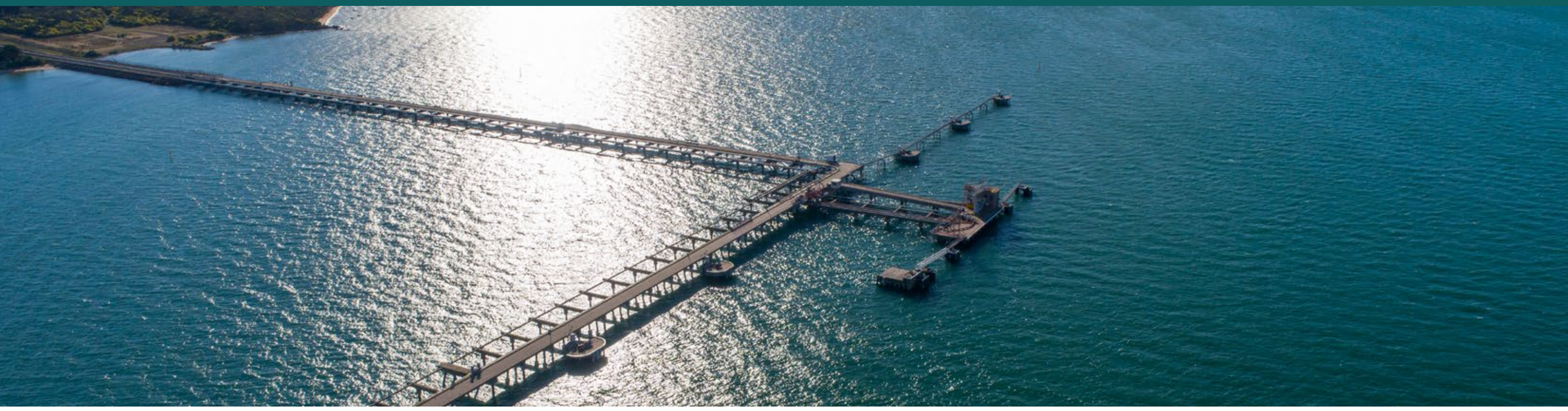
Chapter 4
Project description



4.1 Introduction

This chapter describes the design, construction and operation of the proposed Gas Import Jetty and Pipeline Project (the Project), including relevant design standards. The purpose of this chapter is to provide a clear understanding of the scope of works for which subsequent approval is being sought and the basis upon which the Environment Effects Statement (EES) has been prepared.

The Project description in this chapter provides details of all Project components as outlined in **Table 4-1**. This chapter should be read in conjunction with Attachment VII *Map book*.

Table 4-1: Project description

Project description	Location in EES
Location, footprint, layout and access arrangements, including laydown areas, equipment/machinery storage and stockpiling areas, during construction and operation	**Section 4.2** *(Project overview)* **Section 4.5.2** *(Project construction laydown and pipe stockpiling areas)* Attachment VII Map book
Proposed or foreseeable marine activities that may be necessitated by the Project, such as seawater intakes and discharges and mixing zones	**Section 4.3.1** *(Floating storage and regasification unit – Seawater use and discharge ports)* **Chapter 6** *Marine biodiversity*
Design and expected construction staging and scheduling for the Project	**Section 4.5.1** *(Indicative construction schedule)*
Proposed construction methods (to the extent relevant and practicable), temporary occupation of land, extent of areas to be disturbed during construction and infrastructure and service relocation	**Section 4.5** *(Construction)*
Solid waste, wastewater and hazardous material generation and management during construction and operation	**Section 4.8** *(Waste and spoil management)*

Project description	Location in EES
The visual appearance of proposed materials and finishes	**Section 4.3** *(Gas Import Jetty Works)* **Section 4.4** *(Pipeline Works)* **Chapter 14** *Landscape and visual*
Lighting, safety and security requirements during construction and operation	**Section 4.3** *(Gas Import Jetty Works)* **Section 4.4** *(Pipeline Works)* **Section 4.6** *(Operation and maintenance)* **Chapter 14** *Landscape and visual* **Chapter 16** *Safety, hazard and risk*
Hours of construction work and operational activity	**Section 4.5.5** *(Construction workforce for the Project)* **Section 4.6.2** *(Operational workforce for the Project)*
Information on the Project's operational life and any decommissioning and rehabilitation arrangements	**Section 4.5.4** *(Pipeline Works construction – Rehabilitation of the right of way)* **Section 4.6** *(Operation and maintenance)* **Section 4.7** *(Decommissioning)*
Other necessary works directly associated with the Project, such as road upgrades or connections, and infrastructure and services relocation	**Section 4.3.2** *(Jetty Infrastructure)*
Approach to be taken to address visual and landscape impacts	**Chapter 14** *Landscape and visual*

4.1.1 Status of Project design

For the Gas Import Jetty Works, the design of the floating storage and regasification unit (FSRU) is well resolved. It is an existing vessel that would be modified to ensure it operates in accordance with the description set out in this chapter and to meet the recommendations of the Minister's assessment and requirements of subsequent statutory approvals.

The Jetty Infrastructure and Crib Point Receiving Facility aspects of the Gas Import Jetty Works are well developed with front end engineering design close to completion. Some further refinement may be required as part of detailed design.

Similarly, the Pipeline Works design, including the pipeline and its facilities, is well developed, with resolution of the final pipeline alignment and constructability to be completed following Project approvals, landholder agreement and appointment of construction contractors. Landholders and relevant stakeholders along the proposed alignment and alignment options have been engaged throughout the Pipeline Works design process to address concerns about construction and operation of the pipeline.

It is common practice for projects to be amended as they progress through the assessment process. These changes may be in response to community engagement during the exhibition of the EES, detailed technical feedback received from agencies or in response to the Minister's assessment.

4.2 Project overview

The Project would provide an additional supply of natural gas into the south-eastern Australian gas market for industrial, commercial and residential customers. Potential supply gaps in Victoria's gas market are predicted from 2024 due to a forecast decline in gas production from the Gippsland, Bass and Otway basins. The Project would improve energy security for industrial, commercial and domestic customers and increase competition in the market.

The Project proposes to continuously moor a floating storage and regasification unit (FSRU) at Berth 2 of the Crib Point Jetty at Crib Point. An FSRU is a ship that can store liquified natural gas (LNG) and which is also fitted with an onboard regasification unit that can return stored LNG into a gaseous state.

The FSRU would be approximately 300 metres long and 50 metres wide with an LNG storage capacity of approximately 170,000 cubic metres (m^3). The FSRU would store LNG at a temperature of 163 degrees Celsius below zero (-163 ˚C) in cryogenic storage tanks. The cold temperature keeps the LNG in its liquid state until it is required to be supplied into the gas network.

When gas is needed, the LNG would be converted back into a gas using the FSRU's onboard regasification unit. Seawater would be used to warm the LNG into a gaseous state. The gas would then be discharged under pressure from the FSRU through marine loading arms (MLAs), into gas piping installed on the Crib Point Jetty and eventually into the existing gas transmission network via a new pipeline between Crib Point and Pakenham.

When the FSRU is empty (when there is no more LNG in the storage tanks onboard), another ship would arrive to fill the FSRU. Visiting ships, known as LNG carriers, would moor alongside the FSRU and refill the FSRU storage tanks. The refilling process would take up to 36 hours, after which the visiting LNG carrier would depart.

A visualisation of the FSRU at Berth 2 of the Crib Point Jetty and an LNG carrier moored alongside is shown in **Figure 4-1**. A detailed description of the FSRU and the onboard storage tanks and regasification unit is provided in **Section 4.3.1** of this chapter.

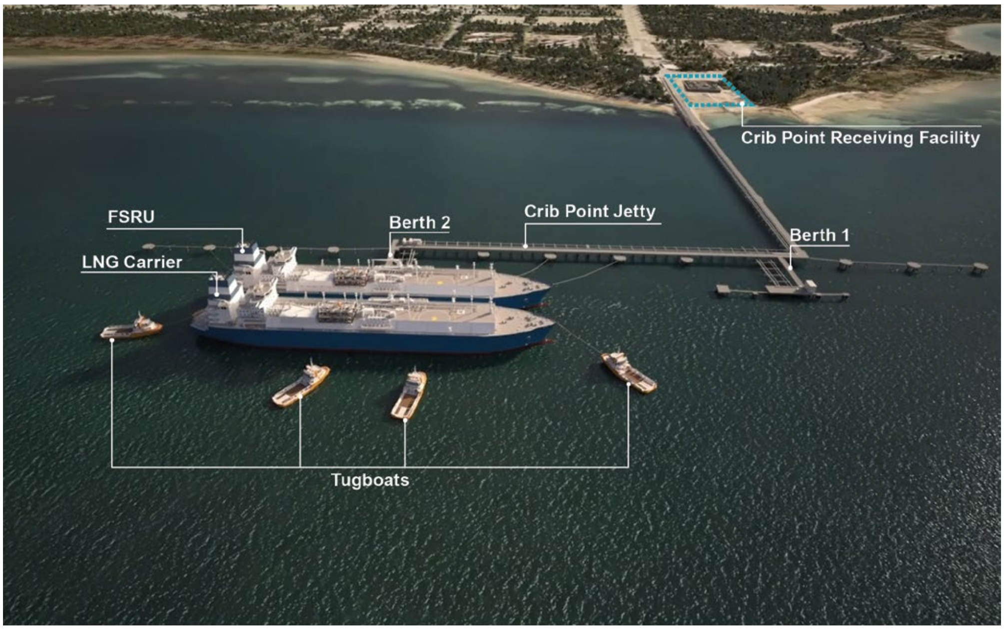


Figure 4-1: Visualisation of FSRU and LNG carrier berthed side by side at Crib Point Jetty

4.2.1 Project works

The Project comprises two sets of works: the Gas Import Jetty Works and the Pipeline Works.

AGL would undertake the Gas Import Jetty Works which would comprise:

- continuous mooring of an FSRU at Berth 2 of the existing Crib Point Jetty to store LNG and regasify LNG into natural gas using the onboard regasification unit
- Jetty Infrastructure on the Crib Point Jetty including marine loading arms (MLAs) that would connect to the FSRU and gas piping installed on the Crib Point Jetty, to transfer the gas from the FSRU to the Crib Point Receiving Facility
- Crib Point Receiving Facility, including gas metering, odorant injection and nitrogen injection (if required to meet the standard gas quality specifications) – the Crib Point Receiving Facility would be located on land adjacent to the Crib Point Jetty.

The Gas Import Jetty Works are described in further detail in **Section 4.3** of this chapter.

APA would undertake the Pipeline Works which would comprise:

- an underground gas pipeline approximately 57 kilometres long linking the Crib Point Receiving Facility at Crib Point and the Victorian Transmission System (VTS) east of Pakenham
- a pigging facility at the Crib Point Receiving Facility to enable in-line inspections of the pipeline with a pipeline inspection gauge (pig)
- the above-ground Pakenham Delivery Facility adjacent to the Pakenham East rail depot to monitor and regulate gas
- a below-ground End of Line Scraper Station (EOLSS) located at the connection point to the VTS, north of the Princes Highway in Pakenham
- two above-ground mainline valves (MLV1 and MLV2) located at different points along the pipeline alignment to enable isolation of the pipeline in an emergency.

The Pipeline Works are described in more detail in **Section 4.4** of this chapter.

The FSRU is proposed to operate for 20 years. The Pipeline Works would have a design life of 60 years. The Project and its key components are shown in **Figure 4-2**.

Pipeline pigging

A pipeline inspection gauge (pig) is a cylindrical tool which is inserted into a pipeline to clean and inspect the pipe internally.

The pig is inserted into the pig launcher and is propelled by the gas flow or hydrotest water, travelling the full length of the pipeline to the receiver.

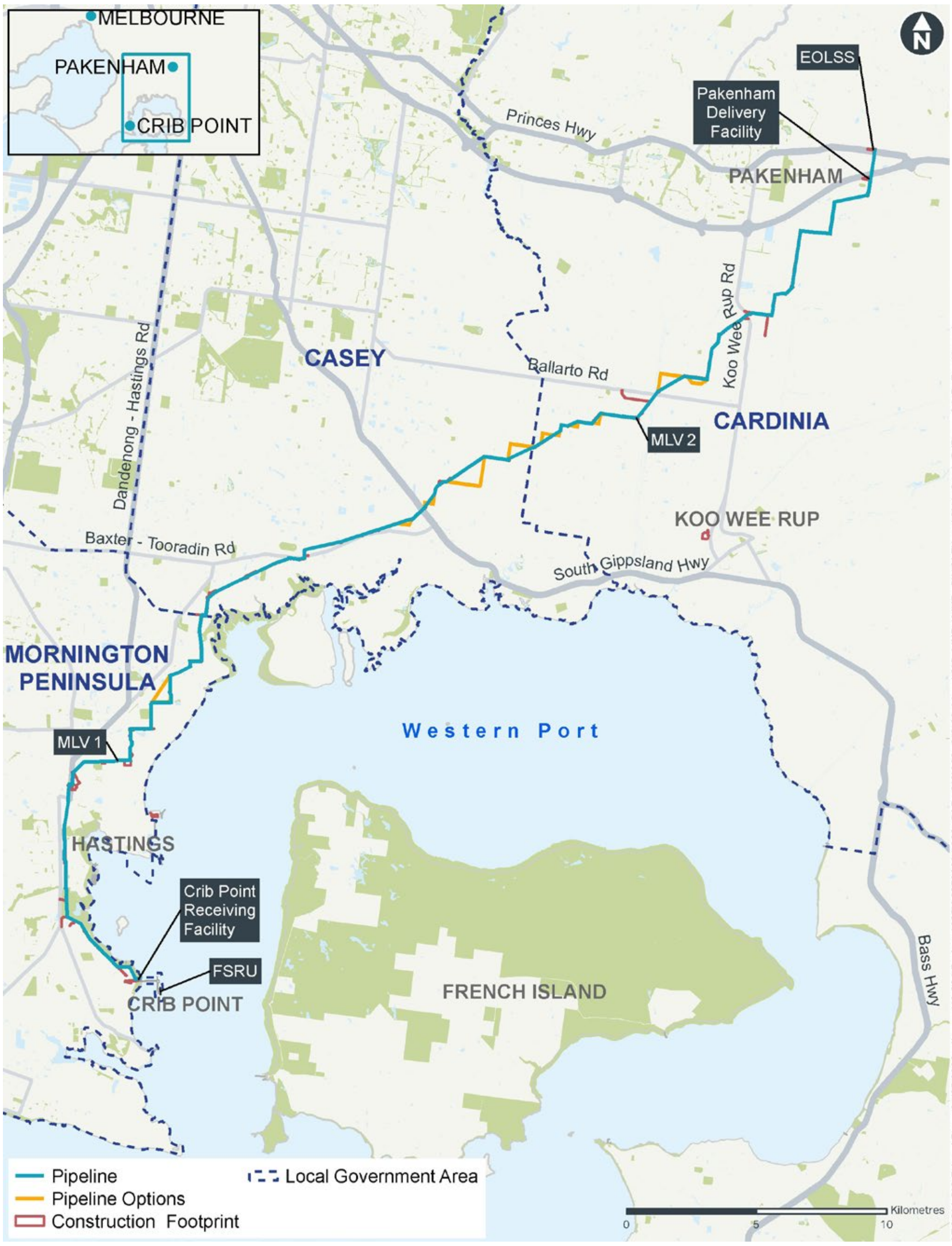


Figure 4-2: Gas Import Jetty and Pipeline Project - location of key components

4.3 Gas Import Jetty Works

This section outlines the key components of the Gas Import Jetty Works including the function of the FSRU, the topside Jetty Infrastructure and the Crib Point Receiving Facility. An overview of these works is provided in **Table 4-3**.

As shown in **Figure 4-3** above, the Project proposes to continuously moor an FSRU at Berth 2 of the Crib Point Jetty at Crib Point. An FSRU is a ship that can store LNG which is also fitted with an onboard regasification unit that can return stored LNG into a gaseous state and then supply it into the gas network. The gas would be used as a fuel by domestic, commercial and industrial customers.

The FSRU would be capable of storing approximately 170,000 m^3 of LNG and regasifying it using the onboard regasification unit as required to meet gas demand. Following regasification, the gas would be transferred from the FSRU to the Crib Point Receiving Facility via MLAs that would connect to gas piping mounted on the jetty.

The FSRU would receive LNG from ships known as LNG carriers. LNG carriers are vessels of a similar size and design as the FSRU. The FSRU would initially receive approximately 45 petajoules (PJ) of LNG per annum (approximately 12 LNG carriers). The amount of LNG could increase to 160 PJ per annum (approximately 40 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 140,000 to 170,000 m^3.

Table 4-2 summarises key data for the Gas Import Jetty Works. Further details on the FSRU, Jetty Infrastructure and Crib Point Receiving Facility are provided in **Sections 4.3.1**, **4.3.2** and **4.3.3** of this chapter.

Unit measurements for gas – Energy versus Volume

Joules (J) are a measure of **energy.**

- 1 PJ (petajoule) = 1,000 TJ (terajoule) = 1,000,000 GJ (gigajoule) = 1 x 10^{15} J
- Million standard cubic feet per day (mmscf/day) is a **flow rate** used to measure gas.
- 250 mmscf/day (the capacity of one regasification train) ≈ 265 TJ/day
- Conversion from volumetric flow rate (mmscf) to energy flow rate (TJ) is:
- required due to gas market retailers selling gas to consumers as an energy quantity while the physical gas network operation is based on volumetric gas flows
- dependent on actual, measured gas heating value which can vary a little and provides the energy rating of one volumetric unit of gas.

