Delphi Risk Management Consulting

Victorian Planning Authority

Arden Draft Structure Plan V2.2,

AS 2885.6 Safety Management Study
Workshop & Report

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1. EXECUTIVE SUMMARY

1.1 Background

The Victorian Planning Authority (VPA) and City of Melbourne (COM) are currently developing the Arden Draft Structure Plan, approximately 3 kilometres north of Melbourne's Central Business District. The precinct is currently used primarily for industry and some housing. The precinct is ~50 hectares in area. This SMS report is based on version 2.2 of the draft structure plan.

The proposed Structure Plan is positioned over two existing APA Group Transmission Pressure (TP) Gas Pipelines and adjacent to one AusNet Services TP Gas Pipeline (Pipeline PL208, PL66 and PL203). The Australian Standard for TP Gas Pipelines (AS2885) requires the risks associated with operation and maintenance of the pipelines during development and into the future be assessed and suitably mitigated as the development proceeds.

To comply with Australian Standard AS2885.6-2018, land use changes in the immediate vicinity (or Measurement Length, ML) of a high pressure gas pipeline must be subjected to a Safety Management Study (SMS) to review all possible threats to the safe operation and maintenance of the pipeline and ensure that any threats that cannot be mitigated by design or procedures are risk assessed and confirmed to be As Low As Reasonably Practical.

Mark Harris from Delphi Risk Management Consulting was engaged by the VPA to facilitate an SMS Workshop for this Development.

This SMS Report captures the findings of the "Land Use Change" (AS2885.6 Table 5.1) SMS Workshop held on the 10th of June 2020. The Arden Structure Plan provided for review at the SMS Workshop was a DRAFT, sufficient to allow the Workshop to assess all likely risks. The findings from this SMS Report will provide direction to the Developers as part of their Planning Permits in the future. A more detailed SMS Workshop and Report will be required for each future Developer once they prepare their individual development plans.

1.2 Key Findings

The workshop found that based on the known and anticipated threats considered, Pipeline PL208, PL66 and PL203 would all be considered as "no rupture" pipelines.

Given the proposed population density within the precinct is considered "High Density" under AS2885 with the additional presence of "Sensitive" land uses (schools, child care, shopping etc…) within the ML, several Threats were considered to be at an "Intermediate" risk level. As a result, a more detailed Risk Assessment (ALARP Assessment) will be required under AS2885 to confirm if additional physical protection of the pipelines will be needed to minimise the risk to the pipeline and the public as the development proceeds. The ALARP assessment will be conducted separately as an action from this SMS Report.

As the structure plan is still being refined, many of the actions from the workshop entail future review of all utility and vehicle crossings by APA and/or AusNet to ensure they comply with the standard pipeline licensee crossing designs as a minimum.

The pipelines within the precinct all have a brittle "Coal Tar Enamel" coating so use of vibratory construction activities near the pipelines must be closely managed with the approval and oversight of the pipeline licensee(s).

It was highlighted at the SMS Workshop that whilst the workshop was focused on the TP's there are numerous lower pressure network pipelines and it will be important for future Developers to take all precautions to protect these pipeline networks also.

1.3 Outcomes

The SMS undertaken is considered to be an Encroachment SMS. All actions raised at the SMS will need to be closed out to the satisfaction of APA and AusNet prior to any works commencing.

Continued liaison between City of Melbourne (COM), AusNet and APA should ensure that construction activities and post construction activities pose no significant increase in the operational and maintenance risk to the transmission pipelines running past the Development.

Upon satisfactory close out of the actions raised from this SMS Workshop and completion of the relevant Project Lifecycle SMS studies required under AS2885.6-5.6, it can be confirmed that the requirements of AS2885.6-2018 are met and that the APA and APT assets under review will continue to be in compliance with the SMS requirements of AS2885.6-2018 in the Arden structure plan area.

A detailed list of Actions raised at the SMS Workshop can be found in Section 12.

2. ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
APA	APA Group (Pipeline Licensee)
APT	APT Services, part of APA Group (Pipeline Licensee and Gas Network Operator)
AS	Australian Standard
AusNet	AusNet Services (Pipeline Licensee and Gas Network Operator)
CDL	Critical Defect Length (mm) is a hole size where a pipeline is likely to rupture
CIC	Common Infrastructure Corridor
COM	City of Melbourne Council
CTE	Coal Tar Enamel Pipe Coating
CTMS	Custody Transfer Meter Station
CWW	City West Water
DBYD	Dial Before You Dig
DN	Diameter nominal
DRMC	Delphi Risk Management Consulting – SMS Facilitator
DOC	Depth of Cover
DOT	Department of Transport
EIP	External Interference Protection
ESV	Energy Safe Victoria
FJC	Field Joint Coating
GIS	Geographical Information System
GJ/s	Gigajoules per Second (energy release rate)
GPT	General Purpose Teeth (used on excavator buckets)
HDD	Horizontal Directional Drill (used for installation of utilities under existing assets)
km	Kilometre(s)
KP	Kilometre Point
kPag	kiloPascals (gauge)
kW/m2	Kilowatts per metre squared (heat radiation flux)
LOPA	Layers of Protection Analysis (Likelihood/Probability of Failure Calculation)
m	Metre(s)
MAOP	Maximum Allowable Operating Pressure
ML	Measurement Length (4.7 kW/m2 radiation contour in the event of a full-bore rupture of the pipeline, results in 2nd degree burns within 30 sec of exposure at this distance)
MLV	Main Line Valve
MW	Melbourne Water
PE	Polyethylene plastic gas pipe
PIMP	Pipeline Integrity Management Plan
PL	Pipeline License
PPC	Primary Pressure Control
PPV	Peak Particle Velocity, related to degree of ground movement or vibration
R1	Rural location classification
R2	Rural Residential location classification
ROW	Right of Way
RTP	Resistance to Penetration
S	Sensitive Use location classification
SAOP	Safety and Operating Plan
SMS	Safety Management Study
SMYS	Specified Minimum Yield Stress
SP	Structure Plan
SPC	Secondary Pressure Control
SWMS	Safe Work Method Statement
T1	Residential location classification
T2	High Density location classification
TP	Transmission Pipeline
TOR	Terms of Reference
w.r.t.	With Respect To
WT	Wall Thickness
VPA	Victorian Planning Authority

3. INTRODUCTION

The Victorian Planning Authority (VPA) and City of Melbourne are currently developing the Arden Structure Plan located in North Melbourne, approximately 3 kilometres north of Melbourne's Central Business District. The precinct is currently used primarily for residential and industrial purposes.

3.1 ARDEN URBAN RENEWAL PROJECT

The Arden Urban Renewal Precinct forms the southern part of the Arden and Macaulay urban renewal area of North Melbourne. The project area is approximately 50 hectares – refer Appendix E. The Metro Tunnel and new Arden train Station will be the catalyst for intensive mixed use and residential redevelopment of the precinct. The station in Arden is scheduled to open in 2025 near the corner of Laurens Street and Barwise Street.

The Arden project presents a significant opportunity to deliver best practice urban renewal outcomes. Large areas of the precinct are government owned and this provides the opportunity for holistic planning of the precinct and potential to transform the area into an exemplary urban renewal precinct.

Arden is expected to accommodate 15,000 residents and 34,000 jobs by 2051. The Structure Plan will include a spatial plan and associated planning controls to guide future land use, built form, access, drainage and sustainability features. The Plan will support the precinct's transition from a primarily industrial area to an area with a variety of land uses including commercial, residential, educational, and open space. Arden Draft Structure Plan v2.2 heights are provided in Appendix E.

The structure plan area includes three sub- precincts:

(i) Arden North (approx. 22 hectares in area)

New land uses in this precinct will include high rise buildings both commercial and residential, civic and community uses, drainage functions and open space. A blue-green open space will create a landscape that reduces flooding risks and expands the recreational and biodiversity assets along the Moonee Ponds Creek.

(ii) Arden Central (approx. 16 hectares in area)

The future redevelopment of this sub-precinct will be staged over a period of up to 30 years. The precinct will feature a mix of research, institutional, commercial, educational, recreational, retail, cultural and residential land uses, with the greatest intensity of activity occurring around the new Arden Metro Tunnel train station including multi-storey high-rise buildings. A potential new government primary school is proposed in the vicinity of Laurens Street.

(iii)Laurens Street (approx. 12 hectares in area)

This area's notable heritage buildings will guide the character of the sub-precinct. Existing industries in the sub-precinct are expected to transition over time to commercial and residential uses including multi-storey high-rise buildings, and there are opportunities to expand North Melbourne's vibrant creative start-up sector, including additional innovative co-working spaces.

3.2 GAS TRANSMISSION INFRASTRUCTURE

The transmission pressure (TP) gas pipelines under specific AS2885 review in this SMS are located in Langford Street, Green Street, Fogarty Street, Macaulay Road, Dryburgh Street and Railway Place. The 250mm diameter main has a Measurement Length (ML) of 103 metres, and the 450mm diameter main has a measurement length of 240 metres on either side of the pipeline. *(Note:-the ML distance is the heat radiation contour generated if the pipeline was to rupture and ignite, at this distance a clothed person would expect to receive 2nd degree burns if they were to remain in place for 30 seconds.)*

The pipelines have a coal tar enamel coating which is a relatively old coating technology and is well known to be brittle in nature making these pipelines sensitive to vibration leading to coating damage and ultimately corrosion and loss of containment without proper management of vibration during construction works.

APA has indicated that there are no future planned upgrades for gas infrastructure in Arden although some gas main renewal works have been recently completed in the area adjacent to the Arden urban renewal precinct.

APA have advised there is an existing "Custody Transfer Meter Station" (CTMS) facility operated by APA located to the west of Langford Rd on the western side of the Arden Development. APA advised that there are two additional transmission pressure regulator pit facilities in the vicinity of the project footprint with one located on Vaughan Terrace (P7-011) and one on Dryburgh Street (P4-286). These types of facilities were confirmed to not create any adverse impact upon the amenity of surrounding land users as they don't generate significant noise or smell during usual or maintenance operation. The regulator pits are located in the road and so should not be impacted by the development subject to any traffic management plans proposed in the future as the Arden precinct is developed.

AusNet Services have a 450mm Transmission Pipeline which starts from the "CTMS" before travelling west, away from the Arden precinct. The Arden Draft Structure Plan v2.2 does not directly encroach on any AusNet Assets but the ML of the AusNet pipeline does overlay the western side of the Arden precinct significantly and so as the population increases within the ML, the Location Class of the pipeline under AS2885 may need to change to acknowledge the higher density development encouraged in Arden.

The APA Group/AusNet Services have advised of the following assets are within the SP area:

Pipeline Licensee	**Pipeline Licence**	**Easement Width (m)**	**Diameter (mm)**	**Measurement Length (m)**
APA	PL208 (Route Plan T18)	3m either side of pipeline	450	240
APA	PL66 (Route Plan T36)	3m either side of pipeline	250	103
AusNet	PL203 (Route Plan T18)	3m either side of pipeline	450	240
Note: Measurement Length is applied to either side of the pipeline				

The Arden Structure Plan overlays significant existing gas network distribution assets in the form of low, medium and high-pressure gas mains (all less than 1050kPag in pressure). These network pipelines are not covered under the AS2885 Standard but instead are covered under AS4645 Gas Distribution Network Management. That said it is important to acknowledge the network infrastructure because it is made of Polyethylene (PE) plastic pipe or in some locations cast iron pipe. It will be important to treat all pipelines as high risk and it is important that Dial Before You Dig (DBYD) and relevant excavation procedures are followed closely by all future Developers as works proceed. It is particularly important to note that cast iron pipe is particularly brittle when impacted and very difficult to weld on and repair so great caution is required in working around these assets as it is for high pressure gas assets.

