



Eastern Gas Pipeline

Port Kembla Looping Lateral - Modification Report

Response to Submissions



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Port Kembla Looping Lateral - Modification Report

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Date	Revision	Author	Reviewed	Approved
21/08/2020	0 - Issued for Use	Jodi Wood - Stakeholder / Approval Manager, Jemena	Nathan Biggins - Project Manager – Major Projects, Jemena	Russell Brooks - Senior Approvals and Stakeholder Manager, Jemena

1. Introduction

1.1 Background

Jemena Eastern Gas Pipeline (1) Pty Ltd and Jemena Eastern Gas Pipeline (2) Pty Ltd (Jemena) are proposing to duplicate the existing Port Kembla lateral pipeline, which forms part of the Eastern Gas Pipeline (EGP). The EGP is a key natural gas supply artery between gas fields in the Gippsland Basin in Victoria and to New South Wales (NSW) and Australian Capital Territory (ACT).

The EGP was recently transitioned to State Significant Infrastructure and accordingly the proposed Port Kembla lateral looping modification (proposed modification) may be assessed as a modification under section 5.25 of the Environmental Planning and Assessment Act 1979 (EPA Act).

Jemena submitted the Eastern Gas Pipeline Modification Scoping Report (GHD, 2019) to the Department of Planning, Industry and Environment (DPIE) in November 2019 outlining the proposed approach to preparing the modification report, including the level of environment assessment and community engagement proposed. The approach was approved by the Department in their direction letter dated 6 December 2019.

Jemena submitted the Eastern Gas Pipeline - Port Kembla Lateral Looping Modification Report (Coffey, 2020) to DPIE in May 2020 which detailed the proposed duplication of the existing Port Kembla lateral pipeline, which forms part of the EGP. The Modification Report was published for exhibition seeking submissions by DPIE, which ended on 2 June 2020.

DPIE issued a Response to Submissions letter on 18 June 2020 requesting Jemena provide a response to the issues raised in the submissions by 17 July 2020. DPIE accepted a request for extension from Jemena, with the response due 21 August 2020.

1.2 Purpose of this report

This report has been prepared in accordance with the requirements under the Environmental Planning and Assessment Act 1979 and the guideline Responding to Submissions (DPIE, 2017).

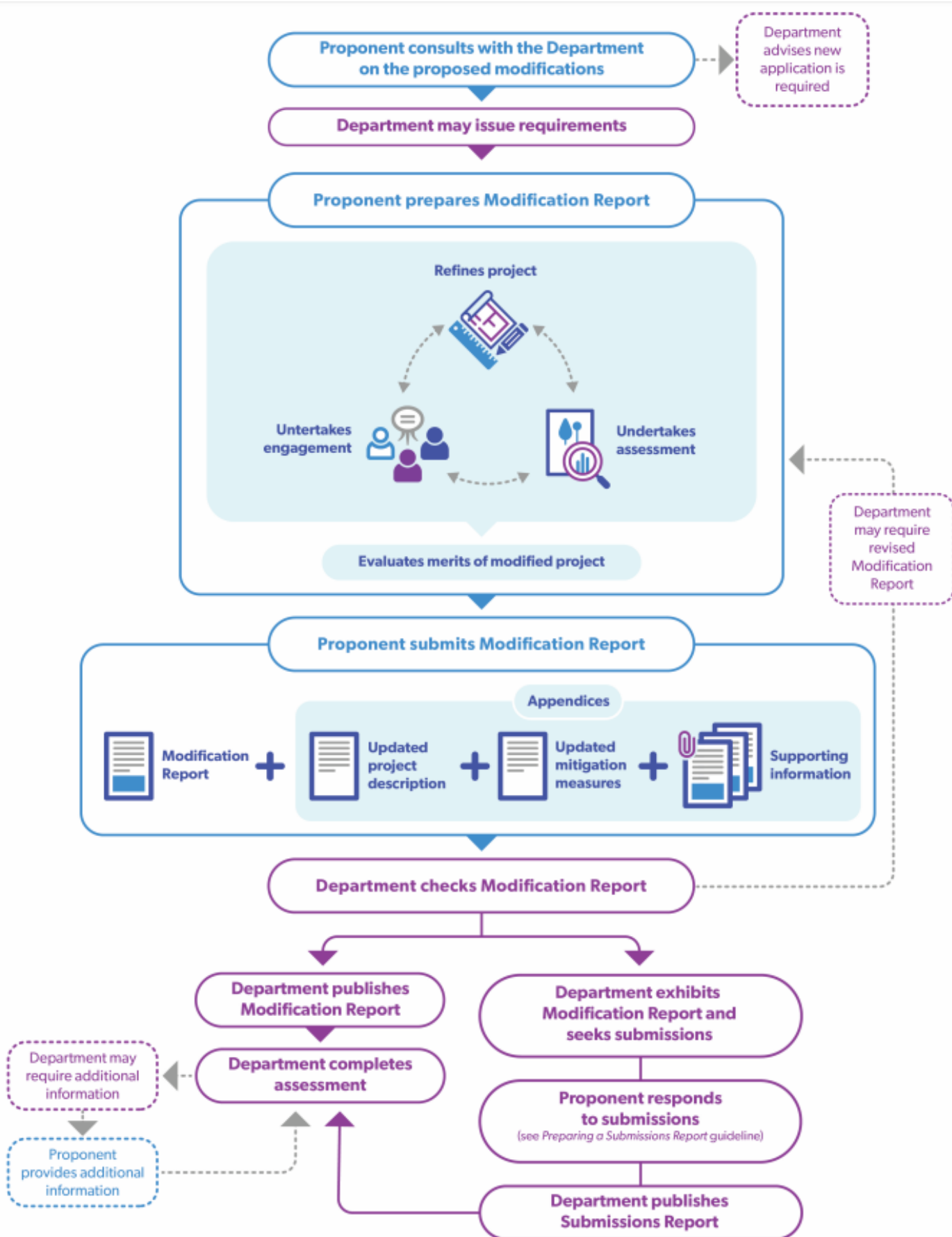
This submissions report summarises the submissions made during public exhibition of the Modification Report, identifies the issues raised across the submissions and responds to those issues. It also provides an overview of amendments to the project description.

