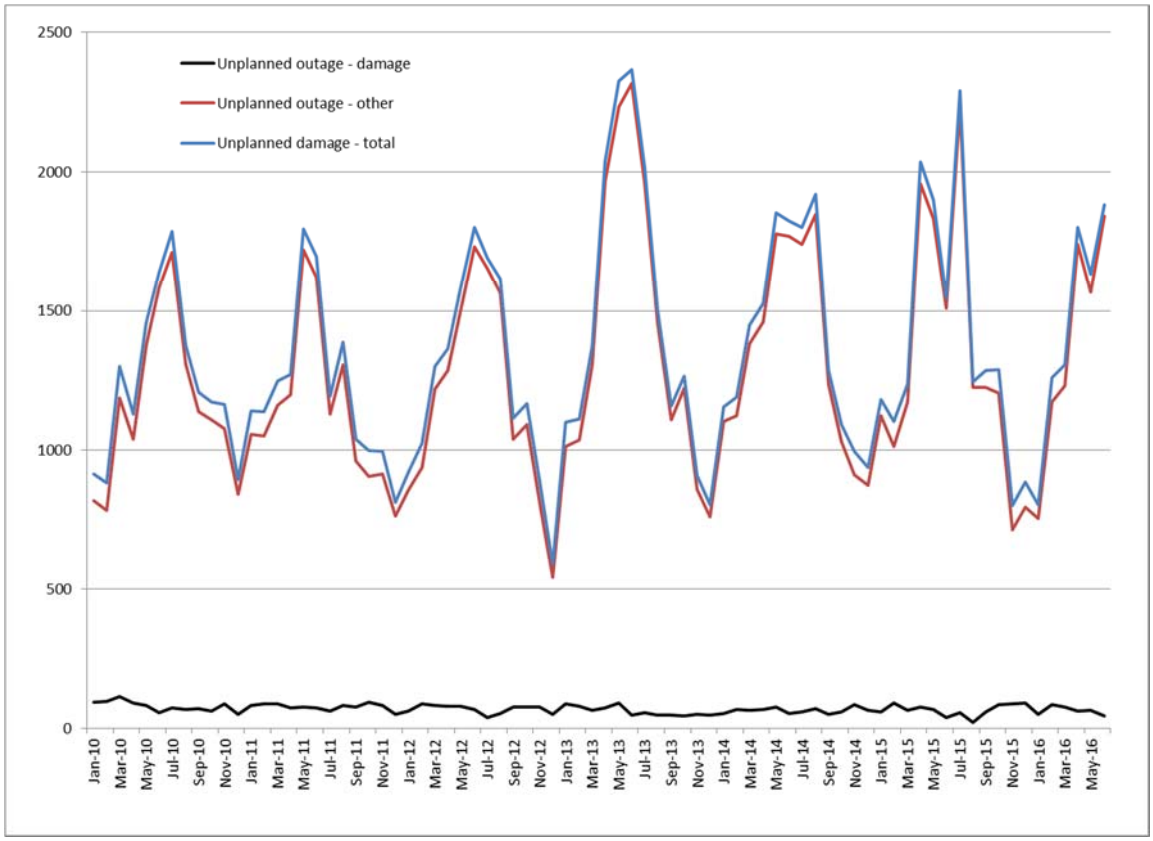
- unplanned outages;
- gas in building incidents
- third party network incidents;
- UAFG; and
- leak repair rates.

Current performance against these indicators is discussed in the following sections.

7.1.1. Unplanned Outages

Figure 7.1 shows incidents of unplanned interruption to customer supply.

Figure 7.1: Unplanned Outages

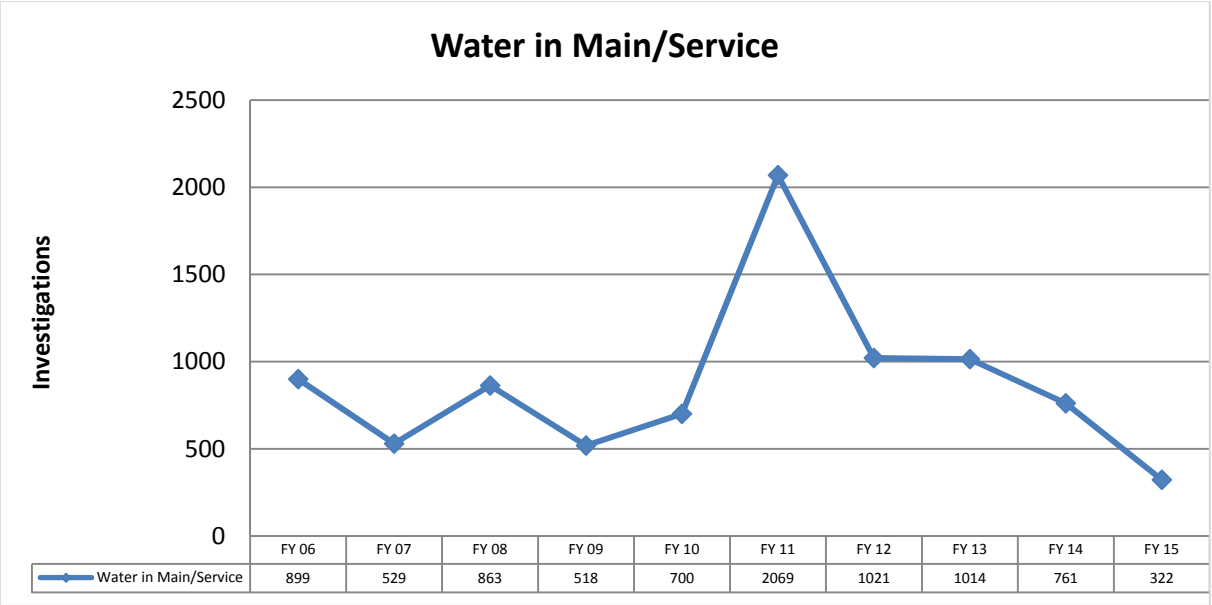


The seasonal peaks are associated with water in mains outages. A high incidence of water in mains often indicates corrosion, cracking or breaks in the pipe. This in turn gives rise to increase likelihood of gas escape, which has the potential to cause explosion and major harm in certain circumstances.

Water in mains is most likely to occur during the winter and in times of heavy rainfall. AGN monitors unusual or unseasonal trends in unplanned outages, particularly those that occur in a concentrated area. In most instances the only effective method of addressing water in mains is to replace the asset, therefore unplanned outage rates are a key driver of AGN's mains replacement program.

Figure 7.2 shows the number of customer supply investigations where water in the main was identified as the primary cause of supply problems.

Figure 7.2: Water in Main Incidents



The sharp rise in incidents during 2011 was associated with the 'breaking' of the drought. While subsequent winters have been relatively wet there has been a declining trend over the last few years with a 68% reduction in water in mains incidents since 2011 attributed to the replacement of CI and UPS mains.

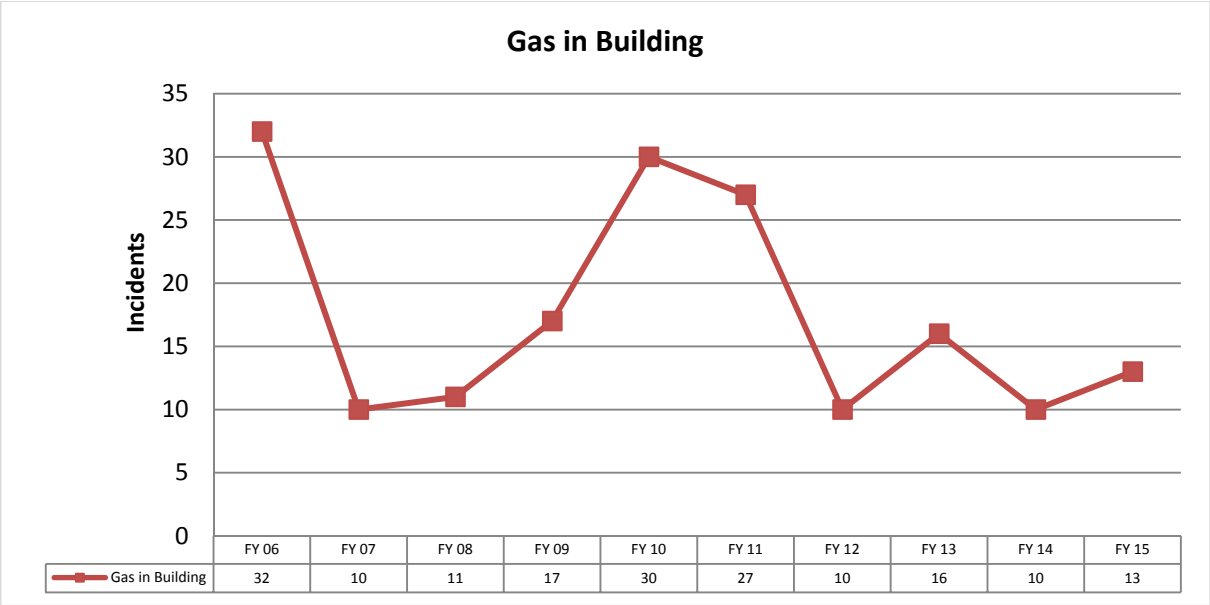
7.1.2. Gas in Building Incidents

AGN monitors gas in building (GIB) incidents as a check on the effectiveness of its other leak detection and repair activities. If a GIB incident is reported, it means that a leak has gone undetected long enough for gas to collect inside a building or structure. An explosion can occur if the quantity of gas is sufficient and contacts an ignition source.

Not all GIB incidents give rise to circumstances that can lead to an explosion. However, a small number of significant incidents occur each year where damage to a service line or a crack in a nearby main allows gas to enter a building in material amounts.

The most effective method of reducing the risk of GIB incidents is to replace the at-risk mains or services. Risk mitigation activities such as installing vents, increasing leak survey frequency and in-line camera inspection can help manage the risk to ALARP. However, cracks in mains that are adjacent to buildings or located in densely populated areas present a 'high' risk profile (under the AS/NZS 4645 risk framework) and is a driver of the mains replacement program. Figure 7.3 shows GIB incidents in the network since 2006.

Figure 7.3: Gas in Building Incidents

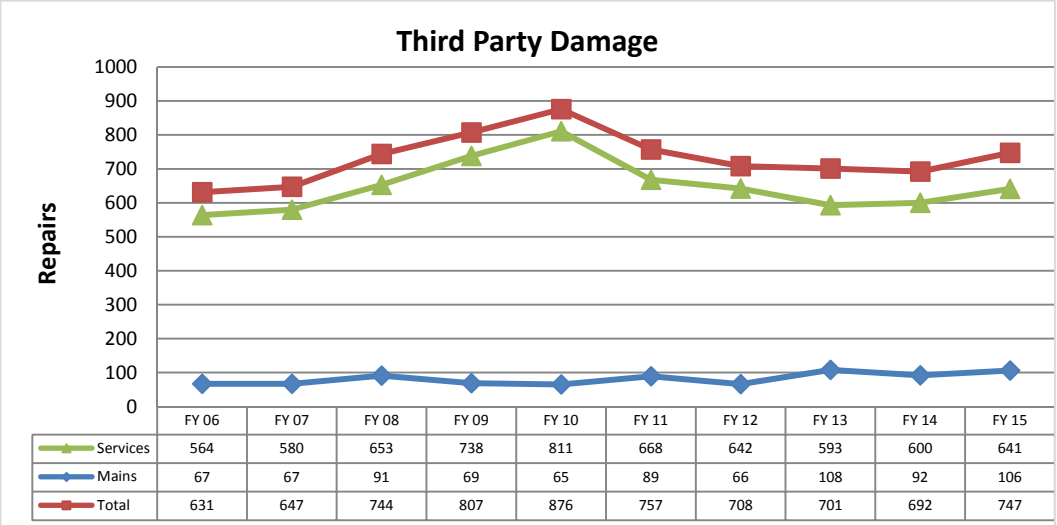


Historically, GIB incidents have occurred near CI and UPS mains. The current CI/UPS mains replacement program has resulted in a significant reduction in GIB incidents since 2010.

7.1.3. Third Party Incidents

Third party incidents are when damage occurs on the network because of the actions of a third party (for example damage caused by builders using mechanical diggers). AGN monitors third party incidents to measure how such incidents contribute to leak repairs and water in mains, as well as to identify opportunities to prevent incidents. Figure 7.4 shows third party damage incidents on mains and services since 2006.

Figure 7.4: Third Party Damage Incidents



The primary activity aimed at reducing the number of incidents is the Dial Before You Dig program. The Dial Before You Dig service provides information to the public and construction industry about the dangers and location of the gas distribution network when digging or working on line of main. Use of the Dial Before You Dig service has increased year-on-year, and the low levels of third party damage, despite high levels of construction activity in Melbourne, suggests the service has improved public awareness of these assets. Most third party incidents occur on services, which are not captured in the GIS location data and hence are not available via Dial Before You Dig.

