



## Application for Works Approval

### Division 3, Part V *Environmental Protection Act 1986*

---

**Works Approval Number** W6199/2018/1

**Works Approval Holder** Chevron Australia Pty Ltd

**ACN** 089 197 757

**File Number** DER2018/001650

**Premises** Gorgon LNG Project  
Part of Crown Lease L077431  
Certificate of Title Volume 3158 Folio 477  
BARROW ISLAND WA 6712

**Date of Report** 10 April 2019

**Status of Report** Final

## Table of Contents

<b>1. Definitions of terms and acronyms .....</b>	<b>1</b>
<b>2. Purpose and scope of assessment .....</b>	<b>3</b>
2.1 Application details .....	3
<b>3. Background .....</b>	<b>3</b>
<b>4. Overview of Premises .....</b>	<b>4</b>
4.1 Operational aspects .....	4
4.2 Infrastructure .....	6
<b>5. Legislative context .....</b>	<b>6</b>
5.1 Part IV of the EP Act .....	7
5.1.1 Background .....	7
5.1.2 Ministerial Statement 800 .....	7
5.2 Other relevant approvals .....	10
5.2.1 Department of Mines, Industry Regulation and Safety .....	10
5.2.2 <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) .....	10
5.3 Part V of the EP Act .....	10
5.3.1 Applicable regulations, standards and guidelines .....	10
5.3.2 Works approval and licence history .....	10
<b>6. Modelling data .....</b>	<b>11</b>
6.1 Mercury and BTEX .....	11
6.2 NOx .....	13
<b>7. Consultation .....</b>	<b>13</b>
<b>8. Location and siting .....</b>	<b>14</b>
8.1 Siting context .....	14
8.2 Residential and sensitive Premises .....	14
8.3 Specified ecosystems .....	14
8.4 Meteorology .....	15
8.4.1 Wind direction and strength .....	15
8.4.2 Regional climatic aspects .....	15
<b>9. Risk assessment .....</b>	<b>17</b>
9.1 Determination of emission, pathway and receptor .....	17
<b>10. Works Approval / Licence conditions .....</b>	<b>19</b>
<b>11. Applicant's comments .....</b>	<b>19</b>
<b>12. Conclusion .....</b>	<b>19</b>
<b>Appendix 1: Key documents .....</b>	<b>20</b>
<b>Appendix 2: Summary of Applicant's comments on risk assessment and draft</b>	

<b>conditions .....</b>	<b>22</b>
<b>Attachment 1: Issued Works Approval W6199/2018/1 .....</b>	<b>23</b>

<b>Table 1: Definitions .....</b>	<b>1</b>
Table 2: Documents and information submitted during the assessment process.....	3
Table 3: Prescribed Premises Categories in the Existing Licence .....	3
Table 4: New and existing infrastructure to support the flaring of MEG flash gas vapour .....	6
Table 5: Relevant approvals and tenure.....	6
Table 6: Consideration of MS 800 conditions relevant to this application .....	8
Table 7: Works approval and licence history .....	11
Table 8: MEG flash gas vapour flowrate data.....	11
Table 9: Pollutant emission rates .....	12
Table 10: Applicable ambient air quality criteria .....	12
Table 11: Modelled receptor locations and their approximate distance from the emission source (ground flare).....	12
Table 12: Wet flare measured fuel consumption (February 2016 to May 2017).....	13
Table 13. Predicted NOx contribution (ppb) at the Communications Tower monitoring station compared to ambient air quality criteria.....	13
Table 14: Receptors and distance from activity boundary .....	14
Table 15: Environmental values .....	15
Table 16. Identification of emissions, pathway and receptors.....	17

## 1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

**Table 1: Definitions**

Term	Definition
AACR	Annual Audit Compliance Report
ACN	Australian Company Number
AER	Annual Environment Report
BTEX	benzene, tyoluene, ethylene and xylene
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CS Act	<i>Contaminated Sites Act 2003 (WA)</i>
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act.
Department	means the department established under section 35 of the <i>Public Sector Management Act 1994</i> and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986 (WA)</i>
EP Regulations	<i>Environmental Protection Regulations 1987 (WA)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>
Licence Holder	Chevron Australia Pty Ltd
MEG	monoethelene glycol
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
mtpa	million tonnes per annum
NEPM	National Environmental Protection Measure
Noise Regulations	<i>Environmental Protection (Noise) Regulations 1997 (WA)</i>

Occupier	has the same meaning given to that term under the EP Act.
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Primary Activities	as defined in Schedule 2 of the Revised Licence
Review	this Licence review
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this Review.
Risk Event	As described in <i>Guidance Statement: Risk Assessment</i>

## 2. Purpose and scope of assessment

Chevron Australia Pty Ltd (the Applicant) hold an Existing Licence to operate the Gorgon LNG Project (L9102/2017/1). An Application for a Works Approval was submitted on 6 December 2018 to re-route air emissions associated with the MEG (monoethylene glycol) regeneration unit to the wet flare. The Application was submitted under s53 of the EP Act as it alters the nature or volume of waste emitted from the Premises.

### 2.1 Application details

Table 2 lists the documents submitted during the assessment process.

**Table 2: Documents and information submitted during the assessment process**

Document/information description	Date received
Application Form: works approval, licence, renewal, amendment, or registration	6 December 2018
MEG Flash Vapour Compressor Discharge Destination Study (Document reference: GOR-0000-HES-RPT-WOP-00001)	
Email dated 18 March 2019 Entitled <i>FW: W6199 – MEG Flash Gas to Flare</i> and attachment	18 March 2019
Email dated 18 March 2019 Entitled <i>FW: W6199 – MEG Flash Gas to Flare – Request for minor changes</i> and attachment	29 March 2019

## 3. Background

The Gorgon LNG Project is located on Barrow Island; an A-Class Nature Reserve (Crown Reserve 11648) situated 85 km north-west of Onslow. Natural gas is extracted from the Gorgon and Jansz-lo gas fields (situated 65 and 130 km off the west coast of the island) and transported to the gas treatment plant (GTP) on Barrow Island for processing. The GTP produces liquefied natural gas (LNG) via three LNG processing trains with a maximum annual throughput of 18 mtpa (15.6 mtpa nameplate design throughput). Lesser amounts of condensate and DomGas are also produced.

