

New Primary School at Gregory Hills, NSW

AS 2885 Land Use Change Safety Management Study for Gas Pipeline Corridor

For School Infrastructure NSW

4 October 2022

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2	4 Oct 2022	RF	Changes for consistency with other EIS documents		

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Summary

Introduction

This report by Arriscar Pty Limited (Arriscar) accompanies an Environmental Impact Statement (EIS) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), in support of a State Significant Development Application (SSDA) for the construction and operation of a new primary school at Gregory Hills (SSD-41306367).

This report addresses the Secretary's Environmental Assessment Requirements (SEARs) issued for the project, notably:

SEARs Requirement	Response
If the development is adjacent to or on land in a pipeline corridor, report on consultation outcomes with the operator of the pipeline, and prepare a hazard analysis.	A previous land use change Safety Management Study workshop was held with representatives from Jemena and APA.

Proposal

The proposal is for a new primary school at Gregory Hills that generally comprises the following:

- 44 General Learning Spaces.
- 4 Support Learning Spaces.
- Administration, staff hub, amenity and building service areas.
- Library, communal hall and canteen.
- Outside School Hours Care (OSHC) services.
- Sport courts, outdoor play space, a Covered Outdoor Learning Area (COLA) and site landscaping.
- Dedicated bicycle and scooter parking.
- Three (3) kiss and drop spaces for Supported Learning Students (SLS) located on Wallarah Circuit.
- On-site car parking.
- Signage.
- Footpath widening on Wallarah Circuit.

Figure 1: Site Plan (source Bennett and Trimble)



Site Description and Location

The site is located in Dharawal Country at 28 Wallarah Circuit, Gregory Hills NSW 2557, and is legally described as Lot 3257 DP1243285.

The site is located within the Camden Local Government Area and is within the Turner Road Precinct of the South-West Growth Centre.

The site has an area of approximately 2.926ha (by Deposited Plan). This will be reduced to 2.907ha under approved DA2022/742/1 once Long Reef Circuit has been widened.

Topography is minimal with a fall from the south-east corner (RL116.5) to the north-west corner (RL113).

The site has three (3) street frontages:

- Wallarah Circuit (Southern boundary)
- Gregory Hills Drive (Northern boundary)
- Long Reef Circuit (Eastern boundary)

The site is primarily vacant land, with the exception of an existing group of trees in the southwest corner of the site that pre-date the subdivision and development of the precinct. There is also an existing electrical substation located on the south-eastern boundary.

There are easements of varying widths located to the northern boundary identified for drainage.

Figure 2: Locality Map (Six Maps)

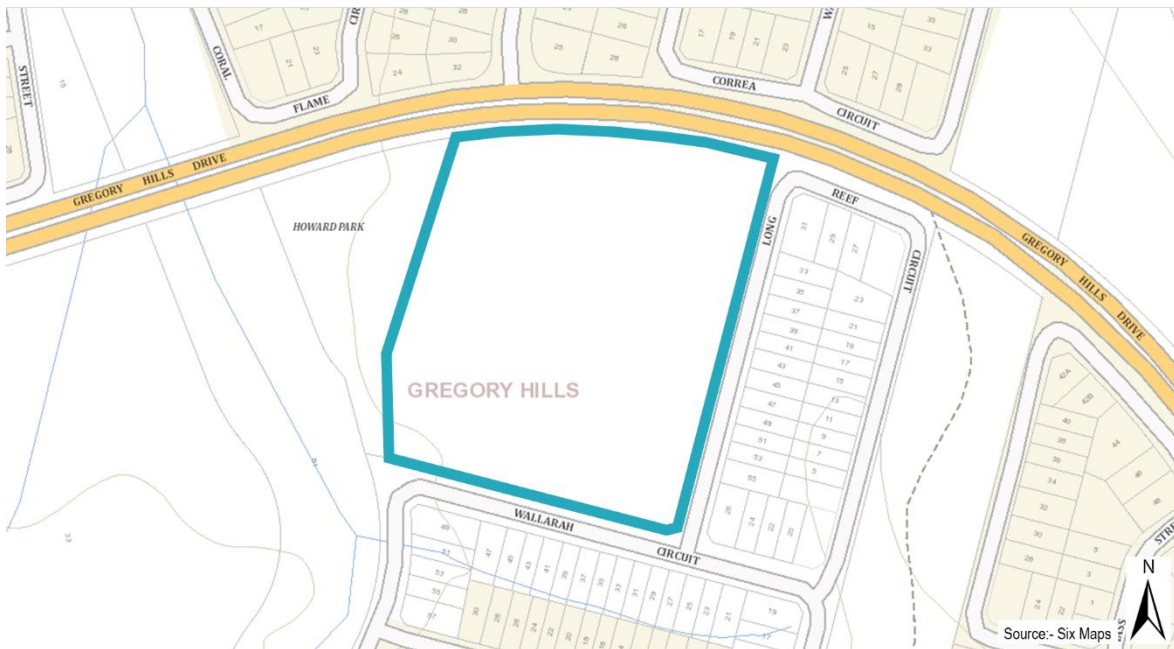


Figure 3: Site Aerial Map, (Source Bennett and Trimble)



Surrounding Development

To the north, east and south of the site is emerging and recently completed residential development.