Figure 1 - Arden SMS Map showing location of APA & AusNet Services Pipelines

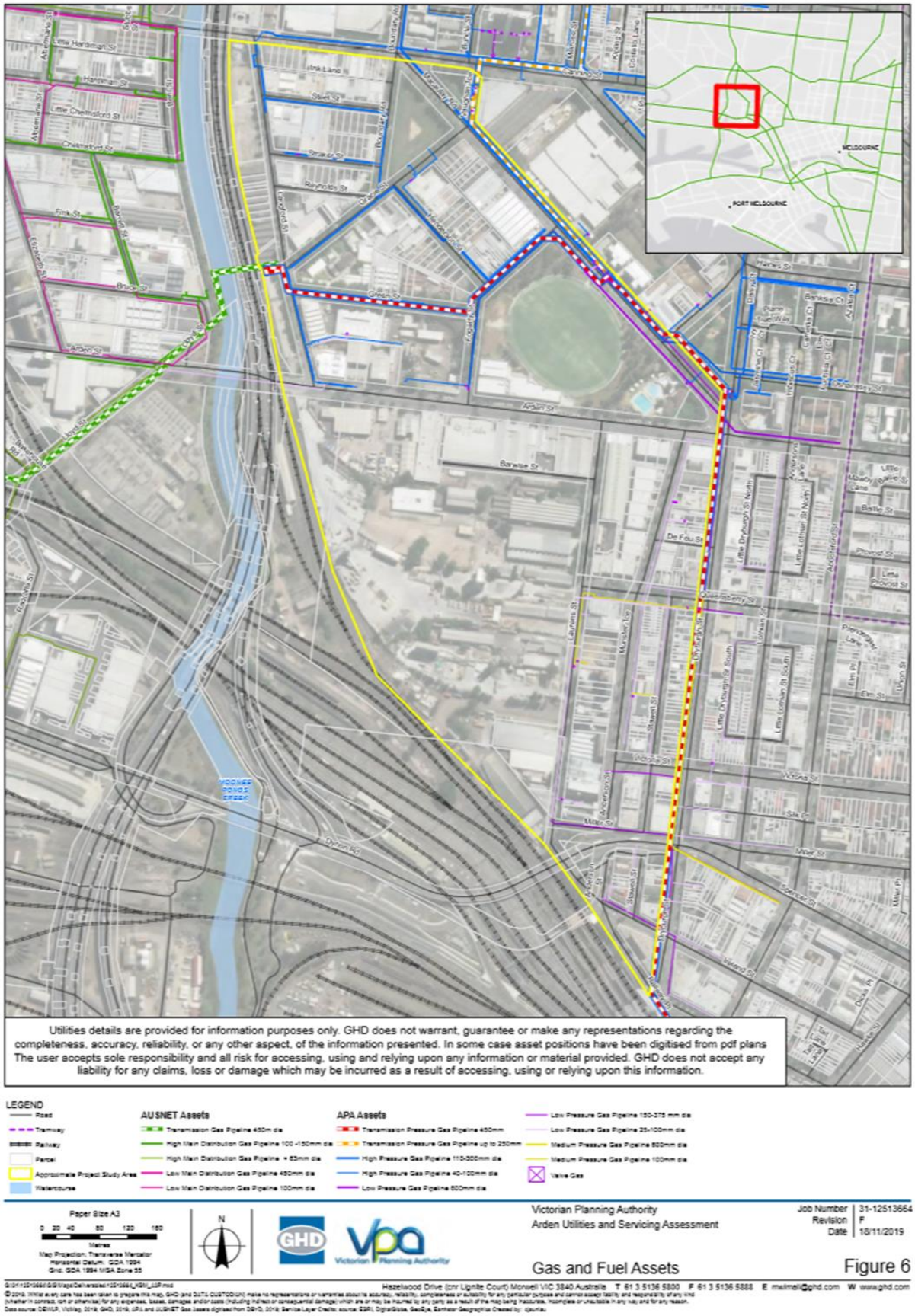
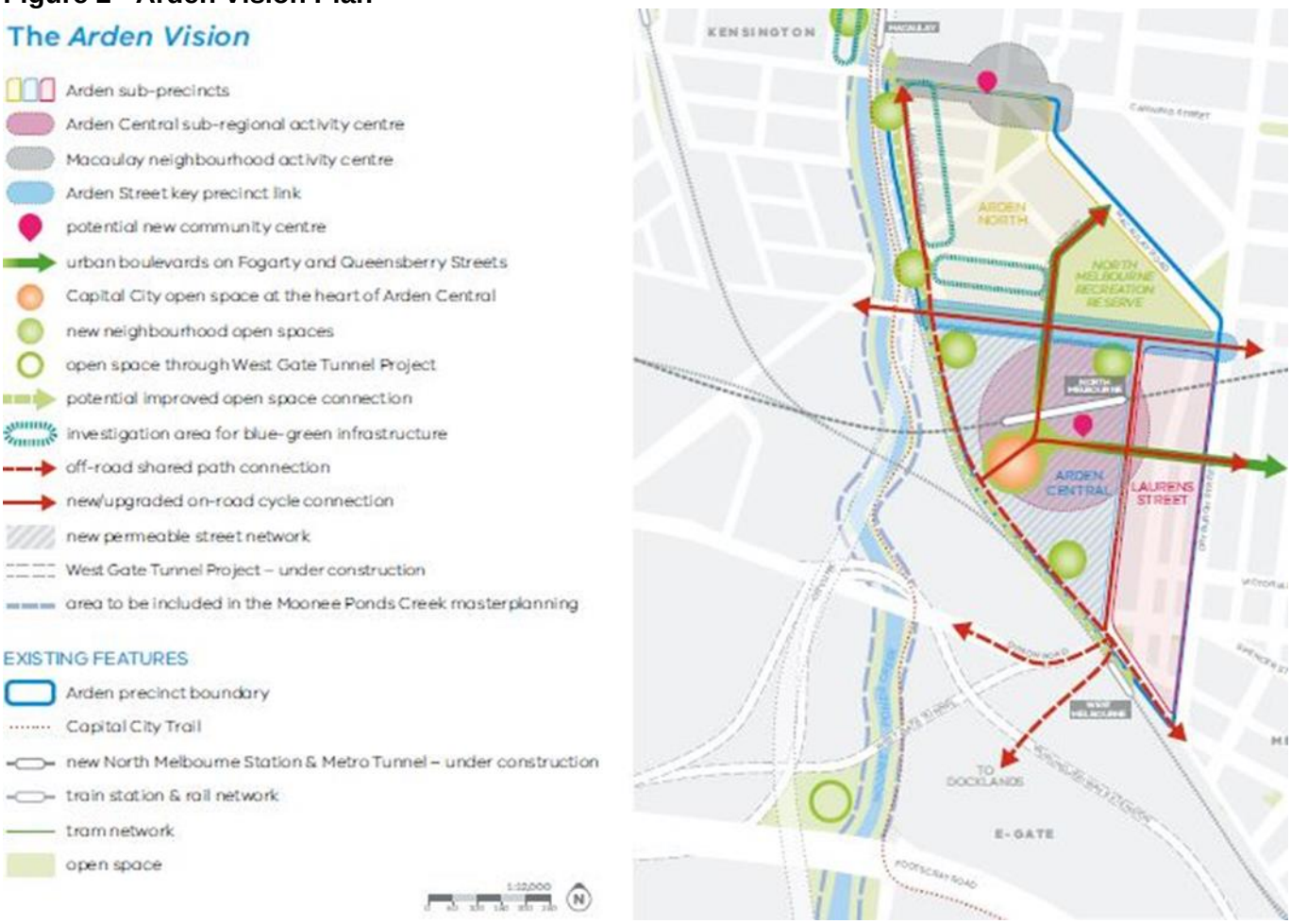


Figure 2 - Arden Vision Plan



4. WORKSHOP PARTICIPANTS

The Safety Management Study Workshop was held on the 10th of June 2020. As the SMS Workshop was undertaken over the internet using Microsoft Teams it was not possible to record a written and signed attendance sheet.

The Workshop was attended by a range of qualified people comprising representatives from the Licensees (APA Group) & AusNet Services (AusNet), Melbourne Water, City of Melbourne (COM)and the Victoria Planning Authority (VPA). The group included sufficient disciplines, knowledge, and experience to provide confidence that the output of the workshop is soundly based.

The nominated attendees for the workshop are listed below.

Table 1, Participants

Name	Position	Organisation
Mark Harris	SMS Facilitator	DRMC
Pam Neivandt	Senior Strategic Planner	VPA
Stefan Bettiol	Strategic Planner/(Scribe)	VPA
John Tinkler	Infrastructure Services Contractor	VPA
Timothy Benedict	Strategic Planner	VPA
Thomas Cochrane	Strategic Planner	City of Melbourne
Sanjeeva Rajapaksa	Drainage Engineer - Infrastructure and Assets	City of Melbourne
Amir Esmaeili	Integrity Engineer	APA Group
Sam Pitruzzello	Gas Engineering Services Manager	AusNet Services
Saj Ganegoda	Senior Engineer - Pipelines & Infrastructure Services	Downer (AusNet Services)
Andrew Grant (Part-time)	Waterways & Stormwater Planner	Melbourne Water

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5. APPROACH AND METHODOLOGY

5.1 Approach

The Australian Standard AS 2885.1–2018 & AS2885.6-2018 describes the requirements for pipeline SMS including:

- Threat identification.
- Application of physical, procedural and design controls for each credible threat.
- Review of threat control; and
- Assessment of residual risk from failure threats.

The SMS process focuses on eliminating threats to pipeline integrity from location specific and non-location specific activities, present and future, and conditions foreseeable, including likely land use, during the pipeline operational phase. Where failures are assessed as possible after the application of control measures, risk assessment is undertaken for the relevant threat and it must be demonstrated that the risks are 'as low as reasonably practicable' (ALARP).