Table 3 lists the prescribed premises categories that are included on the Existing Licence L9102/2017/1.

**Table 3: Prescribed Premises Categories in the Existing Licence**

Classification of Premises	Description	Approved Premises production or design capacity or throughput
Category 10	Oil or gas production from well: premises, whether on land or offshore, on which crude oil, natural gas or condensate is extracted from below the surface of the land or the seabed, as the case requires, and is treated or separated to produce stabilised crude oil, purified natural gas or liquefied hydrocarbon gases.	LNG: 18 million tonnes per Annual Period DomGas: 300 TJ/day Condensate: 1 million tonnes per Annual Period
Category 34	Oil or gas refining: premises on which crude oil, condensate or gas is refined or processed.	
Category 52	Electrical power generation: premises (other than premises within category 53 or an emergency or standby	585.5 MW

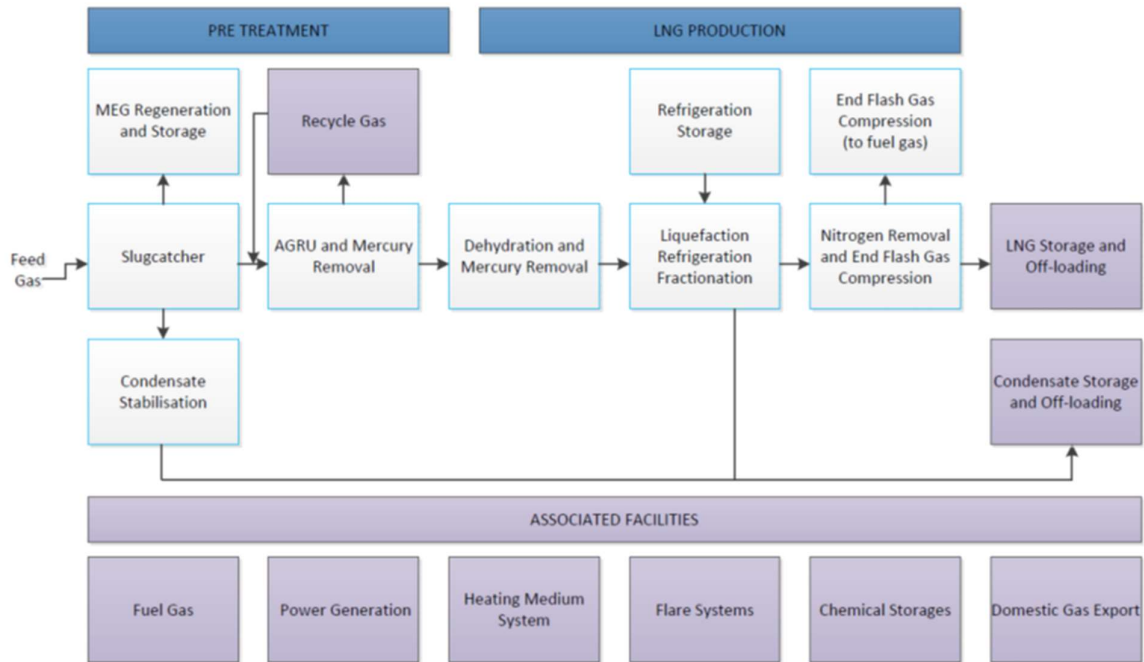
	power generating plant) on which electrical power is generated using a fuel.	
Category 54	Sewage facility: premises — (a) on which sewage is treated (excluding septic tanks); or (b) from which treated sewage is discharged onto land or waters.	1,385 m <sup>3</sup> /day
Category 62	Solid waste depot: premises on which waste is stored, or sorted, pending final disposal or re-use.	240,000 tonnes of stockpiled concrete Waste per Annual Period 52,050 tonnes of other solid Waste per Annual Period
Category 73	Bulk storage of chemicals, etc: premises on which acids, alkalis or chemicals that – (a) contain at least one carbon to carbon bond; and (b) are liquid at STP (standard temperature and pressure), are stored.	1,090 m <sup>3</sup>

## 4. Overview of Premises

### 4.1 Operational aspects

As part of the LNG/Domgas process, Jansz-lo and Gorgon feed gas arrives at the inlet processing facility slug catchers, which segregate incoming fluids into three phases (gas, condensate and aqueous). The majority of the gas phase is sent to the LNG trains for processing; and a portion is sent to the DomGas plant. The condensate phase is directed to a condensate stabilisation unit where light hydrocarbons are stripped out to produce condensate which is shipped as a product (Figure 1).

The aqueous phase is sent to a MEG regeneration unit, which regenerates the rich-MEG by removing water and salts. Recovered lean-MEG, which is reused to inhibit hydrate formation in feed gas pipelines, is returned to the production wellheads via dedicated MEG utility pipelines. Remaining wastewater is disposed of via deep well injection.



**Figure 1: LNG process**

During the MEG regeneration process, MEG flash gas vapours are produced. According to the Application, the original design basis was for the MEG flash gas vapours to be disposed of by geosequestration via injection into the CO<sub>2</sub> wells or vented from the MEG flash gas compressor discharge point (Discharge point A11 on Existing Licence L9102/2017/1) when the CO<sub>2</sub> Injection System was off-line. With the delays to the CO<sub>2</sub> Injection System, all MEG flash gas has been vented via Discharge Point A11 to date.

As stated in the Application, the Applicant is proposing to re-route the MEG flash gas to the wet flare for combustion to alleviate occupational health and safety concerns associated with venting of MEG flash gas vapours. The wet flare forms part of the ground flare system (Discharge Point A8 on Existing Licence L9102/2018/1) consisting of both the wet and dry flares. Connection pipes and pressure valves will be installed to enable rerouting of MEG flash gas vapours to the wet flare. Commissioning and operation of the MEG flash gas vapour compressor is also proposed. The compressor is required to feed the vapours to the flare and was installed as per the original design but has not been operated to date as vapours are being directly vented to atmosphere.