To the east of the residential area fronting Long Reef Circuit are high voltage power lines within an easement which include pedestrian paths and cycleways.

To the west of the site, beyond Sykes Creek and Howard Park, is the Gregory Hills town centre. A pedestrian bridge links Wallarah Circuit with the town centre across Sykes Creek.

Figure 4: Surrounding Development (Nearmap)



Recommendations

1. Extend the T1, CIC, S classification for the Gregory Hills development starting at KP 24.2 to KP 28.0 and update the Licence 1 pipeline (Central Trunk) database accordingly. This will encompass the section of pipeline within one ML of GHPS and eliminate the section of pipeline classed T1, CIC in the Gregory Hills development area.
2. Reduce the maximum spacing of pipeline markers in the section of pipeline within 1 ML of the proposed GHPS to 50 m, consistent with AS 2885.1, Table 4.10.1.
3. The Preliminary Hazard Analysis (PHA) should address risk to GHPS occupants and thermal radiation impact on school buildings.
4. Based on the findings of the PHA, identify additional risk reduction measures to minimise thermal radiation impact on buildings and occupants in the GHPS site.

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Notation

Abbreviation	Description
ABLV	Automatic Line Break Valve
APA	Australian Pipelines Association
Arriscar	Arriscar Pty Limited
AS/NZS	Australian Standard/ New Zealand Standard
CDL	Critical Defect Length
CIC	Common Infrastructure Corridor
EGP	Eastern Gas Pipeline
GHPS	Gregory Hills Primary School
GJ/s	Giga Joules / second
HDD	Horizontal Directional Drilling
ILI	Internal Line Inspection
JGN	Jemena Gas Network
KP	Kilometre Point (Chainage)
kW/m ²	Kilo-Watt per square metre
LEP	Local Environmental Plan
m/s	Metres/ second
MAOP	Maximum Allowable Operating Pressure
ML	Measurement Length
MPa	Mega Pascals
SINSW	School Infrastructure NSW
SMS	Safety Management System
SMYS	Specified Minimum Yield Strength
T	Tonne

1 INTRODUCTION

1.1 Background

School Infrastructure NSW (SINSW) is planning to construct a primary school on a vacant block of land in the residential area of Gregory Hills, NSW. The subject site is at the corner of Long Reef Circuit and Wallarah Circuit, Gregory Hills, in the Local Government Area of Camden.

A gas pipeline corridor exists approximately 750m from the proposed site. Three gas pipelines currently use the pipeline corridor. These are:

- Licence 1 pipeline (Central Trunk) (operated by Jemena Australia). The Central Trunk is part of the Jemena Gas Network (JGN) system.
- Eastern Gas Pipeline (operated by Jemena Australia), and
- Ethane Liquefied Gas Pipeline (operated by the APA Group)

Of the three pipelines, a potential loss of containment incident at the EGP and ethane pipeline would have no adverse impact on the proposed school site or buildings, but a failure of the Central Trunkline may affect the school in terms of thermal radiation from a full bore rupture fire.

Jemena operates the Central Trunk under a Class 1 Licence from the Pipeline Authority of NSW. The installation and operations are governed by a suite of Australian Standards, AS 2885 – Parts 1 to 6. A Safety Management System (SMS) addressing the design, installation, and operation of the Central Trunk has been developed by Jemena [1].

AS 2885.6 (2007) [2] requires that any land use changes in the vicinity of the pipeline be subject to a Safety Management System (SMS) review, jointly by the Stakeholders, in accordance with the SMS Process described in the Standard. The stakeholders in the proposed Gregory Hills Primary School (GHPS) project are: SINSW as the developer, Jemena as the Central Trunk Operator and Jacobs Group, the project managers for the school design and construction project.

SINSW commissioned Arriscar Pty Ltd to facilitate the Land Use Change SMS review and produce a report, in accordance with the requirements of AS 2885.6.

The SMS for the GHPS development was facilitated and validated by Arriscar in a stakeholder workshop on the 17th of June 2022.

This SMS Report, in particular its inputs and outputs, is to be reviewed by the relevant stakeholders to ensure the details are accurate at the date of issue of this report.

1.2 Gregory Hills Primary School Site Location

The site is located in Dharawal Country at 28 Wallarah Circuit, Gregory Hills NSW 2557, and is legally described as Lot 3257 DP1243285.

The site is located within the Camden Local Government Area and is within the Turner Road Precinct of the South-West Growth Centre.

The site has an area of approximately 2.926ha (by Deposited Plan) and falls from the south-east corner (RL116.5) to the north- west corner (RL113).