5.2 Methodology

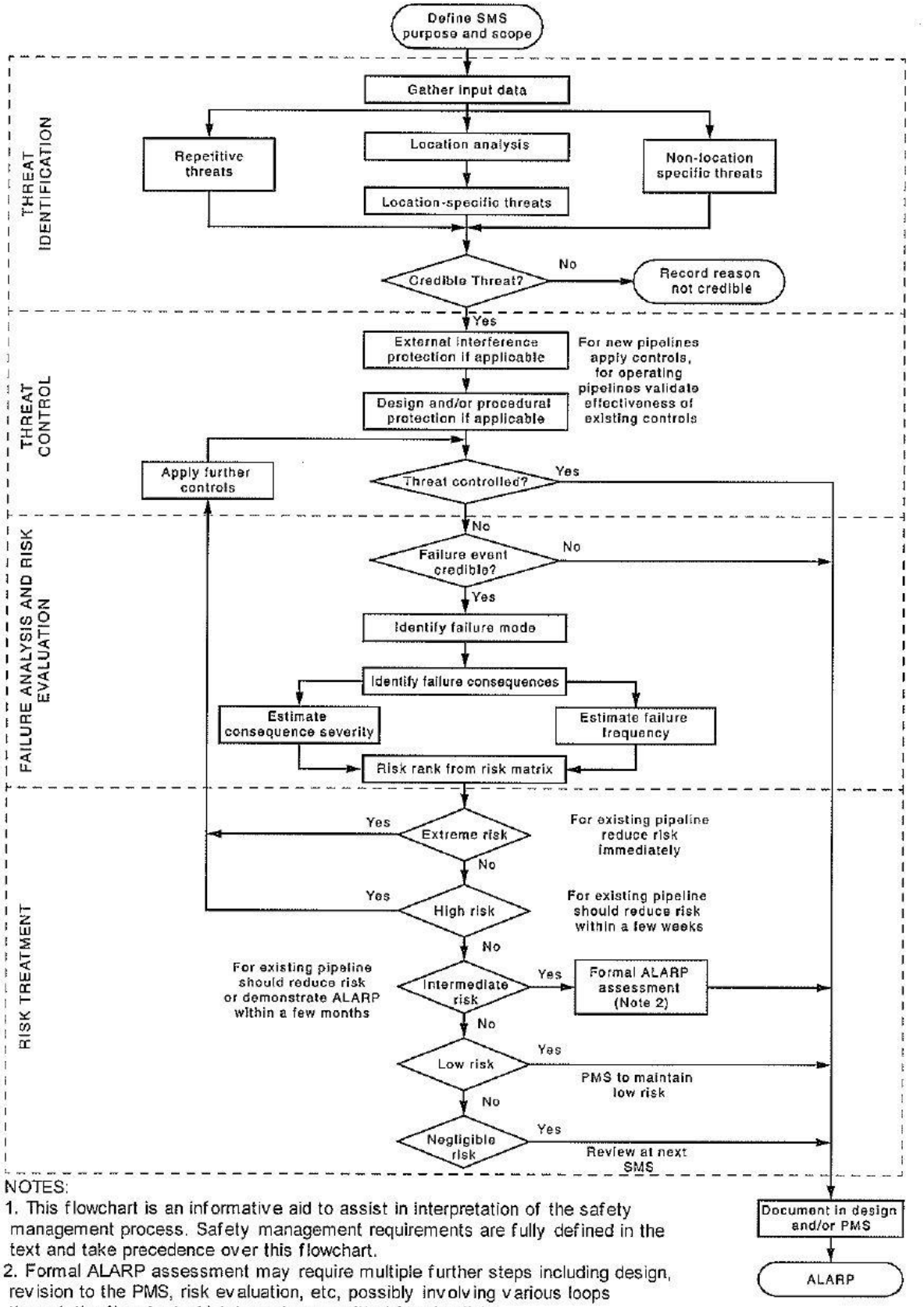
Prior to the SMS workshop being convened, APA, AusNet and the VPA teams prepared a range of relevant information to be presented to the workshop.

All threats developed prior to the SMS workshop were documented in a spreadsheet and to the workshop. Changes or additions to the threats and risk mitigations were recorded directly into the spreadsheet. Additional actions not related to particular threats were also recorded.

A copy of the Arden Draft Structure Plan was available to the workshop electronically as were all other documents referenced in the TOR Document.

The SMS study is based on the risk assessment process defined in AS 2885.6–2018 and in particular the Flowchart presented in the Standard and referenced below.

Figure 3 - AS2885.6 Risk Assessment Process



5.3 Location Classification

The AS 2885.6 – 2018 definition of Location Class is “The classification of an area according to its general geographic and demographic characteristics, reflecting both the threats to the pipeline from the land usage and the consequences for the population, should the pipeline suffer a loss of containment”. For the selection of location class, the area along the pipeline route and the surrounding land uses are considered.

Classification of locations is defined in AS 2885.6-2018, Section 2.2.

The primary location class reflects the population density of the area. It is defined based on an analysis of the predominant land use in the broad area traversed by the pipeline/s. There are four primary location classes to select from, as described in, Appendix B. One or more secondary location classes, reflecting special uses, may also apply to an area, as described in, Appendix B. Changes in location class occur when there are changes in land use planning along the route of existing pipelines. Where this occurs a safety assessment (SMS) shall be undertaken, and additional control measures implemented until it is demonstrated that the risk from loss of containment involving a rupture is As Low As Reasonably Practical “ALARP”.
The assessment shall include analysis of at least the alternatives of the following:

a) MAOP reduction.
b) Pipe replacement (with no rupture pipe).
c) Pipeline relocation.
d) Modification of land use; and
e) Implementing physical and procedural protection measures that are effective in controlling threats capable of causing rupture of the pipeline.

5.4 Threat Identification

The threat identification process seeks to list all location specific and non-location specific threats with the potential to:

- Damage any of the pipelines.
- Cause interruption to service for any of the pipelines.
- Cause release of fluid from any of the pipelines; or
- Cause harm to pipeline operators, the public or the environment.

Prompts are used to aid the team, drawn from the Standard, and include the most commonly identified threats for gas and liquid petroleum pipelines. The threat prompts are provided in Appendix C.
Threats determined to be non-credible are documented, along with the reasoning.

5.5 Threat Control

For each credible threat identified in the previous step, effective controls are listed. Controls are considered effective when failure as a result of that threat has been removed for all practical purposes.

For external interference threats, physical and procedural controls are required, and the minimum number of effective controls required for a threat depends on the location class, as shown in, Appendix C. The categories of physical and procedural are also displayed in Appendix C.

For all other threats, design and/or procedures are required.

To assist in the analysis and in determining if controls are effective (e.g. pipeline wall thickness), pipeline calculations can be completed. The pipeline calculations establish:

- The maximum excavator size and teeth that can be used during construction to ensure the pipelines are not compromised; and
- Radiation contours (distances) of interest for full bore rupture incidents

A radiation of 4.7 kW/m2 will cause injury (at least second-degree burns) after 30 seconds exposure. Therefore, for example, it is preferred that there are no sensitive groups located within range of a pipeline's 4.7 kW/m2 measurement length as these population groups may be unable to be evacuated or to seek shelter.

5.6 Residual Threats Risk Assessment

For threats where failure is still possible despite the control measures, and no further threat controls can be applied, an assessment of the residual risk is undertaken. This is completed by:

- Assessment of the severity of the consequence of a failure event
- Analysis of the frequency of occurrence of the failure event and
- Risk ranking

The results of the risk ranking determine the required treatment action for the threat. Refer to the Risk Matrix in Appendix D.

If the risk of a particular threat cannot be considered to be low or negligible according to recognised industry risk matrix then further investigation of the threat will take place to confirm that the risk is "As Low As Reasonably Practical" (ALARP).

At the end of the Workshop, participants will be required to form an opinion on the quality of the SMS presented for review, and to reach a conclusion as to whether the SMS satisfies the requirements of AS 2885.6.

Actions minuted during the course of the SMS workshop will fall into two general categories, those requiring close out before the change in land use can proceed and those that will form part of the future Pipeline Integrity Management Plan (PIMP) or equivalent.

An SMS Report (this report) is produced following the workshop to capture proceedings of the workshop and highlight key decisions or issues. It will also contain all the threats and their associated mitigations and/or agreed actions.

5.7 Specific Approach for this Study

Under AS2885 the pipelines under consideration during this study all have their own existing pipeline SMS database which covers the existing known threats and controls for the pipeline based on the existing land use for the development site.

The focus of this study is to ensure the safe operation and maintenance of the pipelines under AS2885 when considering the potential new threats or changes to existing threats resulting from construction of, and long-term presence of, the Arden Draft Structure Plan proposed at this SMS Workshop.

6. AS 2885 LAND USE REQUIREMENTS

6.1 AS 2885.6 – Pipeline Safety Management

AS 2885.6 2018 is the Australian Standard that governs the management of safety & risk around and associated with petroleum pipelines, including transmission pressure (>1050kPag) natural gas pipelines. Within the Standard there are four Primary zones discussed, ranging from R1 – relatively remote, undeveloped land, through R2 (rural residential), and T1 (typical suburban development) to T2, which is intense multi-storey or CBD areas. There are also Secondary zones defined that categorise land use into heavy industrial (HI) or light industrial (I), common infrastructure corridor (CIC), crowds (C), or Sensitive (S) use. A copy of Section 2 of AS2885.6 is included in Appendix B of this document for reference.

		Current Location Class		**Proposed Location Class**			
Pipeline Licensee	**Pipeline Licence**	**Primary Location Class**	**Secondary Location Class**	**Primary Location Class**	**Secondary Location Class**	**KP point (km)**	**Reason for change**
APA	PL208 (Route Plan T18)	T2	CIC/I	T2	CIC/I	Thru entire Arden SP and 240m either side of SP	High Density population now within ML
APA	PL66 (Route Plan T36)	T1	CIC/I	T2	CIC/I	Thru entire Arden SP and 103m north of SP	High Density population now within ML
AusNet	PL203 (Route Plan T18)	T1		T1 (1)		240m west of Arden SP	High Density population now within ML

Note (1): AusNet advised at the SMS Workshop that they will formally reassess their Location Class at next year's 5 yearly SMS Review.

A fundamental principle of AS2885.6 is that pipeline safety management and safe operation are on-going imperatives during the life of the pipeline and must be actively supported and documented by the pipeline licensee. This places on-going obligations on a pipeline licensee to operate and maintain robust systems, plans and procedures during the pipeline's operational phase.
A review of any transmission pressure gas pipeline is undertaken as a minimum every 5 years under AS2885 but is also triggered under the standard if there is a change in the design or operation of the pipeline or a change in land use within the Measurement Length of the pipeline that increases the likelihood or consequences of a FAILURE EVENT.

6.2 Measurement Length

The concept of Measurement Length (ML) is a key parameter in assessments of land use changes such as the Arden Structure Plan.
The measurement length of a pipeline is defined in AS 2885.6 Appendix B1 as the radius of the 4.7 kW/m2 radiation contour for a full-bore rupture. At this distance it is expected that an able bodied and clothed person are likely to sustain 2nd degree burns within 30 seconds if they were to remain in the area.
This is derived from calculations of the heat radiation intensity if a full-bore rupture of the pipeline is ignited.
A related parameter is the radiation contour for a heat radiation intensity of 12.6 kW/m2. At this distance it is expected that an able bodied and clothed person would sustain 3 degree burns and life-threatening injuries within 30 seconds if they were to remain in the area.
These distances are calculated for each pipeline, and used in the assessment of land uses, both existing and planned for new and operational pipelines. AS2885.6 provides that the assessment of an existing pipeline's Location Class is based on land use within the measurement length.

The practical outcomes of the above are that for land use changes around an existing pipeline, such as the Arden Structure Plan, the SMS Workshop assesses the population density and proposed activities of the land within the measurement length to determine what risks are present. The SMS Workshop assesses the level of existing (and possible new) protections required to protect against interference and other threats necessary to keep the pipeline and the people around the pipeline safe. Sensitive use activities such as places where people congregate, and/or have limited means of escaping from a pipeline incident and fire (shopping centres, sports stadiums, schools, child care, aged care facilities etc) within the measurement length impose the most stringent protection requirements on the pipeline, to the extent that significant measures are required to ensure that rupture of the pipe is not a credible event.

7. PHYSICAL AND PROCEDURAL PROTECTION MEASURES

7.1 AS 2885 Requirements

For pipeline Location Class T1 or T2 the design requirements against External Interference Threats within AS2885 seek to have a minimum of two physical protection measures and two procedural measures wherever possible.

7.1.1 Physical Protection

Physical protection measures comprise:

- Separation of external interference activities from the pipeline – exclusion of activities which may damage the pipeline. Typically, these are excavation activities by third parties, but can also include intensive vibration such as might be employed during the construction of roads and other infrastructure. Typical separation measures include burial, exclusion of the public or third parties from the pipeline alignment or barriers.
- Resistance to penetration, such as adequate wall thickness to resist the identified excavation equipment threats, or again a barrier to penetration.
- Concrete slabbing directly above pipelines is one barrier method that is accepted to provide adequate exclusion as a second physical barrier, particularly where a pipeline is at risk of holing or rupture due to the known threats. The concrete slab usually has a minimum width of the nominal pipeline diameter plus 600 mm either side and shall be placed a minimum of 300 mm above the pipeline. This solution is usually paired with marker tape installed above the concrete slab to warn of what is underneath the slab.