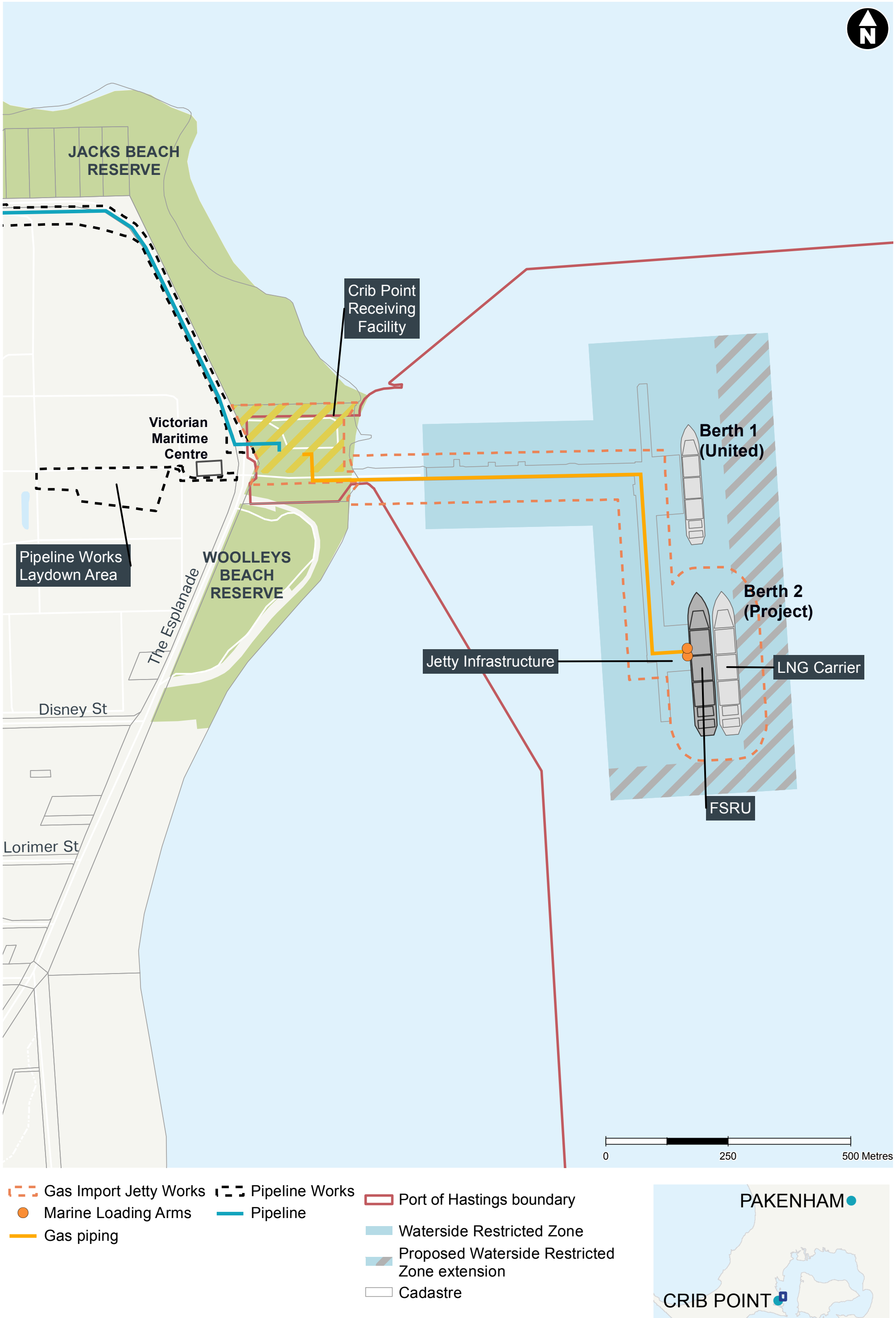


Figure 4-3: Gas Import Jetty Works

Table 4-2: Summary of key data for the Gas Import Jetty Works

Gas Import Jetty Works key data		
Number of LNG carriers per annum		Base case of 12, which could increase to approximately 40
Energy equivalent of LNG per annum		45 - 160 PJ
FSRU		
FSRU length		approximately 300 m
FSRU breadth		approximately 50 m
Number of LNG cargo tanks		4
LNG storage capacity		approximately 170,000 m^3
Temperature of LNG storage		-163 °C
Number and diameter of flexible hoses to receive LNG		4 x 10 inches
Number and diameter of flexible hoses to return vapour		2 x 10 inches
Number of engines		4 x dual fuel engines
Number of regasification trains		3
Maximum output of each regasification train		250 mmscf/day
FSRU gas send out capacity		Maximum output of 750 mmscf/day (3 trains)
Chlorine concentration in seawater at point of discharge		100 parts per billion or 0.1 milligrams per litre (mg/L) at the point of discharge from the FSRU and before any mixing with seawater
Open loop regasification mode	Seawater intake and discharge volume for open loop regasification	1 train – 156,000 m^3/day 2 trains – 312,000 m^3/day 3 trains – 468,000 m^3/day Inclusive of cooling water for engines and auxiliary machinery Excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire testing water
	Seawater intake velocity	≤ 0.15 metres per second (m/s)
	Seawater discharge velocity	≥ 5 m/s
	Temperature difference of seawater at discharge point (below ambient)	No more than 7 °C
	Number of seawater discharge ports for open loop regasification LNG heating	6
Closed loop regasification mode	Seawater intake volume for closed loop regasification	Cooling water for engines and auxiliary machinery – 184,000 m^3/day Excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire testing water
	Number of gas-fired boilers	3
Diesel fuel storage capacity		approximately 5,600 m^3
Lubrication oil storage capacity		approximately 220 m^3

Gas Import Jetty Works key data	
Jetty Infrastructure	
Number of MLAs	2
Jetty gas piping nominal diameter	600 mm
Jetty gas piping length	Approximately 1.5 km
Firefighting system	Fire pumps, fire monitors, hydrants
Associated infrastructure	Gangway tower, substation, air compressor, transformer, lighting and CCTV system
Crib Point Receiving Facility	
Liquid nitrogen storage capacity	3000 tonnes
Mercaptan (odorant) storage capacity	40 m^3
Firefighting system	Water tanks, fire pumps, hydrants
Associated infrastructure	Meter run and gas analysers, vent stack, vaporiser towers, truck gantries

4.3.1 Floating storage and regasification unit

The FSRU is approximately 300 metres long and 50 metres wide with a maximum draft of 12 metres (the distance between the surface of the water and the lowest point of the vessel). The height of the vessel is approximately 50 metres above the sea surface to the top of the exhaust stack.

The FSRU is a double-hulled ocean-going vessel with four cargo tanks suitable for storing LNG at very low temperatures (-163°C). The cargo tanks are lined with specialised membranes to allow the storage of chilled LNG. The cold temperature and insulation keeps the LNG cargo in a liquid state until it is required for regasification.

The FSRU has the capability to receive LNG from an LNG carrier, return the LNG to a gaseous state using the onboard regasification unit ('regasification'), and transfer the gas into the MLAs on the jetty. Regasification would primarily use the 'open loop mode', meaning that seawater would be used to warm the LNG into a gaseous state. The FSRU would also be able to operate in closed loop regasification mode and combined loop regasification mode as described in the following sections.

The FSRU would be continuously moored at Berth 2 of the Crib Point Jetty. The FSRU would receive LNG from LNG carriers. Arriving LNG carriers would berth facing north, immediately alongside the FSRU as shown in **Figure 4-1**. Tugboats contracted by the Port of Hastings Development Authority (PoHDA) would be required to moor the LNG carrier safely next to the FSRU.

The LNG carriers would typically tether next to the FSRU for up to 36 hours while LNG is transferred into the cargo tanks of the FSRU. Purpose-built flexible cryogenic hoses would be used to transfer the LNG from the LNG carriers to the FSRU. LNG may be reloaded back from the FSRU to an LNG carrier if this ever became necessary. This would generally only be required if the LNG is not being used, to avoid the LNG composition changing.

Once the transfer of LNG is complete, LNG carriers would depart from alongside the FSRU with the assistance of tugboats.

FSRU engines

Dual fuel engines are used to provide all the electrical power required on board the FSRU, including for driving the compressors, pumps, ventilation fans, general utility and other equipment. The engines also provide electric power for propulsion of the FSRU. The engines normally operate on boil-off gas with marine diesel oil used as a pilot fuel and can also operate on marine diesel oil if required. Seawater use on the FSRU

The FSRU would use seawater for a range of purposes, including:

- regasification to convert stored LNG into natural gas
- emergency fire water
- water curtain, a spray to ensure there is no direct contact between LNG carrier and the hull of the FSRU if LNG were to escape during unloading operations, is to protect the hull from cryogenic temperatures
- ballast water, to maintain the vessel's stability and longitudinal strength (bending movements):
  - the FSRU would take in seawater as ballast during regasification operations, to compensate for the reduction of LNG volume in the cargo tanks as the natural gas is exported to shore – ballast water would be discharged from the FSRU during LNG loading from LNG carriers
  - visiting LNG carriers would arrive full of LNG and would not need to discharge ballast water into Western Port – they would take on seawater as ballast as they unload their cargo
- cooling water for the engines and auxiliary machine systems, which would be directed to the open loop regasification cycle instead of directly discharged to sea, reducing the overall water consumption
- generation of freshwater onboard the FSRU.

Maximum daily seawater intake and discharge flows from the FSRU for open loop and closed loop regasification modes are shown in **Figure 4-4** and **Figure 4-5**, and listed in **Table 4-3**. Intermittent and minor flows associated with the purposes listed above are also presented in **Table 4-3**. Seawater intake and discharges for the combined loop regasification mode would be the same as for the open loop regasification mode.

Table 4-3: Seawater use in the FSRU

Seawater usage	Assumptions	Maximum seawater flow rates (m^3/day)		Temperature difference
		Open loop mode	Closed loop mode	
Intermittent flows				
Ballast water during LNG loading	Total ballast capacity is 53,500 m^3	53,500	53,500	-
Water curtain		5,760	5,760	-
Fire water	System tested 1 hour every 2 weeks	1,550	1,550	-
Continuous flows				
Cooling of freshwater generator	There are 2 freshwater generator units. Only 1 unit operates at any given time	2,112	2,112	+8˚C
Heating for regasification operation	All 6 seawater pumps in use	468,000	-	-7˚C
Regas backflush filter	Each filter is flushed for 1 hr/day	723	-	-
Cooling of auxiliary machinery systems		-	45,480	+5˚C
Cooling of engines		-	58,560	+12˚C
Cooling of atmospheric dump condenser	In closed loop mode steam is not dumped during normal operation. However, if there is operational upset such as a regas plant trip causing an unexpected shutdown, the steam in the boilers may be dumped in the condenser.	-	80,400	+16.5˚C (full steam dumping) Ambient in normal operation

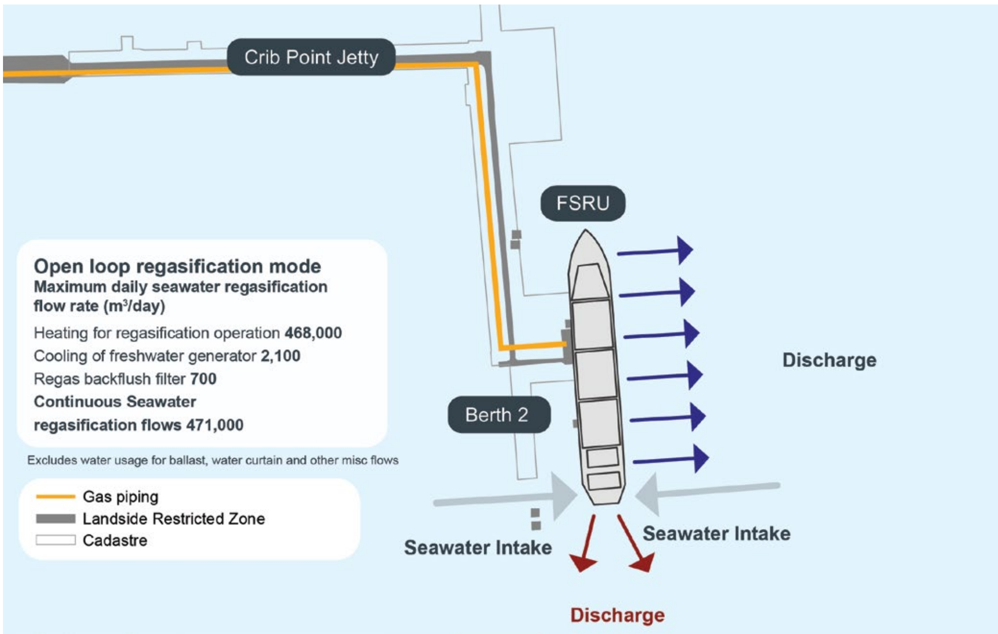


Figure 4-4: Continuous seawater flows in open loop regasification mode

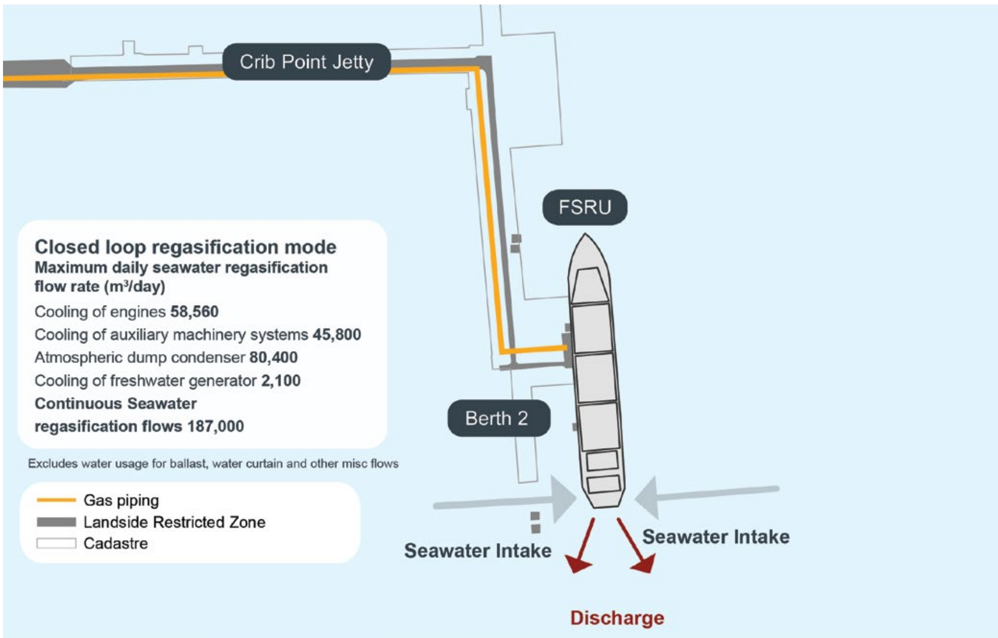


Figure 4-5: Continuous seawater flows in closed loop regasification mode

Seawater inlets on the side of the FSRU are at least two metres from the surface and three metres from the seabed to minimise entrainment of biota, debris and sediments. The seawater intake velocity would be less than 0.15 metres per second to allow mobile marine biota to swim away and the seawater inlets would be fitted with a screen with bar grilles. Screen grilles would not exceed 100 millimetre horizontal by 100-millimetre vertical spacing.

Following the intake of seawater into the vessel, an electric current would be passed through the seawater (a process known as electrolysis). Electrolysis breaks up the naturally occurring salt molecules (sodium chloride) in seawater and produces chlorine and hypochlorite, which prevents the growth of marine organisms in the internal piping system and the seawater heat exchangers of the FSRU. When the seawater is discharged from the vessel back into the marine environment, some short-lived residual chlorine would be present before mixing and decay.

Regasification on the FSRU

The FSRU converts stored LNG into natural gas via a process called regasification using an onboard regasification unit. A heat-exchanger is used as an interface to transfer heat from a heat source to the LNG in the regasification train.

This section describes the different modes of regasification that can be used on the FSRU including associated seawater intakes and discharges, and the proposed mode of regasification for the Project.

Open loop regasification mode

The FSRU regasification unit would use open loop to regasify LNG under normal operations. In open loop regasification mode, seawater would be continuously drawn into the FSRU through seawater inlets on the side of the FSRU and circulated through the heat exchangers. The heat exchangers rely on two phases of heat exchange process:

- between seawater (as the heat source) and an intermediate fluid (propane)
- between propane and LNG.

Circulated seawater would be continuously discharged from the FSRU. The discharged seawater used in regasification would be up to 7 °C below ambient seawater temperature, before any mixing.

In open loop regasification mode, cooling water for the engines and auxiliary machine systems would be redirected to the open loop regasification cycle instead of being directly discharged to Western Port.

Regasification

Regasification is a process of converting LNG at -163°C back to natural gas.

The FSRU converts stored LNG into natural gas via a process called regasification using an onboard regasification train. A regasification train is a heat-exchanger used as an interface to transfer heat from a heat source to the LNG in the FSRU.

Figure 4-6 provides a simplified diagram of open loop regasification.

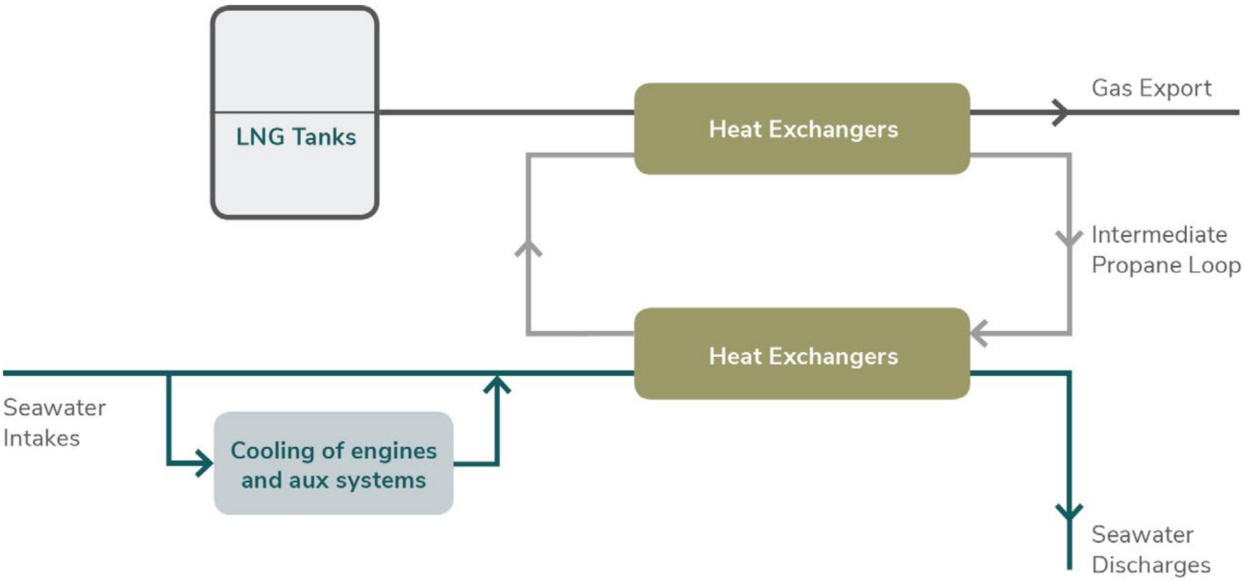


Figure 4-6: Open loop regasification process

All the seawater pumps onboard the FSRU are fixed speed and pumps would be turned on or off as required based upon cooling/heating demand onboard the vessel. While the gas production rate is variable (the rate at which the onboard regasification unit converts stored LNG into gas), the required water flow (seawater intake and discharge) used to heat the LNG depends on the number of regasification trains running.