The site has three (3) street frontages:

- Wallarah Circuit (southern boundary)
- Gregory Hills Drive (northern boundary)

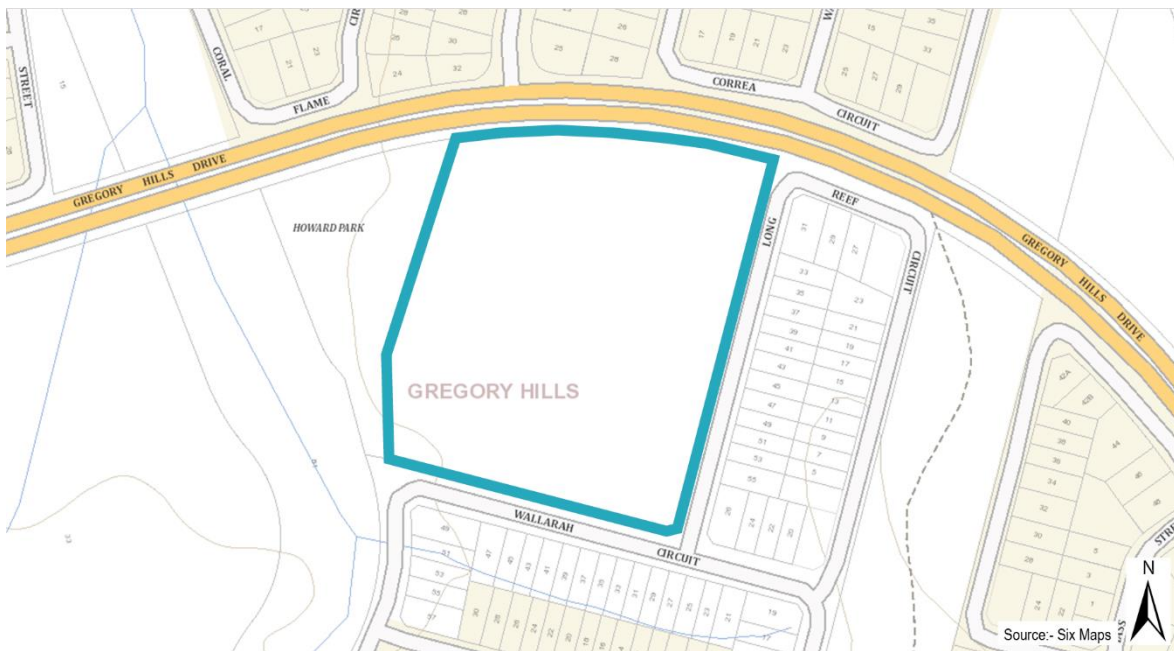
- Long Reef Circuit (eastern Boundary)

The site is primarily vacant land, with the exception of an existing group of trees that have been retained in the southwest corner of the site that pre-date the subdivision and development of the precinct. There is also an existing electrical substation located on the south-eastern boundary.

There are easements of varying widths located to the northern boundary identified for drainage.

A site location map is shown in Figure 5.

Figure 5: Gregory Hills Primary School Location (©NSW Department of Customer Services, Spatial Services)



A site aerial map is shown in Figure 6 .

Figure 6: Site Aerial Map



1.3 Pipelines Location

The location of the three gas pipelines near the GHPS site is shown in Figure 7.

The pipelines share the same corridor.

Figure 7: Gas Pipelines Location



2 AS 2885.6 REQUIREMENTS

2.1 SMS Required

AS 2885.6 (2018) requires SMS to be prepared and/or reviewed at the following milestones:

1. Pipeline design
2. Pipeline construction
3. Pipeline operations (reviewed and updated 5-yearly)
4. SMS relating to management of change
 - (a) Land use change (when there is an increase in population density in the vicinity of the pipeline)
 - (b) Encroachment (3rd party construction near the pipeline that may affect the pipeline from excavation etc)
 - (c) Change in pipeline operating conditions
 - (d) There has been a pipeline failure event

For the present context, the SMS required is Item 4(a) above, change in land use.

2.2 Previous SMS

Jemena has developed an SMS document for Items 1 to 3 and the latest 5-yearly review conducted in 2020 is in Ref. [1].

The actions arising from the previous SMS mainly related to pipeline integrity management and operational issues. The actions are not specifically relevant to the change in land use arising from the GHPS project.

2.3 Scope of Land Use Change SMS

AS 2885.6 (Clause 5.5.2) states that:

- The safety management process shall be used to review the changes in risk to and from the pipeline when land use change is identified
- The objectives of a land use change safety management study are (AS 2885.6):
 - Informing stakeholders such as local government, planning authorities, development proponents of the requirements of AS/NZS 2885. This was done through a workshop.
 - Reviewing proposed development plans to determine whether they can be optimised to minimise impacts on the pipeline. Addressed in this report.
 - Managing construction activities in the vicinity of the pipeline to minimize risk. School construction activities will not have any impact on the pipelines, due to the large separation distance available.
 - Identifying any additional protective measures that might be required so that risk remains ALARP despite changed surroundings. This is addressed in this report.
- The land use change considered is the development of Gregory Hills Primary School in a region currently zoned general residential (R1) in the Camden LEP. The land also has a location classification of T1 according to AS 2885.6.
- The proposed school introduces a sensitive use (Gregory Hills Primary School) as defined by AS 2885.6 within the Measurement Length of the Central Trunk.
- The scope of the study considers the impact on both the final permanent school infrastructure with a population > 1,000, and the temporary school infrastructure with demountables and a smaller school population (~300).
- The Land Use Change SMS will be restricted to only that part of the pipeline where the land use change is within the Measurement Length