7.1.4. UAFG

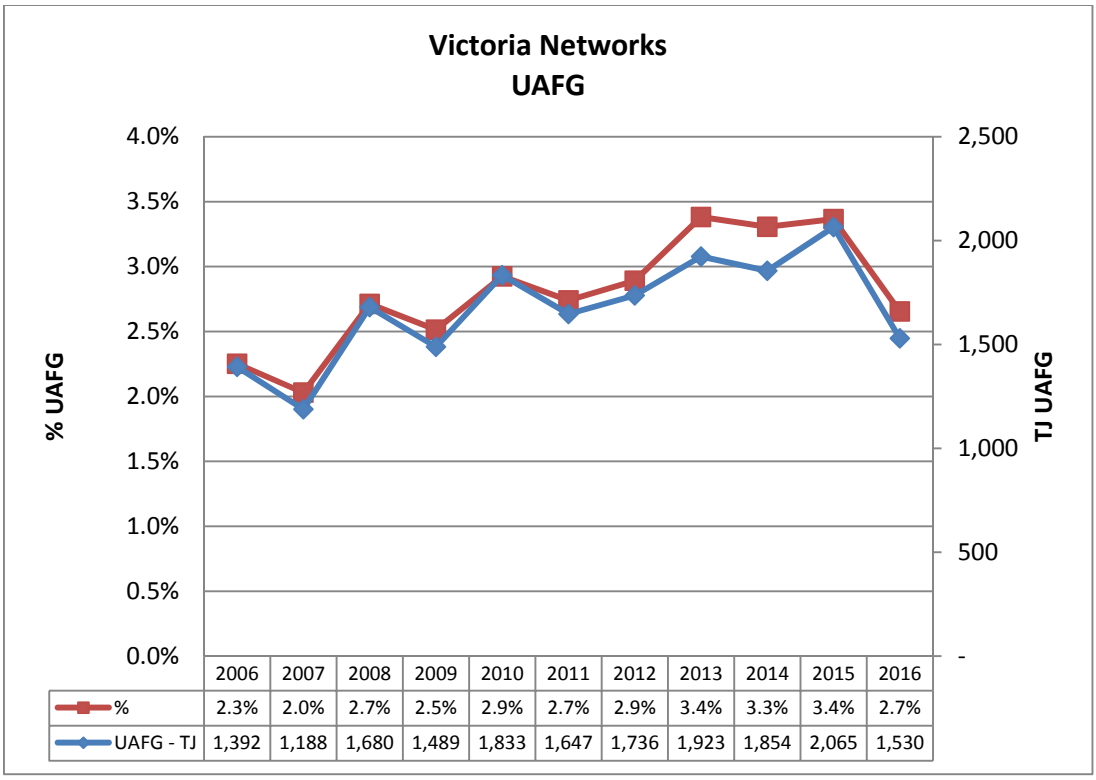
UAFG is the volume of gas that is not accounted for when input metering data is compared to output metering data. UAFG can be a result of meter tolerances, heating value discrepancies, metering pressure tolerances, as well as leakage and other factors. Where the level of UAFG in a gas network is higher than industry norms, it can indicate issues with leakage in the network. The level of UAFG within the AGN network is considered to be within industry norms, and while there is an element of leakage in UAFG, the various factors that comprise UAFG are not constant and overshadow leakage factors from aged mains.

Analysis of recent trends in UAFG give rise to the conclusion that it is not possible to make any direct correlation between UAFG trends and network leakage associated with CI and UPS mains. Consequently, there is little value currently placed on UAFG as an indicator in relation to mains integrity[6]. Investigations into contributory factors of UAFG are om-going.

[6] UAFG analysis is considered in more detail in a report titled Assessment of Contributing Elements of UAFG in AGN's Victoria Network, AIA, Sep 2016.

Figure 7.5 details the historical trend in UAFG for the Victoria network.

Figure 7.5: Victoria Network UAFG



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
%	2.3%	2.0%	2.7%	2.5%	2.9%	2.7%	2.9%	3.4%	3.3%	3.4%	2.7%
UAFG - TJ	1,392	1,188	1,680	1,489	1,833	1,647	1,736	1,923	1,854	2,065	1,530

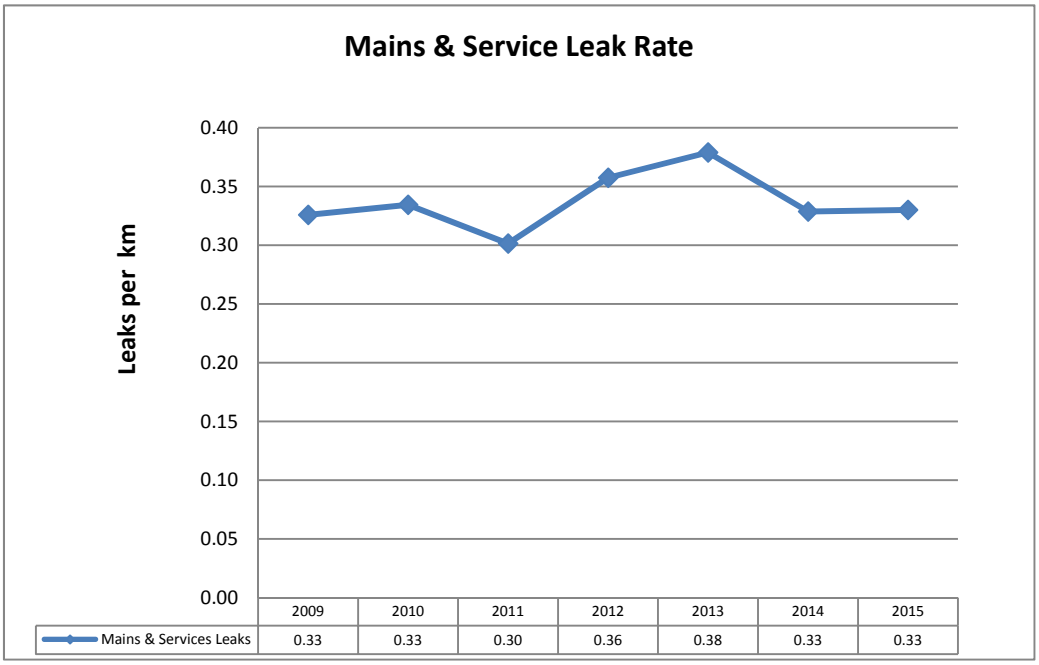
7.1.5. Leak Repairs

Leaks are inherent in natural gas distribution networks. Leaks typically occur at joints between assets, particularly gas mains, inlet services and meters. Most leaks develop slowly and release minimal quantities of natural gas, which dissipates harmlessly into the atmosphere. However, in specific circumstances (relating to location, material type, and pressure), leaks can pose a potential safety risk.

Though leaks cannot be eliminated from the network, APA has a rigorous inspection and leak detection program to help identify and prevent leaks. AGN invests in technology and training to improve leak detection capability, which in turn improves the quality and accuracy of data and risk assessment.

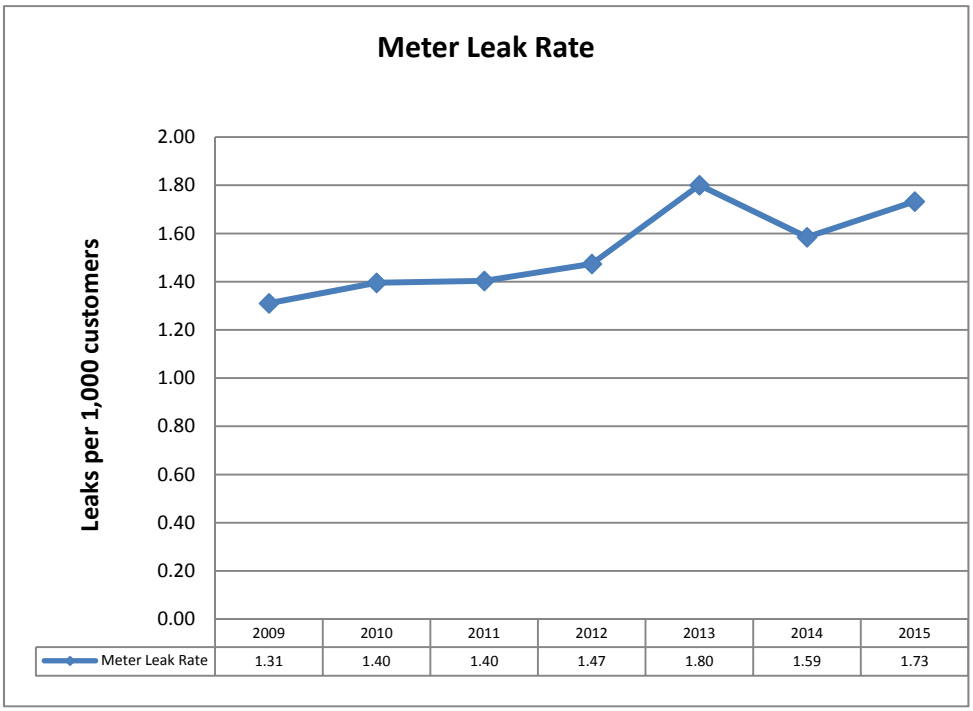
Figure 7.6 shows leak rates for mains, services and meters in the Victoria natural gas distribution network.

Figure 7.6: Mains and Services Leak Rate



The overall leak rate for mains and services has remained relatively static at about 0.33 leaks per kilometer per year. A reduction in CI/UPS mains leaks, as result of mains replacement over the last few years, has been offset by an increase in PE and protected steel service leaks. Figure 7.7 details meter facility related leak repairs. The metering facility includes the meter isolation valve, pipe and fittings, pressure regulator and the meter. The increasing trend in meter facility leaks has been associated with the service regulator. A design fault discovered in 2013 resulted in gas leaking from the regulator relief valve. These regulators are now being replaced with an improved design, and leaks are expected to reduce over time as a result.

Figure 7.7: Meter Leak Rate



7.2. Leak Response

Public leak reports are assigned a Priority A or Priority B upon being reported. Quarterly reporting for ESV requires monthly reporting for ESV in respect of the percentage of Priority A leak reports attended to within one hour:

- during business hours in the metropolitan area;
- during after hours; and
- outside of the metropolitan area.

Response times vary depending on volume of calls, traffic conditions, weather, etc. Table 7.1 sets out the historical performance.

Table 7.1: Leak Response Performance- Priority A

Region	2012	2013	2014	2015*	2016
Metropolitan	90%	88%	86%	92%	86.5%
Metropolitan – after hours	78%	83%	81%	91%	83.6%
Country priority	98%	97%	97%	91%	96.5%

AGN targets to respond to 96% of all leak reports within two hours. Performance for Victorian networks year to date November 2016 is 95.7% and for AGN's NSW networks it is 97.6%.

8. Asset Life Cycle Strategies

This chapter provides an overview of the key asset groups that make up AGN's gas distribution networks and describe the maintenance and replacement strategies for these groups. It includes information on asset performance and condition, which helps inform the appropriate treatment for assets throughout their life cycle. It also provides a summary of recommended actions for each asset class, which is used to inform ongoing network and maintenance and capital expenditure programs.

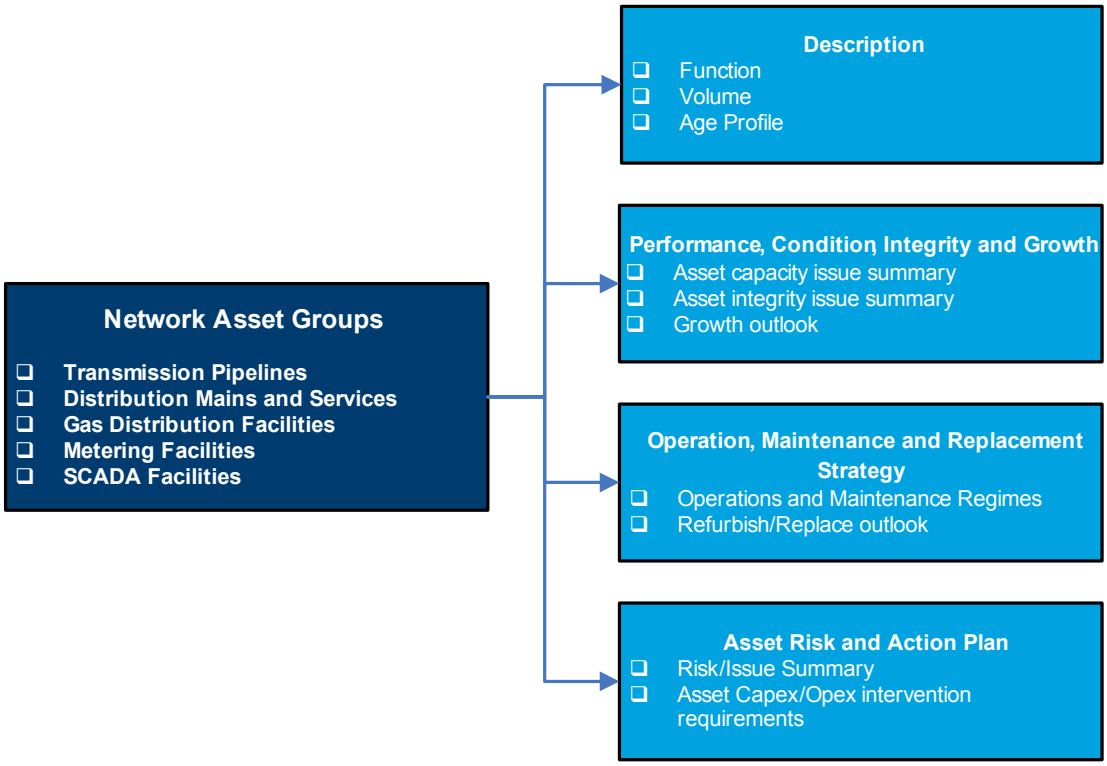
Network assets have been grouped into the following key groups and sub groups.