Table 4-4 shows the maximum seawater flow rates for open loop regasification (m^3/day) based on the number of regasification trains operating. While the water flow demand may be less based on operations, the maximum flow rate has been used throughout the EES assessment process as a predicted worst-case seawater flows scenario.

Table 4-4: Maximum seawater flow rates for open loop regasification

Number of regasification trains in operation	Gas production rate (mmscf/day)	Number of seawater pumps in operation	Maximum seawater flow rates in open loop regasification mode[a] (m^3/day)
1	50–250	2	156,000
2	250–500	4	312,000
3	500–750	6	468,000

Notes to table: Excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire testing water.

Seawater used in the open loop regasification process would be discharged using a six-port configuration. Discharge ports would be orientated to deliver a horizontal water jet below the water surface to optimise mixing and return of the seawater to ambient conditions. Two discharge ports would be used per operating regasification train. In addition to the six seawater discharge ports for regasification water, several auxiliary discharge ports would be located near the FSRU engine room, including for cooling and ballast as is typical for ocean-going vessels.

A simplified diagram of the proposed seawater intake and discharge configuration in open loop regasification mode is shown **Figure 4-7**.

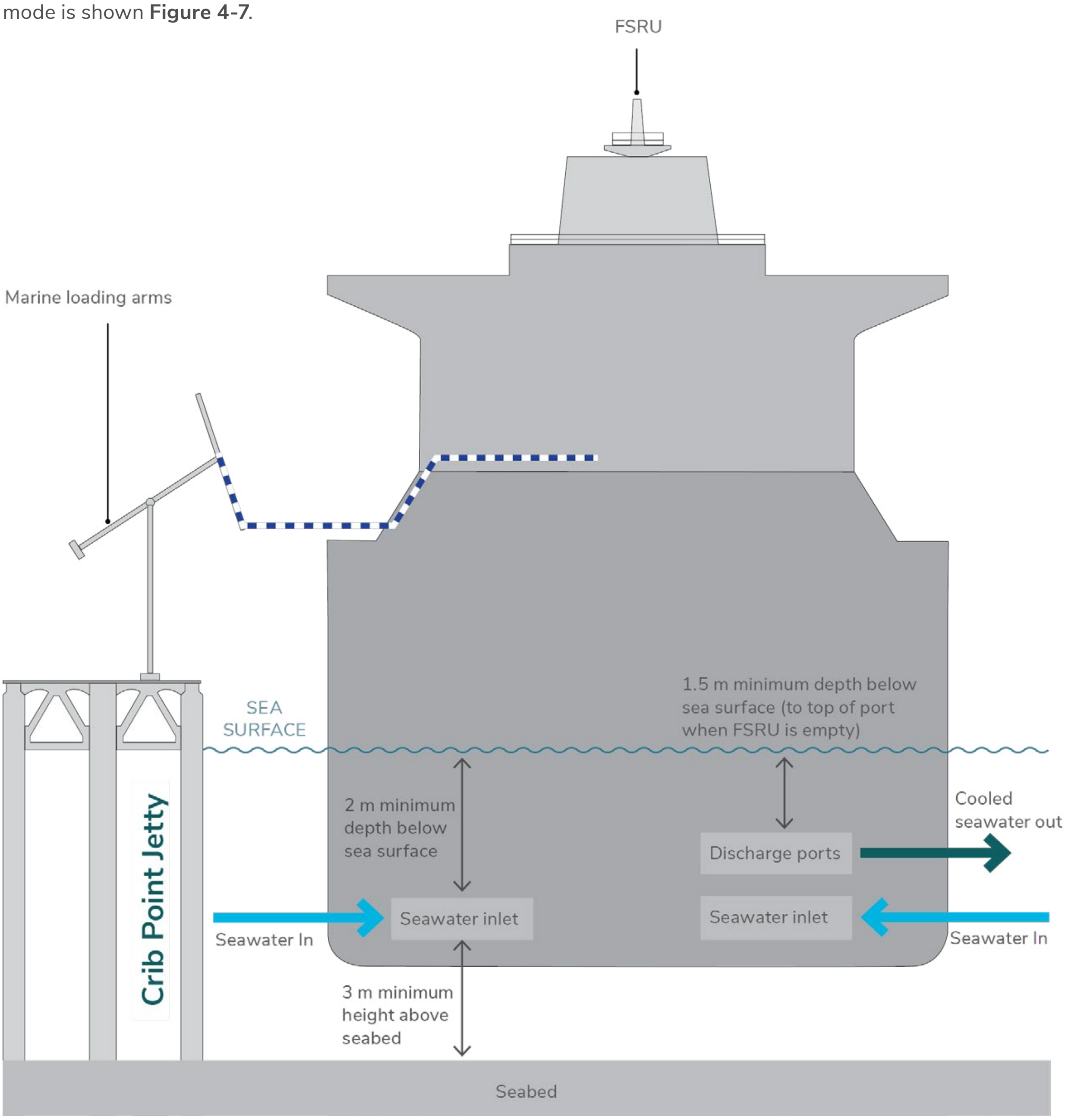


Figure 4-7: Open loop regasification seawater intake and discharge (not to scale)

Closed loop regasification mode

In closed loop regasification mode, around 500 m^3 of seawater would fill the FSRU heat exchange piping. Once filled, the seawater inlet and outlet on the FSRU would be isolated and the water circulated within a closed loop. Seawater cooled in the heat exchanger is then reheated by steam from the gas-fired boilers and continually circulated in the process, instead of being discharged from the FSRU as per the open loop mode. **Figure 4-8** shows a simplified diagram of how the closed loop regasification mode operates.

Seawater flow rates (intake and discharge) in the closed loop mode are shown in **Table 4-5**. Under closed loop regasification mode, seawater used for engine cooling would be discharged at the rear of the FSRU.

In addition to the continuous seawater discharges for closed loop regasification described above and shown in **Table 4-5**, the seawater used in the closed loop system would be discharged to Western Port when the system is switched back to open loop mode. Discharged seawater from the closed loop process would be around 5 °C warmer than the ambient Western Port water temperature.

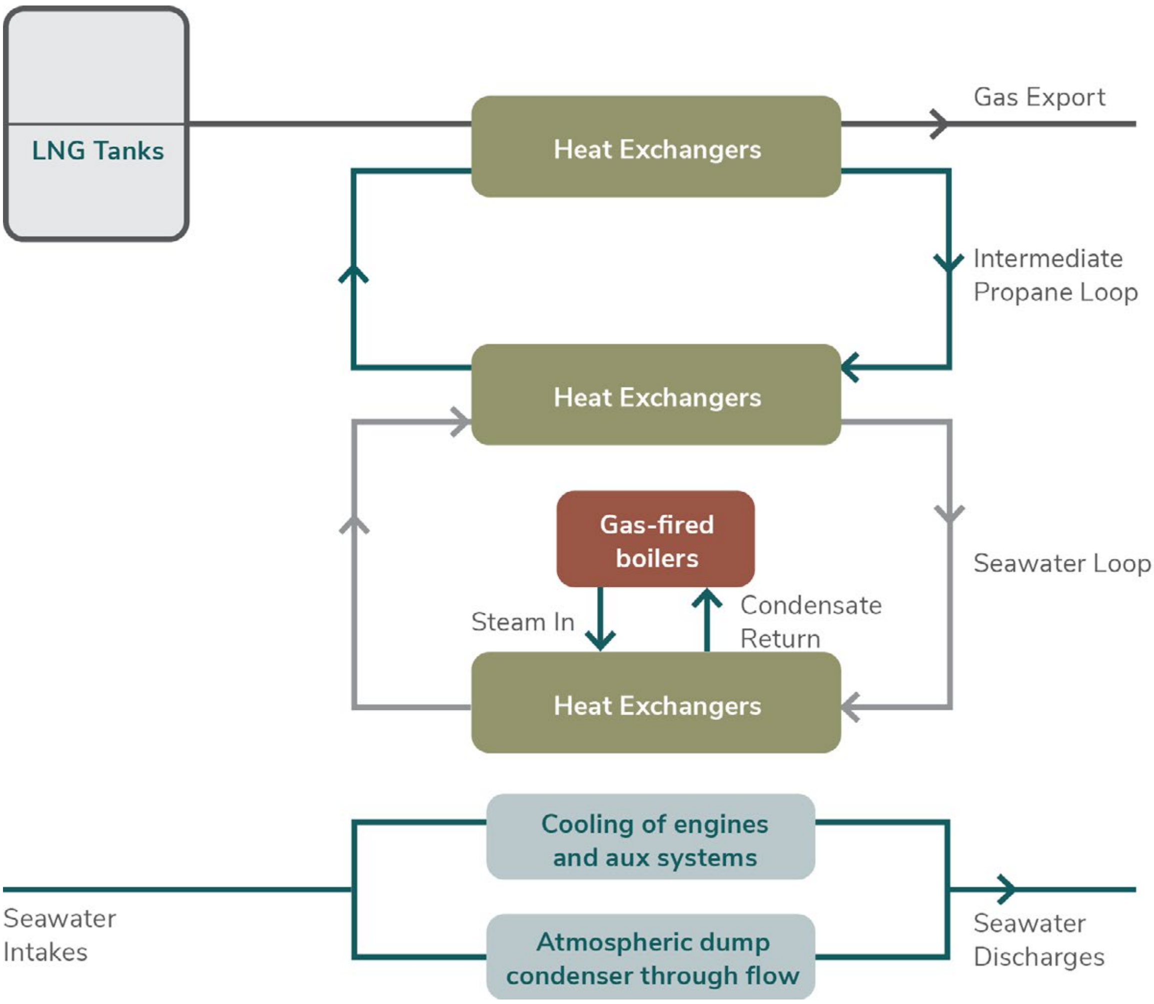


Figure 4-8: Closed loop regasification process

Table 4-5: Seawater flow rates for closed loop regasification

Seawater usage in closed loop regasification mode	Maximum seawater flow rates in closed loop regasification mode [a] (m^3/day)
Cooling of engines	58,560
Cooling of auxiliary machinery systems	45,840
Atmospheric dump condenser	80,400
Total (m^3/day)	184,800

Notes to table: Excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire testing water.

Boil-off gas

Despite insulation of the tanks in which the LNG is stored which limits the admission of external heat, slight evaporation of the LNG would occur during storage, shipping and loading/unloading operations. This natural evaporation of small amounts of LNG is known as boil-off and results in boil-off gas that needs to be removed from the tanks to manage tank pressure.

When the FSRU is regasifying and sending out gas, boil-off gas is recovered and used as a fuel source in the generators on the FSRU, with any excess being recondensed back into a liquid and stored as LNG. Boil-off gas can also be compressed via a minimum send out compressor (MSO) onboard the vessel and delivered to the gas transmission network.

A dump condenser is provided on the FSRU to remove the energy from any excess steam generated by the FSRU boilers. In normal operation, when in closed loop mode, there is no excess steam and water runs through the dump condenser without any change in temperature. However, if there is an unforeseen operational upset that causes a regasification train to shutdown unexpectedly, the dump condenser is used to safely take away the energy of the excess steam until the system is fully shutdown. The dump condenser is also used to remove the heat from burning any excess boil-off gas if the MSO compressor cannot be used due to maintenance or any unexpected outage.

Combined loop regasification mode

In addition to being able to operate in open loop and closed loop regasification modes, the FSRU has been designed to operate in what is termed combined loop mode. The combined loop mode operates similar to open loop mode; however, seawater is heated via steam from gas-fired boilers prior to reaching the regasification system on the FSRU. The seawater is continuously drawn into the FSRU through seawater inlets and the seawater is heated by heat exchange with steam. Seawater use associated with combined loop regasification mode is the same as seawater use for open loop regasification shown in **Table 4-4** above.

Proposed mode of regasification for the Project

The open loop regasification mode is proposed to be used as the primary regasification mode onboard the FSRU. An explanation of the rationale for selection of the proposed mode of regasification is provided in **Chapter 3** *Project development*.

Combined loop regasification mode would be used when the seawater intake temperature is close to 10 °C or below to improve operational efficiency with respect to regasification. This mode is unlikely to be used for more than 30 days during winter in any given year. The seawater flow volumes when using the combined loop regasification mode are the same as those for the open loop regasification mode.

Closed loop regasification could be used as an alternative to open loop regasification mode, however open loop is the preferred operation mode for the Project. The seawater flows associated with closed loop regasification are shown in **Table 4-5** above.

Table 4-6 below sets out the proposed FSRU regasification operating parameters for open loop regasification and associated regasification water flows, expressed as mean daily flows (intake and discharges) in cubic metres per day (m^3/day). The equivalent gas production rate is also shown.

To minimise potential entrainment impacts during periods of the year when fish eggs and larvae are more prevalent in Western Port North Arm, a 14-day average (mean) regasification flow of 312,000 m^3/day is proposed between September and February (inclusive).

Table 4-6: Proposed FSRU regasification operating parameters

Season	FSRU regasification mode	Mean daily seawater[a] regasification flows (m^3/day, 14-day average)	Equivalent gas production rate (mmscf/day)
Autumn and winter (Mar – Aug)	Open loop	468,000	500-750
Spring and summer (Sep – Feb)	Open loop	312,000	250-500

Notes to table: Excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire testing water.

The FSRU design and development process including the range of operating options and scenarios assessed in the EES is described in **Chapter 3** *Project development*. The assessment of potential impacts on the marine environment set out in **Chapter 6** *Marine biodiversity* has played a crucial role in identifying the FSRU regasification operating parameters proposed for the Project. The EES assessments have identified open loop regasification at the proposed mean gas production rate and corresponding seawater flows outlined in **Table 4-6** as meeting the Project's gas production and environmental objectives.

4.3.2 Jetty Infrastructure

The Gas Import Jetty Works would require new Jetty Infrastructure to be installed on Berth 2 pierhead and on the existing pipe rack that extends from the Berth 2 pierhead to where the jetty connects to the land. The Jetty Infrastructure layout at Berth 2 of Crib Point Jetty is shown in **Figure 4-9**.

PoHDA is also undertaking upgrades to the Crib Point Jetty, which would enable the installation of the Jetty Infrastructure and berthing of the FSRU at Berth 2. These works include replacement of the pierhead, new lighting and repairs to concrete on the jetty, pylons, mooring dolphins (marine structures for mooring vessels) and pipe racks. The works to be carried out by PoHDA at the Crib Point Jetty would be carried out in accordance with relevant environmental approvals obtained by PoHDA and do not form part of the Project.

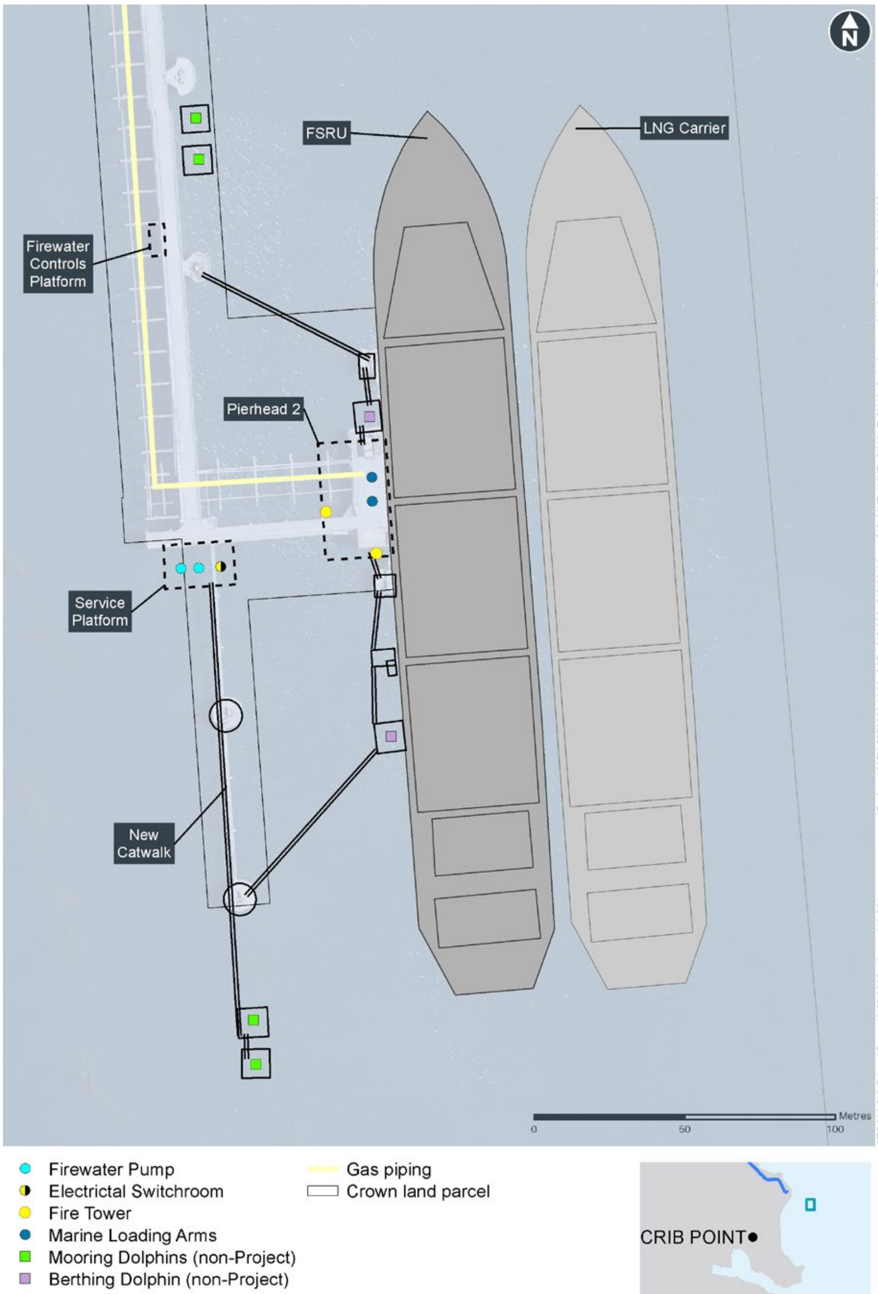


Figure 4-9:
Berth 2 pierhead with Jetty Infrastructure, FSRU and LNG carrier

The Jetty Infrastructure to be installed at the Crib Point Jetty as part of the Project includes:

- Two MLAs to be installed at Berth 2 of the Crib Point Jetty – MLAs are composed of rigid pipe sections which can swivel to transfer gas from the FSRU to the gas piping to be installed on the Crib Point Jetty. The top of the MLAs would be approximately 30 metres above the deck of the jetty. A visualisation is shown in **Figure 4-10**.
- Gas piping approximately 1.5 kilometres long to be mounted on the Crib Point Jetty – the gas piping would run from Berth 2 along the existing pipe rack on the western and southern side of the trunk way (the north-south part of the Crib Point Jetty) and approach jetty (the east-west part of the Crib Point Jetty that extends between the land at Crib Point and the trunk way) respectively. The existing pipe rack is shown in **Figure 4-11**. The new gas piping would be mounted adjacent to this existing piping.
- Associated infrastructure would be installed on the deck pierhead, including:
  - hydraulic gangway tower to access the FSRU
  - substation
  - air compressor
  - fire system
  - contaminated spill containment equipment
  - lighting and CCTV security system.