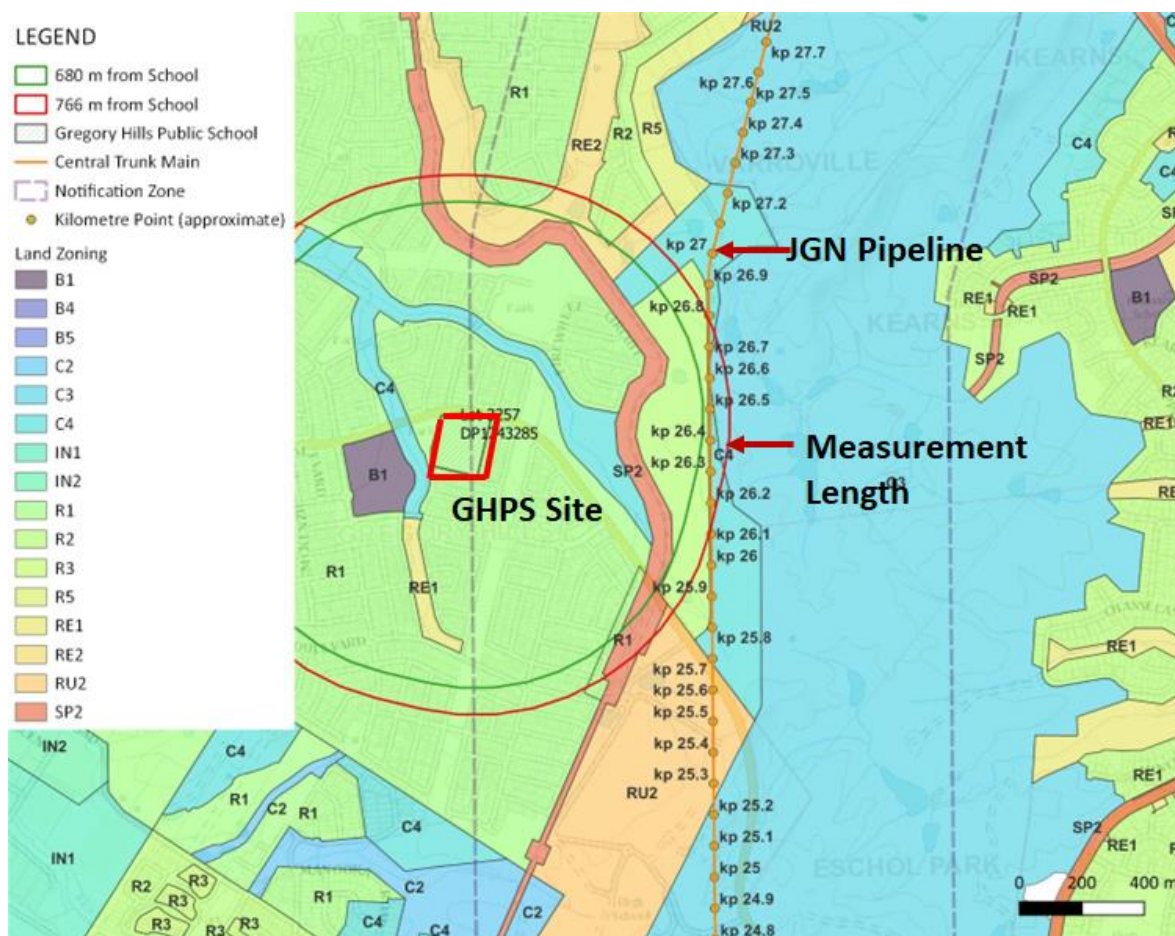
2.4 Measurement Length

The “Measurement Length” is a technical term referred to in AS 2885.6-2018, that determines the extent to which the Land Use Change SMS is applicable.

“The Measurement Length is defined as the distance from the centre of pipeline to a distance to 4.7 kW/m² thermal radiation intensity, from a full bore rupture of the pipeline and ignition.”

The section of the pipeline within one Measurement Length of the proposed Gregory Hills Primary School is shown in Figure 8. The reported measurement length is 759m .

Figure 8: Central Trunk Measurement Length and GHPS Site (Source: NSW Department of Customer Services and Australian Pipeline Database)



The Measurement Lengths for the APA pipeline and the EGP do not reach the school and hence a Safety Management Study for these two pipelines is not required by AS 2885.6.

2.5 SMS Workshop

An SMS workshop was held on the 17th of June 2022. The session was held online through Microsoft Teams. The list of participants is provided in Table 1. The session lasted 2.5 hours.

Table 1: List of SMS Workshop Participants

Name	Organisation	Title
Shay Bergin	SINSW	
Alastair Burdon-Jones	Jacobs	Graduate Project Manager
Paul Walters	APA	Senior Risk Engineer
Rhys Edwards	ACOR	Consultant, Hydraulics Engineering
Danny Guerrera	Jemena	EGP & EVO Lands Management
John Lawson	APA	Senior urban Planner

Name	Organisation	Title
Brendan Madders	Jacobs	Senior Program Manager
Kashif Rahman	Jemena	Senior Engineer, Pipelines
Raghu Raman	Arriscar	Facilitator
Laukik Rane	SINSW	
John Paul Maiorana	Arriscar	Scribe
Marisa Sidoti	Jacobs	Design Manager
Jarred Statham	SINSW	

The minutes were taken online in the notes column of PowerPoint presentation. This report has been developed from the notes.