Table 8.1: Network Asset Groups

Asset Group	Sub Group	Function Description
Transmission Pipelines	None	Primary supply to HP distribution networks
Distribution Mains and Services	HP Network	450 kPa reticulation to domestic, commercial and industrial customers
	MP Network	35 kPa
	LP Network	Up to 7 kPa
	Services	Connection of mains to customer metering facilities
Distribution Facilities	Gate Stations (GS)	Pressure reduction from upstream GasNet TP to AGN TP network
	District Regulator Stations (DRS)	Pressure reduction from AGN TP network to HP, MP, LP networks
	Network Isolation Valves	Mainline and branch valves
	Cathodic Protection Facilities	Corrosion protection for coated steel pipes
Customer Metering Facilities	Residential Metering Facilities	Basic residential metering - capacity up to 10 m3/hr
	I&C Metering Facilities	Industrial and Commercial metering - less than 10 TJ p.a.
	Demand Metering Facilities	Industrial and Commercial metering - greater than 10 TJ p.a.
SCADA Facilities	GS and DRS Monitoring and Control	Telemetry monitoring and control
	Network Fringe Point Monitoring	Telemetry fringe point pressure monitoring
	Demand Metering Measurement	Interval (hourly) metering data acquisition at demand metering sites

The following sections present a description of the assets, and a summary of performance/condition, management strategies and action plans for each network asset group. Figure 8.1 maps out the structure of the information provided in this chapter.

Figure 8.1: Structure of Information Provided in Asset Life Cycle Chapter of the AMP



8.1. Transmission Pipelines

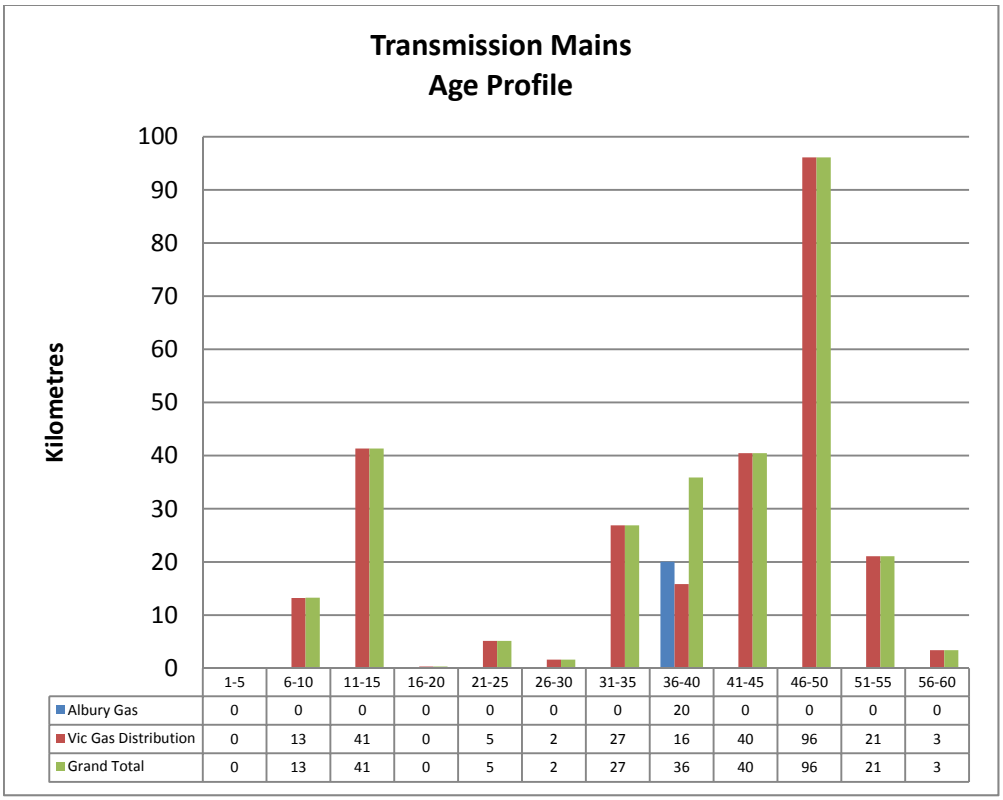
8.1.1. Description

AGN's transmission pipelines are the primary supply to the gas distribution networks across Victoria and southern New South Wales, and as such are critical to the safe and reliable supply of gas to customers. Consequences of a pipeline failure can include serious public harm (gas jet fires) and/or loss of supply to tens of thousands of customers.

AGN's transmission pipelines are designed, constructed, operated and maintained in accordance with AS/NZS 2885. These pipelines are steel, externally coated and cathodically protected with impressed current or galvanic anodes. They have maximum allowable operating pressure ratings ranging from 2650 kPa up to 4,200 kPa.

There are 286 kilometres of transmission pipelines supplying AGN's Victoria and Albury. Figure 8.2 summarises the age profile of these mains.

Figure 8.2: Transmission Mains – Age Profile



	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60
Albury Gas	0	0	0	0	0	0	0	20	0	0	0	0
Vic Gas Distribution	0	13	41	0	5	2	27	16	40	96	21	3
Grand Total	0	13	41	0	5	2	27	36	40	96	21	3

8.1.2. Performance, Condition and Integrity, and Growth

Performance

The capacity/performance of all transmission pipelines is monitored and reported annually in the Distribution System Performance Review. The key performance issues and proposed actions have been summarised below. Further details are provided in Table 8.3.

- **Peak Day Capacity –** there were no shortfalls in capacity experienced during the 2015 peak demand periods
- **GasNet Warragul Lateral –** a section of the GasNet Warragul lateral is at capacity. This will be addressed by balancing supply to AGN's Warragul distribution network from the adjacent AGN Darnum network
- **Dandenong – Crib Point (DCP) –** network modelling has confirmed that ongoing residential growth over the next AA period will reduce end-of-main pressures below the recommended minimum necessary to maintain adequate supply in the downstream HP network. Operating below the required minimum places at risk the safe and reliable supply of gas to over 14,000 customers in the Mornington and Mount Martha area. APA plans to complete the final segment of the DCP duplication between the Dandenong City Gate and Abotts Road during the next AA period. Refer to business case V23 for details.

  The completion of the DCP duplication will provide sufficient capacity to sustain growth for at least the next 15 years. The duplication will also facilitate the 'intelligent pigging' of the 45-year-old DN300 DCP pipeline without putting supply to over 100,000 customers at risk. The pigging of the old pipeline is required to prove the integrity of the pipeline for ongoing service.

- **Sale to Maffra –** the AEMO is seeking to reduce the minimum supply pressure at the Sale city gate station from 5,000 kPa to 4,500 kPa[7]. This reduced pressure will allow the AEMO to better utilise the linepack of the Longford Melbourne pipeline (LMP) to support forecast Tariff V and gas powered generation demand.

  The reduction in the Sale gate station pressure will impact the capacity of the downstream AGN Sale to Mafra transmission pipeline. A full impact assessment and option analysis by AGN is not expected until early in 2017, however the AEMO considers investment in the AGN network would cost much less than would be required to provide additional linepack on the LMP. Preliminary indications suggest up to 8 kilometres of AGN's transmission pipeline may require duplication to recover the lost capacity from the pressure reduction.

Integrity

The integrity of AGN's transmission pipelines is assessed and managed through a system of five-year location class and safety management studies, intelligent pigging (where possible), five-year DCVG coating surveys, and ten-year remaining life reviews. Key integrity issues and proposed actions are summarised below. Further details are provided in Table 8.3.

- **Morwell to Tramway Road** – a DCVG dig up on the DN80 TP pipeline between the Morwell gate station and the Tramway Road DRS found a lengthy gouge and a dent in the pipeline. The complex nature of the damage required a specialist engineering assessment, provided by GasNet. A temporary repair was completed in December 2014 and a permanent repair was completed in late 2015. No customers were impacted by these events.

  This pipeline was commissioned in 1957 under Ministerial approval to operate at an MAOP of 2,760 kPa, despite not being hydro-tested to verify operation at this pressure. ESV is currently considering a requirement to hydro-test this pipeline to confirm the MAOP. If this is mandated, the pipeline will require significant capital works to undertake the testing
- **Dandenong to Crib Point** – this pipeline is over 50 years old, and the tar epoxy coating is showing signs of degradation, with potential for significant corrosion. To assure the long-term integrity of this pipeline a program including modification of the pipeline to allow in line inspection (ILI), upgraded CP facilities, vegetation removal, and decommissioning of a section of pipeline is required over the next few years. Most refurbishment works will be completed by the end of 2017, however, the ILI has been deferred until the next access arrangement period
- **Dandenong to Frankston** – deterioration of the tar epoxy coating has raised concern regarding the long-term integrity and remaining life of this pipeline. An ILI of this pipeline is planned to determine the long-term integrity management strategy.
- **North Melbourne to Fairfield** – deterioration of the tar epoxy coating has raised concern regarding the long-term integrity and remaining life of this pipeline. An ILI of this pipeline is planned to determine the long-term integrity management strategy.
- **Longford to Sale Pipeline** – shallow cover (150mm) across Thompson River and Latrobe River junction near the swing bridge. Consultation with the council and river authority re heritage requirements has delayed immediate remediation, which is now expected to be completed by year end 2016.

[7] Signed_letter_to_AGN_Sale_pressure_Nov2016.pdf.

Growth

Growth of the transmission pipeline is driven by extensions and augmentation to supply residential, industrial and commercial development. Key growth drivers are:

- growing demand in the Mornington Peninsula requiring further augmentation of the DCP pipeline; and
- the AEMO's proposal to reduce the minimum supply pressure to AGN's Sale to Maffra Gate Station, which will require augmentation of the 16.5 kilometres DN100 Sale to Maffra transmission pipeline.

8.1.3. Operation, Maintenance and Replacement Strategy

Maintenance

Transmission pipelines are maintained through a program of inspections and condition monitoring activities as summarised in the Table 8.2.

Table 8.2: Transmission pipelines inspection and monitoring regime

Maintenance Activity	Frequency
Pipeline patrols	Weekly
Above ground mains inspections	Annually
Cathodic protection potential checks	Every six months
DVCG coating survey	Every five years
Integrity excavations	Condition based
Leak survey	Annually
Vegetation management	As required

There are no planned changes to transmission pipeline maintenance regimes.

Refurbishment and Replacement

Asset refurbishment or replacement is undertaken based on asset condition and performance. The most common replacement driver for transmission pipeline is coating failure, particularly on older pipelines that are coated with coal tar enamel.

More than 50% of transmission pipelines have an external tar epoxy coating and are more than 40 years old. Experience has shown that coatings of this type and age tend to break down allowing corrosion to develop. Coating defects continue to be detected on TP pipelines of this vintage. These are being assessed and remediated as required as part of the normal pipeline maintenance activities.

Due to the rise in coating defects on the DCP, Dandenong to Frankston (DF) and North Melbourne to Fairfield pipeline, AGN plans to undertake ILI (also known as 'intelligent pigging'). The pipelines will require modification to allow the 'pig' to pass the full length of the pipeline.

ILI is an efficient means to confirm the extent of any degradation of pipe and the level of remediation required to ensure the pipeline is fit for ongoing service. The DCP ILI has been deferred pending completion of the duplication (for growth) and installation of 'pig' launching and receiving facilities. An engineering risk assessment highlighted the potential for loss of supply to over 100,000 customers should the 'pig' get stuck in a section of the pipeline. The pipeline duplication will significantly mitigate this risk.

8.1.4. Asset Risk and Action Plan

Transmission pipelines issues over the next AA period are summarised in Table 8.3. Details of project scope, risk assessment, option analysis are provided in the associated business cases (identified by the project reference number).