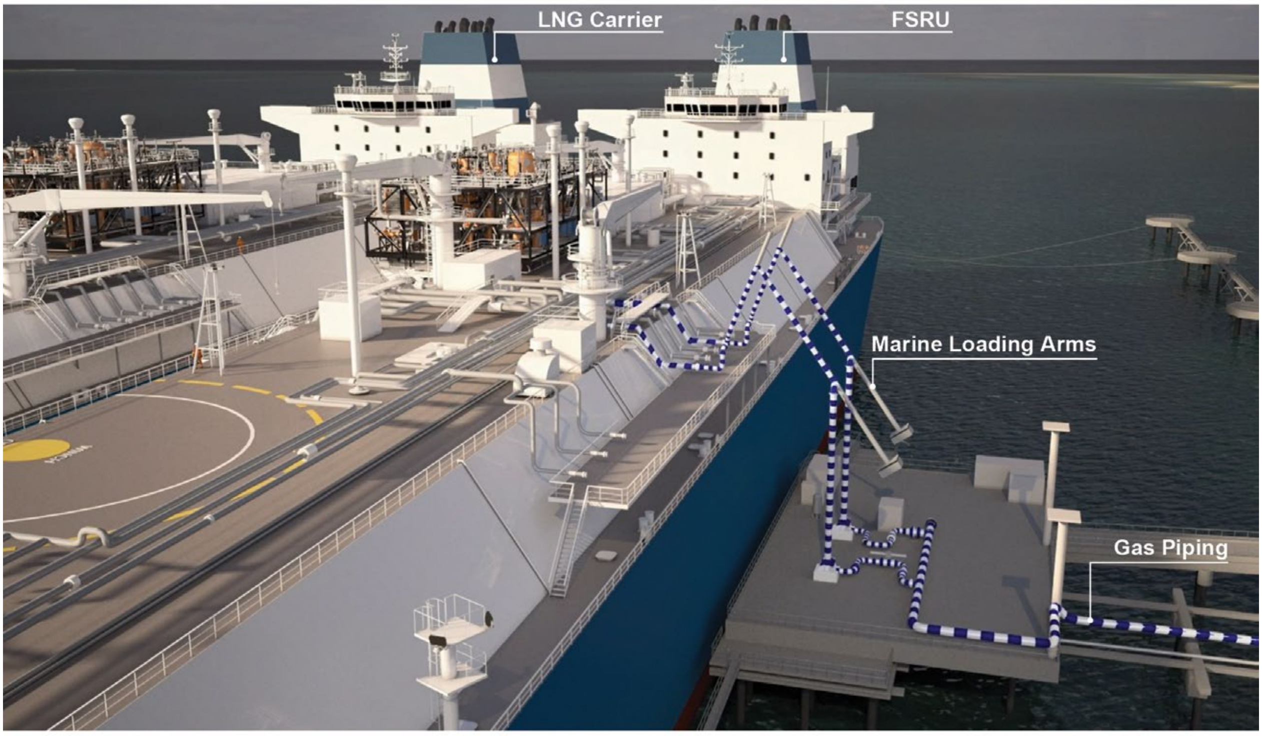


Figure 4-10: Conceptual visualisation of transfer of gas from FSRU to Crib Point Receiving Facility via marine loading arms and gas piping

Figure 4-11: Existing pipe rack at Crib Point Jetty

The gas piping would then connect to the onshore Crib Point Receiving Facility. Where the gas piping crosses the jetty road, the piping would be located in a culvert under the road.

Berth 1 has an operational firefighting system owned by United Petroleum. There is currently no firefighting capability on Berth 2. A firefighting system would be installed at Berth 2 pierhead to provide firefighting capability at the base of the MLAs and cooling protection for the FSRU hull and equipment on the jetty. This would include:

- fire towers on the pierhead deck, capable of providing cooling to the exposed hull area of the FSRU and pierhead area
- fire pumps with remote and local start/stop functionality, each capable of delivering full cooling of the pierhead area and the hull of the FSRU.

The Gas Import Jetty Works may also include relocating existing utility services and existing service connections to accommodate the new infrastructure.

4.3.3 Crib Point Receiving Facility

The Crib Point Receiving Facility would be located landside of the Crib Point Jetty at Crib Point on a land parcel of approximately 2.8 hectares. The Crib Point Receiving Facility would be located on freehold land owned by PoHDA, and zoned Port Zone and Public Conservation and Resource Zone under the Mornington Peninsula Planning Scheme. Front end engineering design is close to completion for the Crib Point Receiving Facility and is shown in **Figure 4-12**. Further engineering refinement may be required as part of detailed design.

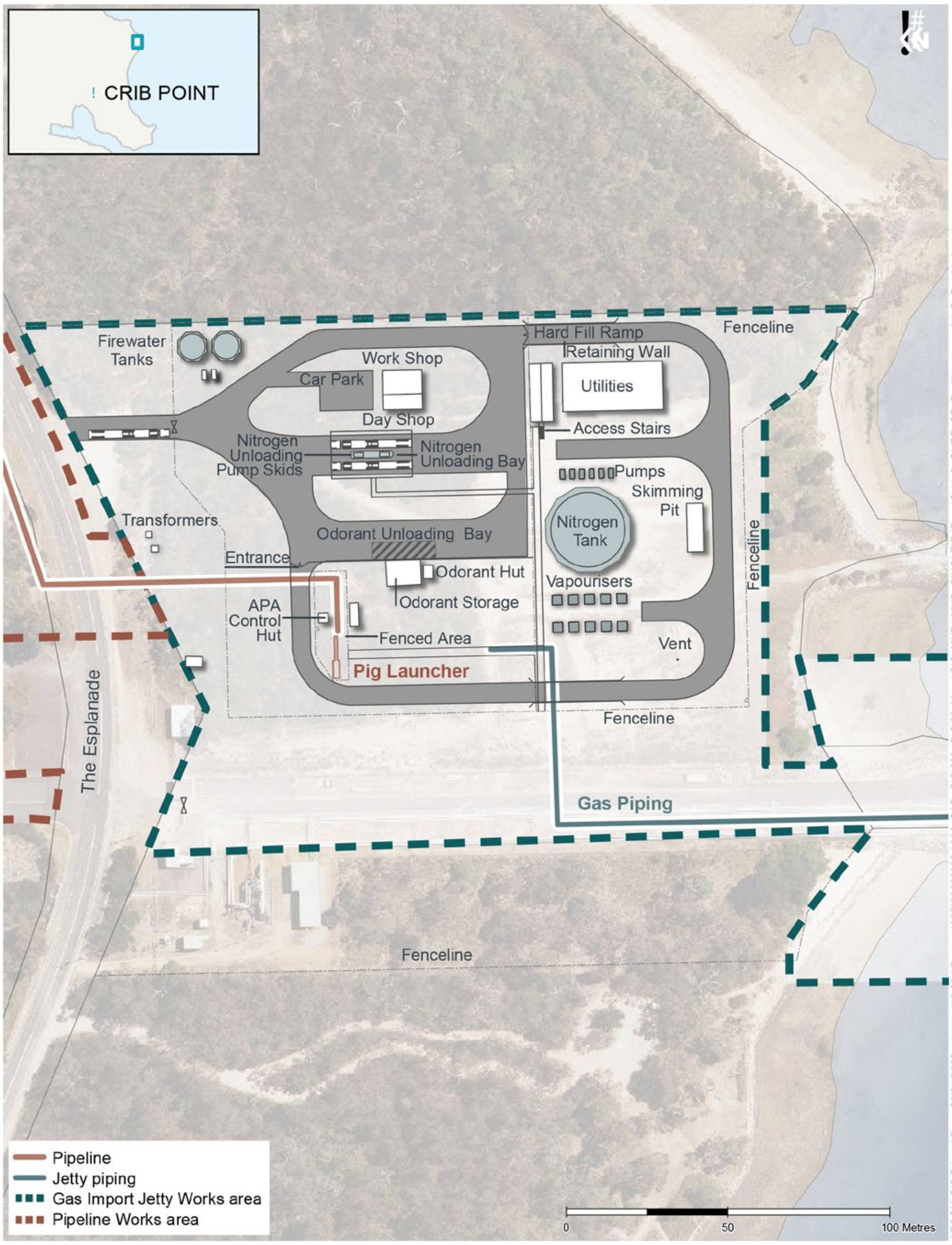


Figure 4-12: Crib Point Receiving Facility layout

The Crib Point Receiving Facility would receive the natural gas from the FSRU via the jetty piping. The main function of the facility is gas metering, odorant injection (a safety requirement that enables the normally odourless gas to be smelt), nitrogen injection (to dilute the natural gas when required) and measurement of gas composition.

The purpose of the metering at Crib Point is to measure the gas flowrate to calculate the required odorant injection rate, as well as managing transmission pipeline linepack (volume of gas in the pipeline). At this point, if the gas received from the FSRU had a heating value (energy density) which did not meet the Australian Energy Market Operator (AEMO) requirements, gaseous nitrogen would be injected into the gas stream so that it meets the required specification.

The Crib Point Receiving Facility would include one liquid nitrogen storage tank (approximately 20 metres high and 25 metres in diameter) and four vaporiser towers (of approximately 15 metres high with a footprint three by three metres) to convert the liquid nitrogen into nitrogen gas using ambient air. The nitrogen tank would be painted white, and the vaporiser towers would have stainless steel finishes. Liquid nitrogen would be stored at approximately minus 196°C and converted into gaseous nitrogen to be injected into the natural gas whenever required.

Trucks would deliver the liquid nitrogen, which would be unloaded via two nitrogen unloading gantries. Gas odorant would also be delivered to the site via trucks and stored in tanks. The odorant would be injected into the natural gas stream to allow the gas to be detected by scent.

The Crib Point Receiving Facility's manually operated vent stack would service the facility as well as the jetty piping in the event of emergency situations and for maintenance. A separate vent would be required for venting of boil-off nitrogen gas from the nitrogen storage tank to prevent overpressure of the tank. Design and controls to prevent emergency situations are described in **Chapter 16** *Safety, hazard and risk* and EES Technical Report K: *Safety, hazard and risk assessments*.

Stormwater runoff from the site would be collected in a skimming pit as a management measure to capture sediments or contaminants before the stormwater enters Western Port. The skimming pit would be cleaned out as required and any sediment would be tested for contamination before disposal. If contamination is detected outside the acceptable Environment Protection Authority (EPA) Victoria limits, the sediment and stormwater would be disposed of to a licensed facility. Further details on waste management during operation are described in **Section 4.8.2 (***Operation waste management***)**.

The Crib Point Receiving Facility is designed to be automated and may operate unmanned under normal operating conditions, although lighting would be provided for security and emergencies. The Crib Point Receiving Facility would have floodlights installed at an angle to cover a broad area of the facility and the car parking area. Emergency lighting would also be installed to illuminate walkways and stairs.

4.4 Pipeline Works

The Pipeline Works comprise a gas transmission pipeline from Crib Point to east of Pakenham, where it would connect to the VTS. **Table 4-7** summarises key data for the Pipeline Works. An overview of the Pipeline Works is shown in **Figure 4-2**. Further details of the proposed pipeline alignment are shown in Attachment VII *Map book*.

The gas transmission pipeline would transport natural gas from the Crib Point Receiving Facility to a delivery facility east of Pakenham (the Pakenham Delivery Facility). The natural gas would be conditioned to meet the operating parameters of the VTS and AEMO gas quality specifications (such as temperature) before injection at the connection location on the VTS, east of Pakenham.

The Pipeline Works consists of the following:

- approximately 57 kilometres of underground gas transmission pipeline with a nominal diameter of 600 millimetres, constructed within a temporary construction right of way (ROW) of generally 30 metres wide and an operational easement of generally 15 metres wide
- two mainline valves (MLV) stations, MLV1 and MLV2 at the indicative locations shown in **Figure 4-2** – the MLVs would enable isolation and depressurisation of the pipeline (via a temporary portable vent) if required during an emergency
- a cathodic protection system to protect the pipeline from corrosion
- a pipeline inspection gauge (pig) launcher at the Crib Point Receiving Facility, with the pig to be received at Pakenham Delivery Facility's pig receiver once it has traversed the pipeline
- the Pakenham Delivery Facility, located adjacent to the Pakenham East rail depot at Pakenham, including a pig receiver, filtration, metering, heating, pressure control and a vent stack
- the EOLSS, a buried facility located at the connection point to the VTS east of Pakenham.

Table 4-7: Summary of key data for the Pipeline Works

Pipeline Works key data	
Length	Approximately 57 km
Material	American Petroleum Institute specification 5L X60 high strength steel pipe. Internally lined with epoxy and externally coated with dual layer fusion bonded epoxy with field applied joint coating
Nominal diameter	600 mm
Nominal capacity	Approximately 750 TJ/day
Pipe wall thickness	10.41 mm for standard wall sections 12.7 mm for heavy wall sections
Pipe segment length	12 m and 18 m
Depth of cover (depth below ground surface)	Minimum of 1.2 m to the top of the pipeline (deeper at crossing of third-party infrastructure and waterways)
Easement	Nominally 15 m wide (reduced at areas of ecological sensitivity or other constraint)
Facilities	Pakenham Delivery Facility, two mainline valves (contained within easement) and buried End of Line Scraper Station.
Design principles	Strictly in accordance with the latest version of AS2885 *Pipelines – Gas and liquid petroleum*
Design life	60 years

4.4.1 Pipeline design

The pipeline would be designed in accordance with the Australian Standard AS2885 *Pipelines – Gas and liquid petroleum*. The pipeline would be bi-directional, to allow gas to flow in both directions as required.

The pipeline would be constructed of high strength steel line pipe, fully welded. The pipeline wall thickness is determined by the external environment. The pipeline wall would be thicker where the pipeline traverses an urban environment, sensitive locations, special crossings and possible future urban development as an additional protection measure.

The pipeline would be underground for its entire length other than at surface facility locations. All surface facilities would be bounded by security fencing in accordance with AS2885. The minimum depth of cover based on AS2885 and current permitted land use is 0.9 metres, although the pipeline is proposed to have a minimum depth of cover of 1.2 metres.

Above the pipeline, signposts would be installed to indicate the presence of the underground service.

At locations where the pipeline is potentially exposed to increased erosional forces, such as watercourse crossings and floodplains, additional protection would be provided, including by burying the pipeline deeper. The pipeline would also be buried deeper beneath road and railway crossings and further protected by concrete slabbing over the top of the pipeline if required.

Major watercourses and environmentally sensitive areas would be crossed using horizontal directional drilling (HDD) to protect surface environmental values. Further information on the pipeline construction methodology is provided in **Section 4.5.4**.

4.4.2 Pipeline alignment

The proposed pipeline alignment extends between Crib Point and the connection point to the VTS east of Pakenham. The pipeline alignment has been refined following extensive consultation to avoid and minimise, to the extent possible, the impact of construction and operation. A map series showing the pipeline alignment and its options is presented in Attachment VII *Map book*. Sections of the alignment are marked as kilometre points (KP) of the pipeline, beginning at KP0 at Crib Point, heading north and ending at KP57 at Pakenham.

The pipeline alignment has a number of minor alternatives referred to as 'pipeline options', generally within the same parcel of land. These options provide some flexibility to address specific landowner requirements, while meeting the pipeline alignment criteria. A detailed discussion on previous pipeline options and the alignment selection process is provided in **Chapter 2** *Project rationale* and **Chapter 3** *Project development*.

The key sections of the pipeline alignment are:

- Crib Point Receiving Facility to Graydens Road, Hastings (KP0 to KP8.5):
  - From the Crib Point Receiving Facility at Crib Point (KP0), the pipeline would generally follow existing oil and gas pipeline infrastructure corridors for the first five kilometres to the south of Hastings at Reid Parade (KP5). These existing infrastructure corridors include a 1.7-kilometre crossing of Warringine Park, a local conservation reserve managed by the Mornington Peninsula Shire.
  - Through Hastings, the pipeline alignment would follow the Stony Point rail line corridor from Reid Parade (KP5) to Hodgins Road (KP7).
  - Between Hodgins Road and Graydens Road, Hastings (KP8.5), the pipeline would traverse through Mornington Peninsula Shire land that runs parallel to the rail corridor.

- Graydens Road, Hastings to Baxter–Tooradin Road, Devon Meadows (KP8.5 to KP25):
  - From Graydens Road, the pipeline would generally be located within private property following the crossing of the Stony Point rail line and Frankston–Flinders Road (KP9.1).
  - Between KP9.1 and KP255, the pipeline would be generally located adjacent to the existing Esso Australia oil and gas pipeline corridor. In a number of instances, the pipeline alignment diverges from this existing linear infrastructure corridor to avoid social and environmental constraints or to facilitate the proposed construction methodology. The pipeline alignment would be located to the south of the Western Port Highway and the townships of Tyabb and Pearcedale, with the crossing of Baxter–Tooradin Road at around KP25.
- Baxter–Tooradin Road, Devon Meadows to Soldiers Road, Rythdale (KP25 to KP44.1):
  - Following the crossing of Baxter–Tooradin Road (KP25), the pipeline would generally be located in open agricultural land and diverges from the Esso Australia oil and gas pipeline corridor before crossing of the South Gippsland Highway (KP30.1) to take a more direct route to the east of Pakenham. The pipeline would cross the disused Leongatha rail line at about KP33.4.
  - Between the South Gippsland Highway (KP30.1) and Pakenham South (around KP50), the pipeline would traverse the low lying Koo Wee Rup swamp area and a number of drainage features that are maintained by Melbourne Water, including Western Outfall Drain (KP31.6), Cardinia Creek (KP40.1), and Deep and Toomuc Creeks (KP41.1).
- Soldiers Road, Rythdale to VTS, Pakenham (KP44.1 to KP56.7):
  - Towards Pakenham, the pipeline would cross the Gippsland rail line (KP55), before reaching the Pakenham Delivery Facility (KP55.6).
  - From the Pakenham Delivery Facility, the pipeline would then follow Oakview Lane and Mt Ararat Road to reach the terminal point on the VTS on the northern side of the Princes Highway. The pipeline would cross below the Princes Freeway (KP55.8) and Princes Highway (KP56.7).