3 PIPELINE PARAMETERS

The main parameters of the pipeline are given in Table 2.

Table 2: Central Trunk Parameters

Parameter	Value
Pipeline Name	Jemena Gas Networks licence 1
Installation date	1976
Nominal Outside Diameter	864 mm (DN 850, 34")
Maximum Allowable Operating Pressure (MAOP)	6.895MPa
Pipe Grade (Carbon steel)	API 5L X65
Yield Stress	448 MPa
Wall Thickness	13.3 mm
Current Location Class	T1, CIC, S between KP 24.2 and 26.5 T1, CIC between KP 26.5 and 28.0
Longitudinal Weld	SAW
Hoop Stress @ MAOP	50%
Pipe Coating	Coal Tar Enamel
Field Joint Coating	Coal Tar Enamel
Depth of Cover	0.8m (minimum)
Isolation Valves	Upstream – Menangle Park ALBV (KP 18.15) Downstream – Catherine Field ALBV (KP 29.24)
History of Leaks	None
Cathodic protection	Impressed current type. Pipe potentials inspected 3 times a year (4 month intervals). Jemena reported that Cathodic Protection is adequate
Pipeline Condition (based on 2014 audit by Jemena)	Last dig in the area detected coating defects based on DCVG survey, no corrosion identified 2014 ILI – No significant defects identified Next ILI planned in 2024

4 SAFETY MANAGEMENT PROCESS

The Safety Management Process consists of the following steps.

1. Location Analysis
2. Threat Analysis
3. High Consequence Area Analysis
4. ALARP Assessment

Each of the above steps are described below.

4.1 Location Analysis

The LOCATION CLASS for the pipeline is selected based on the predominant land use in the broad area traversed by the pipeline.

There are 4 primary location classes defined in AS 2885.6:

R1 – Rural

R2 – Rural residential

T1 – Urban residential

T2 – High density

In addition, six secondary location classes are defined:

- S – Sensitive use. Locations where the consequences of a failure are increased because it is used by sectors of the community who may be unable to protect themselves in the event of a pipeline failure. Design requirements for T2 apply;
- E – Environmental.
- I – Industrial. Locations where the surrounding land poses a different range of threats because it is developed for manufacturing, processing, storage or similar activities. Design requirements for T1 apply;
- HI – Heavy Industrial. Sites developed or zoned for use by heavy industry or toxic industrial use. Design requirements shall be T1 or T2, depending on the assessed severity;
- CIC – Common Infrastructure Corridor. Land where multiple parallel infrastructure development within a common easement or reserve occurs. CIC classification includes pipelines within reserves or easements for roads, railways, powerlines, buried cables, or other pipelines;
- C – Crowd. Locations where there may be crowds or congestion leading to concentrations of population that are both intermittent and much higher than typical for the prevailing location class.

The location classes defined in the Jemena SMS [1] for the Gregory Hills development area is reproduced in Table 3.

Table 3: Location Classification based on Jemena 2020 SMS for Gregory Hills Development Area

Description	KP start	KP end	2020 Location Class		Comments
			Primary	Secondary	
Narellan Area past St. Gregory's College	24.2	26.5	T1	CIC,S	St. Gregory's College/ boarding school. School property continues beyond 25.6 KP. New residential development Gregory Hills will extend within both 4.7 and 12.6 kW/m ² .
North of St. Gregory's College and Macarthur Park golf course	26.5	28	T1	CIC	New residential development Gregory Hills will extend within both 4.7 and 12.6 kW/m ² .

Based on the new primary school in Gregory Hills, the T1, CIC, S location class Table 3 will be extended at least 300m north. The suggested new classification is shown in Table 4, but Jemena workshop participants suggested that the T1, CIC, S classification may be extended for the full Gregory Hills development to KP 28.

Table 4: New Location Classification based on Gregory Hills High School Development

Description	KP start	KP end	2020 Location Class		Comments
			Primary	Secondary	
Narellan Area past St. Gregory's College	24.2	26.8	T1	CIC,S	St. Gregory's College/ boarding school. School property continues beyond 25.6 KP. New residential development Gregory Hills will extend within both 4.7 and 12.6 kW/m ² . Gregory Hills Primary School on the border of 4.7 kW/m ² (Measurement Length)
North of Gregory Hills Primary School and Macarthur Park golf course	26.8	28	T1	CIC	New residential development Gregory Hills will extend within both 4.7 and 12.6 kW/m ² .

Due to the pipeline sections being in the Sensitive Use location, it is classified as a High Consequence Area. AS 2885.6 requires that the pipeline sections in the radiation contour measurement length (T1,S) shall meet T2 (High Density) protection requirements of AS2885.

At this location the Central Trunk is required to;

- Meet the 'No Rupture' requirements.

- Limit credible energy release to 1 GJ/s.
- All other design requirements for T2 locations, such as depth of cover and pipeline marker sign spacing.