The vapours form a continuous (variable rate) flow stream composed primarily of CO<sub>2</sub> (83 mol%), hydrocarbons (16.6 mol%) and Nitrogen (N<sub>2</sub>) (0.8 mol%). As feed gas entering the inlet facilities is yet to be treated in the mercury removal units (MRU), the mercury content within the vapours is 13,000µg/m<sup>3</sup>, which is significantly higher than gas entering the LNG and Domgas processing trains which has been treated via MRUs. The concentration of BTEX (benzene, toluene, ethylene and xylene) within the feed gas is approximately 300 ppm.

Assist gas consisting primarily of methane will be added to the MEG flash gas vapour feed to ensure its effective combustion due to the high inert quantities of CO<sub>2</sub>. A calorific value analyser is installed in the wet gas flare feed line and ensures that the calorific value of the gas going to the wet flare does not fall below vendor specifications ensuring efficient combustion of the MEG flash gas vapours.

The ability to vent the MEG flash gas vapours will remain as a contingency should flaring be unavailable.



Flaring of MEG flash gas vapours is expected to be a temporary measure with a long term solution yet to be confirmed by the Applicant. Options for long term disposal of the MEG flash gas vapours being considered by the Applicant include:

1. Option 1: Re-routing to the Condensate Stabiliser Overhead Compressor where gas will be directed back to the front end of the plant. Mercury will be removed via existing MRUs. CO<sub>2</sub> will be captured and sequestered by the CO<sub>2</sub> injection system and hydrocarbon streams captured for export. Estimated start up Q2 2020.
2. Option 2: MEG Flash gas sequestered via CO<sub>2</sub> injection with the installation of a new MRU. Estimated start up Q4 2020.
3. Option 3: MEG Flash gas sequestered via CO<sub>2</sub> injection which will require a reassessment of risks associated with mercury being injection into the CO<sub>2</sub> system.

## 4.2 Infrastructure

The new and existing infrastructure, as it relates to this Application, is detailed in Table 4 and with reference to the Site Plan (attached in the Issued Works Approval).

**Table 4: New and existing infrastructure to support the flaring of MEG flash gas vapour**

	Infrastructure	Site Plan Reference
<b>Existing infrastructure</b>		
1	MEG flash gas vapour compressor	Jansz MEG Module
2	Ground flare system	Ground Flare
<b>New infrastructure</b>		
3	Two actuated valves (a pressure control valve and a shutdown valve)	Re-routed pipeline shown in green
4	A pressure transmitter (to support over-pressure protection via operation of the shutdown valve)	
5	20 metres of steel pipe to reroute the pipe from Vent 6 to the wet flare by connecting the existing compressor discharge piping to the flare tie-in piping	

## 5. Legislative context

Table 5 summarises approvals relevant to the assessment.

**Table 5: Relevant approvals and tenure**

Legislation	Number	Subsidiary	Approval
<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</i>	EPBC 2008/4178	Chevron Australia Pty Ltd	Conditional approval was issued for the initial two train Gorgon LNG Project on 2 October 2007 (EPBC 2013/1294). Approval for the expanded Gorgon LNG Project was issued on 26 August 2009 (EPBC 20084178). See section 5.2.2.
<i>Barrow Island Act 2003</i> <i>Land Administration Act 1997</i>	L007431 Volume 3158; Folio 477		The <i>Barrow Island Act 2003</i> (BW Act) and the Gorgon Gas Processing and Infrastructure Project Agreement (Schedule 1 to the BW Act) allows for the implementation of the Gorgon Gas

Legislation	Number	Subsidiary	Approval
			Development and makes provision for land within the Barrow Island Nature Reserve to be used for gas processing purposes under the <i>Land Administration Act 1997</i> .
Part IV of the EP Act (WA)	Ministerial Statement Number 800 (MS 800)  EPA Reports 1221 and 1323		Refer to section 5.1 below

## 5.1 Part IV of the EP Act

### 5.1.1 Background

The initial Gorgon Gas Development (two LNG trains) was subject to assessment under Part IV of the EP Act. Approval was granted on 6 September 2007 subject to conditions outlined in Ministerial Statement 748 (MS 748).

In September 2008, the Applicant sought both State and Commonwealth approval through a Public Environment Review (PER) assessment process for the revised and expanded Gorgon Gas Development, as outlined below:

- Addition of a 5 mtpa LNG train, increasing the number of LNG trains from two to three;
- Expansion of the CO<sub>2</sub> injection system, increasing the number of injection wells and surface drill locations; and
- Extension of the causeway and the MOF into deeper water.

The revised and expanded Gorgon Gas Development was approved on 10 August 2009 (MS 800). MS 800 superseded MS 748 for the initial proposal, providing approval for both the initial Gorgon Gas Development and the revised and expanded Gorgon Gas Development.

The Applicant applied for a section change to MS 800 to relocate the ground flares in March 2011. This was determined to not be a significant change and no assessment was necessary.

Since the revised and expanded Gorgon Gas Development was approved, further minor changes have also been made and/or approved and updates to MS 800 made as necessary.

