Business Case – Capital Expenditure

Encroachment High Consequence
Business Case Number BC230 AA23-27

1 Project Approvals

TABLE 1: BUSINESS CASE – PROJECT APPROVALS

Updated By	Matthew Clark Glenn Ogilvie	Team Leader Risk and Engineering Services Senior Risk Engineer, Risk and Engineering Services
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Reviewed By	Scott Mitchell	Manager Pipeline Engineering, Engineering & Planning
Approved By	Daniel Tucci	Victorian Asset Manager, Asset Management

2 Project Overview

Project resubmitted as an ongoing program of work

TABLE 2: BUSINESS CASE – PROJECT OVERVIEW

Description of Issue/Project	This project is to ensure the safety of the public, APA personnel and the pipeline by reducing the risks associated with third party interference causing damage to high pressure pipelines. Some of the VTS pipelines need physical changes to ensure risk levels are acceptable due to urban encroachment. These pipelines involve those with the high consequence surroundings associated with fully developed urban areas, proposed urban development areas and areas with specific sensitivity.
Options Considered	The following options have been considered: Option 1: Do Nothing Option Option 2: Protective slabbing (Recommended Option) Option 3: Lower the pressure of the pipeline to reduce the consequences and modes of failure Option 4: Combination of option 2 & 3 Option 5: Replace the pipeline
Estimated Cost	$2.2m
Relevant Standards	Australian Standard for design and construction, AS2885.1 and Pipeline Safety Management, AS2885.6.
Consistency with the National Gas Rules (NGR)	The capital expenditure complies with the new capital expenditure criteria in Rule 79 of the NGR because: • it is necessary to maintain and improve the safety of services and maintain the integrity of services (Rules 79(2)(c)(i) and (ii)); and • it is 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 providing services (Rule 79(1)(a)). • To comply with a regulatory obligation or requirement (Rules 79(2)(c)(iii))
Key Stakeholders	Stakeholders involved with urban encroachment and the risks associated are • Australian Energy Market Operator • Landowners • Energy Safe Victoria • Local Councils • Victorian Planning Authority

Benefits to Customers and Consumers	This project will improve safety for public in close vicinity to pipelines. By reducing the risk of loss of containment (gas leakage) resulting in potential explosion and fire. Loss of containment, explosion and fire could potentially result in fatalities.

3 Background

3.1 Transmission Pipelines

Transmission Pipelines have an Australian Standard for design and construction, AS2885.1 and Pipeline Safety Management, AS2885.6. The standards require physical and procedural mitigation measures to be applied to 'external interference' or mechanical damage threats to the pipeline (e.g. auger, excavators, horizontal directional drills). This requirement is in place because external interference threats are the greatest contributor to loss of pipeline containment incidents. Physical and procedural measures are required to ensure the risk ranking associated with the threat is at an appropriate level.

Each pipeline segment is primarily classified as either: T1, T2, R1 or R2. This classification is based on the land use within the 'Measurement Length' (ML). The ML is the distance from the pipeline that an ignited full bore rupture would affect the surrounding area. The ML is dependent on maximum operating pressure and diameter of the pipeline, thus each pipeline has a different ML.

AS2885.1 standard states for new pipelines in section 4.9.2: *"In Residential (T1), High Density (T2), Industrial (I), Sensitive (S) and Environmental(E) location classes the pipeline shall be designed such that rupture is not a credible failure mode."*

A requirement of AS2885.1 clause 4.9.2 is that the Critical Defect Length (CDL) is required to be at least 1.5 times the maximum damage length from credible threats. The critical defect length is dependent on pipeline pressure and other factors. The definition of CDL is "The length of a through wall axial flaw that, if exceeded, will grow rapidly and result in pipeline rupture…"

AS2885.1 addresses the Maximum Energy Release Rate in section 4.9.3. This is defined as:

- For general residential areas (T1) and Industrial locations (I), maximum energy release rates must be less than 10 GJ/s
- For high density areas (T2) and Sensitive (S) locations, maximum energy release rates must be less than 1 GJ/s.

Existing pipelines within the VTS must comply with the requirements of AS2885.1 for No-Rupture and Maximum energy release rate.

Generally, the VTS pipelines are not at risk of releasing 10 GJ/sec from the largest leak prior to rupture. Typical release rates from credible threats on VTS pipelines are up to 2 GJ/s and are associated with Pilot Holes of HDD and Augers. The requirement for less than 1GJ/s release rate in T2 or S locations is very difficult to achieve and generally removing the threat with an additional protective measure is the only practical alternative.