The submissions report in the broader context of the assessment of the modification of an approved project by the NSW Department of Planning and Environment (DPIE) is shown in Figure 1-1.

The structure and content of this submissions report is as follows:

- Section 1 – provides an overview of the submissions report and ongoing engagement;
- Section 2 – overview of the submissions from government agencies and stakeholders;
- Section 3 – provides a detailed response to issues raised in submissions; and
- Section 4 – documents changes to the project description presented in the Modification Report.

Figure 1–1: Modifying an Approved Project (SSI) Flowchart - DPIE



1.3 Overview of the project

The proposed modification is a duplication of the existing Port Kembla lateral pipeline, which forms part of the EGP. The existing lateral pipeline transports gas from the EGP to Port Kembla industrial users, although gas can also be transported in the other direction. The Port Kembla lateral pipeline has a design capacity of 32 petajoules per annum. The operating pressure of the pipeline is consistent with that of the EGP.

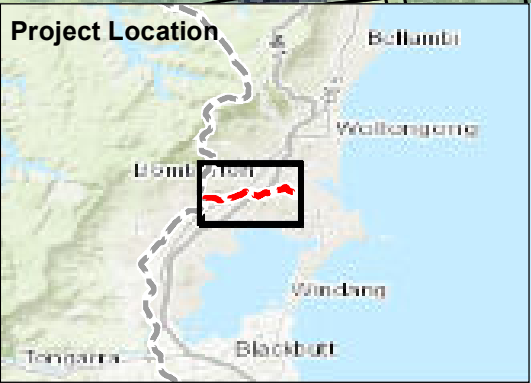
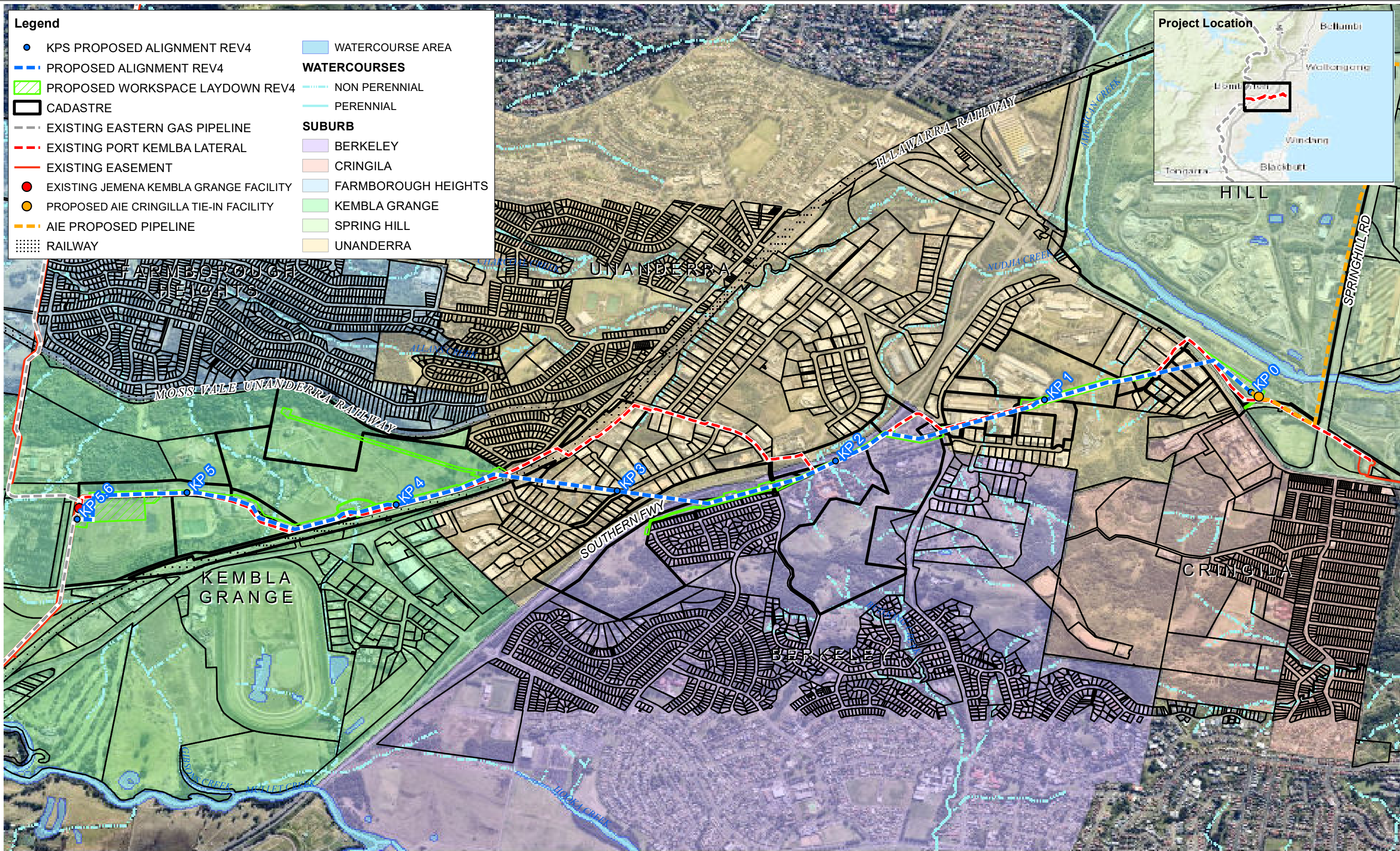
The modification is required to increase the amount of gas that can be transported from the Port Kembla Gas Terminal to the EGP. The terminal is a separate project to be developed by Australian Industrial Energy (AIE) (GHD, 2019a) and was approved under the EPA Act in April 2019. The liquefied natural gas (LNG) import terminal will re-gasify the LNG for input to the NSW gas transmissions network. The EGP transports natural gas from Longford in Victoria to Hoskinstown, just outside the ACT and Wilton and Horsley Park near Sydney. The EGP transports natural gas to demand centres in Sydney, Canberra and Wollongong as well as regional centres such as Bairnsdale, Cooma, Nowra and Bomaderry.

The EGP is 797-km-long and was constructed from 457 mm diameter high tensile steel in November 2000. The pipeline is buried along its length to a minimum of 750 mm of pipe cover. A 20-m-wide easement centred on the pipeline is provided along its length to allow access for inspection and maintenance. Several above ground facilities are located along the pipeline to allow the EGP to be operated safely and efficiently, including compressor stations, mainline valves, meter stations, receiver stations and scraper stations. The EGP has a capacity exceeding 350 terajoules of gas per day.