7.1.2 Procedural Measures

Procedural mitigation measures which are recognised by AS 2885 comprise:

- Pipeline Awareness activities, such as marker signs, dial-before-you dig service (DBYD), third party liaison programs to inform other parties of the presence of the pipeline and consequences of damage, and activity agreements with other entities.
- External interference detection measures such as pipeline patrolling, planning notification zones and remote intrusion detection. The most common for existing pipelines are the first two. Remote intrusion detection is usually only implemented at pipeline facilities such as valve or city gate stations. APA & AusNet have a nominated patrol frequency of every weekday in this area

8. PIPELINE TECHNICAL DETAILS

The SMS focused on the sections of pipelines within the Arden Draft Structure Plan v2.2. The pipeline's technical details and resistance to penetration data in the area of the Structure Plan v2.2 can be summarised as follows:

Table 2, APA Group Pipeline PL208 - Technical Details

Substance conveyed	Natural Gas
Pipeline License No.	Lic 208, T18
Measurement Length (ML)	240m (4.7 kW/m2 Heat Radiation Zone)
	147 (12.6 kW/m2 Heat Radiation Zone)
Length of pipeline affected	1500 m + 2 x 240m (Total 2000m approx)
Pipeline section under review within PSP	~KP1.95 to KP 3.54
Outside Diameter	457 mm
Easement	Permit required within 3m of the pipeline
Wall Thickness	7.95 mm WT
Depth Of Cover	1.2m+
Pipe specification	API 5L Grade A (with Coal Tar Enamel coating)
Max. Allowable Operating Pressure	2760 kPa (MAOP)
Location Class - Primary	T2
Location Class – Secondary	CIC/I (from KP ~2.0 to KP 3.5)
CDL	285.5mm
Hole size & ML based on 10GJ/s release rate	249mm and 206m
Hole size & ML based on 1GJ/s release rate	79mm & 65m

The pipeline excavator risk can be summarised as follows:

Table 3, Excavator Risk PL208

Max equipment sizes without risk of a leak: -	
Excavator with std bucket	N/A (>55T)
Excavator with Single Tiger Tooth	5T (max hole size 90mm)
Excavator with Twin Tiger Tooth	N/A (>55T)
Excavator with Penetration Tooth	5T (max hole size 90mm)
Max equipment sizes without causing rupture: -	
Excavator with std bucket	N/A (>55T)
Excavator with Single Tiger Tooth	N/A (>55T)
Excavator with Twin Tiger Tooth	N/A (>55T)
Excavator with Penetration Tooth	N/A (>55T)

Table 4, APA Group Pipeline PL66 - Technical Details

Substance conveyed	Natural Gas
Pipeline License No.	PL66, T36
Measurement Length (ML)	103m (4.7 kW/m2 Heat Radiation Zone)
	63m (12.6 kW/m2 Heat Radiation Zone)
Length of pipeline	673m approx
Pipeline Under Review within PSP	KP0 to KP 673
Outside diameter	250 mm
Easement	Permit required within 3m of the pipeline

Wall thickness	6.35mm
Depth Of Cover	1.2m+
Pipe specification	API 5L Grade A (with Coal Tar Enamel coating)
Max. Allowable Operating Pressure (MAOP)	2760 kPa (MAOP)
Location Class - Primary	T2
Location Class – Secondary	CIC/I
CDL	N/A (no Rupture pipe)
Hole size & ML based on 10GJ/s release rate	249mm and 206m (Max Credible Hole 145mm by 55T Excavator cannot produce 10GJ/s release)
Hole size & ML based on 1GJ/s release rate	79mm & 65m

The pipeline excavator risk can be summarised as follows:

Table 5, Excavator Risk PL66

Max equipment sizes without risk of a leak: -	
Excavator with std bucket	N/A (>55T)
Excavator with Single Tiger Tooth	5T
Excavator with Twin Tiger Tooth	15T
Excavator with Penetration Tooth	5T
Max equipment sizes without causing rupture: -	
Excavator with std bucket	N/A (>55T)
Excavator with Single Tiger Tooth	N/A (>55T)
Excavator with Twin Tiger Tooth	N/A (>55T)
Excavator with Penetration Tooth	N/A (>55T)

AusNet's pipeline sits immediately adjacent and to the west of the draft Structure Plan V2.2 and apart from landscaping of the Moonee Ponds Creek banks there is no direct development over their pipeline.

Table 6, AusNet Pipeline PL203 - Technical Details

Substance conveyed	Natural Gas
Pipeline License No.	Lic 203, T18
Measurement Length (ML)	240m (4.7 kW/m2 Heat Radiation Zone)
	147 (12.6 kW/m2 Heat Radiation Zone)
Length of pipeline affected	240m
Pipeline section under review within PSP	KP0 to KP 0.24
Outside Diameter	457 mm
Easement	Permit required within 3m of the pipeline
Wall Thickness	7.95mm
Depth Of Cover	1.2m+
Pipe specification	API 5L Grade A (with Coal Tar Enamel coating)
Max. Allowable Operating Pressure	2760 kPa (MAOP)
Location Class - Primary	T1
Location Class – Secondary	Nil
CDL	285.5mm (@ 7.95 mm WT)
Hole size & ML based on 10GJ/s release rate	Max Credible Hole 145mm by 55T Excavator cannot produce 10GJ/s release
Hole size & ML based on 1GJ/s release rate	90mm & 68m

The pipeline excavator risk can be summarised as follows:

Table 7, Excavator Risk PL203

Max equipment sizes without risk of a leak: -	
Excavator with std bucket	N/A (>55T)
Excavator with Single Tiger Tooth	5T (max hole size 90mm)
Excavator with Twin Tiger Tooth	25T (max hole size 125mm)
Excavator with Penetration Tooth	5T (max hole size 90mm)
Max equipment sizes without causing rupture: -	
Excavator with std bucket	N/A (>55T)
Excavator with Single Tiger Tooth	N/A (>55T)
Excavator with Twin Tiger Tooth	N/A (>55T)
Excavator with Penetration Tooth	N/A (>55T)

9. WORKSHOP RESULTS

The workshop team reviewed the draft structure plan v2.2and confirmed that the existing T2, CIC, I Location Classes for the APA pipelines are appropriate. The existing T1 Location Class for the AusNet pipeline was confirmed as acceptable for AusNet at the moment and that a potential change in Location Class from T1 to T2 would be formally reviewed at the next 5 yearly SMS Review planned for 2021.

The workshop facilitator pre-populated an SMS Risk Register prior to the workshop using the threats listed in Appendix C as a guide when considering draft structure plan v2.2. Forty-Five (45) Threats were specifically considered for comments on the day of the Workshop. The other Threats listed in Appendix C were either unaffected or irrelevant to the draft structure plan v 2.2 and not expected to change the frequency of these threats occurring.

The results of the 45 Threats specifically considered can be summarised as follows: -

Table 8, Risk Assessment Summary

Pipeline	Threats		Threats Requiring Risk Assessment	Risk Assessment		
	Non-Credible	Credible		Negligible	Low	Intermediate
PL208	12	33	14	-	9	5
PL66	15	30	12	-	7	5
PL203	25	20	9	-	4	5
Network Pipelines	-	1	1	-	-	1

The workshop results were recorded in the minutes, provided in Appendix H.

9.1 Low Threats

The LOW risk assessments were related to nine threats, not all the threats were credible to all three pipelines hence the variation in numbers of low threats for each pipeline. As they were risk assessed as LOW, they did not require further ALARP or LOPA assessment however there were a range of actions raised help mitigate the threats.

9.1.1 Pipeline Dent or Gouge or Coating Damage

The threats leading to a dent or gouge or coating damage were: -

- an excavator (Threat ID1),
- an Auger (Threat ID6)
- or an HDD (Threat ID9)

The workshop considered Supply consequences only as it was not considered possible for people to be injured with this threat:

For coating damage or a gouge in the pipeline

- Loss of Supply consideration only: -
    - Consequence - Severe as supply can be significantly impacted in the local area with no opportunity to make up the supply from other sources.
    - Likelihood - Remote as the pipelines can be impacted from time to time but the high degree of patrolling and the fact the pipeline is largely in the road and the act of setting up for these activities can be a major exercise would limit the ability for contractors to access the pipeline without being discovered.

The risk was deemed LOW.

9.1.2 Coating Damage or Overstressing of the Pipeline

The threats leading to coating damage or overstressing of the pipeline were: -

- a tram crossing (Threat ID12),
- vibration due to the large rail tunnel being installed under the pipeline in Dryburgh St (Threat ID19),
- subsidence due to the large rail tunnel being installed under the pipeline in Dryburgh St (Threat ID20),
- vibration due to heavy machinery working near the pipeline (Threat ID29)
- and blasting causing vibration near the pipeline (Threat ID31).

The workshop considered Supply consequences only as it was not considered possible for people to be injured with this threat:

For coating damage or overstressing of the pipeline: -

- Loss of Supply consideration only: -
    - Consequence - Severe as supply can significantly impact the local area with no opportunity to make up the supply from other sources.
    - Likelihood - Remote as the pipelines could be impacted by vibration if the proper mitigations are not implemented during the development. Degradation of the pipeline due to these threats would take a long time before resulting in sufficient corrosion to lead to a loss of containment. CP testing and periodic internal pipeline inspection should pick up any defects before they result in a leak.

The risk was deemed LOW.

9.1.3 Cathodic Protection (CP) damage

The threat of a major tram crossing with high voltage power associated could lead to CP damage if not properly designed and controlled, ultimately leading to pipeline corrosion and leakage (Threat ID13).

The workshop considered Supply consequences only as it was not considered possible for people to be injured with this threat:

For CP damage leading to corrosion of the pipeline: -

- Loss of Supply consideration only: -
    - Consequence - Severe as supply can significantly impact the local area with no opportunity to make up the supply from other sources.
    - Likelihood - Remote as the pipelines could be impacted by the high voltage power if the proper mitigations are not implemented during the design phase. Degradation of the pipeline due to this threat would take a long time before resulting in sufficient corrosion to lead to a loss of containment. CP testing and periodic internal pipeline inspection should pick up any defects before they result in a leak.

The risk was deemed LOW.

9.2 Intermediate Threats

The INTERMEDIATE risk assessments were related to 6 threats, all the threats were credible to all three pipelines. As they were risk assessed as INTERMEDIATE, they require further ALARP or LOPA assessment which will be undertaken post the SMS Workshop once APA/AusNet confirm the preferred ALARP method. There were also a range of actions raised help mitigate the threats.

9.2.1 Threat ID 2

The threat leading to a hole in the pipeline was an excavator with a hole up to 80-90mm.

The workshop considered both Safety and Supply considerations when making the assessment on the following basis:

- Loss of Supply consideration: -
    - Consequence - Severe as loss of supply can significantly impact the local area with no opportunity to make up the supply from other sources.
- Safety consideration: -
    - Consequence - Catastrophic as the Workshop considered the potential for work crew and an onlooker could be seriously injured or killed resulting in multiple fatalities.
- Likelihood of Failure: -
    - Likelihood - Hypothetical as to cause multiple fatalities would only occur under extraordinary circumstances.

9.2.2 Threat ID 7

The threat leading to a hole in the pipeline was an Auger with a hole up to 50mm.