In an effort to enforce this section, and to clarify, AS2885.6 section 5.5.1 states:

> *"All pipelines in high-consequence areas shall be assessed for conformance with the requirements of AS/NZS 2885.1 for No-Rupture and maximum energy release rate. Where the pipeline does not comply with one or both of these requirements, a formal ALARP assessment shall be done. Additional control measures shall be applied until it is demonstrated that the risk associated with Rupture is ALARP in accordance with Section 4"*

Almost all pipelines within the VTS are capable of rupture if severely damaged. The assessment of compliance to the standard mainly revolves around the credibility of the hazards that could create a rupture. Primarily this is the credibility of certain types of excavation equipment being used in certain environments.

Where the environment is conducive to threats that have the potential to rupture or cause a large leak in the pipeline, and that environment is or will become a High Consequence Area (HCA) (T1, T2, I, S and E) either additional physical

or procedural measures need to be implemented until the residual risk can be lowered to As Low As Reasonably Practical (ALARP) or Low or Negligible and thus acceptable. Similar logic applies to any threat in a High Consequence Area (HCA).

3.2 APA and ALARP

Since the publication of AS2885.1 in 2007 and the revisions in 2012 and 2018, APA has been required to assess the safety of pipelines retrospectively for sections 4.9.2 and 4.9.3. For many pipelines in specific urban areas the risk associated with external interference from credible threats was determined to be Intermediate. A typical example of this is Vertical Drilling/Boring during construction activities causes penetration and leak of pipelines within the VTS. (Refer to ALARP Report 320-RP-AM-0248). AS2885 states that Intermediate is only acceptable risk ranking if ALARP is demonstrated. ALARP is defined in AS2885 as achieved "when the cost of further risk reduction measures is grossly disproportionate to the benefit gained…".

3.2.1 APA's Approach to ALARP

APA's approach to ALARP reflects an appropriate balance to the likelihood of an event and its consequences. The approach appropriately accounts for low likelihood, high consequence outcomes. The obvious example of the strengths of the APA approach is it would avoid the incident that occurred in Ghislenghien, Belgium.

In 2004 in Ghislenghien, Belgium earthmoving equipment damaged a transmission pipeline sufficiently to cause a full bore rupture of the pipeline. The rupture ignited and killed 24 people and injured a further 132 in an industrial region. The similarities with the pipelines in this business case is, that they are in HCA, rupture is possible and there are credible earthmoving and excavation threats to cause rupture in these areas.

The APA approach is consistent with the work that the Australian and international pipeline industry has developed in its approach to risk assessment and ALARP analysis. The Australian Pipeline and Gas Association's (APGA) Research and Standards Committee (RSC) and the Energy Pipelines Cooperative Research Centre (EPCRC) have invested significantly in this area, particularly for high-consequence, low-likelihood risks such as pipeline failures. This topic has featured at prominent Australian and international industry and research conferences. ALARP guidelines have been developed to enable Licensees to better understand and demonstrate that further risk reduction measures would incur costs grossly disproportionate to their incremental benefit.

The final report – Project RP4.21A: Understanding ALARP and • Interim Report One - Project 4.20A Third Party Risks to Pipelines were utilised in understanding the technical obligations imposed by ALARP. These reports are attached [CONFIDENTIAL].

The APA approach is consistent with industry practice of assessing the existing pipeline risk and mitigating where necessary approaching to a similar risk of a new pipeline with respect to AS2885.1 clause 4.9.2 and 4.9.3.

The approach APA is now undertaking assessment of risks and mitigations that effect those risks that are triggered by land use and land use changes around each pipeline. For example, the assessment of ALARP is not contained to just the affected pipeline segment (land use change) but adjoining pipeline segments that are also affected by land use changes.

3.3 Urban Growth

The Victorian Government moved the urban boundary in 2011 to make metropolitan Melbourne larger. This boundary is known as Melbourne 2030 boundary. The expansion alters the land use from rural to urban in areas where APA has pipelines not designed for urban areas.

The boundaries have been divided into Precinct Structure Plans (PSP) and are progressed through planning stages individually. The Victorian Government's Victorian Planning Authority (VPA) and local Councils manage the PSP approval process which includes basic structure design such as roads, land uses and institutions, employment areas and applies various Government policies for town planning applicable at the time.

