

CHAPTER 16- HAZARDS AND RISKS



Table of contents

16.	Hazards and risks	16.1
16.1	Approach	16.1
16.2	Existing environment	16.2
16.3	Construction impacts	16.4
16.4	Operation impacts	16.6
16.5	Decommissioning impacts	16.7
16.6	Mitigation and management	16.7

Table index

Table 16.1	Hazards and risks mitigation measures	16.8
------------	---------------------------------------	------

Figure index

Figure 16.1	Bushfire prone land	16.3
-------------	---------------------	------

16. Hazards and risks

This chapter provides a summary of the potential hazards and risks of the project, including a description of the results of the preliminary hazard analysis (PHA) undertaken in accordance with the SEARs.

Gas pipelines can pose risks to human health and the environment if not properly designed and managed. The construction of a pipeline can also present risks, which need to be addressed during construction planning.

Designing, constructing, operating (including maintaining) and decommissioning the project in accordance with AS 2885 will ensure risks are appropriately managed. The results of the PHA show that appropriate risk management measures can be applied to the project to meet *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning* (Department of Planning, 2011a). Through the development and implementation of relevant identified hazard safeguards and controls, including bushfire management measures, potential hazards and risks associated with the project can be appropriately managed.

Further information is provided in Technical Report 12 (Preliminary hazard analysis).

16.1 Approach

16.1.1 Overview

The assessment of potential hazards and risks has been undertaken by conducting a PHA in accordance with *Hazardous Industry Planning Advisory Paper No. 6 – Hazard Analysis* (Department of Planning, 2011b) (HIPAP No. 6) and *Assessment Guideline: Multi-level Risk Assessment* (Department of Planning and Infrastructure, 2011).

As required by the SEARs, the PHA included a quantitative risk assessment to estimate the potential risks of the project on surrounding land uses, with reference to applicable Australian Standards and licensing requirements under the Pipelines Act. Identified project risks were assessed in accordance with *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning* (HIPAP No. 4) (Department of Planning, 2011a). Consideration was also given to the risk assessments completed for the Narrabri Gas Project EIS and Hunter Gas Pipeline EIS.

In accordance with the SEARs, the assessment considered the potential for hazard and risk impacts associated with gas leaks; the transport, handling and management of dangerous goods; and the potential impacts on and from bushfires and floods.

The hazards and risk assessment does not consider health and safety risks to workers regulated by workplace health and safety legislation (including the *Work Health and Safety Act 2011* (NSW)). Management of site conditions, activities and worker health and safety would be the responsibility of the construction contractor, who would be required to manage the site in accordance with relevant regulatory requirements.

An overview of the approach to the PHA is provided below. Further information on the assessment methodology is provided in section 2 of Technical Report 12 (Preliminary hazard analysis). The assessment of flooding risks was informed by Technical Report 3 (Flooding).

16.1.2 Methodology

Study area

The study area for the PHA consists of a three kilometre radius around the project site. The study area is shown in Figure 2.1 of Technical Report 12 (Preliminary hazard analysis).

Key tasks

The PHA involved:

- reviewing the existing environment, including land uses and sensitive receivers with the potential to be affected by or contribute to hazards and risks
- hazard identification, including:
 - reviewing the quantities and types of dangerous goods and hazardous materials that would be stored and handled on site
 - consideration of possible hazardous scenarios associated with the project during construction, operation (including maintenance) and decommissioning
- risk assessment and evaluation, incorporating:
 - a quantitative risk assessment of gas release events consistent with HIPAP No. 6 to determine the potential fatality and injury risk from loss of containment, using the criteria for individual and societal risk in HIPAP No.4
 - a qualitative risk assessment of other hazardous scenarios using the outcomes of the safety management study conducted by Santos in accordance with *AS/NZS 2885.6:2018 Pipelines - Gas and liquid petroleum Part 6: Pipeline safety management (AS/NZS 2885.6:2018)* to determine the risk of each identified hazard
- qualitative consideration of the potential for flooding and bushfire risks
- risk mitigation and management – identifying management measures and controls to reduce risks to as low as reasonably practicable (also known as ‘ALARP’) levels.

16.2 Existing environment

Key existing hazards and risks associated with the study area and outlined below include transport and gas infrastructure, bushfire prone land and flooding.

A total of 85 sensitive receivers have been identified within the study area for the PHA. The majority of sensitive receivers are located at the eastern end of the study area, and include rural properties and residences within Baan Baa. Identified receivers are shown on Figure 3.1, Figure 3.2 and Figure 3.3 of Technical Report 12 (Preliminary hazard analysis).