This aspect is further discussed below.

4.2 Threat Analysis

Residual risks pertaining to the section of pipeline within 1 ML identified in the 2020 SMS were considered. The workshop team concluded that the change in location class resulting from a school approximately 750 m from the pipeline did not change the nature nor likelihood of threats to the pipeline.

The major threats to the pipeline integrity are (AS 2885.6):

- External interference - Vertical auger or horizontal directional drilling (HDD)
- Corrosion
- Natural events (scouting from flooding, land subsidence)
- Faults in design, materials of construction
- Faults in operation, maintenance and management systems (overpressuring)
- Intentional damage

The above threats were reviewed, and two residual risks were summarised in the Jemena 2020 SMS. In the present workshop, the other threats were also assessed for risk. These are summarised in Section 4.4.

4.3 Risk Assessment

The threats were assessed in terms of their consequences and likelihood, using the rule sets in AS 2885.6 (see Table 5 and Table 6). Consequence severity was assessed only for potential impact on people (safety), as increase in population density is the only change in the land use change.

Table 5: Rule Set for Consequence Category

Catastrophic	Major	Severe	Minor	Trivial
Multiple fatalities	One or two fatalities, several life-threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and safety

Table 6: Rule Set for Likelihood Category

Frequency Category	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

Frequency Category	Frequency Description
Remote	Not anticipated for this pipeline at this location
Hypothetical	Theoretically possible but would only occur under extraordinary circumstances

The risk matrix is shown in Table 7.

Table 7: 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

4.4 Residual Risk

The Jemena SMS [1] identified two (2) residual threats. These are listed in Table 8 and highlighted. Four additional risks, which had been considered by Jemena, but not listed in the residual risk summary, were also considered in the present workshop.

Table 8: Summary of Residual Risk

No.	Threat description	Safeguards	Severity Rating	Frequency Rating	Risk
1	Stress corrosion cracking due to high soil/ liquid pH in contact with the pipeline resulting in cracks causing leak	<ul style="list-style-type: none"> Coal Tar Enamel protection and 6 monthly inspections Cathodic protection and monitoring Integrity digs Intelligent pigging (last inspection was in 2014) 	Major	Remote	Intermediate
2	Procedural control failure. Third party excavation using auger or excavator	<ul style="list-style-type: none"> Line markers "Dial Before You Dig" service for pipeline 	Minor	Hypothetical	Negligible

No.	Threat description	Safeguards	Severity Rating	Frequency Rating	Risk
	causing damage to pipeline	<ul style="list-style-type: none"> • Encroachment Management System • Landowner/ Government liaison • Weekly surveillance patrol of pipeline • Wall thickness in design offering resistance to penetration • Will resist puncture against excavators greater than 30T with any tooth type, and provide protection against puncture for gouges up to approx. 8-10mm deep at the MAOP. 			
3	HDD and pipeline gauging resulting in leak. Expected leak size 50mm.	<ul style="list-style-type: none"> • Procedural control as above 	Minor	Unlikely	Low
4	Soil erosion/ scouring from flooding	<ul style="list-style-type: none"> • Major flooding not expected • Depth of cover 	Severe	Hypothetical	Negligible
5	Failure of APA pipeline or EGP and escalation to adjacent Central Trunk	<ul style="list-style-type: none"> • Adequate distance between parallel pipelines within the Measurement Length • No crossing of utility pipelines within Measurement Length • 12m distance of Central Trunk from edge of easement 	Severe	Hypothetical	Negligible

No.	Threat description	Safeguards	Severity Rating	Frequency Rating	Risk
6	Pipeline overpressurised due to downstream valve closure	<ul style="list-style-type: none"> Pressure monitoring and shutdown 	Severe	Unlikely	Intermediate

No events were 'High' or 'Extreme' residual risk were identified.

4.5 High Consequence Area Analysis

AS2885.1 Clause 4.9 outlines the provisions for High Consequence Areas. As there are sections of the Central Trunk that have been classified as Sensitive (equivalent to T2 Classification) or T1 (or equivalent due to Crowd Classification) it is required that these sections of the Central Trunk satisfy the following conditions:

- "No Rupture" (Section 4.5.3)
- Maximum Energy Release (Section 4.5.4)

4.5.1 Leak Detection

For large leaks, the pressure monitoring system would initiate a low pressure alarm in the control room and the automatic line break valves (ABLV) at – Menangle Park (KP ~ 18) and Catherine Fields (KP ~ 29) would be shut to isolate a leak.