An additional 25.7 km of lateral pipelines provide connections from the EGP to Smithfield, the Moomba-Sydney Pipeline at Wilton, Bairnsdale and Port Kembla. The existing Port Kembla lateral pipeline is approximately 6.3-km-long and is located between the suburbs of Kembla Grange and Cringila. This lateral pipeline supplies gas from the EGP to industrial users in Port Kembla.

A detailed environmental impact assessment process was undertaken for the EGP to meet the combined legislative requirements of Victoria and NSW, as well as the Commonwealth. The environmental impact statement (EIS) for the EGP was finalised in November 1996 (EGP, 1996), and subsequently received approval. Pipeline licences for the EGP were issued under both Victorian and NSW legislation.

Figure 1-2 displays the proposed modification in relation to the existing Port Kembla lateral pipeline alignment.



05001,0001,500

Metres

Scale: 1:18,000 (at A3)

Coordinate System: GCS GDA 1994
Datum: GDA 1994

N

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Native Title Data sourced from National Native Title Tribunal
Department of Aboriginal & Torres Strait Islander

0	Issued for Information Only	RW	ND	JW	12/08/2020
Rev	Description	DRN	CHK	APP	Date

Produced by GIS Gas Transmission
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Port Kembla Looping Lateral Project
Overview Map

Map1 of 1

Date12/08/2020

Doc No-

Map IDGAS-MAR-MA-PL-008

Revision0

\\wprfil122\GIS\Projects\Active Projects\2019_ProjectMarlin\04.Projects\GAS-MAR-MA-PL-008_Marlin_Mod_Response\GAS-MAR-MA-PL-008_Overview_Marlin_Mod.mxd While every effort was made to ensure the accuracy and currency of the information shown on this map, Jemena does not accept any responsibility for errors or omissions that may have occurred.

1.4 Ongoing engagement

The Modification Report was publicly exhibited from Wednesday 20 May 2020 to Wednesday 2 June 2020. During this time, an electronic copy of the Modification Report was available for appraisal on the NSW Department of Planning Industry and Environment's (DPIE) Major Projects website. Jemena has also undertaken engagement activities which occurred since the submission of the Modification Report which are summarised in Table 1-1 below.

Table 1–1: Summary of engagement activities

Category	Engagement activities
Advertising	20 May 2020 — A public notice was placed in the Illawarra Mercury newspaper advising that Jemena lodged the modification proposal with DPIE and would be available for viewing at DPIE Planning Portal. The notice included addresses of DPIE's website as well as a contact email and number to reach Jemena.
Website	11 May 2020 — The Jemena Eastern Gas Pipeline website was updated to reflect details of the proposed Port Kembla Lateral Looping Project. The update included a summary of the proposed project, as well as information advising of the lodgement of the modification proposal to DPIE. The website also contains the link to the DPIE Planning portal, project fact sheet as well as contact email and number to reach Jemena.
Local stakeholders and community	<p>13 May 2020 – Email provided to Illawarra Land Council to advise of Jemena's lodgement of the modification proposal with DPIE and commencement of exhibition period.</p> <p>20 May 2020 – Letters sent to potential affected landholders advising of Jemena's intent to duplicate the Port Kembla Lateral and notification of the lodgement of the modification proposal with DPIE and commencement of exhibition period. A copy of the project fact sheet was also provided as part of the letter.</p>
Additional Stakeholders	<p>23 June 2020 – Meeting held with DPIE, Jemena and Jemena's contractor Worley Parsons to clarify submission regarding preliminary hazard assessment and request for further information / assessment.</p> <p>1 and 3 July 2020 – Meeting held with AIE to further define interface at Cringila Facility in relation to DPIE's submission regarding preliminary hazard assessment.</p> <p>15 July 2020 – Meeting held with DPIE to seek general clarification on submission requests and process for requesting extension for Jemena response to be provided to DPIE.</p> <p>27 July 2020 – Further meeting held with DPIE, Jemena and Jemena's contractor Worley Parsons to clarify submission regarding preliminary hazard assessment and request for further information / assessment.</p> <p>Ongoing – Engagement with potential affected landholders on the proposed pipeline alignment and temporary works spaces to further define to address concerns raised.</p> <p>Ongoing – engagement with third parties including Wollongong City Council, Sydney Trains, Endeavor Energy and NSW Transport regarding potential interactions with third party assets.</p>
Additional Assessments	<p>15 July 2020 – Updated Biodiversity Development Assessment Report finalised by Biosis to include assessment of Serious and Irreversible Impacts (SAII) entity Illawarra Lowlands Grassy Woodlands.</p> <p>5 August 2020 – Letter of advice detailing the assessment of the potential impacts to listed heritage items within the vicinity of the project, specifically the site of former Berkeley House and associated areas of archaeological potential identified in previous archaeological reports available was finalised by Biosis.</p> <p>14 August 2020 – Updated Preliminary Hazard Analysis - NPG2 and Kembla Grange Tie-in-Facility to address requests for information and clarification from DPIE.</p> <p>Ongoing – Jemena are currently undertaking on ground geotechnical and contamination investigations to further identify and understand constraints for detailed design and construction. It's expected the investigations will be completed by November 2020.</p>