16.2.1 Transport and gas infrastructure

The project site crosses and/or involves intersection works with regional and local roads and access tracks, including the Newell and Kamilaroi highways, and the Mungindi railway line. Further information on transport infrastructure in the vicinity of the project site is provided in section 13.2.

The study area encompasses the existing Leewood and Bibblewindi facilities, gas infrastructure such as gas wells, gas and water gathering systems, and supporting infrastructure.

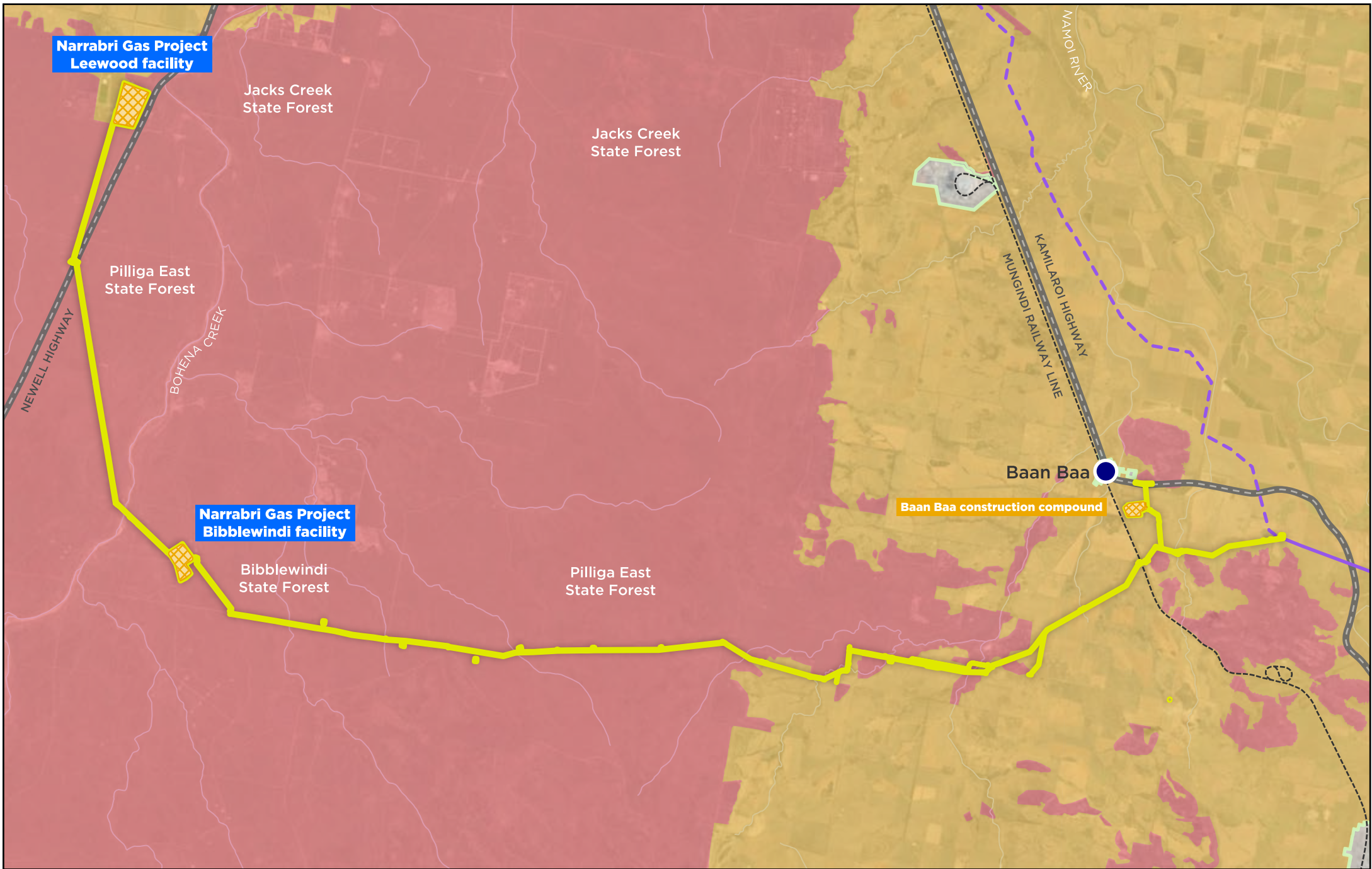
The Wilga Park Power Station is located about 15 kilometres north of the Leewood facility. An existing gas pipeline, between the Leewood and Bibblewindi facilities to the Wilga Park Power Station, is located in the study area. Existing gas infrastructure is shown on Figure 3.1 and Figure 3.2 in Technical Report 12 (Preliminary hazard analysis).