APA is not currently a Referral Authority at the planning level and thus has very limited rights to influence the land use changes within any PSP. This has two major problems for APA and transmission pipelines, firstly APA is not required

to be notified of a land use change and second APA's ability to object to a land use change is very minimal. As a result, APA is not able to modify the land use planning to suit the safety or asset management requirements stated in AS2885 and thus the licence requirements set by the Victorian Government on APA.

APA is a Referral Authority at the sub-division level. This is too late in the process as the land has already been rezoned and objection powers are very limited.

The map below shows the PSPs to be developed in relation to the VTS pipeline system (in red). In almost all circumstances the entire urban growth boundary can be considered as a minimum T1 and in certain locations, T1-S.

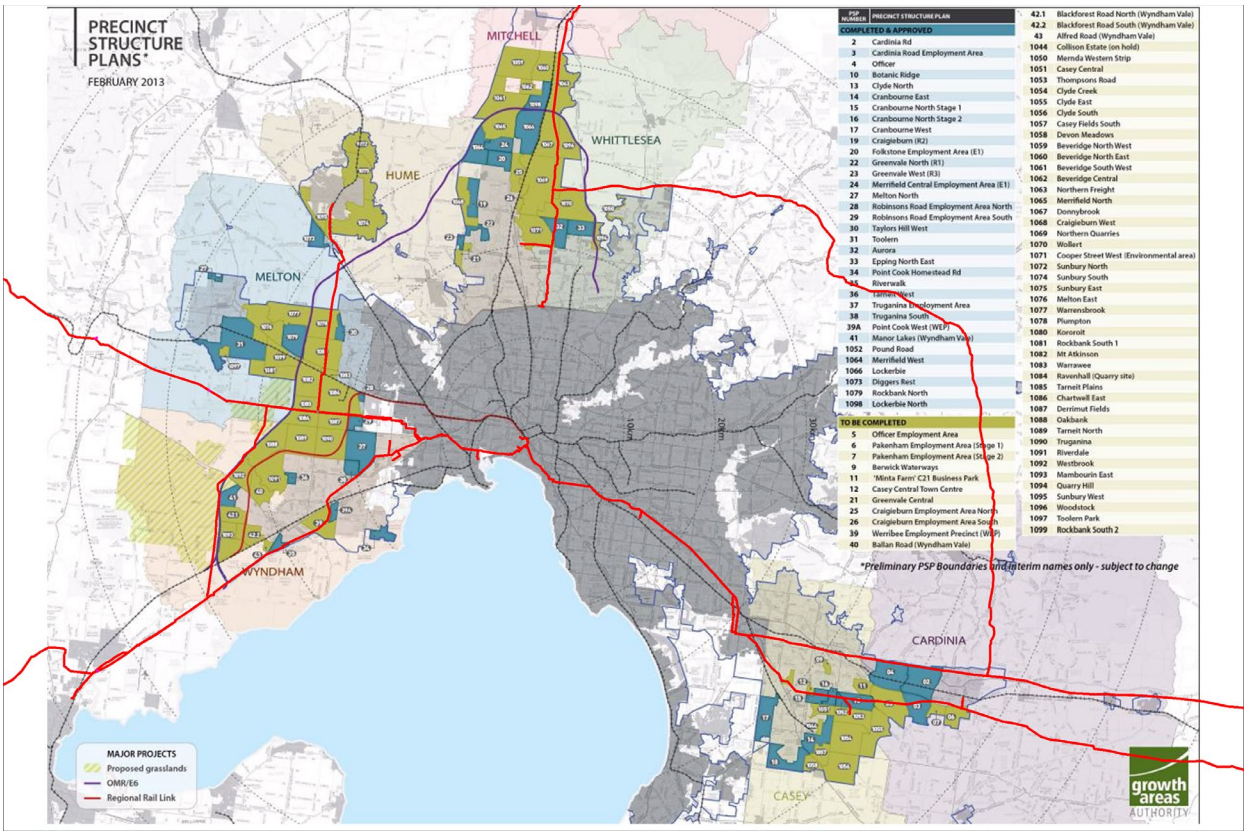

Figure 1 Map of PSPs with VTS pipelines in Red

3.4 Acts and Regulations

There are many legislative instruments associated with natural gas infrastructure that are utilised to enforce safety to personnel and the public. The following table lists each Victorian Act or Regulation that directly or indirectly relates to the urban encroachment of pipelines.