### 5.1.2 Ministerial Statement 800

MS 800 contains conditions that need to be considered in the assessment of emissions and discharge from the Premises and the imposition of regulatory controls. These are summarised in the following table:

**Table 6: Consideration of MS 800 conditions relevant to this application**

Condition	Overview	Delegate Officer considerations
8	Condition 8 requires the submission of a Terrestrial and Subterranean Environmental Monitoring Program (TSEMP). The objective of the TSEMP is to <i>'establish a statistically valid ecological monitoring program to detect any Material or Serious Environmental Harm to the ecological elements outside the Terrestrial Disturbance Footprint'</i> . The TSEMP specifies procedures for monitoring vegetation, fauna (mammals and land birds), surface water landforms and groundwater, including monitoring locations, triggers and reporting.	Environmental monitoring programs described in the TSEMP have been considered in the determination of risk associated with potential emissions and discharges; however, conditions relating to environmental monitoring (e.g. monitoring of flora and fauna) will not be included on the licence to avoid duplication.
16	A Long-term Marine Turtle Management Plan was developed in accordance with condition 16 and specifies commitments to minimise lighting and noise as far as practicable through design and operation to prevent impact on marine turtles. Procedures for monitoring lighting and impacts on turtle populations are also included.	The primary instrument for regulating the impacts on marine turtles from light and noise emissions is MS 800 and the Long-term Marine Turtle Management Plan.
26	<p>Condition 26 sets requirements for the injection of reservoir CO<sub>2</sub> to an underground reservoir. The condition specifies that all practicable means shall be implemented to inject reservoir carbon dioxide removed during gas processing operations on Barrow Island and that at least 80% of reservoir carbon dioxide that would otherwise be vented to atmosphere is injected (based on a 5 year rolling average).</p> <p>Reservoir carbon dioxide is defined in MS 800 as <i>'a gas stream that consists overwhelmingly of carbon dioxide and coming from the acid gas removal units of the Gas Treatment Plant to be located on Barrow Island. The carbon dioxide will contain incidental associated substances derived from the natural gas and the process used to separate the carbon dioxide from that natural gas.'</i></p>	The project is designed to dispose of 100% of CO <sub>2</sub> via the re-injection system. However, construction and commissioning of the carbon dioxide compression and injection infrastructure is not complete. Until this equipment is operational, it is proposed that all acid gas (including CO <sub>2</sub> ) is vented directly to atmosphere.

Condition	Overview	Delegate Officer considerations
28	Condition 28 specifies that a Best Practice Pollution Control Design Report was required to be submitted as part of the Works Approval application for the Gorgon LNG Project. The purpose of the report is to demonstrate best practice pollution control would be implemented for the Gas Treatment Plant.	<p>The Application indicates that the original design basis is for MEG flash gas vapour to be disposed of via geosequestration however the Best Practice Pollution Report does not suggest direct disposal of the MEG flash gas vapours to the CO<sub>2</sub> injection system from the MEG flash gas compressor.</p> <p>Figure 2-1 of the Best Practice Pollution Control Design Report (developed under condition 28 of MS 800), suggests that the original design is for vapours from the MEG Regeneration Unit and Condensate Stabilisation Unit to be returned to the front end of the LNG processing plants which would result in disposal via geosequestration via the Acid Gas Removal Units. Similarly, Section 2.2.2 of the Best Practice Pollution Control Design Report indicates that the comingled gas phase streams from the Gorgon and Jansz slug catchers and Condensate Stabilisation Unit (which is assumed to include MEG flash gas vapour from the MEG Regeneration Unit according to Figure 2-1) will be routed to the Acid Gas Removal Units and associated Mercury Removal Units and subsequent waste gas disposed of via the CO<sub>2</sub> injection system along with other acid gas.</p>
29	An Air Quality Management Plan was developed under condition 29. The purpose of the Air Quality Management Plan is to ensure that air quality meets appropriate standards for the protection of human health and does not cause environmental harm to flora and fauna on the island. Monitoring programs for ambient air quality and point source emissions, along with committed targets, are specified in the plan.	<p>Commitments made in accordance with condition 29 of MS 800 will be considered as part of this Decision Report noting that the Air Quality Management Plan includes ambient air quality monitoring.</p> <p>Advice in EPA Report 1323 (Appendix 3) recommends that emissions to air (specifically NO<sub>x</sub>, O<sub>3</sub>, SO<sub>2</sub> and PM<sub>10</sub>) are adequately controlled under Part V of the EP Act.</p>

**Key Finding:** The Delegated Officer has considered existing Part IV approvals and notes the following:

- There are no specific conditions relating to the treatment and disposal of MEG gas vapour in MS 800;
- MS 800 does not restrict the flaring of MEG flash vapour on a temporary basis;
- Condition 26 of MS 800 does not include any specific reference to the injection of MEG flash gas vapour (it relates specifically to the injection of reservoir carbon dioxide as defined in MS 800);
- Of the three long term disposal options being considered for the MEG flash gas vapour, Option 1 aligns with the original design basis described in the Best Practice Pollution Control Design Report; and
- DWER's EPA Services recommended that flaring of MEG flash gas vapours is only allowed on a temporary basis until the implementation of Option 1 (estimated to commence in Q2 2020) as a long term option disposal option, which consistent with the original design basis detailed in the Best Practice Pollution Control Design Report.

## 5.2 Other relevant approvals

### 5.2.1 Department of Mines, Industry Regulation and Safety

The Premises is considered a Major Hazard Facility and is subject to the requirements of the *Dangerous Good Safety (Major Hazard Facilities) Regulations 2007*.

### 5.2.2 Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The initial Gorgon Gas Development was approved by the Commonwealth Minister for the Environment and Water Resources on 3 October 2007 (Reference 2003/1294). On 26 August 2009, the Commonwealth Minister for the Environment, Heritage and the Arts issued approval for the revised and expanded Gorgon Gas Development (Reference: 2008/4178) and varied the conditions for the initial Gorgon Gas Development (Reference: 2003/1294).

Conditions imposed under the EPBC Act complement those imposed under Part IV of the EP Act relating to:

- Protection of the terrestrial and subterranean environment;
- Quarantine management;
- Fire management;
- Management of groundwater abstraction;
- Impacts associated with dredging, horizontal directional drilling and offshore pipeline installation;
- Impacts on turtles; and
- Solid and liquid waste management.

Conditions associated with CO<sub>2</sub> injection relate specifically to monitoring potential impacts to the Blind Gudgeon (*Milyeringa verita*); a small subterranean fish.

## 5.3 Part V of the EP Act

### 5.3.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations. The guidance statements which inform this assessment are specified in Appendix 1.

### 5.3.2 Works approval and licence history

Table 7 summarises the works approval and licence history for the premises.