2. Submissions

2.1 Overview

A total of nine submissions were received during public exhibition of the Modification Report, including one from organisations and eight government agencies.

Table 2–1: Overview of submissions

Submitter	Type	Position
Waynote P/L	Organisation	Comment
DPIE Planning and Assessment	Government Agency	Request for information
Crown Lands	Government Agency	Comment
Environment Protection Authority	Government Agency	Recommended conditions for approval
Biodiversity and Conservation Division	Government Agency	Advice and request for information
Transport of NSW Southern	Government Agency	Advice and request for information
Water and the Natural Resources Access Regulator	Government Agency	Advice and request for information
Transport of NSW - Sydney Trains	Government Agency	Recommended conditions for approval
Wollongong City Council	Government Agency	Recommended conditions for approval and request for information

3. Response to Submissions

3.1 Organisation

The one submission from organisations was from Waynote P/L in relation to the development of industrial warehouses on Lot 13 Waynote Place, Unanderra. Jemena's existing Port Kembla Lateral traverses Lot 13, which an Easement is granted. The Waynote P/L development has obtained the relevant development approvals including consent from Jemena to construct the development in the vicinity of their registered Easement, and has commenced construction. The submission advised that Waynote P/L and Jemena are liaising with respect to the proposed location of the looping pipeline and its impact on the development of warehouses.

Jemena have continued to engage with Waynote P/L over the past 3 months, specifically in relation to the approved development and interaction with Jemena's proposed Port Kembla Looping pipeline. During a number of meetings and provision of drawings detailing the extent and layout of the industrial development, it was ascertained that the development footprint was constrained to the south of the property, with no permeant impact to Jemena's existing Easement. During liaison with Waynote P/L, Jemena have further refined the proposed pipeline alignment and proposed work area to:

- Ensure that the Easement area for the proposed Port Kembla Looping pipeline does not extend past the registered Easement for the existing Port Kembla Lateral; and
- The proposed work area required for construction is minimised and refined to avoid permanent infrastructure associated with the approved industrial development.

Jemena have committed to continue to engage and liaise with Waynote P/L to ensure the any impact to the construction of the approved industrial development are avoided in the first instance, and minimised if unavoidable. These minor realignments of the pipeline route and associated temporary construction areas are summarised in Section 4.

3.2 Government Agencies

The submissions from government agencies generally were in relation to the assessment of the Modification Report, and in some cases requested for further information on the project. Submissions from government agencies did not expressly support or raise objections to the project.

A summary of the issues raised in submissions from government agencies are listed in **Table 3-1** along with Jemena response, or Section Reference to responses within this report.