The workshop considered both Safety and Supply considerations when making the assessment on the following basis:

- Loss of Supply consideration: -
    - Consequence - Severe as loss of supply can significantly impact the local area with no opportunity to make up the supply from other sources.
- Safety consideration: -
    - Consequence - Major as the Workshop considered the potential for work crew or an onlooker could be seriously injured or killed resulting in maybe 1 or 2 fatalities.
- Likelihood of Failure: -
    - Likelihood - Remote as relatively frequent installation or replacement of lighting in the footpaths where the pipelines resides when not in the middle of the road. Use of an auger is more likely than the requirement for excavation over the life of the pipelines.

9.2.3 Threat ID 10

The threat leading to a hole in the pipeline was an HDD with a hole up to 2/3rds CDL ~190mm of the DN450 TP.

The workshop considered both Safety and Supply considerations when making the assessment on the following basis:

- Loss of Supply consideration: -
    - Consequence - Major as supply will be curtailed for several days to repair the pipeline significantly impacting the local area with no opportunity to make up the supply from

other sources:

- Safety consideration: -
  - Consequence - Catastrophic as the Workshop considered the potential for work crew and an onlooker could be seriously injured or killed resulting in multiple fatalities.
- Likelihood of Failure: -
  - Likelihood - Hypothetical as to cause multiple fatalities would only occur under extraordinary circumstances.

9.2.4 Threat ID 15

The threat leading to a hole in the pipeline was an excavator with a hole up to 80-90mm when installing utilities crossing the pipeline.

The workshop considered both Safety and Supply considerations when making the assessment on the following basis:

- Loss of Supply consideration: -
  - Consequence - Severe as loss of supply can significantly impact the local area with no opportunity to make up the supply from other sources.
- Safety consideration: -
  - Consequence - Catastrophic as the Workshop considered the potential for work crew and an onlooker could be seriously injured or killed resulting in multiple fatalities.
- Likelihood of Failure: -
  - Likelihood - Hypothetical as to cause multiple fatalities would only occur under extraordinary circumstances.

9.2.5 Threat ID 18

The threat leading to a hole or even potentially a rupture of the pipeline is the use of a Bored or Jacked crossing to install Utilities under pipeline easement (e.g. Sewer pipe).

The workshop considered both Safety and Supply considerations when making the assessment on the following basis:

- Loss of Supply consideration: -
  - Consequence - Major as supply will be curtailed for several days to repair the pipeline significantly impacting the local area with no opportunity to make up the supply from other sources.
- Safety consideration: -
  - Consequence - Catastrophic as the Workshop considered the potential for work crew and an onlooker could be seriously injured or killed resulting in multiple fatalities.
- Likelihood of Failure: -
  - Likelihood - Hypothetical as to cause multiple fatalities would only occur under extraordinary circumstances.

9.2.6 Network Gas Mains – Threat ID 43

The local Network Gas Mains are not licensed under AS2885 however at APA's request, the local area network mains were included in the SMS Workshop (Network Gas Mains are licensed under AS4645) given that they are widespread in the area, relatively shallow compared to the TP's and not particularly robust being either polyethylene or cast iron. Cast iron is known to be difficult to weld when trying to make a repair.

The INTERMEDIATE risk assessment made for the Network Gas Pipelines was based on the following: -

- Loss of Supply consideration: -
    - Consequence - Severe as supply will be curtailed for a short period (~4-12hrs) to repair the pipeline impacting the local area with no opportunity to make up the supply from other sources. The comment was also made that this may impact company reputation locally which is a consideration for Network Pipelines under AS4645.1
- Safety consideration: -
    - Consequence - Severe as the Workshop considered the potential for work crew and an onlooker could be injured but a fatality is not likely given the low gas pressure and the lack of history of fatalities under these circumstances.
- Likelihood of Failure: -
    - Likelihood - Unlikely as pipelines are shallow, low strength and prone to failure if impacted, general excavation across the Arden Development is anticipated.

10. ALARP ASSESSMENTS

There was a total of 6 INTERMEDIATE risk assessments found at the workshop as detailed in the previous section. As such it is required under AS2885 that an ALARP assessment of each risk be undertaken to determine if any further mitigations are justified and if not then provide a justification as to why the INTERMEDIATE finding is ALARP.

The ALARP assessments are yet to be completed and there is an action from the SMS Workshop for APA to confirm the methodology they wish to use to undertake the assessments. Once the ALARP methodology is confirmed then the Facilitator will prepare a DRAFT ALARP Assessment for review and acceptance at a convened ALARP Workshop.

For in-service pipelines where formal ALARP assessment is required under AS2885.6 (Section 4.2), 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.

Without pre-empting the findings of the ALARP assessments, some comments with respect to the above are warranted.

10.1 ALARP Option A

Restricting or lowering the MAOP of the TP would reduce the influence/size of the ML in the event of a loss of containment however it also reduces the capacity of the TP to deliver gas and it is unlikely this will be possible given that broader gas demand will continue to rise in the surrounding areas. This also only partially reduces the credible threat of a fatality so the threat will remain to an extent, noting rupture is already not credible.

10.2 ALARP Option B

Pipeline replacement with a higher strength pipe in situ will all but eliminate the likelihood of a leak and is an option however cost is significant.

10.3 ALARP Option C

Pipeline relocation could be possible by moving the pipeline to the western side of the structure plan area subject to existing infrastructure along the railway and Moonee Ponds Creek but again very expensive, requiring new easements and would only really move the problem rather than solve it.

10.4 ALARP Option D

Modifying the land use means not building the “High Density” development which I suggest is not practical against the wider societal benefit.

10.5 ALARP Option E

As the main risks to the pipeline are from above with an excavator or an auger the pipeline industry regularly mandates the use of concrete slabbing (along with marker tape) over the pipeline along with increased signage and or increased patrolling. The ALARP assessment will determine if this option is justified.

11. DISCUSSION

The issues raised below are for consideration in support of the Threats and Actions raised at the SMS Workshop.

1. It is an industry standard that no built infrastructure be placed over or within 3m of the pipeline to allow the pipeline operators to excavate and access their pipeline unencumbered. In most areas in the Arden Draft Structure Plan v2.2 the pipelines are already installed under or adjacent to a road. New roads or crossings over a pipeline are acceptable so long as the design and depth of coverage over the pipeline is reviewed and approved by the pipeline owner and construction is permitted and supervised by the pipeline owner.
2. As described in Item 1 above, Light poles should not be installed within 3m of a pipeline. If they must be installed within 3m of the pipeline then ministerial dispensation will be required for an exemption to the Pipelines Act Section 120. To avoid using piling or augering equipment near the pipeline the use of “Pad Type” footings should be considered for light poles or other road structures. This type of footing only requires a shallow excavation reducing the risk of deep excavation near the pipelines.
3. It is not clear from the Arden Draft Structure Plan v2.2 what utility crossings are required and where they will be required. This information should be made available at any future SMS Workshop(s) where any bespoke crossing design drawings can be made available for consideration. Any crossing designs will be subject to review and approval by APA/AusNet before work commences. APA and/or AusNet will provide their standard crossing designs to COM for reference by future developers. Note utility crossings should be made as close to 90 degrees to any pipeline as possible.
4. It is also noted that there is a high likelihood that “sensitive” services like childcare, shopping or aged care centres will be within the ML. It is strongly recommended that these types of developments are kept outside the ML wherever possible to reduce the number of people who cannot easily remove themselves from the area. A second option is to ensure the access to sensitive services are positioned on the opposite of any buildings which may face the pipeline easement.
5. It is likely that additional concrete slabbing may be required over the affected pipelines to provide a second layer of physical protection to the pipeline and prevent a gas release leading to a safety incident or a loss of gas supply to dependant users downstream. This requirement will be assessed as part of the ALARP assessments to be taken as an action from the Workshop. APA has a standard concrete slab design they use for such slabbing.
6. Any concrete slabbing will also trigger the need for APA to check the state of the coating and may require the coating to be replaced as part of the slabbing process to ensure the pipeline coating is fit for purpose for the remainder of its operating life (another 40+ years possibly) and ensuring future excavation of the pipeline (with slabbing) will not be necessary.
7. The pipelines are coated in a “Coal Tar Enamel” coating to prevent them corroding however this coating is quite old and very brittle so the use of any vibrating equipment over or near the pipelines can damage the coating. A maximum allowable vibration limit is typically applied at the pipe (APA/AusNet will confirm as part of the actions). Static rollers are recommended when completing road works over these types of pipelines and vibration monitoring will be required under the “APA/AusNet Permit to Work” if any type of significant vibratory construction is occurring near the pipeline (e.g. piling, demolition or compaction etc.).
8. Whilst the SMS is a requirement for Gas Transmission Pipelines under AS2885 there are network/distribution pipelines in the area operating at a much lower pressure (200-700kPag) and are designed to AS4645. These pipes service the local housing and industry and if damaged will curtail local supply until it is repaired. These pipes are polyethylene or cast iron. Cast iron pipes are particularly brittle against an excavator and very difficult to repair because

cast iron is difficult to weld. There is an action to ensure that these assets are brought to the attention of any proposed developers, so they are properly considered in any future works.

9. The APA Meter Station on Langford Street is currently physically protected from public pedestrian and vehicle access by a walled compound with a steel mesh roof for ventilation. This asset will need to remain in place and vehicle access maintained adjacent to the compound for APA Operators to continue to access the asset. Aesthetic cladding could be provided to the structure (including the parking area) so long as it is acceptable to APA and does not prevent their access to the asset.
10. There is a tram crossing of the pipeline easement proposed in North Arden although the location is yet to be confirmed. When finalising the design, it should be completed at 90 degrees to the pipeline easement wherever possible. All pipeline operators prefer that any road crossing is completed at 90 degrees to the pipeline to minimise the length of the crossing over the pipeline and reduce the risk to the pipeline if other utilities are installed at the same location in the future.
11. It is not clear if it is intended that a public playground is planned immediately adjacent to the pipeline easement where young children would be expected to play. Positioning a playground outside the ML is the preferred option or as far away from the easement as possible, particularly given the likely presence of small children.
12. Because the Structure Plan has not been finalised and there is limited detail around location of sensitive uses, crossing locations and construction methodologies, several actions require certain design guidelines to be included in Planning Permits to help guide permit holders to meet pipeline licensee requirements when final design is being developed. Typical guidance may include the following wording.

    Works near gas transmission pipelines
    "Prior to commencement of any buildings or works, including demolition, on land within xx m of APA Pipeline PL208, APA Pipeline PL66 and AusNet Pipeline 203, a construction management plan must be submitted to and approved by the Responsible Authority. The plan must
    1. Prohibit the use of excavators >20T, rippers, HDD's
    2. Set out measures to ensure the protection of the pipelines during construction
    3. Be endorsed by the operator(s) of the gas transmission pipelines
    4. Use of static rollers only within xx m of pipeline
    5. etc…
    6. etc…."

    Final wording will be developed by COM in partnership with the transmission pipeline licensees. This recommendation has been included as a Post Workshop Action (A7).

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12. ACTIONS

Thirty (30) Actions were developed during the SMS workshop including who carried what responsibility for closing out the action. The list of Actions is referenced below.

APA and/or AusNet will require all actions to be documented as they are closed out with a description of what actions were taken and any documented supporting evidence being a Plan, Calculation Updated Drawing etc. All close out material provided by the COM or a third party is to be provided to APA's and/or AusNet's representative for review and approval/acceptance.