4.4.3 Mainline valves

MLVs are in-line block valves to allow for isolation and depressurisation of sections of the pipeline for maintenance or during emergency conditions. The valves can be closed to isolate sections of the pipeline, and a temporary vent can be connected to depressurise the section.

The MLVs along the pipeline would be located between the Crib Point Receiving Facility and the Pakenham Delivery Facility at approximately KP11.5 south of Denham Road, Hastings (MLV1) and at approximately KP40 at the end of Bloomfield Lane, Cardinia (MLV2).

A footprint of 50 by 18 metres is required for the construction of MLV1, which would be fenced with gates opening to Denham Road and to the neighbouring farm. Following construction, the above-ground MLV1 facility would be contained within a chain wire fenced area of approximately 10 by 11 metres.

MLV2 would be located within a triangular area of land 60 by 65 by 85 metres, which would be fenced with rural fencing with gates opening to Bloomfield Land and to the neighbouring farm. Following construction, the above-ground MLV2 facility would be contained within the 15-metre easement in a chain wire fenced area of approximately 10 by 11 metres.

Each portion of land used to construct the MLVs would be subdivided and acquired by APA.

MLVs would be finished with hardstand and chain wire fenced to exclude members of the public. The height of each MLV facility (including fencing) would be approximately three metres. There would be no lighting at the MLV facilities.

MLV1 would be remotely controlled for faster operation due to its proximity to the town of Hastings. MLV2 would be manually operated due to its location in an area of low density.

A typical MLV facility is shown in **Figure 4-13**.

Figure 4-13: Typical mainline valve facility

4.4.4 Corrosion protection system

Each pipe length is coated for corrosion protection purposes. Testing is undertaken during manufacturing and installation to ensure the integrity of the coating. Following completion of construction, further testing is carried out by a direct current voltage gradient survey which involves measuring the voltage gradient in the soil over the top of the pipeline using a pair of probes.

As a secondary protection against corrosion, an impressed current cathodic protection system (ICCP system) would be used. An anode bed would be installed (buried) at MLV1. The ICCP system would be supplied with electricity from mains power. Additional anode beds may need to be added over the life of the pipeline and would be subject to separate approvals. Additions to the ICCP system are not expected for at least 20 years.

Impressed current cathodic protection (ICCP) system

The ICCP system utilises an external source (anode) to apply an electrical current through the environment and on to the pipe.

This protective current changes the environment around the pipe to prevent a corrosive reaction occurring on the metal surface.

The ICCP system requires the installation of monitoring points, in small metal boxes on posts, at spacing intervals approximately one to five kilometres along the pipeline and at all locations where the pipeline is electrically cross bonded to other buried structures.

The pipeline may be electrically cross bonded to the existing VTS system to improve the performance of the ICCP and reduce interference between structures. The pipeline would likely be electrically cross bonded to other buried pipeline structures along the alignment, with permission from their owners.

Inspection of the system would be undertaken in accordance with AS2832 *Cathodic protection of metals*.

4.4.5 Pakenham Delivery Facility

The Pakenham Delivery Facility would be approximately two hectares in size within land currently owned by Public Transport Victoria adjacent to the Pakenham East rail depot. The land would be acquired for the Project.

An indicative layout of the Pakenham Delivery Facility is shown in **Figure 4-14**.

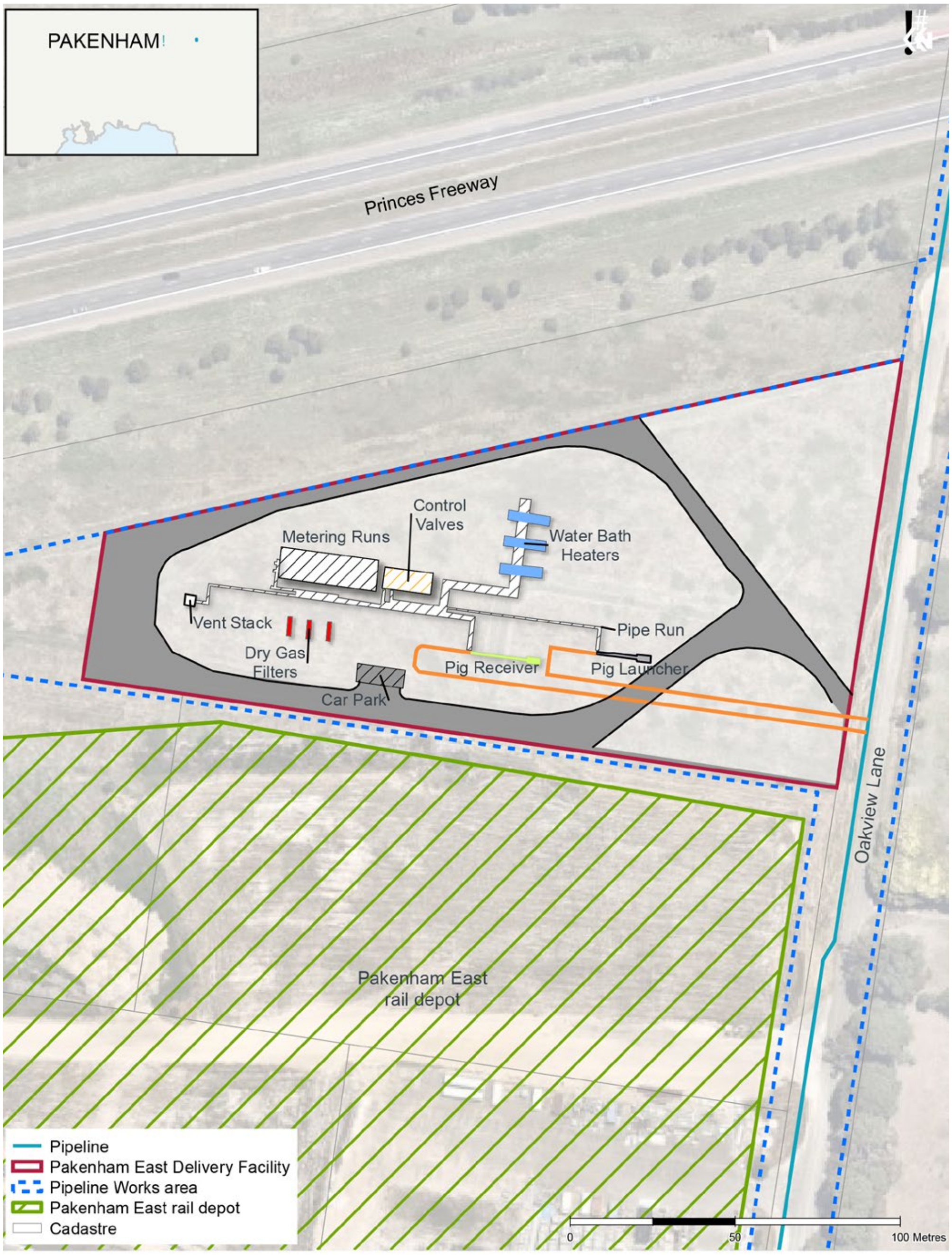


Figure 4-14: Pakenham Delivery Facility layout

The Pakenham Delivery Facility would perform the following functions before delivery of the natural gas into the VTS:

- Removing any particulate solids from the gas stream with dry gas filters. Solids are not expected in the gas, as the gas transmission pipeline would be internally lined and the pipeline would be cleaned post construction. As such, the dry gas filters are proposed as a precautionary measure.
- Metering of the gas to measure the volume of gas being delivered into the VTS.
- Gas composition measurement which is required as part of the AEMO approved Gas Quality Monitoring Plan to determine gas properties, including the heating value of the gas. A flow computer calculates the amount of energy by using the heating value and gas volume in an algorithm.
- Heating of the gas with three water bath heaters. Each water bath heater would be around four metres high, with the vent outlets around seven metres above ground. Heating is required to ensure the gas exiting the Pakenham Delivery Facility meets the minimum temperature requirement for the VTS. The water bath heaters would be heated with gas-fired heaters.
- Multiple parallel flow control valve (FCV) runs would control the gas flow from the pipeline into the VTS. In the event of an equipment failure the valves are designed to close to a safe position. The FCVs would also be the means of reducing the pressure down from the pipeline operating pressure to the lower VTS operating pressure.
- A vent stack for use during emergency situations and during occasional maintenance. The vent stack would be around four metres high.

The Pakenham Delivery Facility would have a scraper station to receive the pig launched from Crib Point and also have a launcher to inspect the approximately 1.4 kilometres of pipeline to the EOLSS.

The Pakenham Delivery Facility would be automated and designed to operate unmanned under normal operating conditions, although lighting would be provided for security and emergencies at the facility as required. Four 10-metre tilt light poles with floodlights would be angled to cover a broad range of the facility and an additional light would illuminate the car park. A number of emergency lights would also be installed.

The Pakenham Delivery Facility would allow gas to reverse flow from the VTS to the gas transmission pipeline. Reverse flow would be required for initial filling of the pipeline for pre-commissioning and also allows for provision of gas supply to customers who may be connected to the pipeline in the future.

4.4.6 End of Line Scraper Station

The EOLSS connects the pipeline into the VTS between the Longford to Dandenong Pipeline and the Bunyip to Pakenham Pipeline. The permanent footprint of the EOLSS would be fully contained within the existing 24-metre-wide easement. The EOLSS is shown in **Figure 4-15**.

The EOLSS facility would be buried, with below-ground valves and buried flange connections accessible via concrete pits. The EOLSS allows for connection of a temporary scraper station (pig receiver) for pipeline pigging to inspect the pipeline during operation. During these events, excavation of the site would be required to enable access to the buried EOLSS.

The EOLSS would be marked above ground with signposts and eight concrete covers on the valve pits within an area of 15 by 12.5 metres.

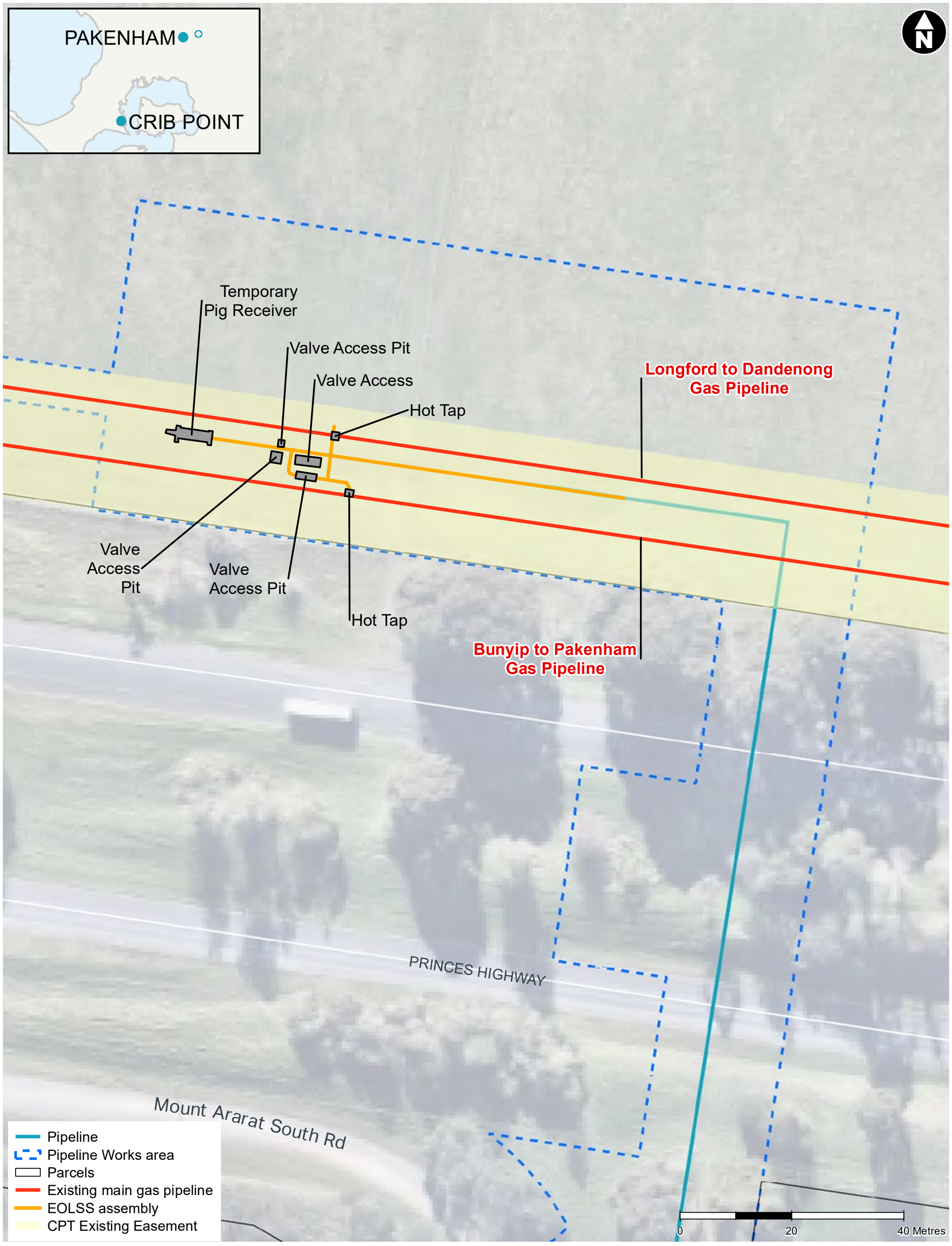


Figure 4-15: End of Line Scraper Station

4.5 Construction

This section describes the construction of the Project, including indicative construction schedule, construction sites including laydown areas, methodology, the expected workforce, types of equipment and traffic during construction for each of the works.

4.5.1 Indicative construction schedule

Indicative construction schedules for the Gas Import Jetty Works and the Pipeline Works are shown in **Table 4-8** below. This schedule is subject to ongoing adjustments as needed to deliver the Project and subject to the grant of approvals within certain timeframes.

Subject to the staging of the works, construction for the entire Project is expected to take approximately 18 to 27 months.

Table 4-8: Project indicative construction schedule

Construction activity	2021				2022				2023
Month	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**
Jetty Infrastructure									
Installation of MLAs, switch room, fire system, CCTV security system					■	■	■		
Installation of cabinets and control units, air compressor, gangway tower, lighting and transformer					■	■	■		
Installation of the jetty piping					■	■	■		
Commissioning							■	■	
Crib Point Receiving Facility									
Mobilisation and site set up	■	■							
Bulk earthworks		■	■						
Civil foundations		■	■						
Structural, mechanical, piping, electrical and instrumentation works (SMPEI)		■	■	■	■	■	■	■	
Roads, landscaping and reinstatement								■	
Commissioning								■	
Final demobilisation									■
Pipeline construction									
Mobilisation			■						
Pipeline construction			■	■	■	■	■	■	
Hydrostatic testing							■	■	
Reinstatement			■	■	■	■	■	■	
Commissioning								■	
Demobilisation									■
Pakenham Delivery Facility									
Mobilisation and site set up			■						
Bulk earthworks, piling (if required) and civil foundations			■	■	■				
Structural, mechanical, piping, electrical and instrumentation works (SMPEI)			■	■	■	■	■	■	
Roads, landscaping and reinstatement							■		
Commissioning							■	■	
Final demobilisation								■	

Gas Import Jetty Works

Construction activities for the Jetty Infrastructure works and Crib Point Receiving Facility would be undertaken over the following periods as provided in **Table 4-9** and **Table 4-10** subject to the Minister's assessment recommending the Project to proceed and the grant of statutory approvals.

Table 4-9: Jetty Infrastructure indicative construction schedule

Construction activity	Work period	Duration
Installation of MLAs, switch room, fire pumps and fire towers, CCTV security system	Quarter 1 (Q1) 2022 to Q3 2022	9 months
Installation of cabinets and control units, air compressor, gangway tower, lighting and transformer	Q1 2022 to Q3 2022	9 months
Installation of the jetty piping	Q1 2022 to Q3 2022	9 months
Commissioning	Q4 2022	3 months
Overall timeframe	Q1 2022 to Q4 2022	Approximately 12 months

Table 4-10: Crib Point Receiving Facility indicative construction schedule

Construction activity	Work period	Duration
Mobilisation and site set up	Q1 to Q2 2021	3 months
Bulk earthworks, piling and civil foundations	Q2 to Q3 2021	6 months
Structural, mechanical, piping, electrical and instrumentation works	Q2 2021 to Q4 2022	18 months
Roads, landscaping and reinstatement	Q4 2022	3 months
Commissioning	Q4 2022	3 months
Final demobilisation	Q1 2023	1 month
Overall timeframe	Q1 2021 to Q1 2023	Approximately 27 months

Pipeline Works

Construction activities for the pipeline and Pakenham Delivery Facility would be undertaken over the following periods as provided in **Table 4-11** and **Table 4-12** subject to the Minister's assessment recommending the Project to proceed and the grant of statutory approvals.

Table 4-11: Pipeline indicative construction schedule

Construction activity	Work period	Duration
Mobilisation	Q3 2021	1 month
Pipeline construction	Q3 2021 to Q4 2022	15 months
Hydrostatic testing	Q3 to Q4 2022	4 months
Reinstatement	Q4 2021 to Q4 2022	12 months
Commissioning	Q4 2022	2 months
Demobilisation	Q1 2023	1 months
Overall timeframe	Q3 2021 and Q1 2023	Approximately 21 months

Table 4-12: Pakenham Delivery Facility indicative construction schedule

Construction activity	Work period	Duration
Mobilisation and site set up	Q3 2021	1 month
Bulk earthworks, piling (if required) and civil foundations	Q3 2021 to Q1 2022	9 months
Structural, mechanical, piping, electrical and instrumentation works	Q3 2021 to Q4 2022	18 months
Roads, landscaping and reinstatement	Q3 2022	1 month
Pre-commissioning and commissioning	Q3 to Q4 2022	6 months
Final demobilisation	Q4 2022	1 month
Overall timeframe	Q3 2021 to Q4 2022	Approximately 18 months

4.5.2 Project construction laydown and pipe stockpiling areas

Construction laydown areas, temporary access tracks and pipe stockpiling areas are shown in Attachment VII *Map book*.