Table 3–1: Government Agency Submission

Government Agency	Summary of Submission	Jemena Comment / Section Reference
Planning and Assessment	Construction program The submission requests provision of an indicative construction program.	Appendix A
	Capacity of the proposed pipeline The submission requests clarification regarding the initial and future capacity of the proposed duplicated pipeline.	Section 3.2.1.
	Management of wastes during construction The submission requests details of the likely quantities and classification of wastes generated during construction and details on waste storage, handling and disposal as well as consideration of the waste hierarchy, as proposed in the projects scoping report (GHD, 2019).	Section 3.2.3.
	Justification for the proposed modification The submission requests a summary of the proposed benefits and justification for the proposed modification.	Section 3.2.2.
	Preliminary Hazard Analysis The submission requests: <ol style="list-style-type: none"> Provision of further information regarding <ol style="list-style-type: none"> Detail regarding the operating pressures and MAOP for the proposed lateral looping pipeline, existing lateral pipeline and existing EGP; Details of the tie-in facilities, for example, whether there will be additional valves, flanges and/or pressure regulators; Details of the looping pipeline going above ground, if any Separation distance between the looping pipeline and the existing pipeline where they are in proximity in the same corridor. A risk transect is to be provided to demonstrate the risk vs distance from the pipeline, in particular at the location close to BOC, residential, and other potentially sensitive occupants. A risk contour should be developed if the risk at the tie-in facilities will be increased due to the looping pipeline and generate off-site impacts. The individual risk results are to be compared against all the relevant risk criteria as published in HIPAP 4. Based on the findings established in point 2, provide justification of whether the modification would comply with societal risks criteria. 	Section 3.2.4.

Government Agency	Summary of Submission	Jemena Comment / Section Reference
Crown Lands	Advice from Crown Lands that no Crown land is affected, with no further comments.	Noted.
Environment Protection Authority (EPA)	<p>Recommended conditions</p> <p>The submission advised that EPA provided recommendation conditions for DPIE's consideration for any approval.</p>	Noted. Jemena have reviewed the recommended conditions.
Biodiversity and Conservation Division (BCD)	<p>Biodiversity and offsets</p> <p>The submission advises that BCD have reviewed the Biodiversity Development Assessment Report (BDAR) and raise no objections to the findings.</p> <p>The submission also notes that due to the minor impacts to regrowth vegetation to the plant community type (PCT) 838, associated with the Illawarra Lowlands Grassy Woodland threatened ecological community (TEC), and a small drainage swale to PCT 781, associated with the Freshwater Wetlands on Coastal Floodplains TEC, BCD recommends that appropriate conditions of consent require the retirement of the requisite credit..</p>	Noted.
	<p>Aboriginal Cultural heritage</p> <p>The submission advises that the due diligence process has been followed, and notes that the limitations of the due diligence assessment include:</p> <ul style="list-style-type: none"> - Low ground surface visibility; - That the survey team could not access some parts of the proposed easement; and - That formal Aboriginal community consultation was not conducted. <p>The submission states that the Aboriginal community consultation in accordance with the NPW Regulation has not occurred. The submission notes that the project has consulted with the Illawarra Local Aboriginal Land Council (ILALC), however, formal consultation with the broader Aboriginal community has not occurred. BCD advised that there is a risk that Aboriginal cultural heritage values that may be impacted have not been identified.</p> <p>The submission advises:</p> <ul style="list-style-type: none"> - If any future re-consideration of the level of prior disturbance suggests that landforms with potential to contain Aboriginal objects may be impacted then a full Aboriginal cultural heritage assessment in accordance with our guidelines must be conducted. - If the impact footprint changes then an updated Aboriginal cultural heritage assessment must be conducted. - If the impact footprint changes and areas of potential archaeological deposit will be harmed, the applicant must conduct archaeological test excavation and formal Aboriginal community consultation in accordance with clause 60 of the NPW Regulation 2019. 	Section 3.2.5.