Act or Regulation	Reference	Particulars
Gas Safety Act 1997	Part 3, Division 1, S32	A gas company must 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;
Gas Safety (Safety Case) Regulations 2008	Part 2, Division 4, Section 25(2)(d)	a description of technical and other measures undertaken, or to be undertaken, to reduce that risk as far as practicable

Pipeline Act 2005	Part 8, Division 1, S109	A licensee must ensure that the pipeline to which the licence applies is operated in accordance with— (a) any standards, specifications and conditions that are prescribed; and (b) any standards, specifications and conditions that are included in the licence
Pipeline Regulations 2007	Part 5, S21(2)	For the purposes of section 109(a) of the Act, a pipeline must be operated in accordance with AS 2885.2—2002 and AS 2885.3—2001
Pipeline Act 2005	Part 9, Division 2, S129	In carrying out a pipeline operation, a licensee must ensure that the operation is carried out in accordance with the Safety Management Plan accepted by Energy Safe Victoria in relation to the pipeline operation.
Pipeline Regulations 2007	Part 6, S32	The Safety Management Plan must contain a safety assessment of the pipeline operation that is consistent with the description of the pipeline in regulation 31 and that— (b) identifies all of the hazards and risks arising from the pipeline operation that have the potential to cause a safety incident; and (c) contains a detailed assessment of those risks; and (d) describes the measures undertaken, or proposed to be undertaken, to eliminate or minimise those risks as far as practicable.

4 Risk Assessment

The risks associated with urban encroachment are varied. The worst consequence that could materialise is inadequate pipeline protection leading to rupture. Refer to the 2016 VTS Safety Management Study Report 320-RP-P-0241 in Appendix A.

The below risk table is based on AS2885 risk matrix. Intermediate risks are only acceptable if ALARP is demonstrated.

"Where the risk rank cannot be reduced to 'low' or 'negligible', action shall be taken to—
(a) remove threats, reduce frequencies and/or reduce severity of consequences to the extent practicable; and
(b) demonstrate ALARP"

The risk scenarios considered are: (Identified during the 2016 VTS 5 yearly SMS)

Excavation during development construction causes penetration and leak of pipelines within the VTS

Vertical Drilling/Boring during construction activities causes penetration and leak of pipelines within the VTS

Risk Assessment of these threats resulted in a (Likelihood: Remote) and (Consequence: Major) leading to an Intermediate Risk Level (refer 2016 VTS SMS ALARP Report 320-RP-AM-0248 in Appendix. A)

Major Consequence is associated with people, whereby *One or two fatalities or several people with life-threatening injuries*

Remote Frequency is defined as Not anticipated for this pipeline at this location

In consideration for this Business Case is the T33 South Melbourne to Brooklyn Pipeline and the T74 Wollert to Euroa Pipeline (Refer to Section 4.1 for Project Details)

Risk Scenario:
Unauthorised excavation activities using equipment capable of causing large release of product (leak) and ignition. Hole size of 50mm based on Auger pilot drill size.

Leak consequence lengths
AS2885 defines two specific thermal radiation intensities from an ignited leak. AS2885.6 Appendix B states:
"A thermal radiation level of 4.7 kW/m^2 will cause injury, at least second degree burns, after 30 seconds exposure. A thermal radiation level of 12.6 kW/m^2 represents the threshold of fatality, for normally clothed people, resulting in third degree burns after 30 seconds exposure".
The distance at which the thermal radiation from an ignited leak of a 50mm hole has intensities of 4.7 kW/m^2 and 12.6 kW/m^2 are as follows:
T33 South Melbourne to Brooklyn Pipeline
A 50mm hole results in a 25 meter radiation contour of 12.6 kW/m^2 and 41m for 4.7 kW/m^2.
T74 Wollert to Euroa Pipeline
A 50mm hole results in a 47 meter radiation contour of 12.6 kW/m^2 and 78m for 4.7 kW/m^2.

APA recognises that T2 and S land uses within the 4.7 kW/m^2 leak consequence length for a pipeline for a threat which is Remotely possible will lead to an intermediate Risk level and as such does not support such uses without additional controls.