Table 8.3: Transmission Pipelines Risks/Issue/Actions Summary

Project Ref	Project	Risk / Issue	Risk Rating	Action	$'000 (2016)
V23	DCP TP Augmentation	Ongoing growth in the Mornington Peninsula is expected to reduce the Dandenong to Crib Point pipeline (DCP) EOM pressures to below that required to maintain adequate supply through the Dunns Road TP/HP DRS. This DRS supplies over 14,000 customers with a risk of supply loss to over 1,000 customers at the network fringe	High	Complete a 3 kilometres duplication of the DCP from the DCG to Abotts Road.	13,800
TBA	Sale to Maffra TP Augmentation	The AEMO plans to reduce the minimum pressure to AGN's Sale Gate station from 5,000 kPa to 4,500 kPa. This will reduce the capacity of the downstream TP pipeline to the extent that supply to the township of Maffra would be compromised. The timing of the AEMO's decision (AGN advised end November 2016) has not allowed a detailed impact assessment and option analysis to be undertaken in time for the production of this AMP.	High	Preliminary modelling indicates an 8 kilometres duplication of the existing 16.5 kilometres DN100 is required to recover the lost capacity. Complete an impact assessment and business case by the end of January 2017.	TBC
V54	DCP Refurbishment and ILI Inspection	The DCP was constructed in 1966 and supplies gas to more than 100,000 customers on the Mornington Peninsula. The age of the pipeline and degradation of the coating has raised concerns regarding the integrity and residual life of this pipeline. AGN plans to use ILI to confirm the extent of pipeline degradation and the pipeline's residual life. AGN will also complete an upgrade of the CP facilities.	High	Install pig launching and receiving facilities, and conduct an ILI once the DCP duplication (V23) is complete.	1,652
V83	Dandenong to Frankston and North Melbourne to Fairfield ILI	The Dandenong to Frankston (24 kilometres DN200) and North Melbourne to Fairfield (11 kilometres DN250) pipelines are the primary supply to over 95,000 customers. These pipelines are about 50 years old and are showing degradation of the tar epoxy coating, with potential for significant corrosion of the underlying steel pipe. AGN plans to use ILI to confirm the extent of pipeline degradation and the pipeline's residual life. Failure of these pipelines would lead to a significant gas escape that may compromise public safety, with potential for loss of supply to more than 40,000 customers connected.	High	Commence a program to modify these pipelines to accommodate ILI tools.	13,951

V89	Morwell Tramway Road Transmission Pipeline	The pipeline was originally constructed in 1957 and upgraded in 1972 from an MAOP of 690 kPa to 2,760 kPa without hydro-testing to verify operation at the increased pressure. This was approved by the Minister at the time. ESV is now considering mandating that the pipeline should downgraded to 690 kPa unless it can be hydro-tested. Hydro-testing of an in service pipeline would be extremely problematic. AGN anticipates a replacement and downgrade strategy would be the most prudent and efficient option.	High	If ESV mandates verification of the current MAOP, AGN plans to downgrade the pipeline MAOP and replace it with a 1.5 kilometres DN100 TP steel pipeline and a new city gate off the GasNet Lurgi line.	3,349

8.2. Distribution Mains and Services

8.2.1. Description

AGN's Victoria and Albury gas distribution networks consist of more than 11,000 kilometres of main and 650,000 services, consisting of a range of materials and pressure regimes. These mains and services form the reticulation network that delivers gas to residential, commercial and industrial customers. The make-up of the network and age profile is summarised in Table 8.4, Figure 8.3 and 8.4.

Table 8.4: Installed Mains Inventory (30 June 2016) - kilometres

Network	Cast Iron	HDPE 575	HDPE PE100	MDPE PE80	PVC	Steel	UPS	Total
Victoria								
Low	169	0	0	2	187	19	18	395
Medium	31	8	0	22	0	25	2	88
High	0	2,853	374	3,902	0	2,794	26	9,949
Total Victoria	200	2,861	374	3,925	188	2,838	47	10,433
Albury								
Low	0	0	0	0	0	0	0	0
Medium	0	0	0	0	0	0	0	0
High	0	224	8	314	0	211	0	757
Total Albury	0	224	8	314	0	211	0	757
Total	**200**	**3,085**	**382**	**4,240**	**188**	**3,049**	**47**	**11,190**

Figure 8.3: Installed Mains Inventory (30 June 2016) - %

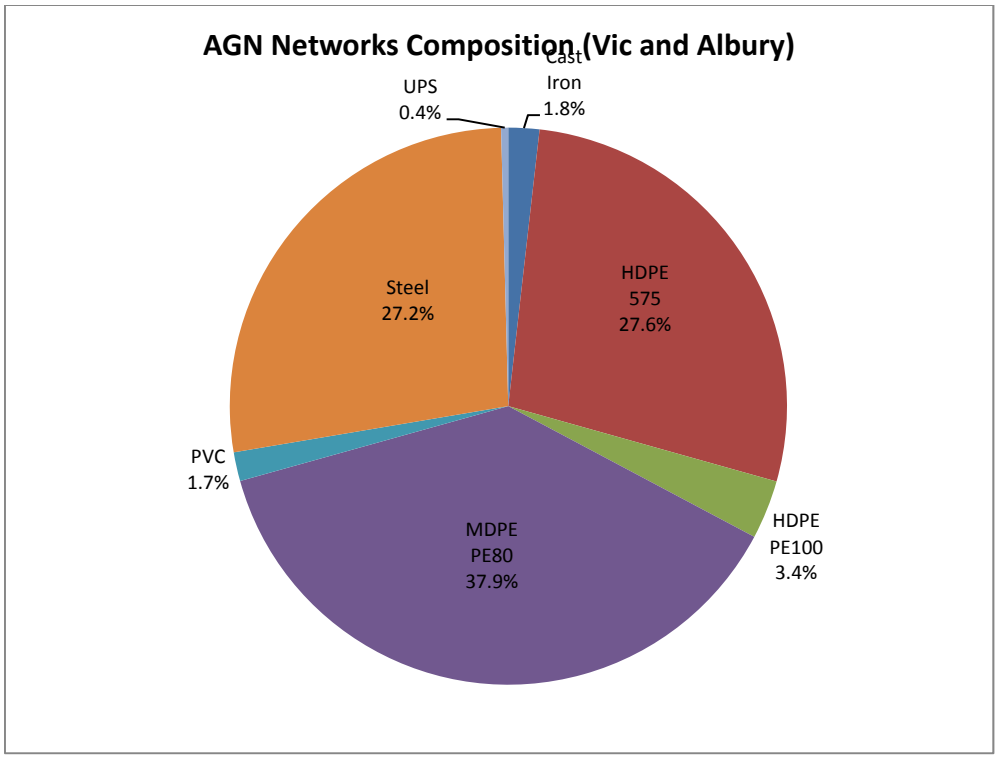
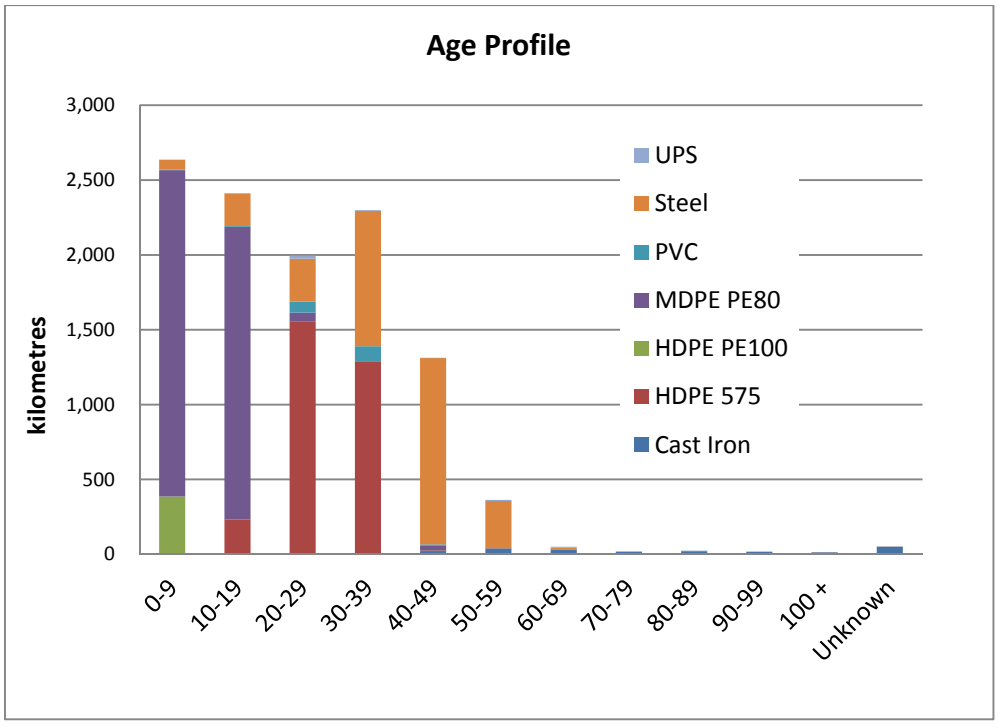


Figure 8.4: Distribution Mains Age Profile



The useful lives of distribution mains depend on factors such as material type, operating pressure, installation practices, soil type, coating quality, and level of cathodic protection. Mains are not replaced based on age but on the frequency and type of failures and the level of risk such failures present.

There are an estimated 650,000 inlet services connecting the main to customer meters. The service comprises the service pipe and fittings with transition from the buried service to the above-ground meter via a metallic service upstand, on which an isolation valve is installed. Services generally consist of material of the same vintage of the gas main to which they are connected, as they generally were laid together as one project. When cast iron mains were laid, galvanised steel services would have been laid at the same time (and when such mains were replaced with PE, the associated services were renewed with PE). When a main is replaced, the associated services are deemed to have the same age as the main.

Pressure regimes within the distribution network are classified into high-pressure (HP), medium-pressure (MP) and low-pressure (LP) tiers. The minimum allowable operating pressure for each tier is set out in the Victorian Gas Distribution System Code. Table 8.5 summarises the operating pressure ranges of these pressure tiers.

Table 8.5: Distribution mains operating pressure

Pressure	Minimum Allowable Operating Pressure - kPa	Maximum Allowable Operating Pressure - kPa
High pressure	140	500
Medium pressure	15	210
Low pressure	1.4	7

8.2.2. Asset Performance, Condition and Integrity, and Growth

Performance

The capacity/performance of distribution mains is monitored and reported annually in the Distribution System Performance Review. Capacity issues are summarised in Table 8.6. Further details are provided in Table 8.10.

Table 8.6: Network Capacity Summary

Region	Location	Asset Class	Issues and Actions
Melbourne	Ivanhoe	HP Mains	Mains replacement in the Ivanhoe area and surrounding areas is drawing down capacity on the HP network to the extent that there will be insufficient capacity to facilitate further replacement and upgrade of the LP CI/UPS/PVC network. Augmentation of the HP trunk main is required as a prerequisite for continuing the mains replacement program. This project is included as part of the mains replacement program.
	Various	LP Mains	Melbourne's LP networks suffer from water ingress due to the poor condition of cast iron and unprotected steel mains. The water ingress results in unplanned customer supply interruptions. LP networks typically have limited capacity to service high demand appliances such as instantaneous hot water and central heating appliances. These networks are being progressively replaced with inserted high pressure mains to address a number integrity and risk issues. As a result, AGN expects the issues with reliability and capacity will be resolved.
Gippsland	Wallan	HP Mains	Growth is forecast to continue, with pressures expected to drop below the recommended minimum over the next AA period. Modelling has highlighted high pressure across Hume Highway. The proposed network augmentation scope, risk assessment, option analysis and costs is detailed in business case V103.
	Cranbourne	HP Mains	The Cranbourne area is one of the fastest growing suburbs in Australia. This rapid growth requires several staged augmentations over the next AA period to maintain network pressures above the recommended minimum. The proposed network augmentation scope, risk assessment, option analysis and costs are detailed in business case V28.
	Traralgon	HP Mains	Growth in the north-west corner will result in fringe pressures falling below the minimum required. Options analysis has shown that augmentation of the city gate trunk main is the most cost effective solution. Nominal timing is 2023.
	Moe	HP Mains	Without augmentation, the pressures in the eastern fringe of the network will fall below the 140 kPa. Refer to business case V102 for details.
Goulburn Valley	Echuca	HP Mains	Growth is forecast to continue in Echuca and Moe with pressures expected to drop below the recommended minimum over the next AA period. The proposed network augmentation scope, risk assessment, options analysis and costs are detailed in business case V103

Condition and Integrity

The condition and integrity of distribution mains and services is reviewed annually. Condition and integrity indicators include:

- **leaks** – leaks indicate a failure of pipe integrity. Leaks are detected by surveys or through public reporting. Leak numbers and leak rate (number of leaks per kilometre) provide an indicator of the integrity of mains;
- **cracks/breaks** – a sub-category of leaks. Cracks or breaks have been usually associated with CI mains, however, PVC and HDPE 575 mains also have a propensity to crack or break. Unlike small leaks from joints, cracks can result in a sudden unpredictable large gas release, and present a higher public safety risk;
- **water in mains** – water in main incidents indicate the integrity of LP networks. Water ingress occurs when ground water head (pressure) is greater than that of the pressure inside the pipe entering through corrosion pinholes, cracks, or poor sealing joints;
- **unaccounted for gas (UAFG)** – UAFG is the difference between gas metered entering the network and the metered volume delivered to customers. UAFG has several contributing factors including metering accuracy, fugitive emissions (leaks from the network), administrative errors, and theft. UAFG is used as a proxy measure for the network condition. Where the level of UAFG is relatively high, compared to industry norms, it can be indicative of how 'leak tight' the network is. The volume of gas lost from leaks is related to the failure type (pinhole, crack, break, joint), operating pressure, and duration before repair is made.