Table 9, Action List

Miscellaneous Actions				
No.	**Issue**	**Action**	**Responsibility**	**Due Date**
A1	Construction of the Development could damage the pipelines	Developer to prepare a Construction Management Plan, Risk Management Plan and SWMS for review and approval by APA/AusNet (pipeline licensee) prior to any third party works. Development plans to be provided to APA/AusNet. Works approval plan to be provided to APA/AusNet.	APA/AusNet/ COM/VPA	Prior to works starting
A2	Unclear who in each organisation is responsible for managing activities and providing information.	COM/APA/AusNet/VPA/ MW/CWW to agree appropriate individuals to be points of contact going forward for this project	VPA	19/06/2020
A3	Water joints over pipelines and easements could leak leading to loss of pipeline integrity.	Consider use of welded PE pipe over the easement.	Melbourne Water	Prior to works starting
A4	Sensitive developments like schools, supermarkets, aged care, childcare could be positioned with the ML	Endeavour to locate these developments outside the ML or at lease facing away from the pipeline easement with entrances/exits on the opposite side of the buildings	VPA/ COM Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of a planning permit
A5	Carparking or building ventilation intake ducts may face onto the street with the pipeline. If there is a gas leak or rupture, then gas could be drawn into the vent and find an ignition source in the building leading to fire and explosion	Ensure all building/carpark intake vents face away from the pipeline on the other side of buildings	VPA/COM Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of a Building permit
A6	Difficult to access the pipeline to inspect coating after a new crossing is implemented	New pipeline crossings trigger requirement for coating inspection and possible rectification prior to crossing proceeding. Undertake coating assessment to determine whether recoating needs to be undertaken where crossings occur.	VPA/APA	Prior to final structure plan and planning scheme amendment or Prior to issue of a planning permit
A7	**POST WORKSHOP ACTION** To be clear about what is included in Planning Permit Applications	Establish a process for referring relevant planning applications to gas authorities for comment. VPA/COM to work with APA and AusNet to develop clear guidance for planning permit applications that trigger referral to a gas authority and inclusion of their recommended conditions as part of a planning permit.	VPA/ APA/AusNet/ COM Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of Planning Permit

Threat Specific Actions				
No.	**Issue**	**Action**	**Responsibility**	**Due Date**
2	Pipe Damage resulting in a hole causing loss of containment. Hole is less than critical defect length or max credible hole size (whichever is the smaller) 80-90mm hole leading to a ML 65-70m.	DRMC to confirm an appropriate ALARP method	DRMC/APA	1/07/2020
3	Pipe Damage resulting in a hole causing loss of containment. Hole is greater than critical defect length leading to rupture	Construction Management Plan (CMP) should include limiting the use of excavators to 20T maximum with GPT only within 3m of the pipeline assets. Responsible Authority to include approval of a CMP and size of excavator as a condition of planning approval.	VPA/ COM Responsible Authority for issuing planning permit/APA/AusNet	Prior to final structure plan and planning scheme amendment or Prior to issue of planning permit
4	Vibration from works damages the coating leading to corrosion and failure of the pipe	APA/AusNet to confirm Peak Particle Velocity vibration limit to be incorporated into Planning Permit	VPA/APA/ COM/ AusNet/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of planning permit
6	Auger impacts pipeline damaging the coating and denting or gouging the pipeline which could require reducing the MAOP or replacement of a section. Potential loss of supply.	Consider use of concrete slab footings for light poles within the road reserve containing a pipeline easement to mitigate need for Augering in these areas. APA/AusNet to approve proposed lighting construction method in these areas.	VPA/ APA/AusNet/COM/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to commencement of any works
7	Auger impacts pipeline causing a hole in the pipe (~50mm) which would require replacement of a section. Potential loss of supply and serious injury to auger operator if gas ignited (2% chance for a gas leak)	DRMC to confirm an appropriate ALARP method	DRMC/APA	1/07/2020
10	Pipe Damage resulting in a hole causing loss of containment. Hole is less than critical defect length or max credible hole size (2/3rds CDL is 190mm, resulting ML ~175m)	DRMC to confirm an appropriate ALARP method	DRMC/APA	1/07/2020
12	Over stressing the pipe resulting in pipe deformation (out of round), which could require reducing the MAOP or replacement of a section to allow for future integrity works. Potential loss of supply. Coating cracks leading to corrosion	Bespoke tram crossing design is required which may include the requirement for concrete slabbing to provide the appropriate load relief on the pipeline. Coating of pipeline to be inspected and upgraded if necessary at the crossing point.	VPA/ APA/AusNet/ DOT/COM	Prior to final structure plan and planning scheme amendment or Prior to commencement of any works
13	High voltage power associated with Tram may influence the CP of the pipeline.	Developer to prepare an electrical crossing design based on AS2832 & AS4853 to mitigate influence of voltage on CP Design and provide adequate electrical drainage. APA/AusNet to review and approve	APA/AusNet/COM	Prior to commencement of any works
15	Pipe impacted during utility installation resulting in damage or a hole causing loss of containment. Hole is less than critical defect length or max credible hole size (whichever is the smaller) Maximum credible hole size for a 30T excavator 80-90mm hole leading to a ML 65-70m.	Standard crossing designs to be applied to all new crossings including use of concrete slab and marker tape to separate or protect the pipeline from third parties accessing their utilities. APA/AusNet to provide relevant Standard Crossing Dwgs to COM. Undertake coating inspection if utility is installed below pipeline and repair coating if necessary	VPA/ APA/AusNet/COM	Prior to final structure plan and planning scheme amendment or Prior to commencement of any works
No.	**Issue**	**Action**	**Responsibility**	**Due Date**

18	Damage to coating, or gouge or a hole or rupture of the pipeline requiring dig up and repair and significant loss of supply.	Bored crossing design to be reviewed and accepted by APA/AusNet prior to works proceeding	VPA/APA/AusNet/ COM	Prior to final structure plan and planning scheme amendment or Prior to commencement of any works
19	Damage to coating on pipe due to vibration requiring dig up and repair and temporary loss of supply.	Due to the brittle coal tar enamel coating (CTE) it is important to limit vibration at the pipeline. Ensure vibration is monitored at the pipe when tunnelling is occurring. May need to provide ongoing vibration monitoring once in service to ensure operational vibration does not exceed limits.	APA/AusNet Transport Authority	17/06/2020
20	Subsidence of soil under pipeline resulting in undue load stress on the pipeline and coating (coating could crack and failure leading to a leak)	Review construction methodology for the tunnel to ensure sufficient support is provided to the newly formed tunnel such that it cannot lead to undue stress on the pipeline or coating. Collect before and after relative levels of pipe to determine if subsidence has occurred after tunnelling	APA/AusNet Transport Authority	17/06/2020
21	Over stressing the pipe resulting in pipe deformation (out of round), which could require reducing the MAOP or replacement of a section to allow for future integrity works. Potential loss of supply.	APA to provide relevant Standard Road Crossing Dwgs	APA/COM	1/07/2020
24	Over stressing the pipe resulting in pipe deformation (out of round), which could require replacement of a section to allow for future integrity works. Coating could also be damaged. Potential loss of supply for perhaps up to a month.	Ensure the Planning Permit includes the requirement for APA to review and approve any proposed crane lifting plans over the pipeline.	VPA/APA/COM Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment and Prior to Construction
26	CP is damaged or compromised during works resulting in the potential for long term corrosion.	APA to confirm possible CP infrastructure within the structure plan area and alert Responsible Authority for issuing planning permit to ensure it is noted in the Planning Permits. Assets to be protected during any construction works	VPA/APA/ COM Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment and Prior to commencement of any works
28	Stormwater scour as a result of the design of the stormwater harvesting as part of the Development	MW/COM need to provide APA/Ausnet an opportunity to review of Stormwater design Projects	VPA/ MW/COM/ APA/AusNet	Prior to final structure plan and planning scheme amendment or Before completion of Detailed stormwater Design
29	Potential localised corrosion resulting in Pipeline Licensee having to reduce MAOP due to loss of wall thickness.	APA to confirm maximum PPV limit. Ensure the Planning Permits include a condition to limit vibration at the pipeline to no more than max allowable PPV during any works. Use of static rollers only within 3m of the transmission pipelines.	VPA/ APA/AusNet/ COM/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment and Prior to commencement of any works
31	Uncontrolled blasting creates damage to coating and potential over stressing of the pipeline. Leading to loss of containment	APA/AusNet to review Blasting plan including vibration mitigation strategy.	VPA/APA/AusNet/ COM/Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment and Prior to commencement of any works
No.	**Issue**	**Action**	**Responsibility**	**Due Date**

34	APA/AusNet cannot access easement/meter/reg assets due to new development	Planning Permits must specify maintaining of the walling around the meter station and carparking and any proposed treatments must not limit access to the meter station or carparking. APA/AusNet to approve any proposed treatments	VPA/APA/ COM/ AusNet/Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment and Prior to commencement of any works
35	New building footing may present an additional stress to the pipeline, resulting in coating damage and eventual corrosion, leading to a leak.	Any multistorey buildings sited adjacent to a pipeline easement must provide a stress loading calc to demonstrate there is no additional loads put on the pipeline. Calc to be reviewed and approved by APA	VPA/APA/ COM/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment and Prior to commencement of any works
42	Blocking line of site between marker signs or roots damaging pipeline coating.	APA/AusNet Easement Landscaping Guidelines to be incorporated into Planning Permit and CMP. COM to provide landscaping proposed landscape plans for APA/Ausnet consideration and approval.	APA/AusNet / COM/ Responsible Authority for issuing planning permit/VPA	Prior to issue of a planning permit and commencement of works
43	PE and Cast-Iron network pipelines are fragile to any significant impact causing a loss of containment, loss of supply to the immediate area and a potential source for an explosive environment leading to injury. The Cast Iron pipe is particularly difficult to weld and repair.	APA to confirm if the local network pipes are "Critical Supply Main Assets". If so, consider providing additional protection. Presence of network gas pipes and their fragility should be noted in the Planning Permit and the Construction Management Plan needs to follow the same DBYD methodology they would for the Transmission Pipelines. APA to provide dwgs showing Network pipe locations.	VPA/APA/COM/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of a planning permit
44	Impacting coating could release asbestos fibres putting health at risk.	Planning Permit to include alert w.r.t. asbestos in the CTE coating and to follow all relevant DBYD procedures in liaison with APA whenever excavating over the easement	VPA/APA/COM/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of a planning permit
45	Undermines or loosens soil around pipeline disturbing (potentially damaging) coating and or stressing the pipeline under its own weight as it is no longer supported	Planning Permit to include alert w.r.t. deep excavation next to pipeline easement and ensure appropriate shoring of wall is included in the SOW and to follow all relevant DBYD procedures in liaison with APA whenever excavating next to the easement	VPA/APA/COM/ Responsible Authority for issuing planning permit	Prior to final structure plan and planning scheme amendment or Prior to issue of a planning permit

13. CONCLUSION

A Safety Management Study (SMS) was undertaken to review whether or not additional protection measures are required to mitigate the risks associated with the Arden Draft Structure Plan v2.2 as per the requirements of the Australian Standard AS2885 for High Pressure Gas Pipelines.

This report summarises the following aspects considered at the SMS:

- The nature of the pipelines in question
- The key land uses proposed by the draft Arden Structure Plan v2.2 that are located near the pipelines
- Review the Location Classification of the pipelines (and associated gas facilities) resulting from the draft Structure Plan
- Review AS2885 requirements for the agreed Location Classification
- Threats requiring a Risk Assessment and the findings of those Assessments
- Actions required to ensure the ongoing safe operation and maintenance of the pipelines in compliance with AS2885
- Implications for preparing the final Arden Structure Plan.

The review was successfully carried out in accordance with the requirements of AS 2885.6 -2018. The workshop was attended by key operations, maintenance, and engineering personnel. The study team comprised a broad cross-section of responsibility, knowledge and experience with the proposed draft structure plan v2.2 and the affected Pipelines, and therefore possessed sufficient knowledge and experience to carry out an effective workshop review.