The construction laydown area for the Gas Import Jetty Works would be within the construction footprint of the Crib Point Receiving Facility. The construction laydown area would include areas for storage of construction machinery and equipment, storage of materials for installation, site offices, a workshop and vehicle parking areas. Additional offsite laydown areas may be required for the Gas Import Jetty Works which would be confirmed with construction contractors once engaged to start works. Any additional laydown areas would be situated within existing commercial or industrial hardstand areas.

A laydown area to the west of The Esplanade is also planned to provide for the storage of equipment for the Gas Import Jetty Works and the Pipeline Works. A temporary site office may also be erected in this area.

Preparatory works for laydown areas would include:

- civil/site establishment works including the installation of temporary site fencing and gates, relocation of utility services and service connections (for example, electricity and potable water), surface levelling and vegetation clearing
- establishment of environmental controls such as fencing no-go areas (such as for isolating potential sensitive habitat areas) and bunding for containing liquids (spill prevention).

At completion of construction, all temporary fencing, buildings and construction equipment/plant would be removed from the Crib Point construction site.

Each pipeline facility (Pakenham Delivery Facility, MLVs and the EOLSS) would have a construction laydown area within the site location. Pipe stockpiling for the Pipeline Works would be in an area south of Denham Road, near the corner of McKirdys Road, Hastings. The stockpiling area would be approximately 4.14 hectares in area and located within land owned by BlueScope Steel. The pipes would arrive by ship at the BlueScope Western Port Facility at Hastings near Long Island Point and be transported from the wharf to the pipe stockpiling area.

An additional pipe stockpiling laydown area of 5.2 hectares may be located at the intersection of Koo Wee Rup Bypass and Railway Road, Koo Wee Rup.

4.5.3 Gas Import Jetty Works construction

The key construction activities for the Gas Import Jetty Works relate to the construction of the Jetty Infrastructure and Crib Point Receiving Facility.

Floating storage and regasification unit (FSRU)

The FSRU (described in **Section 4.3.1** above) is an existing vessel which would be continuously moored at the Crib Point Jetty, so its construction has been substantially determined. The FSRU may go through design refinements to meet requirements associated with the Project approvals and other applicable regulatory conditions. These refinements would be carried out before the FSRU is berthed at Berth 2 of the Crib Point Jetty.

There would be some installation work once the FSRU is berthed prior to start-up. This would include mounting the seawater intakes to the hull of the FSRU and fastening the MLA connection.

Jetty Infrastructure construction

The majority of equipment and piping for the Jetty Infrastructure would be delivered and/or installed using barges. The construction of the Jetty Infrastructure includes relocation of existing utility services and service connections. Scaffolding structures would be installed on the jetty to provide access to relevant work areas. These would be dismantled at the completion of construction.

Installation of the main components of the Jetty Infrastructure is described in **Table 4-13**.

Table 4-13: Jetty Infrastructure construction

Jetty Infrastructure	Construction activity
Marine loading arms (MLAs)	MLAs would be installed from the water using a floating barge with a crane. The MLAs would be fixed to the pierhead deck. The MLAs would be connected to gas piping which would be lifted into place from the barge and installed.
Gas piping mounted to the jetty	Piping on the jetty would predominately be lifted into location by barge and welding, stress relieving, testing and surface protection would be carried out in-situ. Once the piping leaves the jetty, the piping would be run under the jetty access road in a culvert or buried.Installation of the approach jetty piping section would either be transported onto the jetty on rollers assisted by a winch and placed in position or alternatively placed in position by a barge and crane. The pipe lengths would be welded into position and attached to the jetty along the existing pipe rack. Installation of trunk way (perpendicular to the approach jetty section) jetty piping section can be done following a similar method with pipe spools drawn from the pipe neck towards the approach jetty. Transportable temporary works (including scaffolding) to facilitate in-situ pre-heat, welding, testing and surface treatment would be employed along the length of the jetty. A similar method would be used for the installation of the pipe spools along the pipe neck. Hydrotesting of the piping would be conducted once construction is completed.
Electrical and instrumentation installation	The transformer, substation, control panels, lighting and CCTV system would be pre-assembled and placed in position on the pierhead by a barge and crane. Electrical cables would be winched and reeled with temporary rollers from the land out to the pierhead.
Firefighting system	The fire system components would be installed via a crane-mounted barge. The fire water pipe would be reticulated from the fire pump station, to be located on the service platform to the firefighting equipment on the pierhead.
Hydraulic gangway tower	The gangway tower would be mounted on a jetty mooring structure with the aid of a crane-mounted barge.

The construction barges used to install the Jetty Infrastructure would most likely include a crane barge to lift and install the infrastructure and a material barge to store and feed various equipment and infrastructure components to the crane barge during installation works.

The barges are moved with the assistance of multiple tugboats, to manoeuvre and anchor the barge into position. The material barge is moored alongside the crane barge. The barges are expected to remain on site for the duration of the works.

Crib Point Receiving Facility

Construction of the Crib Point Receiving Facility would be undertaken by specialist crews across key distinct phases of works. These include initial earthworks and civil construction, mechanical installation and electrical and instrumentation works (as described in **Table 4-14**). Construction of the facility would take approximately 27 months for construction and commissioning with the final tie-in to the pig launcher as part of the Pipeline Works before a hand-over to operational control.

Table 4-14: Crib Point Receiving Facility construction activities

Construction sequence	Activity	Description
1	Site set-up	Site set up within the construction footprint is required to provide a safe and efficient area for construction activities. This includes constructing temporary haul roads in and out of (and within) the construction site, temporary fencing, and may include installing site offices and site facilities (toilets, lunch rooms etc.), prepping lay down areas, clearing vegetation, and relocating existing services if required.
2	Earthworks	Existing ground levels would be excavated/built up and levelled to the required design levels. The topsoil may be required to be replaced with engineered fill or pilings installed to minimise ground settlement (ground movement would induce stress on piping and equipment post installation in their final positions and can be damaging).
3	Civil works	Steel reinforced concrete foundations and footings would be installed which the permanent buildings, equipment and supports would sit on and be fixed to.
4	SMPEI (structural, mechanical, piping, electrical and instrumentation) installation	Once the concrete foundations are installed, the SMPEI supports and equipment can be installed. This involves ensuring equipment is level and can be bolted up without over-stressing connections. Specialist crews would install structural supports, mechanical equipment, piping spools, electrical equipment, cabinets and panels, cabling, instrumentation (sensors etc.), buildings, and walkways.
5	Testing and commissioning	The piping is tested using hydrostatic testing. Mechanical and electrical equipment are also mechanically and electrically tested to make sure they have been installed correctly and are ready for commissioning. Commissioning involves fine tuning of equipment and instrumentation by running the facilities through various operating ranges. Once the facility passes all checks per the commissioning plan, it is ready to be handed over to Operations and start processing the gas.
6	Roads, landscaping and reinstatement	Final touches within the final facility such as permanent roads, kerbs, pavement, landscaping and permanent fencing would be constructed. Reinstatement of construction areas which are not part of the final facility would also be finished to leave the facility in its finished state.

4.5.4 Pipeline Works construction

The Pipeline Works would involve constructing the underground pipeline, the pig launcher at the Crib Point Receiving Facility, the Pakenham Delivery Facility, two MLVs and the EOLSS. Pipeline construction techniques would include trenching and also alternative techniques such as HDD or horizontal boring. The following sections provide further detail on how the Pipeline Works construction activities are carried out.

Pipeline construction

Pipeline construction would comply with all relevant codes and standards including AS2885.1-2018: *Pipelines – Gas and liquid petroleum* (design and construction) (AS2885.1-2018) and the Australian Pipelines and Gas Association Code of Environmental Practice. The construction would also be guided by the environmental requirements to be specified in a Construction Environmental Management Plan (CEMP) prepared in compliance with the Victorian *Pipelines Act* 2005 and Pipeline Regulations 2017 and approved by the relevant Minister before construction.

The construction footprint would typically comprise a 30-metre-wide pipeline construction ROW, as well as extra work space for temporary facilities to support construction. Indicative locations for extra work space and temporary facilities are shown in Attachment VII *Map book* and include:

- access tracks (upgrade of existing and construction of new), which would be less than 10 metres wide and usually constructed out of gravel
- additional work areas (such as vehicle turn-around points, additional work spaces for crossings, set up areas for construction methodologies, laying out of pipe for HDD, stockpiling and storage areas)
- water supply tanks and temporary dams for storing water required for dust suppression and hydrostatic testing (pressure testing) of the pipeline.

The typical layout of the construction ROW is shown in **Figure 4-16**.

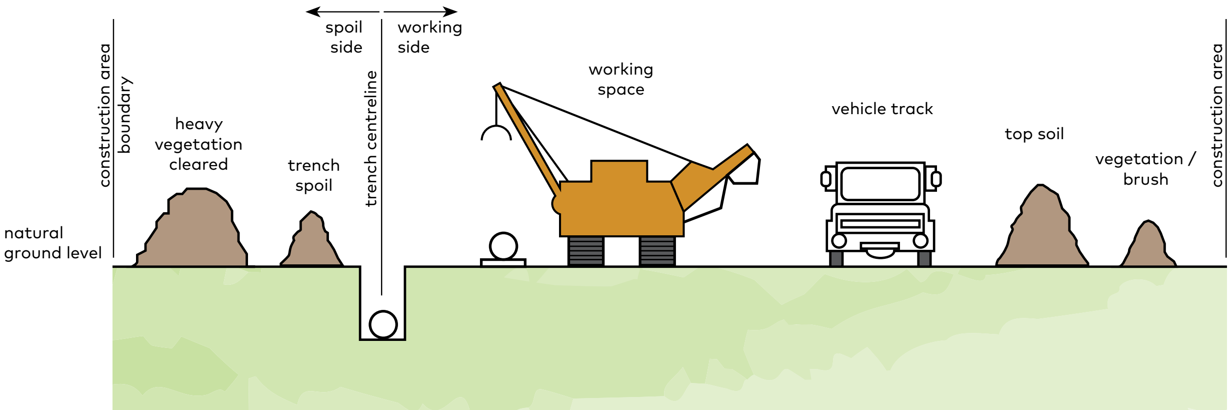


Figure 4-16: Typical construction right of way (ROW) layout for a pipeline

Temporary construction gateways would be installed at fence lines that are intersected by the construction ROW to provide security for farm stock during construction.

The pipeline construction sequence and activities are described in **Table 4-15** and illustrated in **Figure 4-17**. Pipeline construction would progress in a linear manner along the alignment.

In rural areas, each stage of open-cut trenching pipeline construction would take between one and three days at a particular property to complete, with approximately one week between each stage. In urban areas, open-cut trenching amenity impacts for an individual receptor would likely last for up to 10 days, depending on weather and other conditions.

Table 4-15: Pipeline construction

Construction sequence	Activity	Description
1	Clearing of vegetation from the construction ROW	Clearing of vegetation and topsoil within the construction ROW is required to provide a safe and efficient area for construction activities.
2	Pipe stringing	Stringing involves distributing pipe segments along the ROW on sandbags and wooden skids in preparation for welding.
3	Pipe bending	Where required, pipe lengths would be bent using a hydraulic bending machine to match changes in either elevation or direction of the alignment.
4	Welding, non-destructive testing and joint coating	Specialised construction crews would weld pipe segments together manually or using an automated welding process. Pipe segments can be welded into strings of up to around 1.5 kilometres in length, however, this would be determined by the number of stock crossings, water and road crossings and landholder access breaks required. All welds are examined for quality using either X-ray or ultrasonic inspection techniques. Any unacceptable defects in the welds are either repaired or replaced and tested again. All welds are then cleaned and sanded by abrasive blasting and coated to prevent corrosion.
5	Trench excavation	A wheel trencher, rocksaw or excavator would be used to dig the trench to lay the pipeline in. Trenches would typically be excavated to a depth of approximately two metres to achieve a depth of cover of about 1.2 metres to the natural ground level. Excavated material would be stockpiled to the spoil side of the trench area and would be reused during backfilling activities.
6	Lowering in and backfilling	Pipe segments would be positioned on wooden skids and sandbags to protect the pipe coating from damage. The welded pipe strings are lifted off the wooden skids/ sandbags and lowered into the trench using side-boom tractors or excavators. The pipe coating is inspected and tested for defects immediately before lowering the pipe into the trench. Bedding and padding material may be placed around the pipe to protect the pipe coating from damage due to materials in the excavated spoil. Bedding and padding material may be either imported using trucks or, where the excavated material is suitable, produced by sieving the excavated material on site. After lowering-in, the strings are welded together (a 'tie-in') in the trench. The trench is then backfilled using the excavated spoil, and excess excavated material may be collected and transported for disposal at appropriately licensed facilities in accordance with EPA Victoria's waste classification and spoil transportation requirements.
7	Testing and commissioning	The pipeline is pressure tested before commissioning to ensure that the pipeline is structurally sound and without leaks. This is done through a process called hydrostatic testing whereby sections of the pipeline (test sections) are filled with water and then pressurised. This is further discussed below.
8	Rehabilitation of the ROW	Disturbed areas would be re-profiled to a stable landform consistent with original contours and drainage lines and vegetated with shallow-rooted vegetation where appropriate with its land use and in consultation with landowners.

Figure 4-17: Pipeline construction sequence

1. Clear and grade

2. Pipe stringing

3. Pipe bending

4. Welding pipe joints

5. Trench excavation

6. Lowering-in

7. Backfilling

8. Rehabilitation
(ROW approximately 7 months
after construction)

The width of the construction ROW is reduced in areas such as sensitive environments and/or watercourses to minimise disturbance to these features. In some cases, due to the presence of areas of high ecological significance or other constraints, the pipeline would be constructed using trenchless construction techniques such as horizontal directional drilling (HDD) or shallow horizontal boring, to avoid construction disturbance within the sensitive area.

Key areas where trenchless construction techniques would be used include:

- selected watercourses and drains
- sealed road crossings, to avoid traffic disruption
- parts of Warringine Park, which is an area of high ecological significance and partially falls in the Western Port Ramsar site
- identified habitat for the Merran's sun orchid
- Denham Road Farmhouse, which is listed on the Victorian Heritage Inventory
- crossing of third-party assets such as water, gas and oil pipelines, power lines, and fibre optic/copper communication lines.

The locations of trenchless construction are identified in Attachment VII *Map book and noted in* **Chapter 3** *Project development*.

Horizontal directional drilling

HDD is generally used for the crossing of major and sensitive watercourses where standard open cut methods are less desirable from an environmental viewpoint. HDD may also be used for road, railway or third-party asset crossings as an alternative to shallow horizontal boring.

The installation of a pipeline by HDD involves drilling a pilot hole at a shallow angle beneath the surface from an entry point on one side of the crossing to an exit point on the other side of the crossing, as shown in **Figure 4-18**. Typically, the entry and exit pits are approximately three metres wide, five metres long and two metres deep. A schematic showing the typical layout of an HDD entry and exit point is shown in **Figure 4-19**. The hole is enlarged by reaming to allow for the welded pipe string to be pulled back through the drill hole from the exit point to the entry point without damaging the coating.

After drilling and installation of the pipe along the HDD section, bell holes would be constructed at the entry and exit points to facilitate joining of the pipe (known as tying-in). A bell hole is an enlarged hole allowing machinery to operate within it to tunnel under the relevant constraint. These HDD tie-in bell holes would be approximately five metres long, five metres wide, and two and a half metres deep. The pipeline string is then welded to adjoining sections of the pipeline. Once the pipe string is installed and tied into the main section of the pipeline, the entry and exit points are remediated.