AGN compares the performance and integrity indicators for different types of mains in order to understand contributors to risk, and facilitate preventative action by identifying mains that may be prone to failure. All things being equal, increasing trends in these indicators are usually a sign of deterioration in the condition/integrity of the network.

A detailed assessment of the risk and integrity of mains and services and associated management strategies (including replacement) is provided in the 2016 Victoria Network DMSIP.

Table 8.7 summarises the leak and crack rates for the various material types, which is indicative of the risk presented for each main type within AGN's networks.

Table 8.7: Mains Leak Rate

Material	Kilometres* (31 Dec 2015)	Mains Leaks FY 15	Leaks per kilometre	Mains Cracks FY 15	Cracks per kilometre
CI	226	516	2.28	55	0.24
PVC	228	58	0.25	29	0.13
UPS	21	139	6.7	0	0
Steel	3,048	131	0.04	0	0
PE	7,565	188	0.025	86	0.011

*Includes AGC mains inventory

Table 8.7 shows that the leak rates of CI and UPS are significantly higher than other main types. Although lower than CI and UPS, PVC mains leak at a rate more than 10 times higher than PE.

The leak and crack rate per kilometer of residual CI mains is about 2.3 and 0.24 respectively. This compares with 1.1 and 0.27 respectively in AGN's CI South Australian network. CI is considered to pose a 'high' risk and has been the focus of AGN's mains replacement program over the current AA period. AGN expects the crack and leak rate will deteriorate further as these mains continue to age.

The leak rate of PE mains is about 0.03 leaks per kilometre per year. This is about 100 times lower than for CI and UPS mains and 10 times lower than PVC mains. The crack rate of PE is about 0.011 leaks per kilometre per year, which is about 20 times lower than CI and more than 20 times lower the PVC.

While PE leak and crack rates are significantly lower than for other materials, analysis into catastrophic failures of high density polyethylene (HDPE) Class 575 mains in AGN's South Australian network[8] has shown that this material has a propensity for slow crack growth at sites where it has been subjected to stress, particularly from past squeeze-offs. Research has shown that HDPE becomes increasingly brittle as it ages, and has a significant susceptibility to cracking once it approaches 50 years of age.

There is more than 3,000 kilometres of HDPE 575 in AGN's Victoria and Albury networks, of which about seven kilometres is approaching 50 years of age. Further analysis into the residual life of HDPE 575 in AGN's Victoria network is being undertaken. If a significant increase in the likelihood of slow crack growth failures of 50-year vintage pipe is confirmed, this will impact the risk profile of up to 1,300 kilometres of HDPE 575 that will achieve this milestone over the next 20 years.

Routine inspections of railway sleeve crossing sites has found 27 sites that do not comply with current standards. This has potential to increase the likelihood of a gas leak at these sites, potentially impacting public safety and disrupting commuter services.

Growth

Growth in distribution mains and services is associated with extending the network into new areas, and connecting new customers. Typically 150 kilomteres of growth mains and 14,000 to 15,000 services are laid per year. The detailed forecast is provide in Attachment 8.8 of the Final Plan.

8.2.3. Operation, Maintenance and Replacement Strategy

Maintenance

Most maintenance is associated with reactive response and repair of public reported leaks. Table 8.8 shows operation and maintenance activities associated with mains and services.

[8] There have been three gas in building explosions in the South Australian network over the past nine years.

Table 8.8: Mains Maintenance Regime

Maintenance Activity	Frequency/Target
Emergency response to public reported leaks	All public reported leaks to be responded to within 1 hour with a compliance target of 97%
Planned Leak Survey	A rolling 5-year survey of all mains with 6 month and 12 month special surveys of 'high' risk areas
Cathodic protection potential checks	Every six months
Winter Pressure Surveys	Annually

A SCADA system is used to provide surveillance of network pressures and active control of network pressures in the Melbourne and Mornington networks. Additional monitoring is provided through fixed and mobile data loggers and chart recorders. Network pressure data collected from these is reviewed and analysed to diagnose pressure control equipment faults and network capacity problems. A "Dial Before You Dig" (DBYD) service is maintained to mitigate the risk of 3rd party damage.

There are no significant changes proposed to the mains and services maintenance regimes. AGN has commenced the use of in-line camera technology to identify and assess squeeze-off damage on HDPE 575 mains in its South Australian gas distribution network. Consideration will be given to rolling this out to the Victoria and Albury networks over the next AA period.

Replacement

Details of the mains and service replacement program over the next AA period is provided included in the 2016 Victoria Network DMSIP. The key aspect of this plan is the reduction of risk associated with 272 kilometres of 'high' and 'intermediate' risk rated mains over the next AA period, as summarised in Table 8.9.

Table 8.9: Mains Risk Reduction Strategy

Item	Asset Category	Kilometres (2018)	Risk Rating	Risk Treatment Approach	Kilometres of risk to be removed in Next AA Period*
1	LP CI/UPS CBD	25	High	Replace as soon as possible	25
2	LP PVC CBD	12	Intermediate	No additional risk treatment proposed (six-month leak surveys in place)	0
3	LP Steel CBD	7	Low	No additional risk treatment proposed (six-month leak surveys in place)	0
4	MP CI/UPS Trunk	33	High	Replace or decommission as soon as possible– scope and timing related to replacement and upgrade of underlying LP networks.	33
5	LP CI/UPS HDICS	95	High	Replace as soon as possible	95
6	LP PVC HDICS	79	High	Replace as soon as possible as part of CI/UPS replacement program	79
7	LP CI/UPS LDS	11	High	Replace as soon as possible	11
8	LP PVC LDS	19	Intermediate	Replace as soon as possible as part of CI/UPS replacement program	19
9	HP HDPE 575 > 35 Years	597	Intermediate	3 kilometres sampling program and 7 kilometres end-of-life program	10
10	HP HDPE 575 <35 Years	2,480	Low	No additional risk treatment proposed	0
11	HP PE80/PE100	4,410	Low	No additional risk treatment proposed	0

*Note: The length of risk removed covers those mains to be replaced or abandoned effectively eliminating the risk from this category of main. An additional 25 kilometres of mains will need to achieve this risk reduction made up of:

- 12 kilometres of HP trunk main (to effect MP CI/UPS risk reduction). These mains are required to support the capacity the HP network allowing the network to be extended to replace the LP and MP networks; and
- 13 kilometres of short length other materials (HDPE, MDPE, steel) interspersed throughout the LP network.

The proposed program, spread out over the next AA period, will complete the work AGN commenced in 2013 to remove all high-risk CI/UPS mains from AGN's Victoria network by 2022. The replacement program will also clarify potential issues with HDPE 575, by replacing and testing of HDPE 575 mains approaching 50 years of age (seven kilometres) and sampling and testing three kilometres of the remaining population of HDPE 575 mains.

8.2.4. Asset Risk and Action Plan

Distribution mains and services issues over the next AA period are summarised in Table 8.10. Details of project scope, risk assessment, option analysis are provided in the associated business cases (identified by the project reference number).

Table 8.10: Distribution Mains and Services Risk/Issue/Action Summary

Project Ref	Project	Risk/Issue	Risk Rating	Action	$'000 (2016)
2016 DMSIP	LP and MP CI/UPS/PVC Replacement	Mains have demonstrated a high propensity to crack and leak, creating a risk of a GIB incident that could lead to a fire or explosion.	High	Replace all high-risk CI/UPS and PVC mains.	
2016 DMSIP	HDPE 575 Replacement	Mains of the same type in AGN's SA Networks have demonstrated a high propensity to crack at squeeze-off locations. HDPE 575 has also demonstrated that it becomes brittle with age, particularly beyond 50 years. There are about seven kilometres of HDPE 575 approaching this age that may fail indiscriminately from slow crack growth. Failure creates a risk of a GIB incident that could lead to a fire or explosion.	Intermediate	Replace seven kilometres of HDPE 575 mains approaching 50 years of age. Undertake a testing program of a sample of three kilometres of the 3,000 kilometres of HDPE 575	147,100
V18	Echuca Network Augmentation	Ongoing growth is expected to reduce network pressure to below the required minimum to assure a safe and reliable supply, with potential supply loss to more than 100 customers.	Intermediate	Augment the network by duplicating a section (1,000 metres) of the PE trunk mains supplying Echuca, and provide an interconnection (250 metres) of the network in Moama.	491
V28	Cranbourne HP Network Augmentation	Ongoing growth is expected to reduce network pressure to below the required minimum to assure a safe and reliable supply, with potential supply loss to more than 1000 customers.	High	Staged augmentation involving several small to large interconnections and extensions, and a new gate station.	8,638
V102	Moe HP Network Augmentation	Ongoing growth is expected to reduce network pressure to below the required minimum to assure a safe and reliable supply, with potential supply loss to more than 100 customers.	Intermediate	Augment the network by duplicating sections of existing steel and polyethylene (PE) mains (total of 420 metres).	228
V103	Wallan Network Augmentation	Ongoing growth is expected to reduce network pressure to below the required minimum to assure a safe and reliable supply, with potential supply loss to more than 100 customers.	Intermediate	Augment the network with 200 metres DN150 steel trunk main.	489
V27	Railway Sleeve Crossing	A number of installations within rail corridors are not compliant with current standards and rail authority requirements. Left untreated, there is a risk of a major gas escape or leak in the rail corridor, which could affect public safety, result in third party damage, and/or delays to rail services.	High	Inspect and remediate as required 21 non-compliant sites (7 x TP and 20 x HP).	368

8.3. Distribution Facilities

8.3.1. Description

Table 8.11 shows the distribution facilities asset sub groups.

Table 8.11: Distribution Facilities Asset Sub Groups

Asset Group	Sub Group	Function Description
Distribution Facilities	Gate Stations (GS)	Pressure reduction from upstream GasNet TP to AGN TP network
	District Regulator Stations (DRS)	Pressure reduction from AGN TP network to HP, MP, LP distribution networks
	Network Isolation Valves	Mainline and branch valves for emergency isolation and control
	Cathodic Protection Facilities	Corrosion protection for coated steel pipes

Gate Stations

These facilities are typically co-located at the GasNet custody transfer points. They reduce and control the upstream transmission pipeline pressures to a level consistent with the MAOP of AGN's downstream transmission pipelines. The pressure regulating facilities are owned by AGN, while metering and odorant facilities are owned and operated by GasNet.

Gate stations consist of filters, isolation, bypass and pressure control valves, and in some instances gas heating facilities. They are located in fenced compounds.

There are 57 gate stations, which range in capacity and pressure regulation depending on the network they feed. The age of these facilities varies between a few years up to more than 40 years.

Gate stations are typically upgraded or replaced when demand from the downstream networks exceeds their capacity or when components are no longer available to adequately maintain the facility.

Table 8.12 summarises the locations of AGN's gate stations and the networks they supply.

Table 8.12: Custody Transfer Meters (CTMs) – Gate Station Locations

CTM MIRN	CTM LOCATION	CTM GROUP	Logical Network	CTM MIRN	CTM LOCATION	CTM GROUP	Logical Network
30000112PC	Epping	Melbourne	Melbourne Central	30000079PC	Traralgon	Gippsland	Traralgon
30000107PC	Keon Park	Melbourne		30000084PC	Warragul	Gippsland	Warragul
30000013PC	Melbourne	Melbourne		30000086PC	Yarragon	Gippsland	Yarragon
30000017PC	West Melbourne	Melbourne		30000178PC	Bairnsdale	Bairnsdale	Bairnsdale
30000033PC	Healesville	Melbourne	Healesville	30000058PC	Echuca	Goulburn Valley	Echuca
30000145PC	Mernda	Melbourne	Mernda	30000062PC	Kyabram	Goulburn Valley	Kyabram
30000172PC	Whittlesea	Melbourne	Whittlesea	30000068PC	Merrigum	Goulburn Valley	Merrigum
30000194PC	Beveridge	Melbourne	Beveridge	30000075PC	Shepparton	Goulburn Valley	Shepparton
30000205PC	Donnybrook	Melbourne	Donnybrook	30000076PC	Tatura	Goulburn Valley	Tatura
30000002PC	Dandenong	Peninsula	Mornington	30000077PC	Tongala	Goulburn Valley	Tongala
30000040PC	Hampton Park	Peninsula	Berwick	30000094PC	Chiltern	Murray Valley	Chiltern
30000041PC	Narre Warren	Peninsula		30000105PC	Cobram	Murray Valley	Cobram
30000042PC	Berwick	Peninsula		30000106PC	Koonoomoo	Murray Valley	Koonoomoo
30000193PC	Officer	Peninsula		30000103PC	Rutherglen	Murray Valley	Rutherglen
30000038PC	Clyde	Peninsula	Clyde	30000104PC	Yarrawonga	Murray Valley	Yarrawonga
30000036PC	Cranbourne (Huon Park)	Peninsula	Cranbourne	30000050PC	Benalla	Northern	Benalla
30000037PC	Cranbourne (C'bourne Rd)	Peninsula		30000051PC	Benalla North	Northern	Benalla North

30000035PC	Lyndhurst	Peninsula	Lyndhurst	30000053PC	Broadford	Northern	Broadford
30000039PC	Pakenham	Peninsula	Pakenham	30000059PC	Euroa	Northern	Euroa
30000055PC	Churchill	Gippsland	Churchill	30000061PC	Kilmore	Northern	Kilmore
30000092PC	Darnum	Gippsland	Darnum	30000074PC	Seymour	Northern	Seymour
30000057PC	Drouin	Gippsland	Drouin	30000071PC	Tallarook	Northern	Tallarook
30000065PC	Longwarry	Gippsland	Longwarry	30000081PC	Wallan	Northern	Wallan
30000069PC	Moe	Gippsland	Moe	30000082PC	Wangaratta	Northern	Wangaratta
30000070PC	Morwell (City Gate)	Gippsland	Morwell (City Gate)	30000083PC	Wangaratta East	Northern	Wangaratta East
30000066PC	Morwell (Firmins Ln)	Gippsland	Morwell (Firmins Ln)	30000056LC	Wodonga	Northern	Wodonga
30000072PC	Rosedale	Gippsland	Rosedale	20000015LC	Albury	Northern	
30000073PC	Sale	Gippsland	Sale	30000204PC	Traralgon North	Gippsland	Traralgon North
30000078PC	Trafalgar	Gippsland	Trafalgar				

District Regulator Stations

District Regulator Stations (DRSs) control the delivery of gas into the HP, MP, LP distribution networks within allowable operating pressure of the downstream network. These facilities consist of filters, isolation, bypass and pressure control valves that are located either in below ground vaults or above ground kiosks.