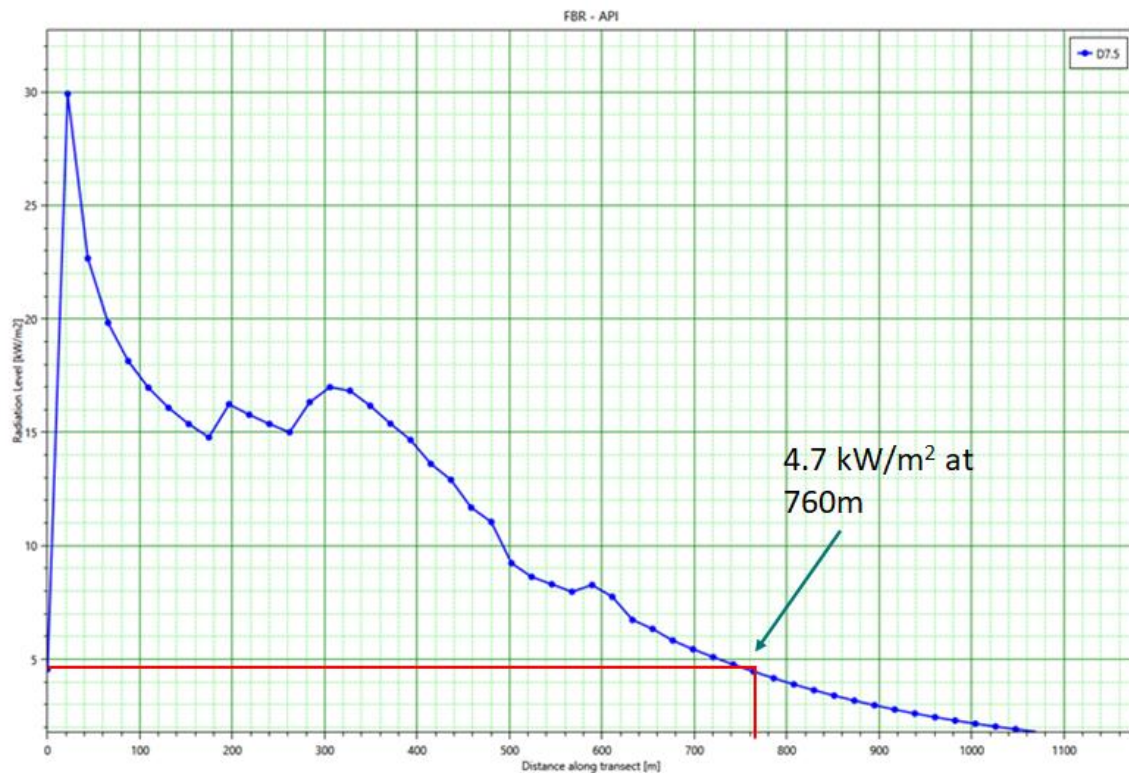
Smaller leaks cannot be detected readily and may take some time. Any reporting by smell (gas is odourised) would be investigated. There are no facilities within the Measurement Length to detect smaller leaks. However, small leaks would have no impact on the GHPS site.

4.5.2 Thermal radiation on School Buildings

For a full-bore rupture of the Central Trunk and ignition, the thermal radiation from a jet fire may be calculated by the correlations provided in AS 2885.6 – Appendix B.

A graph of thermal radiation levels at various distances from the pipeline for a full-bore rupture is shown in Figure 9. The distance depends on the wind speed as the flame is tilted by wind. The worst-case distance occurs at high wind speeds. A value of 7.5 m/s was selected for high wind, based on local meteorological data.

Figure 9: Thermal Radiation Profiles for Full Bore Rupture of Central Trunk (wind speed 7.5 m/s)



4.5.3 No Rupture Assessment

Section 4.9.2 of AS 2885.1-2018 [3] requires that, for location class of T2, the pipeline must comply with a 'No Rupture' criteria. The criteria and compliance are summarised in Table 9. At least one of the two criteria in Table 9 must be satisfied to achieve the 'No Rupture' criteria.

Table 9: No Rupture Criteria Evaluation [4]

Criterion	Actual Value	Complies?	Comments
Hoop stress at MAOP must not exceed 30% of SMYS	50% for wall thickness of 13.3m	No	Operating pressure is < MAOP.
The hoop stress at MAOP shall be selected such that the critical defect length (CDL) is not < 150% of the axial length of the largest hole produced by the threats identified at that location	CDL = 287 mm. Maximum axial length of hole for 30T excavator is 110mm. 1.5 times this value is 165 mm. CDL is > this value.	Yes	Critical defect length is not exceeded and hence rupture would not occur.

In this instance the Pipeline satisfies $CDL > 150\%$ axial length from a 30T excavator, and hence an ALARP demonstration is not required.

4.5.4 Maximum Energy Release

Maximum energy release calculations as a result of third party damage are presented in [1] and [4]. The calculations assume a maximum excavator size of less than 55 T.

The energy release rate criteria for location classes are summarised in Table 10. The hole sizes that could result in reaching the criteria limit are reported by Jemena [4].

Table 10: Energy Release Criteria Evaluation

Criterion	Minimum Hole size to reach criteria	Maximum credible hole size	Complies?	Comments
Not to exceed 1 GJ/s at T1,S location Class	55 mm	50 mm	Yes	50 mm hole size is for a Dozer / Ripper, and also Vertical Auger (300mm).
Not to exceed 10 GJ/s at nearby industrial areas	172 mm	50 mm	Yes	As above

Jemena have determined [4] that penetration is possible with a 55 T excavator with either a single tiger tooth, or a penetration tooth, with hole sizes of 30 and 70 mm respectively. However, the 55 T excavator is larger than the assumed maximum excavator size (30 T). The 70 mm hole results in an energy release greater than that allowable for a T2, S location class.