16.2.2 Bushfire prone land

The majority of the Pilliga forests are classified as bushfire prone land within vegetation category 1, which includes areas of forest, woodlands, heaths, forested wetlands and timber plantations. Vegetation category 1 is generally considered a high-risk bushfire classification.

About 42 kilometres of the project site is located in bushfire prone land, which is shown on Figure 16.1.

A bushfire prone land designation highlights the need to plan for bush fire protection as part of the assessment process.



Legend

- Project site
- Construction facility
- Stage 2 Hunter Gas Pipeline - Indicative pipeline route
- Stage 3 Hunter Gas Pipeline - Indicative pipeline route
- Town
- Highway
- Railway line
- Watercourse

NSW Bush Fire Prone Lands: ■ Vegetation Category 1 - High risk ■ Vegetation Category 3 - Medium risk ■ Vegetation Buffer

Figure 16.1 Bushfire prone land

0 1 2 3 4
Kilometres

16.2.3 Flooding

Areas within the project site are subject to flooding, with the extent of inundation depending on the flood event. Areas in the vicinity of the higher order creeks (such as Bohena Creek, Bibblewindi Creek and Baan Baa Creek) experience more extensive inundation, including broader extents and depths, during larger events (such as the 1% AEP event). During more frequent flood events (such as the 5% AEP event), areas of flooding are restricted to watercourse channels and immediate surrounds.

Further information on the existing flooding environment is provided in section 8.2.

16.3 Construction impacts

During construction, potential risks to the community and the environment may be associated with:

- on site storage, handling and transport of hazardous materials and dangerous goods, such as diesel fuel and explosives
- impact on existing gas infrastructure, which could lead to a loss of containment of natural gas
- accidental ignition of vegetation leading to a bushfire
- a bushfire impacting on construction workers and construction ancillary facilities
- changes to watercourses or floodplains that may result in changes to flood behaviour
- flood impacts on construction workers and construction ancillary facilities.

The results of the assessment of these risks are summarised in the following sections.

The potential for contaminated soil, groundwater and/or hazardous waste to be encountered during construction is considered in chapters 7 (Soils), 8 (Water) and 17 (Waste management). Mitigation measures are provided in those chapters to minimise hazards and risks associated with the handling, transport and disposal of these materials.

16.3.1 Transport, handling and storage of hazardous materials and dangerous goods

Dangerous goods are substances that may pose acute risks to people, property and the environment due to their physical or chemical characteristics. Dangerous goods are defined by the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission, 2024) (ADG Code). Most dangerous goods are also classed as hazardous substances. Excessive quantities of dangerous goods or incorrect storage, handling and transport, may exacerbate the potential for fire or explosion and result in off-site impacts.

During construction, diesel would be the only hazardous material stored and/or used in quantities that may pose a potential risk to nearby people, property, or the biophysical environment. Diesel would be transported and stored in accordance with *AS 1940:2017 The storage and handling of flammable and combustible liquids* (Standards Australia, 2017). Based on these controls, the PHA concluded that there would be a 'low' risk of loss of containment of diesel resulting in risks to people and the environment.

As described in section 3.4.2, the need for blasting would be confirmed during detailed design. The PHA considered typical risks posed by the transport, storage and use of explosives. Explosives would be transported to the project site using suitably licensed contractors and in accordance with the ADG Code. The use and storage of explosives would be undertaken in accordance with the *Work, Health and Safety Act 2011* (Cth), *AS 2187.1:1998 Explosives – Storage, transport and use* (Standards Australia, 1998), the ADG Code, and a blasting management plan. Based on these controls, the PHA identified there would be an 'intermediate' level of risk during transport and/or storage. The PHA concluded that ongoing mitigation and management of these risks in accordance with these requirements and implementation of the mitigation measures provided in section 16.6 would reduce the risk to as low as reasonably practicable.

16.3.2 Ignition of vegetation and bushfire

The accidental ignition of vegetation has the potential to escalate into a bushfire. Potential ignition sources during construction would include:

- hot works (e.g. cutting, welding, etc.)
- vehicles/machinery driving through long grass
- accidental ignition (e.g. from cigarettes).