Below is the Risk level for each Risk Area for the risk scenario for the T33 & T74 pipelines

Risk Area	Consequence	Likelihood	Residual	Target
Health and Safety	Few fatalities of those undertaking excavation and several people with life threatening injuries		Moderate	
Environment	No significant environmental consequences identified.		Negligible	
Operational Capability	Lost productivity while the asset is returned to operation. Both pipelines can be reversed flow so impact is low. Repair may be up to 2 weeks duration		Low	
People				
Compliance	Loss of containment incidents will in turn increase the scrutiny that APA receives for assets in High Consequence Areas and may result in constraints being applied by the regulator or other governing body.		Moderate	

Reputation & Customer	Significant reputational loss may occur as a result of impact with Child Care Centres and High Rise Apartments for the T33. The T33 is in a high profile areas within the inner city. Negligible customer impact as flow can be maintained and customer supply retained via reverse flow of the T33 and looped pipeline of the T74		Moderate Negligible	
Financial	Lost productivity while the asset is returned to operation which will have financial implications. Legal challenges may also require funding.		Moderate	
Residual Risk Rating			Moderate	

5 Options Considered

The encroachment problem is not solved with the same solution in each occasion. Each identified area of land where the land use changes need to be assessed individually and the options available, feasible and prudent are unique to each affected area.

The pipelines detailed below demonstrate the affected length of pipeline of Existing High Consequence areas and Proposed High Consequence.

AS2885.6 section 4.2 states “For in-service pipelines where formal ALARP assessment is required, the risk controls listed below shall be considered as part of formal ALARP assessment:

(A) Imposition of Restricted Operating Pressure or reduction of MAOP (to a level where Rupture is non-credible)

(B) Pipe replacement (with No-Rupture pipe).

(C) Pipeline Relocation (to a location where the consequence is eliminated)

(D) Modification of land use (to separate the people from the pipeline)

(E) Implementing controls that are effective in controlling Threats capable of causing Rupture of the pipeline. ”The above options are considered, however they can be extremely expensive for the benefit gained, or outside of APA’s legal authority (relocating the land use) as described;

> Lowering the pipeline pressure (a) is a credible solution as it is effective for eliminating rupture for almost all credible threats in most environments. However, the consequences of smaller losses of containment are unlikely to be significantly reduced. The entire pipeline must be assessed and not just the isolated area of land use change. Otherwise this option is unlikely to be economically justifiable in many locations within the VTS. Often substantial augmentation of the VTS will be required to meet customer requirements should pressure reduction be implemented.
>
> Pipeline replacement (b) will satisfy the requirements as the new pipeline can be designed for the high consequence area. The cost of this option will be similar to pipeline relocation and could be greater than $10-20 million/km (larger 750mm pipelines in T2 areas) or $3-5 million/km (l00-500mm pipelines)
>
> Pipeline relocation (c) in most circumstances is not practical as the pipelines are constructed to supply gas consumers within the urban boundary. To supply these customers from outside the urban boundary will require enormous effort and could cost upwards of $500m. This figure is based on relocating all pipelines in this business case to outside the urban boundary.
>
> Changing the land use (d) is not within APA’s legal ability and will cost more than pipeline replacement.

The selected option for most pipelines in most locations is to implement a physical protection measure (e) in the form of protection slabbing. This technique is utilised as a standard design for road and rail crossing for decades in Victoria.

Increase procedural protection (e) will reduce likelihood of an incident however cannot prevent leak/rupture from a particular threat to be non-credible without any additional physical protection. Current procedural measures in high consequence areas include daily (5 days per week) pipeline road patrol; landowner and 3rd party liaison, community awareness and dial before you dig, pipeline marker signage and aerial patrols.

APA considers that all effective procedural controls are already in place notwithstanding that improvements are always possible and are ongoing at the time of this business case. Possible additional procedural controls include:

- Increased patrol activity beyond once per day, e.g. two or three times per day
- Weekend Patrol
- Increased surveillance by other means such as CCTV, satellite imagery, drone or helicopter patrol
- Remote intrusion monitoring using fibre optic cables

These options are unlikely to provide any substantial additional risk mitigation, but may reduce the likelihood but have no effect in the all controls-fail scenario when 3rd party works are not detected.

5.1 Option 1 – Do Nothing

This business case describes each affected pipeline, but in all cases the Do Nothing option is the same.

The Do Nothing option is not acceptable as the risk level is not acceptable and under these circumstances would not be compliant with AS2885, the Pipeline Licence and the NGR.

The Belgium incident and recent studies performed by other business units show the Do Nothing option is unacceptable.

5.1.1 Option Assessment

The benefit of the Do Nothing option is the avoidance of capital and operational expenditure. The value of deferred capital is in the forecast expenditure for the proposed solutions.