**Table 7: Works approval and licence history**

Instrument	Issued	Nature and extent of works approval, licence or amendment
W5178/2012/1 (Inactive)	23/08/2012	New works approval for the construction of the Gorgon Gas Project LNG (Trains 1 to 3), DomGas processing trains and support infrastructure such as GTGs and flares.
	06/02/2015	Works approval amendment for the installation of additional mercury removal units, liquid mercury draw-off stations and slug catcher solids removal systems for managing higher than anticipated quantities of mercury in the feed gas.
	14/07/2016	Works approval amendment to extend the duration of the works approval to allow commissioning to be completed and to remove regulatory duplication of environmental risk associated with lighting.
L8952/2016/1 (Superseded)	14/07/2016	New licence for the operation of the Gorgon Gas Project (Train 1) and support infrastructure including DomGas processing and LNG and condensate storage.
	16/02/2017	Licence amendment to include Category 62 (solid waste depot) for the storage of waste concrete at the GTP site.
L9102/2017/1 (Current)	30/07/2018	New licence for the operation of the Gorgon Gas Project (Trains 2 and 3) consolidation of existing licenses for the Gorgon Gas Project including LNG processing trains and supporting infrastructure such as sewage treatment, waste handling and diesel storage.

## 6. Modelling data

### 6.1 Mercury and BTEX

An air quality assessment was submitted with the Application which included modelling of emissions from the flaring of the MEG flash gas vapours to predict potential ground level concentrations of mercury and BTEX. Modelling was undertaken using the TAPM model and assumed the MEG flash gas vapour flow rates shown in Table 8.

**Table 8: MEG flash gas vapour flowrate data**

Percentile	Flowrate (kg/s)
P1	0.1
P10	0.2
P50	0.35
P90	0.67
P99	1.1
Max Design	2.5

The modelling assumes that mercury emissions from the MEG flash gas consist of 100% elemental mercury as the emissions result only from volatilisation or flashing of elemental mercury with no conversation to other forms. Speciation of mercury emissions from combustion sources (e.g. flare) are assumed to be 50% Hg(0), 30% Hg(II) and 20% Hg(p). Emission rates from flaring the MEG flash gas vapour used in the modelling, and compared to those when venting, are shown in Table 9. With the exception of inorganic mercury (Hg<sup>+2</sup>) and particulate bound mercury (Hg<sup>(p)</sup>), flaring is expected to result in a reduction in emissions.

**Table 9: Pollutant emission rates**

Pollutant	Flaring emission rate (g/s)	Venting emission rate (g/s)
Hg <sup>Total</sup>	2.92 E-02	2.92 E-02
Hg <sup>0</sup>	1.46 E-02	2.92 E-02
Hg <sup>2+</sup>	8.76 E-03	0
Hg <sup>(p)</sup>	5.84 E-03	0
Benzene	1.38 E-01	6.91
Toluene	3.34 E-02	1.67
Ethylbenzene	2.39 E-04	1.19 E-02
Xylene	1.43 E-03	7.16 E-02

Results of modelling were compared with ground level assessment criteria shown in Table 10 at 13 receptor locations listed in Table 11.

**Table 10: Applicable ambient air quality criteria**

Pollutant	Averaging period	Assessment criteria (µg/m <sup>3</sup> )	Reference
Mercury (total inorganic)	1-hour	1.8	NSW EPA 2016
Mercury (elemental)	Annual	0.2	WHO 2003
Benzene	Annual	9.6	NEPC 2011
Toluene	24-hour	3,769	NEPC 2011
	Annual	377	NEPC 2011
Xylene	24-hour	1,085	NEPC 2011
	Annual	868	NEPC 2011

**Table 11: Modelled receptor locations and their approximate distance from the emission source (ground flare).**

Receptor Location	Distance from source	Receptor Location	Distance from source
GTP Centre	0.9km	Construction Village	4km
Terminal Tanks	1.7km	WA Oil Camp	4.7km
Old Airport East End	1.7km	Jetty Head	5.9km
Permanent Operational Facility	1.8km	WAPET	6.5km
Old Airport Middle	1.8km	WA Oil Base	6.9km
Old Airport West End	2.1km	Airport	9.7km
Materials Offloading Facility	3.8km		

Modelling indicated that ground level concentrations of mercury and BTEX resulting from flaring of MEG flash gas vapour would be  $\leq 1\%$  the assessment criteria at all modelled receptor locations (including within the GTP centre), which is a reduction compared to the current venting scenario.

Modelling was determined to be suitable and fit for purpose. It is noted that the model slightly over predicted the low wind conditions and slightly under predicted the high wind conditions. Noting that low wind speed is likely to produce higher ground level concentrations, the modelling meteorology is considered to be conservative.

## 6.2 NO<sub>x</sub>

Due to the high CO<sub>2</sub> content of the MEG flash gas vapour, 1.7g/s of assist gas (consisting primarily of methane) will be added to the MEG flash gas vapour prior to flaring to ensure effective combustion. This represents a 10% increase in the average fuel consumption from the flare measured between Feb 2016 and June 2017 (Table 12). The Application states that that the addition of 1.7g/s of assist gas will be required for 25% of the time the flare is operating.

**Table 12: Wet flare measured fuel consumption (February 2016 to May 2017)**

Unit	Measured for various percentiles					
	10 <sup>th</sup>	50 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	Max	Average*
k/g	2.03	12	51	83	654	18

\* The average has been calculated based on data until the 20<sup>th</sup> June 2017.

Modelling for NO<sub>x</sub> emissions was carried out in 2017 for the period between 12 September 2016 and 31 May 2017 (Chevron 2017) based on the above fuel consumption rates. Results of modelling (determined at the Communication Tower which is the location of the nearest ambient air quality monitoring location) indicated that emissions from flaring contributed very little to ground level concentrations of NO<sub>x</sub> (Table 13). Furthermore monitoring data collected at the Communications Tower for the same period did not indicate any discernable trend of NO<sub>x</sub> from the ground flares.