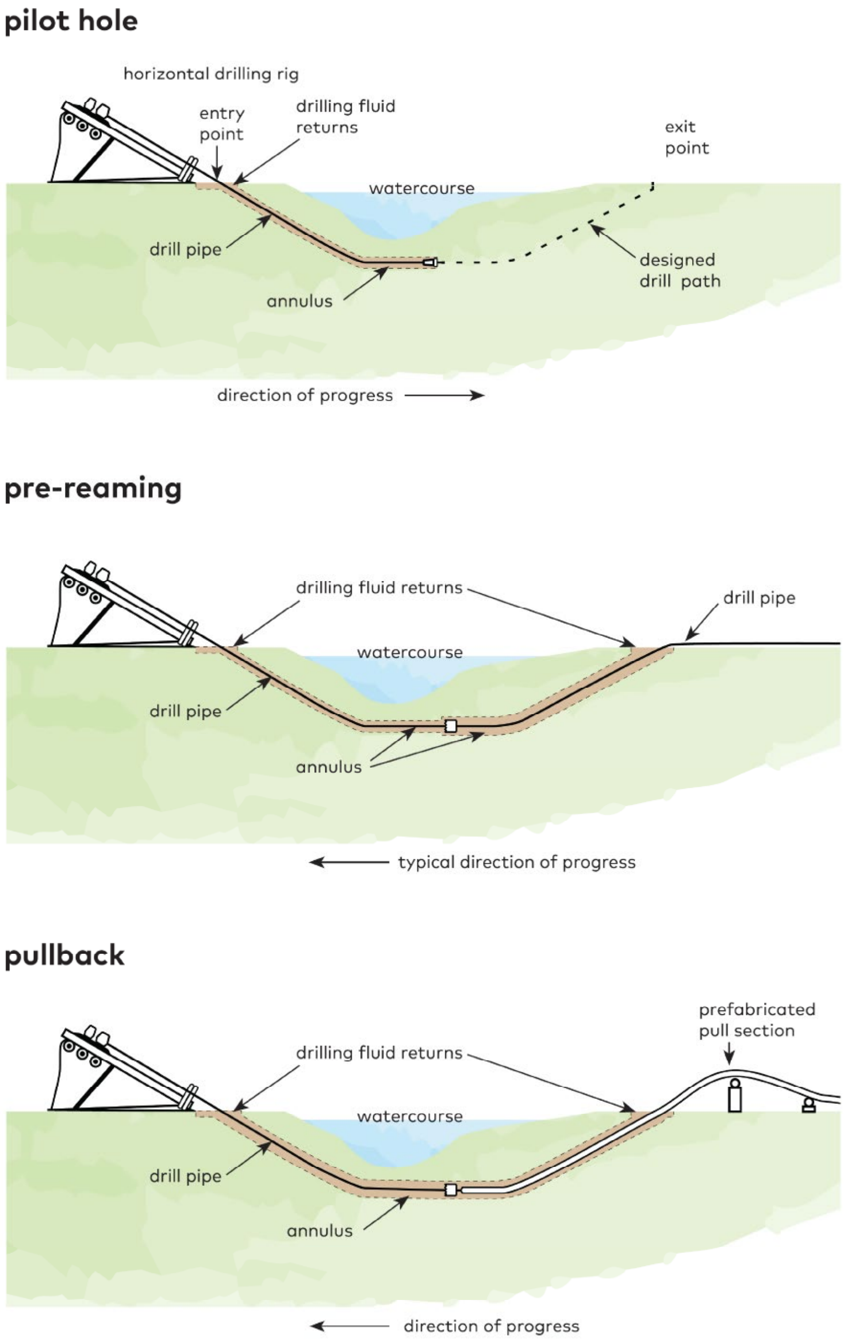


Figure 4-18:
Typical HDD process

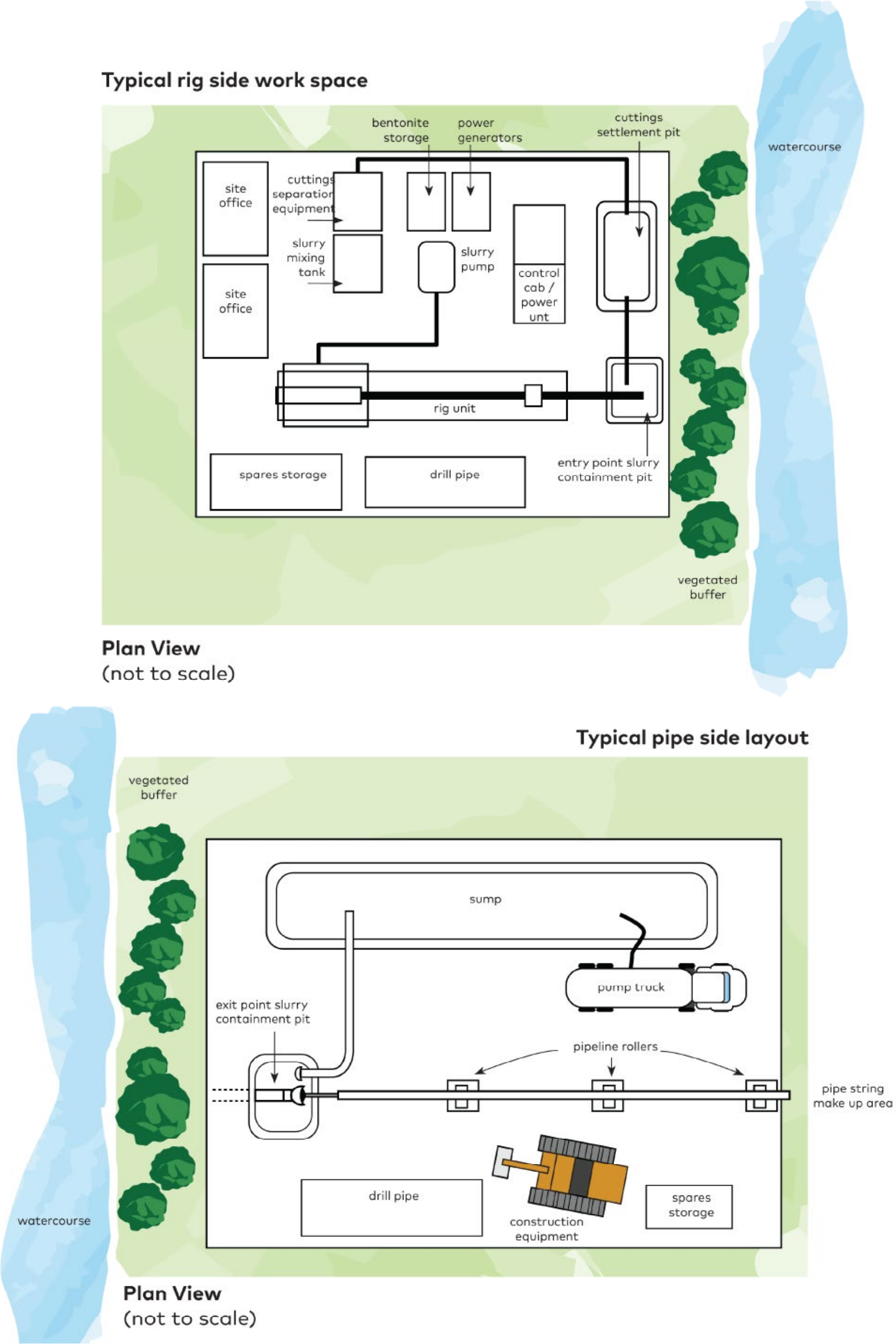


Figure 4-19: Schematic of typical layout of HDD entry and exit points

Drilling is conducted by a specific HDD rig operated by a specialist contractor. The size of the HDD rig and its associated footprint depends on the size of the pipe, the nature of the subsurface geology and the length of the drill.

Drilling mud (typically bentonite) is used to hydraulically drive the drilling head, as a coolant, to wash in-situ material (cuttings) from the drilled hole and to seal and line the hole to facilitate insertion of the pipe. Cuttings are screened, removed at the HDD rig and the drilling mud is recycled. Screened cuttings are diverted to skip bins before disposal in landfill in accordance with EPA Victoria's waste classification and transportation requirements. Treatment of cuttings is only required for acidic soils, which, based on surveys undertaken for the Pipeline Works, are likely to be encountered. If encountered, acidic cuttings can be treated to neutralise the cuttings and then disposed of in landfill or sent off-site for treatment and disposal.

HDD avoids surface disturbance but requires management of other environmental risks including geotechnical constraints (fissures and cracks, unconsolidated substrata and subsurface scour potential), which may prevent HDD being a suitable construction methodology. Where HDD presents unacceptable environmental risks, trenchless construction methodology would be used such as shallow horizontal boring or open trenching.

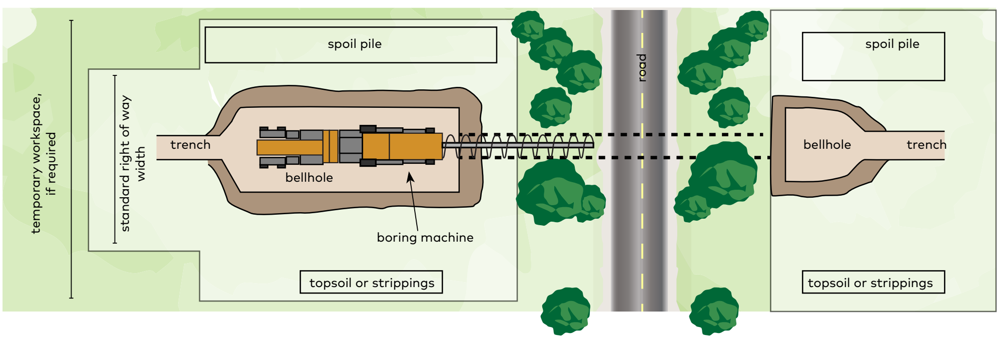
Duration of HDD construction at each HDD site is dependent on length and geological conditions (rock, unstable material, fissures and loss of mud). It is expected that each HDD would take approximately six weeks, although this would be subject to ground conditions. A shorter HDD in good conditions would take around three weeks. A longer HDD could take more than a month to complete. HDD construction may occur 24 hours a day during reaming of longer sections and pullback of the pipe string which is typically completed within a day.

Shallow horizontal boring

The methodology for shallow horizontal boring (referred to as thrust boring or micro-tunnelling) involves constructing a horizontal bore hole for installing the pipeline beneath sensitive surface features, roads and underground services. A typical set up for a thrust bored crossing is shown in **Figure 4-20**.

Bell holes are excavated on both sides of the sensitive feature to the depth of the adjacent trench and graded to match the slope of the pipeline. A bell hole is an enlarged hole allowing a boring machine wider than the width of the trench to operate within it to tunnel under the relevant constraint. Entry bell holes would be approximately 10 metres long, four metres wide and typically four metres deep. The exit bell hole would typically be seven metres long, four metres wide and up to four metres deep.

Plan View
(not to scale)



Profile
(not to scale)

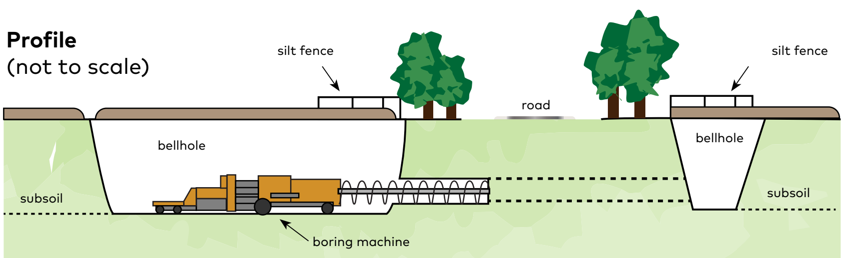


Figure 4-20: Typical thrust bore site set up

This construction method would be used at sealed roads and various other feature crossings including railways or where access is required on a 24-hour basis. The method is not suitable for boring under features where a greater depth is required, such as a major waterway. In these instances, HDD construction methodology would be used.

Pipeline testing and commissioning

The pipeline coating would be tested to ensure it is of a satisfactory standard before and after installation. If the pipeline fails a coating integrity test after installation, the pipeline would be excavated and repaired.

The pipeline would be pressure tested before commissioning to ensure it passes strength and leak tests. This is done through a process called hydrostatic testing whereby sections of the pipeline (test sections) are filled with water and then pressurised. A hydrostatic test plan would be developed and approved by Energy Safe Victoria before testing.

Each pipeline test section would be cleaned internally by pigs propelled by compressed air or water. The test section would then be filled with water and pressurised, and the pressure increased for approximately four hours to assess the strength of the test section. The pipeline would then be subjected to a leak test for a minimum of 24 hours to determine the section is leak free. The hydrostatic testing process would take approximately eight days for a single test section, with the majority of that time required to fill the test section with water.

It is anticipated the pipeline would be hydrostatically tested in a minimum of four and possibly up to eight sections of variable lengths. The exact sequence and timing of hydrostatic testing would depend on the final schedule for construction, availability of water and the final hydrostatic test design of the pipeline.

Hydrostatic testing would require approximately 10 megalitres of water in total and assumes reuse between two adjacent test sections. Break tanks would be used to transfer water between test sections. Depending on the final configuration of hydrostatic test sections and the availability of water, it is possible that chemicals to control biological growth and corrosion may be added to the hydrostatic test water.

Water for hydrostatic testing would be sourced from dams, groundwater bores, irrigation channels or watercourses where suitable supply exists near the pipeline alignment, in preference to using mains water. This water would be obtained subject to agreements and/or licences/permits with relevant landholders and authorities.

Water can be pumped into the pipe at either end of two test sections or from a central location between two test sections. This provides a high degree of flexibility in testing locations with the main consideration being the availability of water. This allows for testing locations to be selected to minimise potential amenity impacts by avoiding areas near sensitive receptors where practicable.

At the conclusion of testing, and subject to confirmation of the water quality, the water would be released onto adjoining land with appropriate slope, soil and groundcover characteristics. Water release would occur through a dewatering structure designed to slow the flow of water. When the dewatering process was complete, the pipeline would be dried using compressed air. Water that is not able to be disposed of onto adjoining land would be disposed of in accordance with relevant legislation and policy requirements.

Following pipeline testing and drying, the pipeline would be gauged using a geometry pig capable of measuring the internal surface of the pipe. Any defects would be located, assessed and rectified.

The pipeline would be commissioned following completion of hydrostatic testing. Commissioning would proceed sequentially from the point where commissioning gas was available and subsequently on completion of the nominated sections.

Commissioning would be in accordance with an Energy Safety Victoria approved plan and procedure prepared during the detailed design and construction phase of the Project and would include as a minimum the following activities:

- instrument calibration
- control system functionality
- safety system testing
- purging of air and gas filling
- pressurisation
- testing and commissioning of stations and valves.

Following commissioning, the pipeline assemblies that include the MLV assemblies, pig launcher at Crib Point Receiving Facility, pig receiver at Pakenham Delivery Facility and associated piping/valving would be tied-in to the pipeline.

Rehabilitation of the construction right of way

The rehabilitation of the construction ROW and all temporary facilities, temporary access tracks and extra work areas would begin as soon as practicable after the completion of the construction activities, with the aim of restoration of ground cover within six months. Rehabilitation of the construction footprint would be undertaken in accordance with good pipeline construction principles to reinstate existing topography and appropriate vegetation in consultation with the landholder. Appropriate reinstatement methods would be included in the CEMP.

Shallow-rooted vegetation and grass would be re-established across the ROW where appropriate with its land use and in consultation with landowners. For example, grain and fibre crops may be re-established in agricultural areas, although tall and deep-rooted vegetation (such as mature trees) cannot be reinstated, due to the potential to interfere with the pipeline coating and impede operational access requirements. No long-term impacts are expected to land uses that rely on cropping and grazing primary production.

Dense cover of suitable native shrubs or vegetation of a similar structure as agreed with the relevant landholder would be reinstated in identified locations of potential Southern Brown Bandicoot (a significant species identified within the Project Area) refuge or core habitat as described in **Chapter 7** *Terrestrial and freshwater biodiversity*, other than directly above the pipeline and a narrow track to allow ground access for surveillance patrols as part of maintenance activities.

Pakenham Delivery Facility

Construction of the Pakenham Delivery Facility would be undertaken by specialist crews across key distinct phases of works. These include initial earthworks and civil construction, mechanical installation and electrical and instrumentation works (as described in **Table 4-16**). Construction of the Pakenham Delivery Facility would take approximately 18 months for construction and commissioning with the final tie-ins to the pipeline before a hand-over to operational control.

Piping spools, pig traps and MLV assemblies would be fabricated off-site in specialised fabrication shops to minimise contamination during the fabrication processes as they provide controlled environments that are hard to achieve on site. Shop fabrication involves cutting, welding, testing and painting of pipe lengths to form the spools/pig traps/assemblies in transportable sections for ease of fitting and bolt-up during mechanical installation.

Table 4-16: Pakenham Delivery Facility construction activities

Construction sequence	Activity	Description
1	Site set-up	Site set up within the construction footprint is required to provide a safe and efficient area for construction activities. This includes constructing temporary haul roads in and out of (and within) the construction site, temporary fencing, and may include installing site offices and site facilities (toilets, lunch rooms etc.), prepping lay down areas, clearing vegetation, and relocating existing services if required.
2	Earthworks	Existing ground levels would be excavated/built up and levelled to the required design levels. The topsoil may be required to be replaced with engineered fill or pilings installed to minimise ground settlement (ground movement would induce stress on piping and equipment post installation in their final positions and can be damaging).
3	Civil works	Steel reinforced concrete foundations and footings would be installed which the permanent buildings, equipment and supports would sit on and be fixed to.
4	SMPEI (structural, mechanical, piping, electrical and instrumentation) installation	Once the concrete foundations are installed, the SMPEI supports and equipment can be installed. This involves ensuring equipment is level and can be bolted up without over-stressing connections. Specialist crews would install structural supports, mechanical equipment, piping spools, electrical equipment, cabinets and panels, cabling, instrumentation (sensors etc.), buildings, and walkways.

Construction sequence	Activity	Description
5	Testing and commissioning	The piping is tested using hydrostatic testing. Mechanical and electrical equipment are also mechanically and electrically tested to make sure they have been installed correctly and are ready for commissioning. Commissioning involves fine tuning of equipment and instrumentation by running the facilities through various operating ranges. Once the facility passes all checks per the commissioning plan, it is ready to be handed over to Operations and start processing the gas.
6	Roads, landscaping and reinstatement	Final touches within the final facility such as permanent roads, kerbs, pavement, landscaping and permanent fencing would be constructed. Reinstatement of construction areas which are not part of the final facility would also be finished to leave the facility in its finished state.

End of Line Scraper Station

The temporary disturbance footprint for construction of the EOLSS is around 55 by 130 metres.

The EOLSS is where the pipeline connects to the VTS, via the Longford to Dandenong Pipeline and the Bunyip to Pakenham Pipeline. The VTS is a major transmission pipeline, and a shutdown of this line would impact on Victorian gas users. Connection to the VTS is therefore required via two hot tap connections; one to the Longford to Dandenong Pipeline and one to the Bunyip to Pakenham Pipeline.

To ensure the cutting and welding of new fittings onto a live gas pipeline is completed in a coordinated manner, thorough planning is completed before the actual hot tap. Part of the planning involves proving works to expose and survey the existing pipeline. Pipeline tests and samples are also collected to confirm the historical data on which the design and welding procedures are to be based on.

Large holes typically six metres wide, 10 metres long and up to 3.5 metres deep, known as bell holes, would be excavated to allow for welding and drilling onto the existing pipeline. The hot tap fittings would be welded to the pipe with an isolation valve pre-bolted on. Once the welds have been inspected and tested, the pipe can be cut. The isolation valve is double isolated with a blind flange which is left on until the new pipeline is installed and ready for connection to the hot tap isolation valve.

Other construction works for the EOLSS include additional excavations to install concrete footings for the portable scraper trap, a concrete retaining wall, the new pipeline for connection to the hot tap isolation valves and associated valve pits. The concrete wall, foundations and valve pits would be installed below the natural surface level and the area would be reinstated to blend in with the surrounding farmland. The temporary scraper trap would be removed after the pipeline is commissioned and stored until required.

Hot tapping

Hot tapping is a tie-in methodology for new connections to existing pipelines without taking them offline and is performed by specialist crews with specialised equipment.

4.5.5 Construction workforce for the Project

During construction of the Crib Point Receiving Facility and Jetty Infrastructure, it is expected approximately 90 people would be employed as part of the Gas Import Jetty Works. The Crib Point Receiving Facility and Jetty Infrastructure construction works would be undertaken between 6 am and 6 pm on weekdays, and between 6 am and 3:30 pm on Saturdays (with no works on public holidays).

At the peak of the construction program, the Pipeline Works are expected to employ a construction workforce of approximately 400 people. The construction workforce for the pipeline would generally work between 6 am and 6 pm, seven days per week. Construction crews would typically work a rostered cycle of 28 days on and nine days off (or 21 days on and seven days off), as per the pipeline industry standard, with seven cycles likely to be required during the construction phase. An indication of the split of the workforce is provided in **Table 4-17**.