The SMS undertaken is considered to be a “Preliminary” Encroachment SMS as many of the proposed crossings are yet to be designed or located. Reference to AS2885 Part 6 Section 5.6 confirms that an Encroachment SMS will need to be completed once the crossing designs and Development layout are completed. This may need to be done in a piecemeal way as each developer submits their detailed proposals at particular locations within the Development.

Continuing liaison between the VPA, COM, AusNet and APA should ensure that construction activities and post construction activities pose no significant increase in the operational and maintenance risk to the transmission pipelines running past the Development.

Upon satisfactory close out of the actions raised from this SMS Workshop and completion of the relevant Project Lifecycle SMS studies required under AS2885.6-5.6, it can be confirmed that the requirements of AS2885.6-2018 are met and that the APA and AusNet assets under review will continue to be in compliance with the SMS requirements of AS2885.6-2018 in the Arden Draft Structure Plan area.

APPENDIX A: Attendance List

The following email from Pam Neivandt at the VPA confirms those who attended the SMS Workshop online.

From: Pamela Neivandt <Pamela.Neivandt@vpa.vic.gov.au>
Sent: Tuesday, 16 June 2020 4:18 PM
To: Mark Harris <ma_harris@me.com>
Cc: Goksel Karpat <Goksel.Karpat@vpa.vic.gov.au>; Stefan Bettiol <Stefan.Bettiol@vpa.vic.gov.au>
Subject: Arden SMS workshop - list of attendees

Hi Mark,

As discussed, last week's workshop was attended by the following people:

Organisation	Name	Position
VPA	Pamela Neivandt	Strategic planner
	John Tinkler	Infrastructure specialist
	Tim Benedict	Strategic Planner
	Stefan Bettiol	Strategic Planner
CoM	Thomas Cochrane	Strategic planner
	Sanjeeva Rajapakse	Drainage Engineer
Melb Water	Andrew Grant	Waterways & Stormwater Planner
APA	Amir Esmaeili	Integrity Engineer
Downer	Saj Ganegoda	Snr. Engineer – Gas Networks
AusNet	Sam Pitruzzello	Engineering Services Manager

Pam

Pamela Neivandt // Senior Strategic Planner
Melbourne Renewal Precincts
Level 25, 35 Collins Street, Melbourne VIC 3000
T: 03 9651 9642

The VPA acknowledges the Traditional Owners of Country throughout Victoria and pay our respects to them, their Elders past and present.
My personal commitment is to plan for great places that are welcoming and inclusive of all people.

APPENDIX B: Classification of Locations

In order to determine the location class, the Standard AS2885 requires that the population, activities, and environment be assessed within a distance described as the "measurement length (ML)" from the centre of the pipeline. For gas pipelines in particular, where the most serious outcome is either injury or fatality due to radiation from an ignited gas leak, the measurement length is deliberately and conservatively defined in AS 2885.1, Cls 4.3.2 as the radius of the 4.7 kW/m2 radiation contour for an ignited full bore rupture calculated in accordance with Clause 4.10. Clause 4.10 states that the calculation is to assume that the pipeline is at Maximum Allowable Operating Pressure (MAOP) at the time of release. A full-bore rupture is a hole which is equivalent to the diameter of the pipeline.

It is important to understand that the measurement length is used to define the corridor around the pipeline that must be considered to determine location classification, regardless of whether a full-bore rupture at MAOP is credible or not.

As is required by the Standard, consideration has been given to future development along the pipeline route both within and outside the pipeline measurement length when assessing the pipeline classification.

For any given location classification, AS 2885 defines minimum compliance requirements. As the consequence of a pipeline failure increases and location classification changes, the requirements of AS 2885 become more stringent. The various Location Classes under the Standard are outlined below

AS2885.1-2012 gives four primary location classes:

R1 - Rural - Land that is unused, undeveloped or is used for rural activities such as grazing, agriculture and horticulture.

R2 - Rural Residential - Land that is occupied by single residence blocks typically in the range 1 to 5 ha**.**

T1 - Residential - Residential applied where multiple dwellings exist in proximity of other dwellings and are surveyed by common public utilities**.**

T2 - High Density - multi storey dwellings where a large number of people congregate.

In addition, AS2885.1-2018 gives five secondary location classes:

S – Sensitive Use: where consequences of a failure may be increased due to use by a community unable to protect themselves from consequences of pipeline failure. Schools, hospitals, aged care facilities and prisons within the pipeline measured length are examples of this classification. The requirements are as for T2**.**

I – Industrial: Manufacturing, processing, maintenance, storage, or similar activities. These are assigned to any portion of land immediately adjoining the pipeline. The requirements are for T1.

HI – Heavy Industrial: Heavy industry or toxic industrial use. Require assessment of any threats to the pipeline or may cause pipeline failure to escalate. Depending on assessment R2, T1 or T2 may apply**.**

CIC – Common Infrastructure Corridor: Multiple infrastructure development within a common easement or reserve or in easements which are in close proximity. A CIC secondary classification places the following requirements on the pipeline owner/operator - To control the activities that take place in the CIC easement some form of agreement should be in place.

APPENDIX C Threats & Controls

Table 10, Threat Identification Prompts

CATEGORY	THREAT
External Interference	Excavation - related to construction
	Excavation - without consent
	Excavation - private landowners post construction (e.g. ploughing, ripping, or trenching)
	Power augers and drilling
	Cable installation ripping & ploughing
	Pipeline access for maintenance activities
	Installation of posts or poles
	Land use development - pavement works, road surfacing &/or grading
	Land use development - landscaping
	Deep ploughing or drilling around pipeline (horizontal)
	Vehicle or vessel impact - during construction
	Vehicle or vessel impact - during ongoing use of the road
	Vehicle or vessel impact - rail
	Vehicle or vessel impact - aircraft crash
	Damage from bogged vehicles or plant
	External loads from backfill or traffic
	Blasting
	Blasting - seismic survey for mining using explosives
	Anchor dropping & dragging
	Other - soil testing with penetrometer
	Other - methane from contaminated land ignited by site works (e.g. welding)
	Other - creeping movement of slope (geotechnical risk)
	Other - loading from the buildings
	Other - Vibration due to piling
Corrosion	External corrosion or erosion due to environmental factors
	Internal corrosion due to contaminants
	Internal erosion
	Environmentally assisted cracking / stress corrosion cracking
	Bacterial corrosion
	Other - stray current corrosion
	Other - CP testing performed incorrectly and potential for corrosion.
	Other - low frequency induction from parallel HV power lines or earthing bed
Natural Events	Earthquake
	Ground movement - land subsidence, soil expansion / contraction
	Ground movement - land subsidence causing breakage of water
	pipelines in region of gas pipe
	Wind and cyclone
	Bushfires
	Lightning
	Flooding or inundation
	Erosion of cover or support
	Other – tsunami or volcanic eruption

CATEGORY	THREAT
Operations & Maintenance	Exceeding MAOP of pipeline
	Incorrect operation of pigging
	Incorrect valve operating sequence
	Incorrect operation of control & protective equipment
	Bypass of logic, control or protection equipment followed by incorrect manual operation
	Fatigue from pressure cycling
	Inadequate or incomplete maintenance procedures
	Maintenance actions contrary to procedures
	Incident due to inadequate, incorrect, or out of date operating or maintenance procedures
	Inadequate servicing of equipment
	Other - inaccurate test equipment, leading to incorrect settings
	Other - overpressure control system failure
	Other - pipe vibration (e.g. underground due to road works)
	Other - failure to adequately manage and implement changes to assets
	Other - incident caused due to project records, as built records and installed material records being lost, ignored, or not maintained
	Other - inaccurate measurement equipment or equipment not calibrated
	Other - inadequate emergency management
	Other - live welding
Design Defects	Incorrect material, component, and equipment characteristics
	Incorrect design or engineering analysis
	Failure to define correct range of operating conditions
	Failure of design configuration and equipment features to allow for safe operations & maintenance
	Other - design for corrosion
	Other - stresses in places that are not earth anchored areas
Material Defects	Incorrectly identified components
	Incorrect specification, supply, handling, storage, installation, or testing
	Under-strength pipe
	Manufacturing defect
	Lack of adequate inspection & test procedures
Construction Defects	Undetected of unreported damage to the pipe, coating, or equipment
	Undetected or unreported critical weld defects
	Failure to install the specified materials or equipment
	Failure to install equipment using the correct procedures or materials
	Failure to install equipment in accordance with the design
	Failure to install the pipeline in the specified location or manner
	Inadequate testing of materials for defects prior to handover
Intentional Damage	Sabotage / Terrorism / Malicious Damage / Vandalism
Other - environmental	Soil excavation
	Ground water and soil contamination from fuel and other chemicals used on site during construction
	Escape of liquid fuel to ground water and soil contamination

Table 11, External Interference Protection – Physical Controls

CONTROL	METHODS	EXAMPLES
SEPARATION	BURIAL	
	EXCLUSION	FENCING
	BARRIER	BRIDGE CRASH BARRIERS
RESISTANCE TO PENETRATION	WALL THICKNESS -	
	BARRIER TO PENETRATION	CONCRETE SLABS CONCRETE ENCASEMENT CONCRETE COATING

Table 12, External Interference Protection – Procedural Controls

CONTROL	METHODS	EXAMPLES
PIPELINE AWARENESS -	LANDOWNER	
	THIRD PARTY LIAISON	LIAISON PROGRAM INCLUDING ALL RELEVANT PARTIES
	COMMUNITY AWARENESS PROGRAM	
	ONE-CALL SERVICE	
	MARKING	SIGNAGE
		BURIED MARKER TAPE
	ACTIVITY AGREEMENTS WITH OTHER ENTITIES	
EXTERNAL INTERFERENCE DETECTION	PLANNING NOTIFICATION ZONES	PLANNING NOTIFICATION REQUIRE BY LAW
	PATROLLING	SYSTEMATIC PATROLLING OF THE PIPELINE
	REMOTE INTRUSION MONITORING	DETECTION AND ALARM BEFORE THE PIPELINE IS DAMAGED

APPENDIX D AS2885 Part6 Risk Assessment

The AS2885 Risk Assessment we used to undertake any risk assessments is provided below

TABLE 3.1

SEVERITY CLASSES

Dimension	Severity class				
	Catastrophic	Major	Severe	Minor	Trivial
	Measures of severity				
People	Multiple fatalities result	One or two fatalities; or several people with life-threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and safety
Supply (see Note)	Widespread or significant societal impact, such as complete loss of supply to a major city for an extended time (more than a few days)	Widespread societal impact such as loss of supply to a major city for a short time (hours to days) or to a localized area for a longer time	Localized societal impact or short-term supply interruption (hours)	Interruption or restriction of supply but shortfall met from other sources	No loss or restriction of pipeline supply
Environment	Impact widespread; viability of ecosystems or species affected; or permanent major changes	Major impact well outside PIPELINE CORRIDOR or site; or long-term severe effects; or rectification difficult	Localized impact, substantially rectified within a year or so	Impact very localized and very short-term (weeks), minimal rectification	No effect; or minor impact rectified rapidly (days) with negligible residual effect

NOTE: Appendix G provides guidance on assessment of consequence severities.

3.5.3 Frequency analysis

A frequency class shall be assigned to each FAILURE SCENARIO. The frequency class shall be selected from Table 3.2.

The contribution of existing controls to the prevention of failure shall be considered in assigning the frequency class.

NOTE: Appendix F provides guidance on estimating frequencies.

TABLE 3.2

FREQUENCY CLASSES

Frequency class	Frequency description
Frequent	Expected to occur once per year or more
Occasional	May occur occasionally in the life of the pipeline
Unlikely	Unlikely to occur within the life of the pipeline, but possible
Remote	Not anticipated for this pipeline at this location
Hypothetical	Theoretically possible but would only occur under extraordinary circumstances

3.5.4 Risk ranking

Table 3.3 shall be used to combine the results of the consequence analysis and the frequency analysis to determine the risk rank.