Even if the 30 T maximum excavator size assumption is invalid, the distance to 4.7 kW/m² heat flux is only 77 m. In this scenario GHPS will not receive injurious levels of radiated heat flux.

4.6 ALARP Assessment

AS 2885.6 states that a formal ALARP assessment is required for the following situations:

- All identified threats where the identified residual risk level is 'intermediate' or higher.
- Creation of new consequence areas. In this instance, the energy release rates are not satisfied for the changed T1,S locational class for GHPS site.
- Existing pipelines without a fracture control plan (a fracture control plan has been developed) [5], and reviewed by Jemena periodically.

The following factors are to be considered in ALARP evaluation of existing pipelines:

1. Pipeline Integrity

Jemena has an integrity management program for the Central Trunk (Licence 1 pipeline). This includes a number of operational controls, and described in Ref. [1]. The integrity program has been designed in compliance with AS 2885 requirements. The key features are:

- Integrity digs for inspection of condition
- Intelligent pigging
- Corrosion management (cathodic protection monitoring)
- Control of third party activities in the vicinity of pipeline and monitoring
- Operational controls (overpressure protection, maintenance of ALBVs)
- Incident reporting, investigation and close out.

2. Safety Management System

Jemena has developed an SMS for the entire pipeline length by segments. The applicable segment in the present context is between Wilton and Horsley Park. The SMS is updated five-yearly, and the last update was in 2020 [1].

In addition to SMS review of pipeline integrity, pipeline operations and maintenance, individual SMS studies are undertaken with land owners and stakeholders if there are changes in land uses in the vicinity of the pipeline. This is to review changes in Location Class, and safety updates that may be required as a consequence.

3. Follow up and close out of recommendations arising from the SMS reviews.
4. Quantitative evaluation of risk of identified threats where necessary, especially in cases where the limits of heat release rates in ASS 2885.1 are not complied with.
5. Residual risks are reduced to “intermediate” levels or lower.
6. For intermediate risks, identification of additional risk reduction measures to reduce the consequence impact on the receptor. This includes additional thermal radiation protection for the target structures and occupants (GHPS buildings and occupants in this instance).
7. Implementation of the additional measures as far as reasonably practicable.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions were reached in the change in land use SMS review:

1. The Measurement Length for the Central Trunk falls within the GHPS school boundary (~760m from the pipeline). This finding triggered the current SMS review.
2. There is a change in Location Class for the GHPS site, from T1, CIC to T1,CIC, S. This requires the requirements of Location Class T2 to be applied to the site.
3. The pipeline satisfies the 'No rupture' requirement for Location Class T1,S. While the hoop stress exceeds 30% SMYS, the CDL is not exceeded in the penetration assessment for interference during excavation and hence a full-bore rupture is prevented. This is largely due to the 13.3mm wall thickness of Central Trunk.
4. For some release sizes, the heat release rate exceeds the 1GJ/s limit of AS 2885.1, for the changed Location Class T1,S. Jemena SMS calculations for the 13.3 mm wall thickness pipeline [4] indicate penetrations causing leaks may occur with a 55T excavator employing a penetration tooth, or single tiger tooth. The largest hole size calculated is a 70 mm hole from the penetration tooth, and thermal heat flux would reduce to 4.7 kW/m² at 77m from the pipeline. This is short of the proposed GHPS.
5. The risk assessment found that there were no 'Extreme' or 'High' risk items and two (2) intermediate risk items.
6. One intermediate risk item relating to corrosion is managed by Jemena through planned integrity digs and cathodic protection monitoring.
7. Intelligent pigging was carried out in 2014, and no major adverse findings were made. A new assessment is due in 2024 (10-yearly).

5.2 Recommendations

5. Extend the T1, CIC, S classification for the Gregory Hills development starting at KP 24.2 to KP 28.0 and update the Licence 1 pipeline (Central Trunk) database accordingly. This will encompass the section of pipeline within one ML of GHPS and eliminate the section of pipeline classed T1, CIC in the Gregory Hills development area.
6. Reduce the maximum spacing of pipeline markers in the section of pipeline within 1 ML of the proposed GHPS to 50 m, consistent with AS 2885.1, Table 4.10.1.
7. The Preliminary Hazard Analysis (PHA) should address risk to GHPS occupants and thermal radiation impact on school buildings.
8. Based on the findings of the PHA, identify additional risk reduction measures to minimise thermal radiation impact on buildings and occupants in the GHPS site.

6 REFERENCES

- [1] Jemena Limited, "Licence 1 Pipeline (Central Trunk) - Five (5) yearly Safety Management Study," 22 July 2020.
- [2] Standards Australia, "Pipelines - Gas and Liquid Petroleum, Part 6: Pipeline Safety Management," 2018.
- [3] Standards Australia, "Pipelines - Gas and Petroleum: Part 1 - Design and Construction," 2018.
- [4] Jemena Limited, "Licence 1 Pipeline SMS Calculation for 13.3mm thickness pipe," 29 April 2020.
- [5] Agility, "Engineering Assessment - Fracture Control Plan for Wilton to Horsley Park Natural Gas Pipeline (Licence 1)," 28 May 2004.