Ignition prevention controls would be confirmed during construction planning and include measures such as using a permit-to-work system to control hot works activities and compliance with total fire bans. These and other measures to manage the risk of igniting vegetation during construction would be included in a fire management plan.

In the unlikely event of a bushfire originating from the project, it may spread to surrounding areas at a fast speed, cutting off access to parts of the site and, impacting construction ancillary facilities. The PHA identified the risk of ignition of vegetation resulting in a bushfire during construction would be 'intermediate'.

There is also potential that bushfires originating outside of the project site could impact project infrastructure or personnel, particularly within the Pilliga East and Bibblewindi State forests, which are classified as high-risk bushfire prone land. The risk of a bushfire impacting the project during construction was also assessed to be 'intermediate'. The PHA concluded that ongoing mitigation and management of these risks in accordance with the mitigation measures provided in section 16.6 would reduce the risk to as low as reasonably practicable.

16.3.3 Disruption to existing gas infrastructure

Construction has the potential to affect existing underground infrastructure, which may result in a loss of containment of natural gas. This could result from accidental striking of buried gas pipelines during excavation activities. If ignited, a release of natural gas has the potential to result in a fire.

With standard construction management controls in place, the PHA identified there would be an 'intermediate' risk of these events. The PHA concluded that ongoing mitigation and management of these risks in accordance with standard construction controls and implementation of the mitigation measures provided in section 16.6 would reduce the risk to as low as reasonably practicable.

16.3.4 Flooding

Changes to watercourses or floodplains as a result of the project (such as from trenching and stockpiling activities) may result in changed flood behaviour. Stockpiles located near existing watercourses, flow paths or within flood prone areas have the potential to obstruct or redirect floodwaters. Other construction ancillary facilities such as compounds also have the potential to obstruct flows or result in loss of flood storage if located inappropriately.

Stockpiles would not be located between the banks of any trenched watercourse that would provide passage for floodwaters in smaller, more frequent flood events. Given the scale of construction works relative to the broader floodplain at each watercourse, the potential impacts of temporary works are expected to be localised to within or in the vicinity of the construction right of way. A consequence rating of minor was assigned by the PHA.

The short duration of the main construction works (e.g. about four months) relative to the frequency of storm/flood events, which have a likelihood of occurrence of once every several years or more, also means that the likelihood of floods occurring of a scale that would result in substantial overland flooding during construction is very low. The PHA concluded the risk of construction activities altering existing flooding patterns and impacting on people and property would be 'negligible'.

Further information about the potential for flooding impacts during construction is provided in chapter 8 (Water).

16.4 Operation impacts

During operation, potential hazards and risks may be associated with:

- loss of containment of natural gas
- ignition of vegetation and bushfire events
- flooding.

16.4.1 Loss of containment of natural gas

The predominant hazardous material during operation is pressurised natural gas. Natural gas consists predominantly of methane (typically greater than 97 per cent), with up to three per cent carbon dioxide (CO₂) and ethane, and less than 0.1 per cent oxygen. It may also include very small quantities of propane and butane (less than 0.5 per cent).

Methane is an odourless, non-toxic, and non-corrosive gas, and is lighter than air at temperatures greater than minus 110 °C. Asphyxia is a possibility if the oxygen concentration in the atmosphere is less than 19.5 per cent. However, due to its buoyancy, a release of natural gas usually disperses rapidly and would not present an asphyxiation hazard.

Potential impacts in the unlikely event of a loss of containment of natural gas may include injuries, fatalities, and damage to properties from a fire or explosion if ignition were to occur. It is noted there are various factors that would be required in order for a natural gas release to result in a fire or explosion, including:

- failure of the pipeline or the associated equipment resulting in a release of gas that forms a flammable mixture
- an ignition source near the release point, e.g. from hot works
- contact between the gas and the ignition source.

A quantitative risk assessment using computer simulation software was undertaken to determine the risk of a loss of containment during operation. This included consideration of the pipeline and surface facilities. Modelling considered the risk of various hole sizes occurring in the pipeline along with the associated frequency of release based on historical incidents. Consideration of the probability of ignition occurring simultaneously with a release event was also modelled to obtain the overall event risk.

The assessment determined the individual and societal risks from the loss of containment of natural gas would comply with the HIPAP No. 4 risk criteria and that there were no sensitive receivers located within any of the relevant risk contours. As such, the risk is considered acceptable.