Construction works on the pipeline would be undertaken outside the standard work hours listed in **Table 4-17** during HDD activities and hydrostatic testing. Construction of the HDD crossings would likely be conducted seven days per week from the start of reaming to maintain HDD section stability. For larger sections, this may also include working 24 hours a day. During pullback operations works would likely be conducted on a 24-hour per day basis until the pipe was installed.

Where night works are required, task-based lighting would be used.

4.5.6 Construction equipment for the Project

Indicative equipment, plant and vehicles required for the Project's construction works is shown in **Table 4-18**.

Table 4-17: Construction workforce

Construction activity	Construction workforce	Standard working hours
Crib Point Receiving Facility and Jetty Infrastructure	90	6 am – 6 pm weekdays 6 am – 3:30 pm Saturdays
Pipeline construction and Pakenham Delivery Facility	390	6 am – 6 pm*
Pipeline testing and reinstatement	22	6 am – 6 pm*
Pipeline project management site	27	6 am – 6 pm

* Works may be undertaken outside of these standard hours during HDD and hydrostatic testing activities

Table 4-18: Indicative construction equipment, plant and vehicles

Activity	Equipment/Plant	Vehicles
Gas Import Jetty Works	Floating barge with crawler crane (600T or 250T) Materials barge Franna crane (20T) Air compressor Generator Elevated work platform (60ft) Excavator Scaffolding Pumps Sub-stations Angle grinder Asphalt paver Continuous flight auger piling rig – to create deep concrete foundations Circular bitumen saw Compactor Crane Bulldozer Drill Front end loader Skid steer loader – small, rigid-frame, engine-powered machine with lift arms used to attach a wide variety of labour-saving tools or attachments Road grader – to create flat surfaces Harvester machine Hydraulic torque wrench Kerbing machine Mulcher Roller Welding machine	Light vehicles (4x4 wagons or utes) Tugboats Work crew boats Table top truck (8T) Truck (2T) Waste truck Deliveries truck Water truck Concrete truck Semi-trailer Tractor Dump truck Vacuum truck Welding truck
Pipeline Works	Fork lift Tractor post driver Excavator (24T, 30T) Backhoe Mulcher Grader Bulldozer Pipe bending machine Compressor Drying unit Pumps Sideboom – for installing the pipe in the trench Water cart (15,000 L) Generator system Mud system Guidance system HDD rig Internal clamp Tack rig – crawler-type tractor where a belt from the tractor motor drives of welding generators mounted in the back Chain trencher – cutting machine with a digging chain Bucket wheel trencher Street sweeper Compactor Padding machine – to backfill the trench Loader Piling rig to drive poles into soil as foundation support Harvester machine Road roller Circular saw	Light vehicles (4x4 wagons or utes) Hiab truck (truck-mounted forklift/crane) Fuel truck Float (50T) Semi-trailer 10T truck Crew cab truck Dump truck Extendable trailer Skid truck Spray truck 4x4 bus Vacuum truck Welding truck Concrete trucks Timber hauling truck

4.5.7 Construction traffic

During construction of the Gas Import Jetty Works, approximately 40 heavy vehicle movements per day are expected to occur to and from the Crib Point laydown area to deliver materials. Vehicles allowed on the jetty during construction activities are restricted in size and weight due to the turning restrictions and width of the jetty itself. Smaller vehicles such as utility vehicles would likely move from the laydown area to the worksite on the jetty at a frequency of about one per hour for the duration of construction works.

Major structural elements for the Jetty Infrastructure, including the MLAs, fire towers, fire pumps and topside piping would be delivered to a local port and unloaded directly onto a material barge or delivered directly to a laydown area and stored until required for installation.

Pipes for the Pipeline Works would be supplied in three separate shipments before construction:

- 500 metres of heavy wall pipe would be shipped into the Port of Melbourne and transported in five loads of 12-metre lengths to Tottenham for fabrication.
- 28,500 metres of pipe would be shipped into the BlueScope Western Port Facility at Hastings and transported to the temporary stockpile facility on Denham Road. The road transportation would be undertaken using five extendable trailers moving four loads a day each which should be completed in 11 days.
- Another shipment of 28,500 metres of pipe would be shipped into the BlueScope Western Port Facility at Hastings. Five kilometres of pipe would be transported to the stockpile site at Crib Point and 23.5 kilometres of pipe would be transported to the Denham Road stockpile. This would be undertaken using five extendable trailers moving 18 loads a day over 12 days.

The construction workforce would travel to site from pre-existing accommodation in the towns and suburbs of Somerville, Hastings, Stony Point, Frankston, Cranbourne, Pakenham, Beaconsfield, Dromana, Rosebud, Safety Beach and Mornington. Workers at the Crib Point Jetty would likely park their vehicles in the designated carpark located at the site. The pipeline welding crew may travel to site daily by bus.

4.6 Operation and maintenance

The Project is expected to operate for 20 years. Operation and maintenance activities are described in the following sections, including the expected operational workforce.

4.6.1 Gas Import Jetty Works

The FSRU would be continuously moored at Berth 2 of the Crib Point Jetty as shown in **Figure 4-3**. The FSRU is an operational vessel and can be moved as required, such as in extreme weather events or for maintenance activities.

When commissioned, the FSRU would be operated under a long-term charter by an experienced third-party operator.

The Crib Point Receiving Facility and associated Jetty Infrastructure would either be owned and operated by AGL or an experienced third-party operator.

Port navigation

PoHDA and the Victorian Regional Channels Authority (VRCA) manage and operate the Port of Hastings. The VRCA controls vessel traffic using the commercial shipping channels of the Port of Hastings through the authority of the Harbour Master.

PoHDA maintains the navigational aids for the VRCA. Harbour control is located at Stony Point and is the responsibility of the VRCA under direct control of the Harbour Master. Vessels using the Port of Hastings including the commercial shipping channels must comply with all requirements outlined in the Port of Hastings Harbour Masters Directions and the Port Operating Handbook.

As described in **Section 4.3** of this chapter, the initial frequency of LNG carriers is expected to be around 12 cargos of LNG per year. This could increase to around 40 LNG carriers per year pending demand supply requirements in the gas market.

LNG carriers could arrive at the Crib Point Jetty at any time of day, under the authorisation of the Harbour Master.

To ensure the safety of a ship's passage, licensed pilots are employed by pilotage services providers to guide ships into and out of port waters. Pilotage is compulsory for all commercial ships exceeding 35 metres long except those whose Master is specifically exempt from pilotage. The FSRU and arriving and departing LNG carriers would be required to use pilotage. Tugboat services would also be required to aid in mooring and departure of LNG carriers, and for the FSRU if there is a need for the FSRU to leave from its berth at the Crib Point Jetty.

Waterside restricted zones

Waterside restricted zones are currently in place within 100 metres of the Crib Point Jetty. This waterside restricted zone is proposed to be increased to 200 metres to the east of Berth 2 and also to the south is shown in **Figure 4-3** in **Section 4.3** of this chapter, subject to approval of the maritime security plan by the Department of Aviation and Maritime Security Division within the department of Home Affairs under the *Maritime Transport and Offshore Facilities Security Act* 2003 (Cth). Access to the waterside restricted zone is controlled and unauthorised entry is an offence.

Jetty Infrastructure

Planned maintenance activities for the Jetty Infrastructure include:

- lubrication of MLA joints and seals
- checking valve operation
- pipeline paint inspections
- firefighting system testing
- checking and emptying stormwater collection tanks located under the jetty.

Additionally, operation and maintenance activities at the jetty may include environmental monitoring and delivery of materials, supplies or waste services to the FSRU.

Crib Point Receiving Facility

The Crib Point Receiving Facility is designed to be automated and may operate unmanned under normal operating conditions with the exception of regular truck deliveries of odorant and nitrogen. There is provision for local control from the control hut to be installed. Maintenance activities and start-ups would also require site access.

Odorant deliveries would depend on the volume of gas vaporised by the FSRU and are not expected to be more frequent than once every two months from Melbourne.

Liquid nitrogen trucks would arrive from Dandenong at a rate of up to five trucks a day in preparation of a shipment of LNG. To fill the 3,000 tonne nitrogen tank from empty would take approximately 19 days for deliveries utilising 33 tonne (33-T) B-double trucks, or if the trucks are smaller (23-T) it would take approximately 26 to 30 days. This would be an estimated maximum of 900 trucks per year.

Pipeline Works

Following the reinstatement of land as part of the pipeline construction, the land would be generally returned to its previous use. Excavating or erecting permanent structures or buildings over the underground pipeline would be prohibited in accordance with the *Pipelines Act* 2005 and pursuant to agreements with landowners. Pipeline markers would be provided at fences, road crossings and other locations as required by AS2885 and APA standards.

When commissioned, the pipeline would be owned and maintained by APA. Routine corridor inspections would be undertaken in accordance with APA procedures and AS2885 to monitor the pipeline easement for any operational or maintenance issues. The ongoing corridor inspections address issues such as:

- unauthorised excavation
- land stability (such as subsidence, erosion)
- revegetation
- weed invasion
- cover at watercourse crossings
- third-party (such as asset owners) and landowner activities.

The routine operation of gas pipelines requires the periodic running of a pig to clean and inspect the wall integrity. Pigging would be undertaken 10 years post construction, then at a frequency determined by the result of each inspection, most likely greater than 10 years.

Maintenance and inspections of the MLVs would also be conducted periodically in accordance with APA procedures. The activities usually include vegetation management, valve operation and corrective maintenance.

Pakenham Delivery Facility

The Pakenham Delivery Facility would be automated and designed to operate unmanned under normal operating conditions. Daily operational control would be from the designated control room at APA's existing Dandenong South Facility via the supervisory control and data acquisition (SCADA) system. The SCADA system allows remote monitoring of real-time data.

There is also provision for local control from the control hut to be installed. Maintenance activities and start-ups would also require site access.

End of Line Scraper Station

The connection to the VTS would operate unmanned. Excavation of the site to access the EOLSS would be required for the pigging activities approximately 10 years after construction then at a frequency to be determined based on the first inspection.

4.6.2 Operational workforce for the Project

The FSRU would be operated and maintained by a work crew of approximately 30 to 35, who would reside on the vessel during their roster, or undertake daily shifts. The timeframe of the roster is yet to be determined. Once the roster is complete, the crew would be switched out on rotation. Other contractors would also be required to attend to the vessel during normal operations and maintenance.

The above-ground facilities are designed to be automated and may be operated unmanned under normal operating conditions.

Operation of the pipeline would require an incremental increase in APA's existing operational workforce consisting of one field staff and one control room staff.

Field staff would be responsible for day to day pipeline operations and maintenance activities, ground patrols, communication with local stakeholders and facilitation of third-party access to the easement.

Contractors operating under APA's supervision would be responsible for activities including:

- easement maintenance (vegetation control, weed management, erosion and subsidence monitoring)
- specialist pigging operations
- cathodic protection surveys for mechanical and electrical preventative and corrective maintenance.

Field staff would access the pipeline to conduct operations and maintenance activities as required, in consultation with relevant landholders.

Gas flow and pressure would be monitored from APA's Dandenong Control Room at Dandenong, Victoria. Dandenong staff would also coordinate maintenance and management activities.

4.7 Decommissioning

The expected operational term for the FSRU is 20 years. When the Project is complete, the FSRU would be able to depart Western Port.

The Jetty Infrastructure installed on the Crib Point Jetty and the Crib Point Receiving Facility would be decommissioned and removed when no longer required under the requirements of the *Gas Safety Act 1997* and relevant legislative requirements at the time of decommissioning. The Crib Point Jetty would remain as an operational jetty under the management of PoHDA.

The pipeline is designed and built with a life span of 60 years although it could operate for longer if pipeline integrity was maintained. When the pipeline and associated facilities are no longer required, they would be decommissioned in accordance with AS2885 and relevant legislative requirements at the time of decommissioning.

A detailed decommissioning or abandonment plan and rehabilitation program would be developed and implemented in consultation with landholders and the Regulator at the relevant time.

Decommissioning would be subject to separate environmental assessment and does not form part of this EES.

4.8 Waste and spoil management

The Project would generate a range of wastes, mainly through the construction phase. During the operation phase, the wastes generated would generally be from activities onboard the FSRU, including wastewater and solid waste. In addition, air and water emissions from the FSRU would be generated during operation, requiring a Works Approval under the *Environment Protection Act 1970* and the issue of an operating licence from EPA Victoria prior to operations commencing.

4.8.1 Construction waste management

Typical construction wastes generated as a result of the activities carried out for the Gas Import Jetty Works would include (but are not limited to):

- waste from transportation of materials (such as plastic and timber packaging)
- waste from excavation/trenching (such as soil/spoil)
- waste from construction and modifications, if required (such as waste oil, rags, chemicals and other products, copper wire and cables, steel cuttings and spent welding rods)
- waste from site office activities (such as paper, food waste, cans)
- waste from obsolete equipment, stationery, light bulbs and Personal Protection Equipment.

Temporary site offices, including kitchen facilities and portable toilets would be available during construction, and wastewater would be appropriately managed by the service contractor, who would hold the relevant licences. The water to be used for hydrotesting of the jetty piping is proposed to be reused or recycled, but if water quality does not allow for this, water would be transported, treated and disposed of by licensed waste contractors.

A range of wastes would be generated during construction activities for the Pipeline Works, particularly in respect to activities along the pipeline construction ROW. These include:

- wastes from transportation and storage of pipe
- wastes from survey, clearing the ROW and trenching
- pipeline coating waste
- drilling cuttings and excess soil and rock (spoil)
- welding/grinding waste (for example, spent welding rods)
- machinery waste.

Cleared vegetation, topsoil and subsoil would be generated during construction of the Pipeline Works. As these materials are generally returned to the ROW as a fundamental part of rehabilitation they are not considered to be wastes, and so are not included in the waste inventory.

The excavation of the pipeline trench is calculated to equate to 91,500 m^3 of spoil, which would be reused across the ROW unless the material could not be used due to its quality. In the event that the excavated material cannot be reused, the spoil would be disposed of according to the requirements of the CEMP. Further discussion on spoil and its suitability for reuse is discussed in EES Technical Report E: *Contamination and acid sulfate soils impact assessment* and **Chapter 10** *Contamination and acid sulfate soils.*

Project construction wastes would be reused or recycled where practicable or collected and transported by licensed waste contractors for disposal at appropriately licensed facilities.

4.8.2 Operation waste management

Wastes generated during operation of the Gas Import Jetty Works are associated with the activities described in **Section 4.6.1** of this chapter. Most of the waste from operation of the FSRU would include (but are not limited to):

- grey/black/bilge wastewaters from vessel operation (such as sewage and bilge water) to be stored on the FSRU and disposed as required by licensed contractors for disposal at appropriately licensed facilities
- waste from plant maintenance activities (such as waste oil, rags, obsolete equipment and light bulbs)
- waste from onboard living activities (such as food waste, plastic and glass containers, cans)
- waste from office activities (such as paper, rubbish, obsolete electronics, batteries, cardboard and other packaging).

As described in **Section 4.3.1**, the FSRU requires the use of seawater to provide cooling for engines and heating water for regasification. Seawater discharges would contain residual levels of chlorine from the regasification process and are further described in **Chapter 6** *Marine biodiversity*.

Air emissions from the operation of the FSRU would include concentrations of air pollutants associated with fuel combustion, including greenhouse gas emissions. **Chapter 11** *Greenhouse gas* and **Chapter 12** *Air quality* provide a detailed discussion on these emissions during operation of the FSRU.

Air and water emissions from the operation of the FSRU would require a Works Approval under the *Environment Protection Act 1970*.

In relation to the Jetty Infrastructure and Crib Point Receiving Facility, wastes would include (but are not limited to):

- waste from general maintenance activities (such as oil and/or grease, rags, empty containers, paint, packaging, obsolete equipment and light bulbs)
- any contaminated stormwater captured and stored in tanks beneath the jetty disposed of to a licensed facility
- any contaminated sediments captured in the skimming pit disposed by a licensed contractor to a licensed facility.

During operation of the Pipeline Works, wastes would include:

- small volumes of waste oils and grease
- dust and millscale (steel flakes) from infrequent maintenance or pigging activities.

Waste generated from pigging is typically dust and millscale from inside the pipe and volumes are expected to be less than one cubic metre for the entire pipeline. This waste would be collected at scraper station locations approximately every 10 years as part of maintenance activities. Pigging waste would be tested for waste classification before disposal at a suitable general solid waste or hazardous waste management facility.

Project operation wastes would be reused or recycled where practicable or collected and transported by licensed waste contractors for disposal at appropriately licensed facilities.

4.9 Project summary

The aim of the Project is to meet the needs of industrial, commercial and residential gas customers on the east coast of Australia against a backdrop of predicted gas shortfalls in the south-eastern Australian states from 2024 onwards. The Project is part of AGL's commitment to deliver gas supply certainty to the south-eastern Australian market safely, within agreed timeframes and at competitive prices, while balancing economic, social and environmental factors.

The design described in this chapter has considered legislative requirements, stakeholder engagement and the environmental impact assessments conducted to date. The design would continue to be refined where relevant to improve operability, minimise impacts on receivers and the environment, and in response to feedback from stakeholders.

Project design alternatives have been assessed having regard to the likely environmental, social and economic effects and in consideration of key Project outcomes such as gas market requirements, cost, program implications and necessary approvals.

The Gas Import Jetty Works would comprise of the continuous mooring of an FSRU vessel at Berth 2 of the existing Crib Point Jetty, which would initially receive LNG from approximately 12 LNG carriers per year with capacity to increase to approximately 40 LNG carriers per year. The FSRU would store and regasify the LNG as required, then send out the natural gas via the Jetty Infrastructure to the Crib Point Receiving Facility to check and verify the gas quality specifications.

The Pipeline Works is designed in accordance with AS2885 and would comprise a bi-directional gas transmission pipeline to transport gas from the Crib Point Receiving Facility to the VTS east of Pakenham. The pipeline alignment was selected to minimise impacts on sensitive land uses and where possible follows existing pipeline easements. The Pipeline Works would also consist of a pig launcher at the Crib Point Receiving Facility, two mainline valves, the Pakenham Delivery Facility and the EOLSS.

Construction of the Project is expected to take approximately 18 to 27 months subject to staging of construction works. The Project would operate for 20 years, although this may be shortened or extended to address security and stability of gas supply to south-eastern Australia.

Assessment of potential environmental effects associated with the construction and operation of the Project are described in Volume 2 of the EES.

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