**Table 13. Predicted NO<sub>x</sub> contribution (ppb) at the Communications Tower monitoring station compared to ambient air quality criteria.**

Air quality criteria (ppb)*	1-hour Average Concentration (ppb)				
	Max	99.5 <sup>th</sup> percentile	99.5 <sup>th</sup> percentile	99.5 <sup>th</sup> percentile	Average
120	1.1	0.81	0.69	0.32	0.01

\* National Environmental Protection (Air Quality) Measure 2016.

The Delegated Officer considers that a 10% increase in the average fuel consumption will have a negligible impact on ground level concentrations of NO<sub>x</sub> as predicted in the Application, especially considering that the additional flaring for the disposal of MEG flash gas vapours is to be a temporary measure.

## 7. Consultation

The application for a Works Approval was made available on DWER's website for public comment from 8 January 2019 to 29 January 2019. Five letters were also sent to direct



interest stakeholders inviting submissions. No comments were received.

## 8. Location and siting

### 8.1 Siting context

The Premises is located on Barrow Island situated 85 km off the Pilbara coast, north-north-east of the town of Onslow and 140 km west of Karratha. Barrow Island is reserved under the Western Australian *Conservation and Land Management Act 1984* (CALM Act) as a Class A nature reserve for the purposes of 'conservation of flora and fauna'. The BINR is a unique remnant of Australia's natural ecology. The island's status as a Class A nature reserve reflects its importance as a refuge for wildlife species, with some endemic to the BINR and some extinct on the Australian mainland.

Oil production has occurred on the island since 1967. The Applicant also manages operations of the Barrow Island oil and gas facility on behalf of a separate joint venture, which includes Santos Offshore Pty Ltd, Mobil Australia Resources Company Pty Ltd, and Chevron (TAPL) Pty Ltd. The Barrow Island oil and gas facility is spread over a large portion of the island with a 4.5% footprint by land area. This facility is regulated under Licence L4467/1972/14.

### 8.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 14.

**Table 14: Receptors and distance from activity boundary**

Sensitive Land Uses	Distance from Prescribed Activity
Butler Park (Chevron operated worker accommodation camp)	2.5 km south of the GTP
OWA Camp (Chevron operated worker accommodation camp)	2.5 km south of the GTP
Varanus Island oil and gas facility (including workers accommodation camp)	18 km north east of the GTP
Residential premises (Onslow)	~85 km from the GTP

**Key finding:** In accordance with the *Guidance Statement: Risk Assessments*, the Delegated Officer has determined that this assessment will not consider the risk of potential impacts to people in accommodation camps occupied by the Applicant. Potential impacts to people at these locations are subject to requirements under occupational health and safety regulations and obligations.

The Butler Park and OWA Camps are both operated by the Applicant (on behalf of different joint venture partners); therefore, the Delegated Officer considers that people at both camps are excluded as potential receptors.

### 8.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 15. Table 15 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting*.

**Table 15: Environmental values**

Specified ecosystems	Distance from the Premises
Managed Lands and Waters	<p>The Gorgon Gas Project is located on the BINR is a Class A Nature Reserve</p> <p>Marine waters surrounding the north, west and south sides of Barrow Island form part of the Barrow Island Marine Management Area (including the Bandicoot Bay Conservation Area ~13 km to the south of the GTP). An exclusion zone exists on the east side of the island adjacent to the GTP for the Barrow Island Port Area.</p> <p>The Barrow Island Marine Park is located on the west side of the island (~10 km from the GTP) and incorporates the Western Barrow Island Sanctuary Area.</p>
Threatened Ecological Communities and Priority Ecological Communities	The BINR is listed as a Priority Ecological Community. Smaller areas identified as Priority Ecological Communities are located at the GTP site as well as to the north, south and west of the Premises.
Biological component	Distance from the Premises
Threatened / priority flora	Three species of priority flora are located on Barrow Island west of the Premises.
Threatened / priority fauna (terrestrial and marine)	<p>Barrow Island is recognised as an important refuge for native terrestrial mammal species that have either declined in numbers or become extinct on the mainland.</p> <p>A considerable number of threatened and priority fauna are known to occur on the island including a number species that are listed under the <i>Wildlife Conservation Act 1950</i> (WA) and the Threatened (Vulnerable) Species list of the EPBC Act. Some of these species are known to occur within or adjacent to the Premises.</p> <p>Green and flatback turtles (both listed as vulnerable under the EPBC Act) nest on Barrow Island. Flatback turtle rookies are recorded near the Premises (300 m away).</p>