16.4.2 Ignition of vegetation and bushfire

The ignition of vegetation during operation has the potential to cause a bushfire as a result of the scenarios described in section 16.3.2 as well as a loss of containment event igniting and subsequently causing a bushfire. However, for the ignition of vegetation to escalate into a bushfire, the fire would need to be large enough, under the right conditions, to extend to densely vegetated areas outside of the easement and not be extinguished in a suitable time.

An estimate of the likelihood of vegetation ignition by the project escalating into a bushfire was based on the cumulative likelihood of a loss of containment of natural gas followed by ignition (taking into account the full length of the pipeline and all surface facilities). The loss of containment frequency assessment was used to determine the potential for gas release events to cause a bushfire. The PHA assessed this risk as 'intermediate'.

Bushfires originating from outside of the project site also have the potential to impact above ground project infrastructure during operation. Potential impacts on surface infrastructure would be minimised by implementing measures provided in a fire management plan, prepared in accordance with *Planning for Bushfire Protection* (NSW RFS, 2019) (see section 16.6.2). Impacts on surface facilities are possible but are very unlikely to result in loss of containment of gas. Impacts on the pipeline are unlikely due to it being buried at depth.

The PHA concluded that ongoing mitigation and management of these risks in accordance with the mitigation measures provided in section 16.6 would reduce the risk as low as reasonably practicable.

16.4.3 Flooding

Flooding could result in the following impacts during operation:

- pipeline damage, such as cracks and rupture, from floodwaters saturating the soil and moving the pipeline through positive buoyancy
- pipeline exposure or suspension in the air from the erosion of a watercourse bed during flooding
- mechanical stress and pipeline cracking or exposure of the pipeline from floodwaters eroding a new, straighter channel through a landscape.

These risks are well understood, and pipelines are designed in accordance with AS 2885 to withstand flooding impacts. Additionally, there are numerous procedural controls implemented following flood events, and during routine operation and maintenance, to ensure the integrity of the pipeline infrastructure. With standard controls implemented, the risk of flooding impacting the project is considered controlled.

Further information about the potential for flooding impacts during operation is provided in chapter 8 (Water).

16.5 Decommissioning impacts

At project closure, the pipeline would be decommissioned as described in section 3.8, including compliance with the Pipelines Act and Regulation, AS 2885 and relevant guidelines and requirements.

Activities with the potential for hazard and risk impacts (if inadequately managed) include:

- Residual gas management, which may (depending on the outcomes of the safety management study and abandonment plan) involve controlled release or controlled combustion using portable equipment. These activities may pose risks related to ignition, heat radiation and pressure release.
- Loss of containment of diesel during on site transport and/or storage, which may result in environmental contamination or fire risk.
- Ignition of vegetation, particularly during hot, dry conditions, which may result in a bushfire if not adequately controlled.

The final decommissioning activities will be determined through the safety management study and segment analysis, and may differ from those listed above depending on site-specific conditions and risk assessments.

Decommissioning activities are expected to have minimal potential for hazard and risk impacts due to the comprehensive and structured risk-based process that governs decommissioning in accordance with AS 2885. This process will ensure that potential risks and impacts are systematically identified, assessed and managed. In addition, decommissioning activities would be less intensive than construction works, involving fewer personnel, less equipment and shorter durations of work at any given location.

With the implementation of these processes, and the measures defined in the abandonment plan, the hazards and risks associated with decommissioning are expected to be effectively controlled, and no significant residual risks to people, property or the environment are anticipated.

16.6 Mitigation and management

16.6.1 Approach to mitigation and management

Mitigation measures have been developed with the aim of minimising or mitigating, where practicable, hazards, risks and impacts. Key measures are described below and detailed in section 16.6.2.

The main risks for the project include loss of containment from existing gas pipelines during construction and the potential for ignition of vegetation and escalation into a bushfire during construction and operation. These risks were identified as having an 'intermediate' risk, which would be further reviewed and reduced in future design development and construction planning.

The safety management process in AS/NZS 2885.6:2018 will be implemented through the lifecycle of the pipeline system. This, together with the application of accompanying standards, codes of practice and guidelines, including the requirements of the Pipelines Act, will continue to govern the ongoing identification and management of risks throughout the project lifecycle. Mitigation will be applied to reduce risks to as low as reasonably practicable in accordance with AS 2885 requirements.