The costs of the Do Nothing option are to accept the risk of leak and ignition of a pipeline in an urban and sensitive environment resulting from an unauthorised activity with its obvious consequences for public safety and a period of interruption to the provision of pipelines services.

5.2 Project 1 – T74 Wollert to Euroa

The Wollert to Wodonga pipeline (T74) operates at 8,800 and 7,400 kPa and has two wall thicknesses of 7.55mm and 6.35mm and was constructed in 1976. The PSP that affect the T74 are 1063, 1067, 1096, 1069 and 1070. The land the pipeline route traverses is renowned for rock and large excavators are commonly used for earth moving activities in the area.

The excavators credibly to be used in vicinity of the pipeline would be equipped with either twin tiger teeth or penetration teeth, AS2885 information indicates both of which are capable of penetrating the pipeline in such a manner that would produce a rupture.

- APA has conducted site investigations into geometry of Penetration and Tiger Teeth used by contractors along the WORM pipeline corridor to which it shares a common easement with the T74 Pipeline North of Wollert. APA has found that actual Penetration teeth are blunter than the dimensions found in AS2885.1 Table E5. Tiger Teeth are not used to strike with bucket force as indicated by AS2885, however a process of Rock Picking using Single Tyne Teeth (similar to Single Point Tiger Teeth) is used to remove broken rock and boulders (Refer to APA report 18035-RP-L-0007 Excavators and Tool Investigation Report. WORM Project"). On the basis of the findings a 49T excavator with field dimension Penetration teeth cannot penetrate the T74 pipeline. Tiger Teeth is not expected to penetrate the pipeline through the discussed Rocking Picking activity.

Vertical Augers for fencing, lighting and power Poles are threats credible to the T74 which can potentially lead to a leak. APA has identified that between KP3.52 and KP4.49 there has been development to the west of the pipeline easement (see figure.2 below). There has been no development to the East in this section. This section is identified as T1 (Residential) with no Secondary Location Class. It is expected that Child Care centres will be utilised within the existing development which will lead to a Secondary location class of S (Sensitive) in the future. APA believes it would be prudent to slab this section of pipeline on the basis of development equipment threats such as Vertical Augering. Whilst information to date indicates that excavators with actual teeth used in developments will not penetrate this pipe, it would be prudent to eliminate the threat from attack with Excavators also. A 50mm pilot hole from augering would lead to an Energy release of 1.42 GJ/s which is non-compliant to AS2885.1 requirements in Sensitive areas. The 4.7 kW/m2 leak consequence length is 78m.

Figure 2 - Aerial Imagery of the affected section of land North of Donnybrook Rd taken in August 2021

The following table shows the affected pipeline lengths by wall thickness in high consequence areas and the length of protective slabbing proposed:

	T74 Pipeline
Existing affected length (km)	0.97 + (2 x 0.078) = 1.13 km

Proposed development length (km)	0
Total (km)	1.13

The cost of the protective slabbing for this pipeline that is required is $1.2m.Protective slabbing is the preferred option for this pipeline.

5.2.1 Alternative to Protective Slabbing – Pressure Reduction

APA conducted in 2014 an MAOP increase of the T74 between Wollert and Euroa from 7400kPa to 8800kPa as part of the Northern Zone Augmentation Project in the VTS.

The project was part of the program to deliver improved deliverability of gas for customers in northern Victoria and ensure that APA met contractual obligations for customers in NSW, including Origin Energy Uranquinty Power, Country Energy and Visy Paper, during times of peak demand. It will also lay the basis for significantly increasing future supply of gas from Victoria into NSW to meet growing demand.

The affected section which requires slabbing is comparatively small relative to the length of the pipeline and would eliminate the additional returns gained by MAOP increase and Augmentation of the Northern Zone on the VTS. Pressure reduction is not justified on the T74 pipeline for the above reasons.

5.3 Project 2 – T33 South Melbourne to Brooklyn

The South Melbourne to Brooklyn Pipeline has a Location Class of T2/S within the first 4.8kms of then pipeline from the South Melbourne end. This section coincides with the Fisherman's Bend renewal project which is a long-term strategic plan to 2050 with the ultimate target of 80,000 residents & 80,000 jobs based around a connected, liveable, prosperous healthy and environmentally sustainable community.

APA has been involved in a number of third party development reviews associated with high rise developments and schools and child care centres within the vicinity of the T33 pipeline, primarily between KP0.46 to KP0.86 between Douglas and Buckhurst Streets, South Melbourne. APA has conducted slabbing over the pipeline between KP0.46 to KP0.6 as a result of South Melbourne Primary School being constructed adjacent to the pipeline and within the leak consequence length (41m).