There are 122 DRSs, which range in capacity and pressure regulation depending on the network they feed. The age of these facilities varies between a few years up to more than 40 years.

DRSs are typically upgraded or replaced when demand from the downstream networks exceeds their capacity, or when components are no longer available to adequately maintain the facility

Table 8.13 summarises DRS installations as of June 2016.

Table 8.13: District Regulator Station Summary

		Outlet Pressure					Total
		Transmission	1050 kPa	High	Medium	Low	
Inlet Pressure	Transmission	7	2	43	1	0	39
	High	0	0	9	11	39	59
	Medium	0	0	0	0	24	24
Total		**7**	**2**	**52**	**12**	**63**	**122**

Network Isolation Valves

There are more than 6,500 mainline and branch isolation valves installed throughout AGN's networks. These provide emergency isolation and control during normal operation and emergency response situations. Table 8.14 summarises the various types of network isolation valves.

Table 8.14: Valve Categories

Valve Category	Total
Mains – Mainline Isolation	41
Mains – City Isolation and Major Control	120
Mains – Isolation	5,724
Service Valve	675
Total	**6,560**

Cathodic Protection Facilities

A network corrosion protection system is used to protect over 3,300 kilometres of steel mains and pipelines in AGN's networks. There are 69 impressed current cathodic protection units consisting of a transformer rectifier and ground bed and over 1,400 magnesium sacrificial anodes in the system.

8.3.2. Asset Performance, Condition and Integrity, and Growth

The capacity/performance of distribution facilities is monitored and reported annually in the Distribution System Performance Review (DSPR). The key performance issues and proposed actions are summarised below. Further details are provided in Table 8.15.

Performance

The performance of gate stations is assessed annually and reported in the DSPR. Key performance issues are listed below.

- Inlet pressure at O'Herns Rd is dropping up to 1,000 kPa under high transient flow rate, potentially impacting overall capacity at this facility. This issue is currently under investigation
- The Whittlesea gate facility is now at capacity, and will be upgraded in the summer of 2016/17
- Land acquisition issues in Pakenham continue to hold up completion of the new gate station. This is now timed to be completed prior to winter 2017
- A review of customer transfer meters (CTM) capacities upstream of AGN's gate stations at Shepparton, Wodonga and Clyde North are approaching their design capacity, and will need to be upgraded. These are GasNet assets. The cost of installing and/or upgrading CTMs is levied as an annual charge by GasNet, which is treated as an operating expenditure
- The AEMO has advised it plans to reduce the minimum inlet pressure to the Sale City Gate station from 5,000 to 4,500 kPa. This will necessitate a rebuild of the gate station to optimise the capacity of the downstream AGN Sale to Maffra transmission pipeline
- Pressure losses upstream of the Lindrum Road DRS is affecting the capacity of this DRS to maintain pressures at the extremity of the downstream HP network above the minimum level required to assure a safe and reliable supply
- The Bairnsdale City Gate is supplied from the Jemena-owned Eastern Gas Pipeline (EGP). Jemena is considering increasing the MAOP of the EGP to 16,500 kPa at some point in the future, which would exceed the MAOP of the existing Bairnsdale facility. This issue is discussed in business case V52

Condition and Integrity

- ESV and AGN reviews have identified 23 gate station sites that pose relatively high health and safety and operational risks. A program of remediation is required to bring these facilities up to AS/NZS 2885 and AS/NZS 1657, and Victorian Occupational Health and Safety (OH&S) Regulations
- Paint on pipework, regulators, valves and fittings on 50 gate station sites has deteriorated to the extent that touch-up painting is no longer sufficient to maintain the integrity of the asset coatings. A program of grit blasting and repainting is required
- Three transmission valves have seized and a further two have cast iron bodies, which are more susceptible to cracking than standard steel valves. There is a risk that the seized valves could hinder emergency response
- Three water bath heater coils are due for end-of-life replacement. A coil failure could lead to failure of the pipe ex the gate station, putting at risk the supply to tens of thousands of customers
- Remote monitoring (SCADA) to 30 gate stations will be completed by the end of this AA period with a further eight sites to be completed over the next period. SCADA enables AGN to detect malfunctioning water bath heaters, so they can be repaired or replaced before failure occurs

- Noise levels at the Berwick City Gate exceed the limits set by the *Environment Protection Act 1970* and subsidiary State Environment Protection Policy
- Maintainability issues at several gate station facilities has been identified, with spare parts no longer available for old regulators. A similar issue has been identified at larger industrial and commercial installations. AGN has initiated a program to replace the pressure regulating runs at these stations. Refer to business cases V34 and V35 for details
- Odorant levels in the Tocumwal network can fall below the minimum threshold set out in regulatory standards. This is currently being managed by manual dosing. A more optimal solution is required
- Nine cathodic protection units and six anode beds have reached / will reach end-of-life replacement, and must be replaced
- Spare parts for the Grove 82 pressure regulator are no longer available. These regulators are used for pressure control at 71 gate station and DRS sites. These regulators are more than 35 years old and considered to be at end-of-life
- Damage to metering facilities during bushfires can cause an uncontrolled release of gas, which may exacerbate the bushfire and cause further damage. AGN plans to install thermal shut-off devices, which have been shown to be effective in mitigating this risk

Growth

- Rapid residential growth in the Cranbourne Clyde corridor means an additional city gate is required to ensure the existing HP network can supply the new developments
- Various augmentation projects over the next five years are expected to require approximately two new HP regulators per year be installed
- There will be small organic growth in valves as the network expands to serve new customers. Typically, 300-400 new industrial and commercial primary isolation valves are added to the network every year
- A number of sites are identified each year where inadequate corrosion protection requires additional CP units/anode beds to maintain adequate protection. Historically, on average, four new small anode beds per annum are added to the CP system to maintain adequate corrosion protection for the steel pipe network

8.3.3. Operation, Maintenance and Replacement Strategy

The following maintenance activities are conducted on distribution facilities:

- **SCADA surveillance** – a SCADA system is used to provide surveillance of network pressures with alarms paged out to standby resources for immediate action. Some sites are fitted with remote pressure control;
- **pressure surveillance** – fixed and mobile chart recorders provide additional pressure surveillance. Network pressure data collected from these recorders is used to diagnose network capacity problems. A winter pressure survey is undertaken to pinpoint and/or confirm pressure supply problems;

- **gate and district regulator stations** – maintenance on district regulator stations is carried out on a three-month, annual, and five-year basis. The three monthly and annual checks include inspection, set point and operational checks. The five-yearly maintenance activities include a major overhaul of the regulators, control valves and pilots. All soft seal components are replaced;
- **Valve maintenance** – valve maintenance comprises annual inspection and maintenance of transmission and critical emergency isolation valves, and three-yearly inspection and maintenance of other network valves; and
- **Corrosion prevention monitoring –** inspection of CP units is carried out in accordance with AS/NZS 2832.1 and AS/NZS 2885. The operational status of galvanic anodes is gathered every six months from control area surveys. Pipeline potentials are provided through impressed current cathodic protection (ICCP) units, which are monitored via the SCADA system. ICCP units provide effective and reliable corrosion protection, particularly in soils with high resistivity, and where high corrosion protection currents are required (e.g. at coating defects).

Operation and Maintenance

A preventative maintenance program is in place, managed through AGN's recently-installed Maximo Enterprise Asset Management system (EAM). This system is used to manage the maintenance and inspection regimes for distribution facilities. Work orders are issued for the specified work activities and tracked to completion. The strategy going forward is to continue existing maintenance regimes, and undertake reactive repair (or replacement) when new issues or risks are identified.

Replacement

Custody Transfer Meters

Asset refurbishment or replacement is undertaken based on asset condition and performance. Where CTMs are found to be operating outside of their specified capacity range, they are required to be replaced to ensure the integrity of data recorded at these locations is not compromised. The cost of installing and/or upgrading CTMs is levied as an annual charge by GasNet.

A review of CTM capacities has highlighted that several sites are approaching their capacity and will need to be upgraded.

District Regulator Stations

Generally, distribution regulator stations are not replaced as complete units but are overhauled (all major components and soft seals are replaced) every five years.

The mains replacement of the LP network, when complete, will allow about 60 LP DRS to be decommissioned. The replacement program is expected to be completed by the end of the next AA period.

8.3.4. Asset Risk and Action Plan

Distribution facilities issues over the next AA period are summarised in Table 8.15. Details of project scope, risk assessment, option analysis are provided in the associated business cases (identified by the project reference number).

Table 8.15: Distribution Facilities Risk/Issue/Action Summary

Project Ref	Project	Risk/Issue	Risk Rating	Action	$'000 (2016)
V44	TP Valve Replacement	Four TP Valves have been identified as inoperable. This could hinder emergency isolation response Seized isolation valves may hinder emergency response, which could affect the safety and integrity of services.	High	Cut out and replace valves.	634
V38	City Gate – Safety Upgrade	ESV and AGN audits have identified 23 sites that pose relatively high health and safety and operational risks. Issues include: • inadequate protection from vehicles; • poor site security; • trip hazards; • inadequate access for maintenance; and • inadequate signage.	High	Upgrade sites to comply with AS/NZS 2885 and AS/NZS 1657, and Victorian Occupational Health and Safety (OH&S) Regulations.	412
V41	City Gate - Painting	Paint on pipe work, regulators, valves and fittings within 50 city gates has deteriorated to the extent that unless remediated will lead to corrosion and potential equipment failure.	High	Grit blast and repaint - program over the next two AA periods (2018 – 2027)	255
V95	DRS - Isolation valve replacement	Isolation valves at three TP DRSs are inoperable (seized), restricting maintenance and emergency response. A risk exists at two other TP DRS sites with potential for the existing CI valves to crack and fail catastrophically. Current standard TP DRS designs use steel body valves to eliminate this risk.	High	Replace the valves at the five identified facilities during the next AA period	286
V37	Water Bath Heater - Coil replacement	End-of-life replacement of water bath heaters coils. Based on historical replacement rates three coils will need to be replaced over the next AA period.	High	Replace when coils fail testing – estimate three over the next AA period	192

V53	Water Bath Heater - Monitoring	A program commenced during the current AA period to install SCADA monitoring of water bath heater temperatures at 38 sites. This was aimed at early detection of malfunction or failure, which could result in failure of the downstream pipework. 30 sites will be completed by the end of this current AA period with a further eight to complete in the next AA period.	High	Complete monitoring installation at the remaining eight sites in the next AA period	52
V01	City Gate – Electrical Upgrade	A program to install surge protection at 21 city gates commenced during the current AA period to mitigate the risk of gas ignition in the event of a lightning strike. This followed a lightning strike at the Seymour City Gate which caused gas ignition and asset damage. Twelve of these sites will have been addressed by the end of 2017, with nine scheduled for action during the next AA period. In addition, 50 city gates (including the nine sites that require surge protection) require the compound fences to be earthed to meet the updated requirements of AS/NZS 2885.1 2012	High	Install electrical surge protection compliant with AS/NZS 4853 - Electrical hazards on metallic pipelines, and AS/NZS 1768 - Lightning protection, at the remaining nine sites. Install earthing on fencing at 50 sites.	182
V91	Odorant Injection - Tocumwal	Odorant levels in the Tocumwal network have been found to fall below the required minimum. An interim solution of manual dosing has been implemented pending a more optimal solution.	High	Install a permanent odorant dosing unit Koonoomoo City Gate.	259
V02	Cathodic protection systems – replacement and installation	The condition of nine CP units and six anode beds have reached end-of-life and require replacement to ensure adequate corrosion protection the steel pipelines is maintained. A number of sites are identified each year where inadequate corrosion protection requires additional CP units/anode beds.	High	Replace nine CP units and six anode beds over 2018-2022. Install 20 new small anode beds.	1,123
V34	Grove 82 Regulator Unit - Replacement	The Grove 82 pressure regulator units located at 71 DRS and city gate stations are at end-of-life. Replacement units are no longer available and some spare parts no longer available.	High	Replace the Grove 82 regulator units at 71 sites with a new unit. Replace 40 sites in the next AA and remaining 31 sites in the following AA	3,091
V62	Bushfire preparedness	Many of AGN's natural gas assets are in high bushfire risk areas. The extreme temperatures generated by bushfires can cause gas network assets to fail, which may result in gas escape, exacerbating the fire. AGN recommends thermal safety devices (TSD) be installed upstream and downstream of the meter control valve in bushfire prone areas. A TSD is a passive thermal device, which shuts off the gas supply at temperatures of 100ºC or more. This installation program would include more than 20,000 sites	High	Install TSDs in all new services upstream of the meter control valve and retrofit in existing services downstream of the meter control valve in bushfire prone areas.	2,947

8.4. Customer Metering Facilities

8.4.1. Description

Table 8.16 shows the customer metering facilities asset sub groups

Table 8.16: CTM – Gate Station Locations

Asset Group	Sub Group	Function Description
Customer Metering Facilities	Residential Metering Facilities	Basic residential metering - capacity up to 10 m3/hr
	I&C Metering Facilities	Industrial and Commercial metering - less than 10 TJ p.a.
	Demand Metering Facilities	Industrial and Commercial metering - greater than 10 TJ p.a.