Measures to mitigate the risk of ignition of vegetation and bushfire will be included in the CEMP, which will include incident management and emergency response processes, responsibilities and measures to manage hazards incidents and emergency situations that may occur during construction.

The mitigation measures provided in Table 16.1 would be implemented during design, construction, operation and decommissioning of the project to manage identified risks to the environment and community.

16.6.2 List of mitigation measures

Measures that will be implemented to address potential hazards and risks are listed in Table 16.1.

Table 16.1 Hazards and risks mitigation measures

Impact/issue	Ref	Mitigation measures	Timing
Ongoing hazard assessment and safety management	HR1	The project will continue to be designed in accordance with the AS/NZS 2885 Pipelines – Gas and Liquid Petroleum series of standards to ensure all potential hazard, safety and risks are identified and appropriately managed. Controls to reduce identified risks to ‘as low as reasonably practicable’ (ALARP) levels will inform the design, including: <ul style="list-style-type: none"> the results of a hazard and operability study (HAZOP) undertaken in accordance with <i>Hazardous Industry Planning Advisory Paper No. 8 – HAZOP Guidelines</i> (DoP, 2011c) and AS/NZS 2885.6:2018 Pipelines – Gas and liquid petroleum, Part 6: Pipeline safety management further pipeline safety management studies completed at each phase of the pipeline lifecycle, in accordance with AS/NZS 2885.6:2018 Pipelines – Gas and liquid petroleum, Part 6: Pipeline safety management. 	Design
	HR2	Control measures to detect and respond to the loss of containment of natural gas will be included as part of the design, including: <ul style="list-style-type: none"> telemetric controls to monitor gas flow into and out of the pipeline a method of remotely stopping gas flow through the pipeline. 	Design
	HR3	The CEMP will include incident management and emergency response processes, responsibilities and measures to manage any hazards, incident and emergency situations that may occur during construction.	Pre-construction
Loss of containment of diesel	HR4	The transport, handling and storage of diesel will be undertaken in accordance with relevant Australian Standards, codes and guidelines, including: <ul style="list-style-type: none"> <i>Australian Code for the Transport of Dangerous Goods by Road and Rail</i> (National Transport Commission, 2024) <i>AS 1940:2017 The storage and handling of flammable and combustible liquids.</i> 	Construction
Ignition of vegetation and bushfire	HR5	A fire management procedure will be prepared as part of the CEMP and implemented with reference to <i>Planning for Bushfire Protection</i> (NSW Rural Fire Service, 2019). The procedure will include: <ul style="list-style-type: none"> measures for the protection of human life and property from the threat of a bushfire asset protection zones for surface facilities requirements in relation to provision of suppression equipment and water supplies work procedures and controls to manage potential risk of ignition during hot works and periods of bushfire danger. 	Pre-construction

Impact/issue	Ref	Mitigation measures	Timing
Loss of containment of natural gas from existing gas pipelines	HR6	Appropriate control measures and processes will be identified and implemented during construction to ensure that impacts on existing gas pipelines are avoided. Measures will be identified in consultation with gas field operators and defined in the CEMP.	Pre-construction, construction
Ignition of explosives	HR7	In the event blasting and storage of explosives is required, the following will be specified in the blasting management plan (mitigation measure NV5) and implemented during construction: <ul style="list-style-type: none"> the storage, transport and use of explosives will be conducted in accordance with <i>AS 2187.1:1998 Explosives – Storage, transport and use</i> the inventory of stored explosives will not exceed the Major Hazard Facility threshold quantities as defined in Schedule 15 of the NSW Work Health and Safety Regulation 2017. 	Pre-construction, construction
Management of hazards and risks during operation	HR8	A pipeline management system will be implemented in accordance with the <i>AS/NZS 2885 Pipelines – Gas and Liquid Petroleum</i> series of standards and Part 3 Division 3 of the <i>Pipelines Regulation 2023</i> , including processes for managing any emergency events during operation and maintenance, and from external events that may affect the safe and reliable operation of the pipeline system.	Operation
Management of hazards and risks during decommissioning	HR9	Measures to manage potential hazards and risks during decommissioning will be identified in the safety management study in accordance with <i>AS/NZS 2885.6:2018 Pipelines – Gas and liquid petroleum, Part 6: Pipeline safety management</i> . These measures will be incorporated into the abandonment plan and decommissioning environmental management plan, consistent with relevant regulatory and best practice requirements in effect at the time.	Decommissioning