APA have been advised of future construction along Buckhurst Street of High Rise Apartments and Child Care Centres. The Child Care Centre and Apartments would be within the 41m leak consequence length of the pipeline and APA would not approve of these developments without additional protection measures. APA has had ongoing discussions with the developers for financing required concrete slabbing protection works, a final position has not been established. APA was not involved in the Planning and approvals process for the Child Care Centre.

On the basis of current approved developments and anticipated High Rise Apartments and Child learning centres it is prudent for APA to slab the remaining section of Buckhurst St to eliminate any potential above pipe threats. The long term plan is to modify Buckhurst St where the pipeline is located and turn it into an open plan walkway/pedestrian area with Landscape and above ground furniture. New installations such as street lighting, landscape, bollards, poles and signage would all pose a threat to the pipeline. Recommendation is to extend slabbing along Buckhurst Street for an additional 260m (see figure.3 below). Please refer to "Fishermans Bend Precinct Development T33 & T89 Pipelines APA Pipelines SMS Workshop Doc. No. 580-RP-L-0002 Rev 1.0" in Appendix. A which has reviewed T2 and S uses within the leak consequence length and confirms additional protection measures are recommended.

Figure 3 - T33 pipeline shown in Red along Buckhurst St, South Melbourne, image taken November 2021

The total required length of protective slabbing for the T56 pipeline is 0.26km. The cost to slab this pipeline is $1M and is the preferred option.

5.3.1 Alternative to Protective Slabbing

5.4 Summary of Pipelines Affected

The following table quantifies the lengths of pipeline that require further risk mitigation. Some pipelines are not capable of rupture from a credible excavator threat or do not traverse existing or future urban development.

TABLE 4: COST ESTIMATE

Pipeline	Total Affected Length (km)	Road Crossings	Cost
T74 Wollert to Euroa KP3.52-4.49 + (2x0.078km)	1.13	0	$1,200,000
T33 South Melbourne to Brooklyn KP0.6-0.86	0.26	0	$1,000,000
Totals	1.39		$2,200,000

	Total
Internal Labour	$350,000
Materials	$200,000

Contracted Labour	$1,500,000
Other Costs	$150,000
Total	$2,200,000

6 Proposed Solution

5.1 Proposed Solution - Protection Slabbing

The affected pipelines described above require either protection slabbing in order to satisfy the requirements of the Safety Case, AS2885, the Pipelines Act and Regulations and the Gas Safety Act and Regulations.

The intent of the proposal is to achieve compliance with the 'Energy Release' credibility assessment requirements of AS2885.1 and ensuring ALARP for intermediate threats due to third party interference.

The assessment of the pipeline to determine which locations require slabbing was conducted with Graphical Information System (GIS) which displays aerial photography imagery of the pipeline environment.

The assessment of locations to have protective slabbing was in reference to the APA philosophy *Physical Barrier Selection and Design for Existing Pipelines*. Essentially this means that all HCA locations where excavator or auger access is credible, including road reserve, local council reserves, private properties other than suburban residential yards, throughout the gazetted urban development zone, depicted in the picture in section 5.3.

5.2 Why are we proposing this solution?

The threat to the pipeline being mitigated by the works is from unauthorised excavation by vertical boring and excavators. AS2885.1 section 4.9.2 requires that for new pipelines the pipeline shall be designed such that rupture is not a credible failure mode in high consequence areas (T1, T2, I, S and E). AS2885.1 section 4.9.3 requires that the maximum energy release shall not exceed 10 GJ/s in T1 and I areas and not exceed 1 GJ/s in T2 and S areas for new pipelines.

For existing pipelines, AS2885.6 section 5.5.1 states; "*All pipelines in high-consequence areas shall be assessed for conformance with the requirements of AS/NZS 2885.1 for No-Rupture and maximum energy release rate. Where the pipeline does not comply with one or both of these requirements, a formal ALARP assessment shall be done. Additional control measures shall be applied until it is demonstrated that the risk associated with Rupture is ALARP in accordance with Section 4*"

The T74 pipeline described above is capable of leak and non-conformance with the Energy Release rate in Sensitive locations. The T33 Pipeline has proposed Sensitive and T2 uses within the leak consequence length where the T33 does not have protective slabbing and existing roadway is intended to be modified. Future redesign of the road environment where the T33 is located poses threats to the pipeline in addition to non-conformance with APA guiding principles for T2 and S uses in the Fisherman's Bend development area.