There are three main categories of meter used in the Victoria and Albury networks:

- **residential meters** – typically diaphragm meters with capacity of up to 10 m^3/hour. Used on domestic and small commercial customer installations;
- **medium to large industrial and commercial meters** – typically rotary meters with capacity greater than 10 m^3/hour. Used on medium to large industrial and commercial customer installations that use less than 10 TJ of gas per year; and
- **major industrial meters** – typically turbine meters with capacity greater than 10 m^3/hour. Used on large industrial customer installations that use more than 10 TJ of gas per year.

AGN currently reticulates gas to approximately 650,000 customers in its Victoria and Albury networks. Each customer has a meter installed at their premises.

The following figures show the age profile of the different categories of meters

Figure 8.5: Age Profile of Residential Meters, June 2016

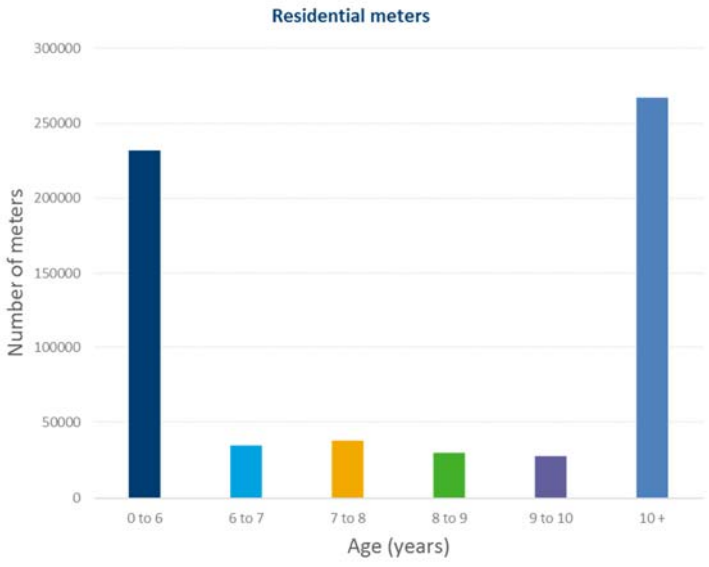


Figure 8.6: Age Profile of Medium to Large Industrial Customer Meters, June 2016

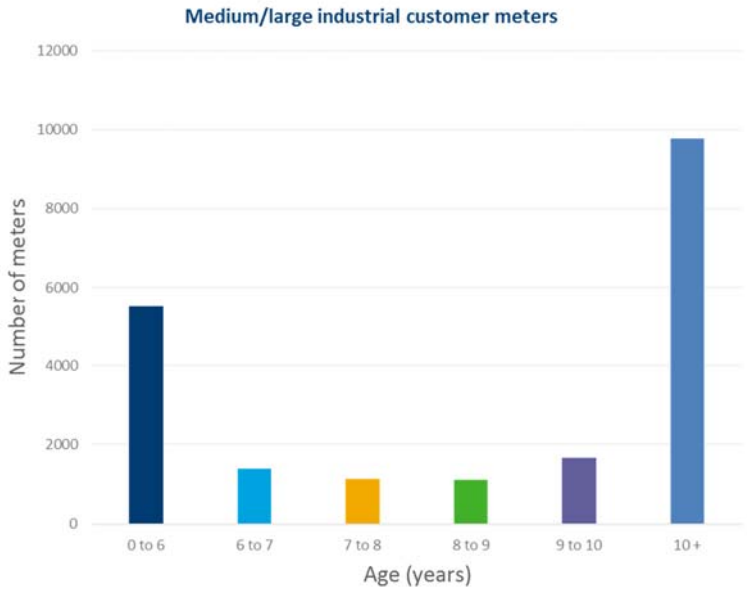
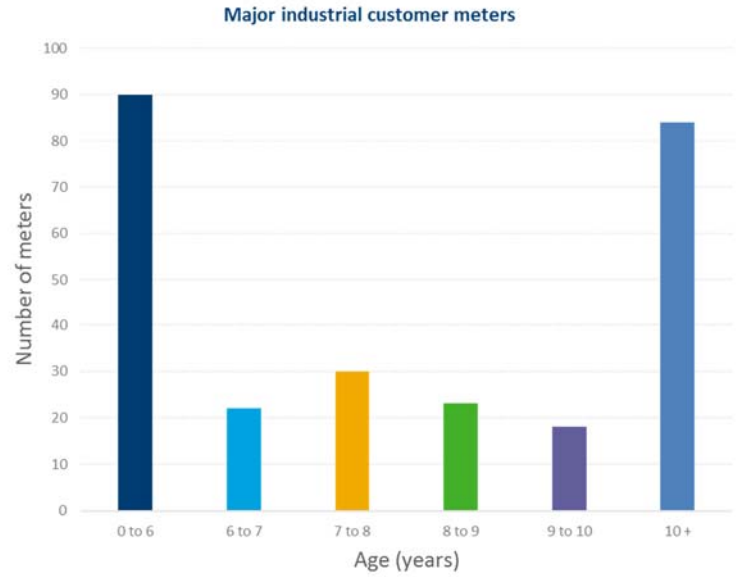


Figure 8.7: Age Profile of Major Industrial Customer Meters, June 2016



8.4.2. Asset Performance, Condition and Integrity, and Growth

The capacity/performance of customer metering facilities mains is monitored and reported annually in the Distribution System Performance Review. The key performance issues and proposed actions are summarised below. Further details are provided in Table 8.19.

Performance

All new residential meters are accuracy and pressure tested on delivery. AGN procures only two types of meters, the AMPY 750 and EDMI U8.

AGN requires that all new meters have an accuracy plus/minus 1%. AGN's new meters have consistently met this accuracy as shown in Table 8.17.

Table 8.17: Residential New Meter Accuracy

Residential Meter Testing Results						
Meter Type		**2011**	**2012**	**2013**	**2014**	**2015**
Ampy 750	Total number	13798	12849	10020	10000	5300
	Mean error (%)	.03	-.02	.11	.15	.16
EDMI U8	Total number	10239	6181	6487	3572	10477
	Mean error (%)	.064	.044	.008	.056	.005

The number of customer meter related complaints remains relatively low compared to a total meter population of 650,000 as shown in Table 18.16.

Table 18.16: Customer Meter Complaints

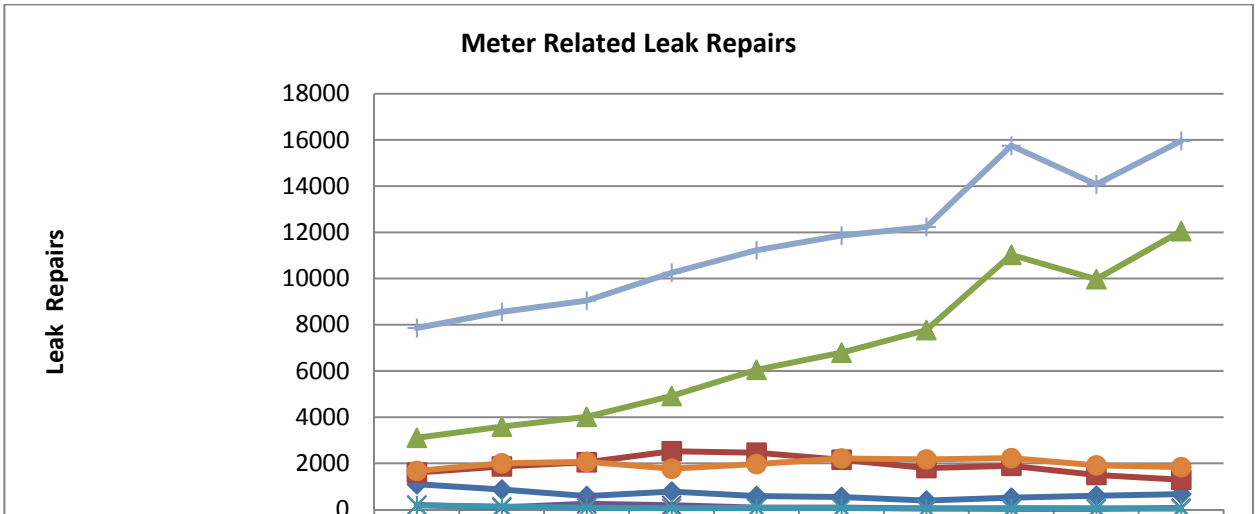
Customer Metering Test Requests						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Total Customer Meter Requests	76	58	83	114	126	138
Meters Within Tolerance	52	31	48	73	77	96
Meters Outside Tolerance	15	12	13	15	16	14
Meters – Unable to Test	8	14	26	26	33	28

Condition and Integrity

The following graph details meter facility related leak repairs. The metering facility includes the meter isolation valve, pipe and fittings, pressure regulator and the meter.

Figure 8.8 shows leak repairs associated with metering facilities.

Figure 8.8: Meter Leak Repair



	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15
Adjusted/Repaired Regulator	1097	866	582	782	585	544	394	513	597	669
Replaced Meter	1602	1869	2048	2527	2466	2159	1800	1894	1498	1293
Replaced Regulator	3107	3591	4012	4917	6049	6791	7769	11023	9972	12048
Replaced Valve	200	93	253	190	84	90	50	31	31	70
Temp Fix	182	138	83	62	73	68	48	65	56	41
Tighten	1674	2003	2067	1771	1972	2210	2172	2224	1918	1839
Total	7862	8560	9045	10249	11229	11862	12233	15750	14072	15960

The increase in service regulator replacement has been attributed to a design fault. These are being progressively replaced with new regulators.

Fisher 298 regulator units located at 51 sites are more than 35 years old and considered to be at end-of-life. Spare parts are extremely difficult to obtain on a cost-effective basis. A replacement program is proposed to replace these over the next AA period.

Approximately 1,950 industrial and commercial meter sets are in poor condition due to corrosion. Touch-up painting during routine inspections and maintenance is no longer sufficient to mitigate corrosion. Grit blasting and painting is required to ensure the life of these assets is not reduced.

Growth

Ongoing residential, commercial and industrial customer growth is expected to continue at rates similar to historical growth. Forecast new meters to facilitate growth is based on the number of new customers expected to connect to the networks (Chapter 13 of the Final Plan). Attachment 8.8 provides the growth forecast derivations.

8.4.3. Asset Replacement and Maintenance Strategy

Maintenance

Domestic meter installations are designed not to require routine maintenance other than in-service compliance testing of meter families. Maintenance is limited to responding to isolated meter failures. The maintenance program for industrial and commercial meters includes periodic operational checks, lubrication, and painting.

Maintenance activities for specific types of meter installation are described below.