## 8.4 Meteorology

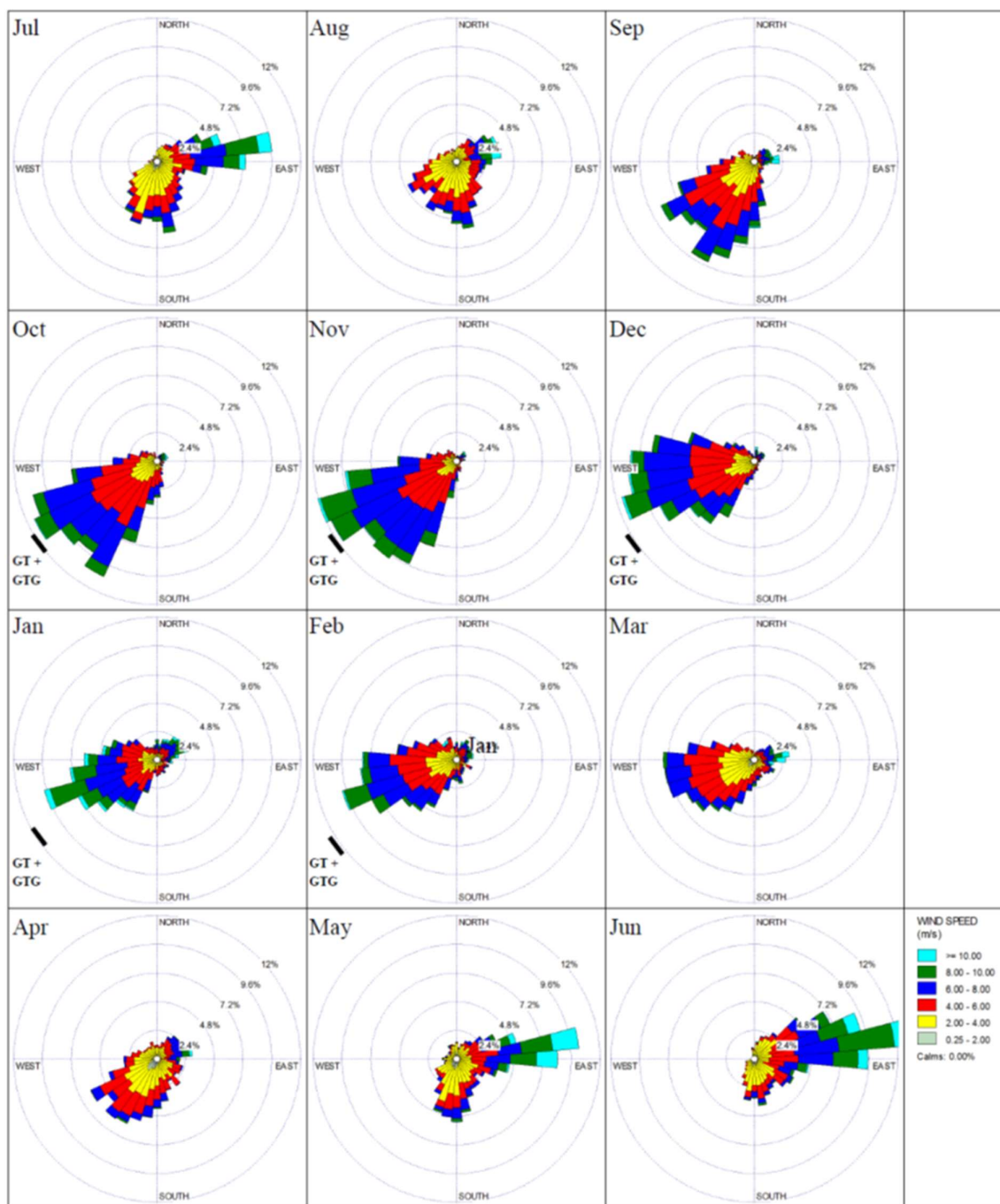
### 8.4.1 Wind direction and strength

The Applicant maintains three meteorological monitoring stations on Barrow Island (Figure 2). Data measured at the P36 Well monitoring station between 2010 and 2014 indicates that the prevailing winds are from the south-west. During winter months (May – July), Barrow Island is subject to easterly winds.

It is important to note that these wind roses show historical wind speed and wind direction data for the P36 Well station and should not be used to predict future data.

### 8.4.2 Regional climatic aspects

Barrow Island is characterised by an arid, sub-tropical environment with hot summers and moderate winters. Tropical cyclone activity occurs from November to April and can generate significant rainfall.



**Figure 2: Wind roses by month for P36 Well meteorological monitoring site for 2010 to 2014 (Chevron, 2017)**

## 9. Risk assessment

### 9.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 16.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 16 below.

**Table 16. Identification of emissions, pathway and receptors**

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Additional flaring resulting from re-routing of MEG Flash Gas Vapours to the ground flare	Light	Turtle nesting beaches located 300m away	Air / wind dispersion	Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that impacts on marine turtles from light are regulated under MS 800 (condition 16) via the Long Term Marine Turtle Management Plan.
	Noise	Applicant operated accommodation camps (Butler Park and OWA Camp) Varanus Island Onslow	Air / wind dispersion	N/A	No	In accordance with the <i>Guidance Statement: Risk Assessments</i> , worker accommodation camps are not considered a potential receptor.  BINR is considered one premises for the purpose of the <i>Environmental Protection (Noise) Regulations 1997</i> ; therefore, the specified limits in the regulations do not apply to the accommodation camps.  The Delegated Officer has determined that there is sufficient separation distance to other sensitive receptor for there to be no source-pathway-receptor link.

Risk Events					Continue to detailed risk assessment	Reasoning
Sources/Activities	Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Turtle nesting beaches located 300m away		Disruption to turtle nesting behaviour.	No	The Delegated Officer has determined that potential noise impacts on marine turtles are regulated under MS 800 (condition 16) through the Long Term Marine Turtle Management Plan.
		Applicant operated accommodation camps (Butler Park and OWA Camp)  Varanus Island  Onslow		N/A	No	In accordance with the <i>Guidance Statement: Risk Assessments</i> , worker accommodation camps are not considered a potential receptor.  The Delegated Officer has determined that there is sufficient separation distance to other sensitive receptor for there to be no source-pathway-receptor link.
	Combustion gases (NOx, CO, PM, SOx and VOCs)  Mercury  BTEX	Flora and fauna within the Class A Nature Reserve	Air / wind dispersion	Survival and health impacts to flora and fauna	No	The Delegated Officer has determined that flaring of the MEG flash gas vapour does not increase the risk of emissions to air as assessed under Licence L9102/2018/1. The modelling assessment indicated that predicted ground level concentrations of mercury and BTEX would be reduced when compared to the existing venting scenario. Although addition of assist gas would result in an increase in NOx emissions, these were considered to be insignificant. Refer to Section 6.  A calorific value analyser is installed on the wet gas flare feed line ensuring that the calorific value of the gas going to the wet flare does not fall below vendor specifications to ensure efficient combustion of the MEG flash gas vapours. Monitoring of the volume of gas flared is also monitored in accordance with condition of the Existing Licence.  Ambient air quality monitoring is undertaken in accordance with the Air Quality Management Plan developed under MS 800. An environmental monitoring program to measure impacts on flora and fauna from the Gorgon LNG Project has also been developed under MS 800. The Delegated Officer considers these controls are suitable for mitigating risk.