Use of the risk matrix in Table 3.3 is mandatory for SAFETY MANAGEMENT STUDIES in accordance with this Standard. Other methods such as a corporate risk matrix may be used only in parallel with Table 3.3 or as part of a separate corporate RISK ASSESSMENT.

TABLE 3.3

RISK MATRIX

	Catastrophic	Major	Severe	Minor	Trivial
Frequent	Extreme	Extreme	High	Intermediate	Low
Occasional	Extreme	High	Intermediate	Low	Low
Unlikely	High	High	Intermediate	Low	Negligible
Remote	High	Intermediate	Low	Negligible	Negligible
Hypothetical	Intermediate	Low	Negligible	Negligible	Negligible

NOTE: Comparative studies sponsored by the Energy Pipelines Cooperative Research Centre have shown that for risks ranked as Intermediate, Table 3.3 produces results consistent with both reliability-based analysis (in accordance with Annex O of CSA Z662-07) and quantitative risk assessment. Use of a different risk matrix or method that has not been similarly calibrated may produce invalid results.

3.6 RISK TREATMENT

3.6.1 General

Action to reduce risk shall be taken in accordance with Table 3.4, based on the risk rank determined from Table 3.3.

The action(s) taken and the planned effect on risk shall be documented.

3.6.2 Risk treatment during design

Risk treatment actions at design stage may include the following:

(a) Relocation of the pipeline route.

(b) Modification of the design for any one or more of the following:

  (i) PIPELINE SYSTEM isolation.

  (ii) PHYSICAL CONTROLS for prevention of external interference.

  (iii) PROCEDURAL CONTROLS for prevention of external interference.

  (iv) Corrosion prevention.

  (v) Operational controls.

TABLE 3.4

RISK TREATMENT ACTIONS

Risk rank	Required action
Extreme	Modify the THREAT, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower. For an in-service pipeline, the risk shall be reduced immediately.
High	Modify the THREAT, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower. For an in-service pipeline, the risk shall be reduced as soon as possible. Risk reduction should be completed within a timescale of not more than a few weeks.
Intermediate	Repeat THREAT identification and risk evaluation processes to verify the risk estimation; determine the accuracy and uncertainty of the estimation. Where the risk rank is confirmed to be "intermediate", where reasonably practicable modify the THREAT, the frequency or the consequence to reduce the risk rank to "low" or "negligible". Where it is not reasonably practicable to reduce the risk rank 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) formally demonstrate ALARP (see Section 4). For an in-service pipeline, the reduction to "low" or "negligible" or demonstration of ALARP shall be completed as soon as possible. Risk reduction or demonstration of ALARP should be completed within a few months.
Low	Determine the management plan for the THREAT to prevent occurrence and to monitor changes that could affect the classification.
Negligible	Review at the next relevant SMS (for periodic operational review, LAND USE CHANGE, ENCROACHMENT, or change of operating conditions).

3.6.3 Risk treatment during operation and maintenance

Risk treatment actions at operating pipeline stage may include one or more of the following:

(a) Installation of additional or modified PHYSICAL CONTROLS.

(b) Additional or modified PROCEDURAL CONTROLS.

(c) Specific actions in relation to identified activities (e.g. presence of operating personnel during activities on the easement).

(d) Modification to pipeline marking.

(e) Changes to the isolation plan.

(f) Changes to the PIPELINE SYSTEM design or operation to satisfy the requirements of this Standard when there is a change to the LOCATION CLASS of the pipeline.

(g) Specific operational or maintenance procedures.

(h) Repair, remediation or removal of a condition or DEFECT that presents a THREAT.

THREAT treatment for operating PIPELINE SYSTEMS should consider interim control measures (e.g. reduction in operating pressure, access restrictions) to allow time for the implementation of permanent control measures (e.g. repair).

APPENDIX E: Documents and References for Workshop

The documents referenced at the SMS workshop are listed below.

Table 13, Documents & References for Workshop

Document Name	Document Number	Available
Proposed Development	Draft Arden Structure-Plan-V2.2	Yes
Proposed Development	Arden Gas Utilities Plan	Yes
Proposed Development	Arden SMS Map (showing pipelines)	Yes
Pipeline Penetration Calc	Penetration Resistance Calculation PL203/208/66	TBC (data only)
Pipeline Radiation Contour Calc	Heat Radiation Release Calculation PL203/208/66	TBC (data only)
Pipeline Route Plan	Yarra_06_011/12	Yes
	PL203 – P4-70-1	Yes

The legislative references for this Workshop are listed below: -
Victoria

- Pipelines Act 2005
- Pipelines Regulations 2017

The Industry Standards referenced for this Workshop are listed below: -

- AS 2885.0 :2018 Gas and liquid petroleum General requirements
- AS/NZS 2885.1:2018 Gas and liquid petroleum Design & Construction
- AS2885.3 :2012 Gas and liquid petroleum Operations and Maintenance
- AS/NZS 2885.6:2018 Pipelines - Gas and liquid petroleum - Pipeline safety management

APA Pipeline Management System - Volume 1 Introduction – dated 3/11/16 Section 2 Coverage states that when conflict exists between the various applicable documents, the following order shall apply, in decreasing order of precedence. Where APA requirements are more stringent, they shall take precedence.

- Acts of law or other legislation
- Government licenses and permits
- APA Engineering Standards. This will be covered by documented practices and any specific inputs from APA risk assessments
- Local engineering standards

APPENDIX F: SMS Terms Of Reference

APPENDIX G: SMS Technical Presentation

APPENDIX H: SMS Workshop Minutes

APPENDIX I: Landscape Guidelines

- Refer to AusNet reference Document TS4156 – Landscaping Guidelines (Dated 1/12/2015)
- APA summarises their Landscape Requirements below.

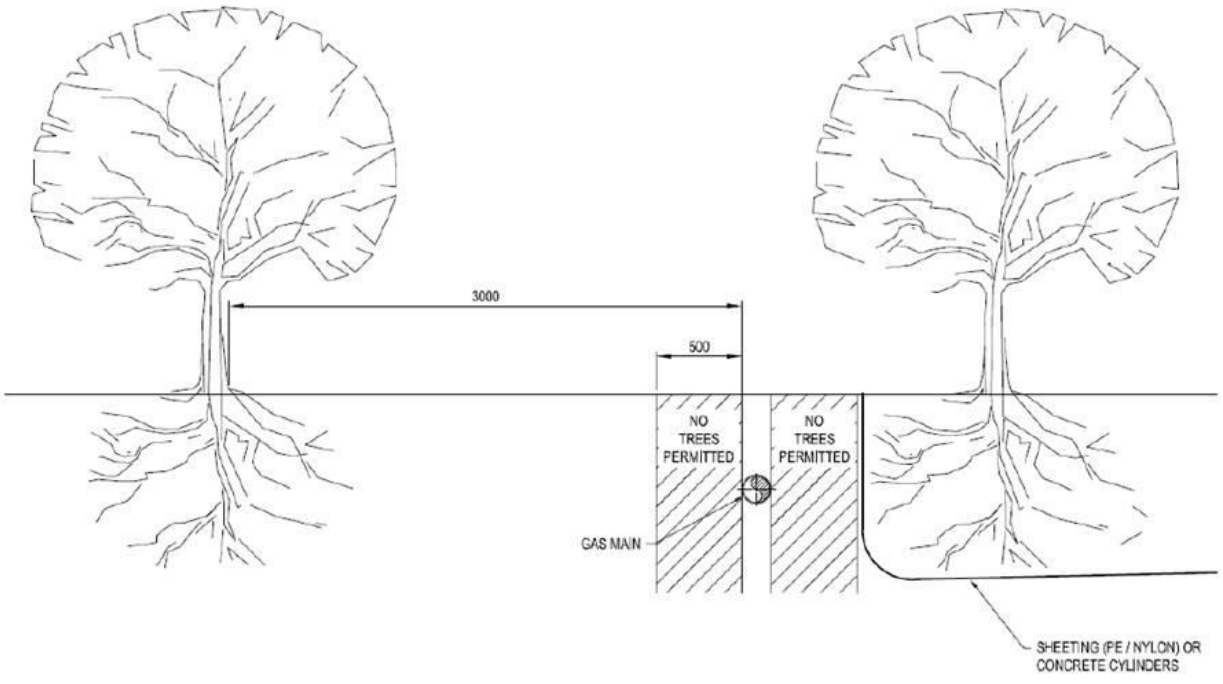
Vegetation

Vegetation may limit line of site, access and passage along an existing gas asset alignment, while the associated roots may damage existing buried pipe, coating or other ancillary equipment (e.g. cables). Above ground gas infrastructure may also be exposed to hazards from falling vegetation and increased fire risk.
Table 3 provides guidance for planting new vegetation in the vicinity of existing buried gas assets.

Table 3: Requirements for Vegetation

Separation	Requirements
> 3000 mm	Deep rooted vegetation may be planted without restriction.
500 – 3000 mm	Vegetation fully grown canopy shall not limit line of site along buried pipe alignment. Trees are not to be planted within 3000 mm of a transmission pressure gas asset without explicit approval of APA. Trees will require root barrier protection (e.g. robust permeable polyethylene / nylon sheeting, or solid concrete cylinders). The root barrier must be installed with the separations provided in Table 2. Continuous parallel plastic sheeting may impact cathodic protection systems for steel pipes and may require additional assessment.
< 500 mm	Planting of trees are not permitted.

Table 2 ref. to 500mm.
Strata cells are not considered an appropriate protection from tree roots. If strata cells are to be installed in the vicinity of existing buried gas assets, the controls identified in Table 3 shall be used for protection.



APPENDIX J: APA Potholing Procedure

8.2.1 Hydro-Vacuum Excavation

Where hydro-vacuum excavation is used in the vicinity or to expose existing gas assets, the following conditions must be applied in conjunction with APA procedure QND00282:

• A check for gas leaks must be conducted prior to commencement of work

- When locating pipelines and mains, a maximum water pressure of 2500 psig may be used to a depth no greater than 450 mm. Below this depth, the maximum water pressure shall be set in accordance with Table 6 for the asset type in the vicinity.

• When locating services, a maximum water pressure of 2500 psig may be used to a depth no greater than 300 mm. Below this depth, the maximum water pressure shall be set in accordance with Table 6 for the asset type in the vicinity.

• Impacting the gas asset must be prevented at all times;

• Vertical movements in the vicinity of the gas asset such as pushing the pressure wand nozzle or vacuum tube into the soil to break it up is prohibited

• The wand shall never remain motionless during excavation;

• A minimum distance of 100 mm shall be maintained between the end of the pressure wand nozzle and the gas asset. Aiming directly at the gas asset shall be avoided at all times;

• A dead man trigger or similar, shall be installed and used on the wand;

• Root cutting heads shall not be used at any time; and

• Once a gas asset has been exposed via hydro-vacuum methods, a visual check must be undertaken to ensure no damage has occurred to the pipe or its coating.

Table 6: Maximum Water Pressure for Hydro-Vacuum Excavation

Pipe / Coating Type	Maximum Water Pressure (PSI)
Steel – Coal Tar Enamel Coated	1000
Steel – Polyethylene Tape Coated	1000
Steel – Polyethylene Coated	2000
Steel – Trilaminate Coated	2000
Steel – FBE or HBE Coated	2000
Steel – Uncoated	2500
Steel – Mummified fittings (e.g. valves, flanges)	Not Permitted
Cast Iron	1000
Polyethylene	2000
Nylon or PVC	1500
Unknown Material or Steel Coating	1000