- **Low pressure installations** – low pressure sites are sites that operate at less than 7 kPa. These sites all have smaller diaphragm meters and no routine maintenance is carried out unless the consumer, retailer or APA personnel report a problem
- **Elevated pressure installations with remote telemetry and correcting instruments –** the sites are currently visited every six months to:
  - check the pressure and temperature transducers for accuracy;
  - compare the uncorrected flow on the meter index with the uncorrected flow from the correcting instrument;
  - check the isolation valve;
  - check the meter site for leaks; and
  - ensure all signage is appropriate.
- **Elevated pressure installations with correcting instruments and no remote telemetry** – these installations are visited annually to:
  - check the pressure and temperature transducers for accuracy;
  - compare uncorrected flow on the meter index with uncorrected flow from instrument;
  - manually check correction factor calculation;
  - check the isolation valve;
  - check the meter site for leaks; and
  - ensure all signage is appropriate.
- **Elevated pressure installations with no correcting instruments and no remote telemetry** – these installations are visited either annually if they have a pressure relief valve or every three years if they do not. The visits consist of checking the site and meter integrity, checking the set pressure on the regulator, checking the isolation valve, checking meter site for leaks, and ensuring all signage is appropriate. The meter set is also painted if required

There are no plans to change the maintenance regimes over the next AA period**.**

Replacement

Gas meters are replaced in line with the requirements of the Gas Distribution System Code (Code[9]) section 7.2.3. Under the Code, customer meters up to 25 scm/hr (typically residential and small commercial meters) replacement is governed by requirements of AS/NZS 4944. Customer meters greater than 25 scm/hr are deemed under the Code to have a life of 15 years. This gives rise to up to 35,000 periodic meter replacements (referred to as Periodic Meter Change or PMC) per year.

In addition to the PMC program, AGN replaces meters in response to leakage and meter measurement inaccuracy found in response to customer complaints. Under AS/NZS 4944, meters must undergo accuracy testing within five years of being in service. Depending on the accuracy found from this in-service testing, the meter is given an initial service life of five, ten, 15, or 18 years.

Field life extension tests can be used to extend the initial life of residential meters. Depending on outcomes of testing, the life of the meter can be extended by one, three, or five years. Meters returned from the field are either repaired and tested for re-use, or scrapped if the meter is uneconomic to repair or parts are no longer available.

Testing and replacement requirements are detailed in AGN's Meter Replacement Plan (Attachment 8.3 to the Final Plan).

8.4.4. Asset Risk and Action Plan

Customer metering facilities issues over the next AA period are summarised in Table 8.19. Details of project scope, risk assessment, option analysis are provided in the associated business cases (identified by the project reference number).

[9] The Code has been developed by the Victorian Essential Services Commission and applies to all distributors that hold a distribution licence. The Code sets out the minimum standards for the operation and use of the distribution system, which include, amongst other things, minimum standards for connections and augmentations. As stated in the notes to section 3 of the Code, clause 4 of AGN's Gas Distribution Licence requires compliance with this Code.

Table 8.19: Customer Metering Facilities Risk/Issue/Action Summary

Project Ref	Project	Risk/Issue	Risk Rating	Action	$'000 (2016)
V35	Fisher 298 Regulator Replacement	Spare parts for Fisher 298 regulator are longer being produced, and are extremely difficult to procure on a cost-effective basis. These regulators are more than 35 years old and considered to be at end-of-life.	High	Replace the Fisher 298 regulator units with a new, modern and readily available alternative. 26 sites will be addressed during the next AA period (2018 to 2022) and 25 in the following AA period (2023-2027).	685
V79	I&C meter set refurbishment program	Approximately 1,950 Industrial and Commercial (I&C) meter sets require re-painting or replacement over the next 15 to 20 years. The poor condition of these assets means touch-up painting is no longer sufficient to mitigate corrosion.	Moderate	Implement a program to recoat I&C meter sets at 732 locations of the 1,950 assessed as presenting the highest risk during the next AA period (2018 to 2022). Continue the program beyond 2022 to treat the remaining locations and any additional sites identified in the intervening period.	3,820

8.5. SCADA Facilities

A SCADA system is used for monitoring and reporting gas flow and pressure. AGA's Victoria and Albury SCADA system monitors approximately 30 district regulators, 40 field regulators and 56 city gates. Major industrial customers' sites are fitted with either data logging (accessed monthly) or telemetry. A further 29 sites have remote monitoring of fringe point system pressures.

Table 8.20 summarises SCADA facilities asset groups.

Table 8.20: SCADA Facilities Asset Groups

Asset Group	Sub Group	Function Description
SCADA Facilities	GS and DRS Monitoring and Control	Telemetry monitoring and control
	Network Fringe Point Monitoring	Telemetry fringe point pressure monitoring
	Demand Metering Measurement	Interval (hourly) metering data acquisition at demand metering sites

8.5.1. Asset Performance, Condition and Integrity, and Growth

The performance of SCADA facilities is monitored and reported annually in the Distribution System Performance Review. The key performance issues and proposed actions are summarised below. Further details are provided in Table 8.22.

Performance

The majority of SCADA faults are associated with the communications infrastructure (phone lines), which are not AGN assets. An upgrade process to shift systems across to GPRS (3G) is now complete, and system tuning has substantially reduced the incidence of such faults.

Condition and Integrity

A program to replace and upgrade degraded, corroded and non-compliant SCADA instruments at field regulator and fringe network sites commenced during the current AA period. There will be 24 sites outstanding at the end of 2017. Equipment at these sites has reached the end of its useful life and is obsolete, requiring upgrades to glands, new transmitters, and complete wiring at some sites. In many cases SCADA instruments have degraded such that the installation fails to comply with AS/NZS 60079.

Growth

Several field regulators and network fringe sites in AGN's Victoria and Albury networks do not have SCADA monitoring equipment. It is therefore not possible to monitor pressures at these sites on an ongoing basis. AGN intends to install pressure monitoring SCADA at a further 30 sites (a mix of inlet and network fringe) as listed in Table 8.21.

Table 8.21: SCADA Fringe Point Monitoring – Additional Sites

Suburb	Site Name	Year	Priority	Metro or Regional
Shepparton (Kiala)	Southern town fringe	2018	1	R
Bairnsdale	Town fringe	2018	2	R
Paynesville	Town fringe	2018	3	R
Sandhurst or Skye	Nth east of Hall Road	2018	4	M
Wodonga	Fringe around south west	2018	5	R
Wodonga	Fringe around south east	2018	6	R
Lalor	East Lalor	2019	7	M
Ivanhoe	South west Ivanhoe	2019	8	M
Warragul	Town fringe	2019	9	R
Pakenham	Near Cardinia Rd	2019	10	M
Tyabb	Gerald St	2019	11	M
Tyabb	Town fringe	2019	12	M
Montmorency	South west fringe	2020	13	M
Koo Wee Rup	Town fringe	2020	14	M
Crib Point	Town fringe	2020	15	M
Hastings	High St	2020	16	M
Moama	Town fringe	2020	17	R
Cranbourne	West Cranbourne	2020	18	M
Albury	Thurgoona Drive	2021	19	R
Albury	Thurgoona Drive	2021	20	R
Albury	South east or north east town fringe	2021	21	R
Albury	Western town fringe	2021	22	R
Shepparton	Northern town fringe	2021	23	R
Healesville	Town fringe	2021	24	R
Fairfield	Yarra Bend Park Road	2022	25	M
Langwarrin	North Road	2022	26	M

North Melbourne	Alfred St	2022	27	M
Lyndhurst	Abbott Road	2022	28	M
Trafalgar	Town fringe	2022	29	R
Morwell	Porters Road	2022	30	R

8.5.2. Operation, Maintenance and Replacement Strategy

Maintenance

The maintenance schedule for SCADA and telemetry systems comprises an annual visit to each site to:

- test and calibrate all instruments, pressure and temperature transmitters, and verify flow computer calculations;
- test batteries conditions and earthing systems;
- clean solar systems and verify functionality; and
- inspect hazardous area installations.

Typical issues currently being found are:

- batteries requiring replacement;
- slam shut switches sticking; and
- drift of pressure transmitter calibration.

Replacement

Generally, SCADA facilities are replaced as result of technical obsolescence. SCADA facilities have a technical life of about ten years. Over the last five years the move to standard communication protocols (GSM/GPRS) has driven changes to field devices using telecommunications.

The central SCADA facility (hardware/software) was upgraded to the national APA ClearSCADA platform in September 2013.

8.5.3. Asset Risk and Action Plan

SCADA facilities issues over the next AA period are summarised in Table 8.22. Details of project scope, risk assessment, option analysis are provided in the associated business cases (identified by the project reference number).

Table 8.22: SCADA Facilities Risk/Issue/Action Summary

Project Ref	Project	Risk/Issue	Risk Rating	Action	$'000 (2016)
V08	SCADA – DRS fringe monitoring	Many field regulators and network fringe sites do not have SCADA monitoring equipment. This prevents early diagnosis and rectification of equipment performance issues before major supply issues are encountered.	High	Install pressure monitoring SCADA at 30 sites (a mix of inlet and network fringe) during 2018 to 2022.	710
V07	SCADA – end-of-life replacement	During the current AA period AGN commenced a program to replace and upgrade degraded, corroded and non-compliant SCADA instruments at field regulator and fringe network sites in the Victoria and Albury networks. 24 sites will be outstanding at the end of 2017. Equipment has reached the end of its useful life and is obsolete, requiring upgrades to glands, new transmitters, and complete wiring at some sites. In many cases SCADA instruments have degraded such that the installation fails to comply with AS/NZS 60079.	High	Replace SCADA instruments at all 24 identified field regulator sites during 2018 to 2022.	398

Appendix A Network Location Maps

Figure A.9: Map of AGN's Victoria Natural Gas Distribution Network

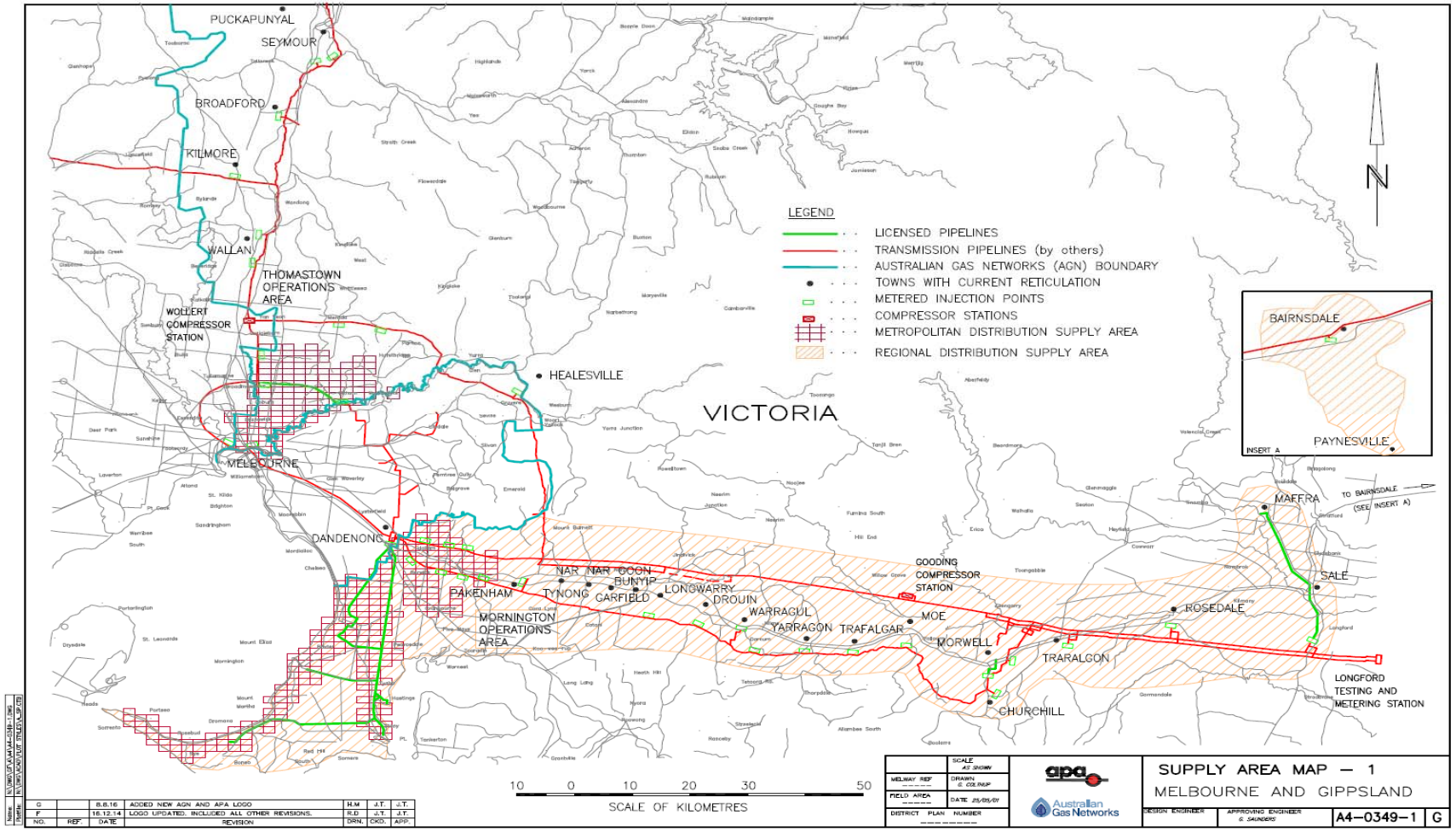


Figure A.10: Map of AGN's Albury and Wagga Natural Gas Distribution Networks