## 10. Works Approval / Licence conditions

The works approval allows the Applicant to undertake works, subject to conditions, in addition to allowing emissions and discharges as a result of the works as construction is completed and the site commences re-routing of the MEG flash gas vapours to the flare. The works approval is limited to a period of 12 months to ensure flaring of MEG flash gas vapours remains a temporary operation while allowing sufficient time for the implementation of a long term disposal option consistent with the original design basis estimated to be completed in Q2 2020 (refer to Section 5.1.2).

The volume of gas flared (and vented) will continue to be monitored and reported in accordance with conditions of the Existing Licence. Environmental monitoring programs relating to ambient air quality and flora and fauna will continue under existing management plans developed under MS 800.

It is expected that the Applicant will apply for a licence amendment for the operation of the CO<sub>2</sub> injection system and prior to implementation of the long term disposal option for MEG flash gas vapours. Emissions and discharges associated with re-routing the MEG flash gas vapours to the flare will continue under the works approval until a licence has been issued.

The determined controls for a licence will be generally consistent with the operation based conditions specified in the works approval although final determination of licence controls will consider information submitted by the Applicant in its licence amendment application.

## 11. Applicant's comments

The Applicant was provided with the draft Decision Report and draft issued Works Approval on 8 April 2019. The Applicant provided comments which are summarised, along with DWER's response, in Appendix 2.

## 12. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (summarised in Appendix 1).

Based on this assessment, it has been determined that the Issued Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

**Caron Goodbourn**  
**Manager, Process Industries**

Delegated Officer

under section 20 of the *Environmental Protection Act 1986*

## Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Application form: Works Approval / Licence / Renewal Amendment / Registration	Chevron 2018	DWER records
2.	Licence L9102/2017/1 – Gorgon Gas Development	L9102/2017/1	DWER records
3.	Ministerial Statement 800	MS 800	Accessed at <a href="http://www.epa.wa.gov.au">www.epa.wa.gov.au</a>
4.	EPA, 2009. <i>Gorgon Gas Development Revised and Expanded Proposal: Barrow Island Nature Reserve, Report and Recommendations of the Environmental Protection Authority (Report 1323)</i>	Report 1323	
5.	Chevron Australia Pty Ltd, 2014. <i>Gorgon Gas Development and Jansz Feed Gas Pipeline: Terrestrial and Subterranean Environment Monitoring Program</i>	Chevron2014c	Accessed at <a href="http://www.chevronaustralia.com">www.chevronaustralia.com</a>
6.	Chevron Australia Pty Ltd, 2015. <i>Gorgon Gas Development and Jansz Feed Gas Pipeline: Best Practice Pollution Control Design Report</i>	Chevron 2015	
7.	Chevron Australia Pty Ltd, 2016. <i>Gorgon Gas Development and Jansz Feed Gas Pipeline: Air Quality Management Plan</i>	Chevron 2016	
8.	Chevron Australia Pty Ltd, 2017. <i>Gorgon Project Emissions Verification Report: LNG Trains 1, 2 and 3 and Associated Facilities (W5178/2012/1)</i>	Chevron 2017	DWER records
9.	National Environment Protection Council (NEPC), 2011. <i>National Environmental Protection (Air Toxics) Measure</i>	NEPC 2011	Available online at: <a href="https://www.legislation.gov.au/">https://www.legislation.gov.au/</a>
10.	National Environment Protection Council (NEPC), 2016. <i>National Environmental Protection (Ambient Air Quality) Measure</i>	NEPC 2016	
11.	Department of Environment and Conservation (NSW), 2005. <i>Approved Methods for the Modelling and Assessment of Air Pollutants in New</i>	NSW EPA 2016	Accessed at <a href="http://www.environment.nsw.gov.au">http://www.environment.nsw.gov.au</a>

	South Wales, Department of Environment and Conservation, Sydney		
12.	Denis, M.S., Song, X., Lu, J.Y. and Feng, X (2003) Atmospheric gaseous elemental mercury in downtown Toronto, <i>Atmospheric Environment</i> , 40 (4016-4024)	St. Denis <i>et al</i> , 2006	Accessed at <a href="http://www.sciencedirect.com">http://www.sciencedirect.com</a>
13.	WHO, 2000. <i>Air Quality guidelines for Europe, 2nd Edition</i> , WHO Regional Publications, European Series, No. 91, WHO Regional Office of Europe, Copenhagen, Denmark	WHO 2000	Access at <a href="http://www.euro.who.int">http://www.euro.who.int</a>
14.	WHO, 2003. <i>Elemental Mercury and Inorganic Mercury Compounds: Human Health Aspects, Concise International Chemical Assessment Document 50</i> , WHO Marketing and Dissemination, Geneva, Switzerland	WHO 2003	Accessed at <a href="http://www.who.int">http://www.who.int</a>
15.	WHO, 2005. <i>Air Quality Guidelines, Global Update 2005</i> , WHO Regional Office of Europe, Copenhagen, Denmark	WHO 2005	Access at <a href="http://www.euro.who.int">http://www.euro.who.int</a>
16.	DER, July 2015. <i>Guidance Statement: Regulatory principles</i> . Department of Environment Regulation, Perth.	DER 2015a	Accessed at <a href="http://www.dwer.wa.gov.au">www.dwer.wa.gov.au</a>
17.	DER, October 2015. <i>Guidance Statement: Setting conditions</i> . Department of Environment Regulation, Perth.	DER 2015b	
18.	DER, August 2016. <i>Guidance Statement: Licence duration</i> . Department of Environment Regulation, Perth.	DER 2016a	
19.	DER, November 2016. <i>Guidance Statement: Risk Assessments</i> . Department of Environment Regulation, Perth.	DER 2016b	
20.	DER, November 2016. <i>Guidance Statement: Decision Making</i> . Department of Environment Regulation, Perth.	DER 2016c	



## Appendix 2: Summary of Applicant's comments on risk assessment and draft conditions

---

Condition	Summary of Applicant comment	DWER response
2 (Table 2)	The Applicant requested that specifications relating to the width of the pipe be removed as this may vary along the length of the pipeline.	Accepted noting that this does not alter the risk profile.

## Attachment 1: Issued Works Approval W6199/2018/1

---