There is a responsibility for implementing the proposed solutions. The Gas Safety Act and the Pipelines Act require APA as owner of these pipelines to minimise risks as far as practicable. The Acts and Regulations also demand adherence to AS2885 which demands a similar risk tolerance.

6.1.1 Consistency with the National Gas Rules

6.1.1.1.1 Rule 79(2)(c)(iii)

The capex is necessary to comply with a regulatory obligations described in section 3. The obligations in each Act and Regulation prescribe the reduction of risk to as low as practicable. In previous submissions to the AER, APA has proposed slabbing for additional physical protection, which was consistent with the assessments for those pipelines at that time.

APA's continual adoption of Industry Best Practise, consistent with NGR 79 (1)(a), is a driver for the proposed works in this Business Case. The capital expenditure described in this business case is required to meet the regulatory obligations in the Gas Safety Act and the Pipelines Act and thus meets NGR rule 79(2)(c)(iii).

6.1.1.1.2 Rule 79(1)

Consistent with the requirements of Rule 79 of the National Gas Rules, APA considers that the capital expenditure is:

- Prudent – The expenditure is necessary in order to maintain and improve the safety of services and maintain the integrity of services to customers and personnel and is of a nature that a prudent service provider would incur.
- Efficient – The field work will be carried out by the external contractor that has been used to date, who has demonstrated specific expertise in completing the installation of the facilities in a safe and cost effective manner. The design of the protection slabbing has been modified to enable the most efficient construction without jeopardising effectiveness of the control measure. The expenditure can therefore be considered consistent with the expenditure that a prudent service provider acting efficiently would incur
- Consistent with accepted and good industry practice – Addressing the risks associated external interference and the reduction of risk to as low as reasonably practicable in a manner that balances cost and risk is consistent with Australian Standard AS2885.
- To achieve the lowest sustainable cost of delivering pipeline services – The sustainable delivery of services includes reducing risks to as low as reasonably practicable and maintaining reliability of supply.

5.3 Forecast Cost Breakdown

The high volume nature of the protection slabbing leads to a unit rate cost estimation. The variances in unit rate will be due to economies of scale for short lengths, ground conditions and reinstatement variables such as asphalt roads or natural surface.

Project 1-T74 Wollert to Euroa lies in an area of Melbourne are dominated by volcanic basalt (rock) and will have significantly higher excavation costs than typical eastern areas of Melbourne where land is predominantly medium clay layers.

Project 2 – T33 South Melbourne to Brooklyn requires existing road pavement to be removed and reinstatement following completion of the works. Works will have to be conducted sequentially such that the length of road that is disturbed is minimised. Similar works in the area required a precast slabbing solution to ensure time of disruption is minimised, which is achieved when concrete is cured off site rather than the typical 'in situ' concrete poured method. The unit rate to slab is significantly hired due to the cost of reinforced pre-cast slab sections, traffic management and road re-instatement costs.

7 Acronyms

Acronym	Definition/Description
AEMO	Australian Energy Market Operator
AGA	Australian gas association – Type B compliance governing body
API	American Petroleum Institute – publisher of standards
CHAZOP	Control system HAZOP – study of the control system functions to identify logic vulnerabilities
ESD	Emergency shutdown – control system-initiated shutdown designed to prevent incident escalation if operating parameters are breached
ESV	Energy Safe Victoria
HAZOP	Hazard and operability study
HMI	Human machine interface
ILI	Inline inspection – pipeline internal inspection
OEM	Original Equipment Manufacturer
RA	Risk Assessment
RBI	Risk Based Inspection – a process used to prioritise maintenance or inspection activities based on risk of failure.
SIL	Safety Integrity Level – an assessment used to rank control systems by their ability to fail safely
SMS	Safety Management Study
VTS	Victorian Transmission System

8 Appendix

Appendix A – Reference Reports

320-RP-AM-0241 Rev.1.0 Safety Management Study Report. Victorian Transmission System Pipelines

320- RP-AM-0248 Rev. 1.0 SMS ALARP Report: Victorian Transmission System – Excavation during development construction causes penetration and leak of pipelines within the VTS

580-RP-L-0002 Rev. 1.0 Fishermans Bend Precinct Development. T33 & T89 Pipelines. APA Pipelines SMS Workshop