Government Agency	Summary of Submission	Jemena Comment / Section Reference
	<ul style="list-style-type: none"> - Our understanding is that this project does not have approval to harm Aboriginal objects. Therefore, if this Modification is approved, a procedure should be developed to manage the discovery of Aboriginal objects during works. - If Aboriginal objects are found during works then work in that area must stop and the find must be reported to Environment Line by calling 131 555. Formal Aboriginal community consultation and archaeological assessment in accordance with our guidelines is likely to be required. 	
Transport of NSW Southern Region	Pipeline route The submission notes that the route for the looping lateral crosses Princes Motorway and Five Islands Road (both managed by Transport of NSW), and Easements will be required at these locations.	Noted. Jemena's intent is to secure registered Easements for the looping project in state controlled road reserves.
	Traffic Impact Study The submission advises that a detailed traffic impact study (TIS) is required to consider the implication of the construction of the pipeline. The submission recommends the TIS be developed by following <i>RTA Guide to Traffic Generating Developments</i> Table 2.1 which outlines the key issues that may be considered in preparing a TIS. The submission includes specific details and requirements that are requested to be included in the TIS.	Jemena request that the requirement of a TIS be included in any project approval that may be issued by DPIE. Jemena commits to undertaking the TIS in accordance with the specific requirements stated by Transport of NSW prior to the commencement of construction activities.
Water and the Natural Resources Access Regulator	Waterfront land The submission requests that the proposed impacts from the proposed works on waterfront land be provided, including detail requiring where the pipeline will cross watercourses and identification of any mitigation measures to minimise these potential impacts.	Section 3.2.8.
	Water take requirements The submission requests that any water take required for the project and / or dewatering requirements be identified. It identifies that if any groundwater and / or surface water take is identified, provision of a site water balance to identify the amount of water required for the project and where the project proposes to obtain this water is required.	It's currently understood that there is no water take or dewatering requirements for the project. Water use that is required for the project will be brought from offsite and any excess water will be removed offsite to an appropriate waste facility.

Government Agency	Summary of Submission	Jemena Comment / Section Reference
	<p>Water licensing</p> <p>The submission notes that if the take of water is forecast to exceed 3ML/yr, the requirement for a water licence would be triggered.</p>	Noted.
Transport of NSW - Sydney Trains	<p>Recommended conditions</p> <p>The submission advised that Sydney Trains provided recommendation conditions for DPIE's consideration for any approval. The proposed conditions are in relation to consultation with Sydney Trains. Prior to commencement of all works in and within 25m of the Rail Corridor (RailCorp land and assets), consultation with Sydney Trains is required so that documentation specific in the submission is provided to Sydney Trains for review and written endorsement is provided.</p>	Noted. Jemena have reviewed the recommended conditions. Jemena has commenced engagement with Sydney Trains to ensure that the project receives the required consent prior to construction.
Wollongong City Council	<p>Recommended development engineering conditions</p> <p>The submission includes recommended conditions of approval.</p>	Noted. Jemena have reviewed the recommended conditions.
	<p>Non-Aboriginal heritage and historic archaeology</p> <p>The submission advises that non-Aboriginal Heritage and historic archaeology is not addressed in the main report or in any of the constraints maps, and that it is not clear whether potential heritage impacts have been considered. The submission draws particular attention to the listed archaeological site for the former Berkeley House (#6519) which is in proximity to the proposed pipeline alignment.</p> <p>The submission requests that a Historic Heritage and Archaeological Due Diligence Report be provided.</p>	Section 3.2.6.
	<p>Aboriginal Heritage</p> <p>The submission advises that the Modification Report notes that a representative of the Illawarra Local Aboriginal Land Council (ILALC) was present during the survey, however it is noted that broader community consultation is not required under the Due Diligence Code. The submission requests the advice of the DPIE in relation to the Due Diligence Report provided and advises that application should be notified (if not already) to the local Aboriginal community for comment and input to ensure the Cultural Significance of the area is properly considered in the assessment of the application.</p>	Section 3.2.5.

Government Agency	Summary of Submission	Jemena Comment / Section Reference
	<p>Environment – Contamination</p> <p>The submission advises that the recommended detailed site investigation and acid sulfate soils assessment as details in the <i>Preliminary Site Investigation</i> (Coffey, 2020a) are to be undertaken prior to commencement of works and appropriate recommendations for management provided in accordance with relevant guidelines.</p>	<p>Section 3.2.7.</p>
	<p>Environment – Biodiversity</p> <p>The submission advises that there are a number of discrepancies that have been identified in the Biodiversity Development Assessment Report (BDAR – Biosis, 2020), and requests that the discrepancies be addressed:</p> <ul style="list-style-type: none"> i. Native Vegetation Extent has not been satisfactorily mapped. Figure 3 shows significant discrepancies between mapped vegetation extent and actual vegetation extent, and is significantly out of alignment with the aerial photo. The BDAR is to be revised to include better aerial photo interpretation and assessment of vegetation extent. ii. The BDAR has not appropriately assessed and classified the planted native vegetation. Box 1 on pg15-16 of the BAM Operational Manual - Stage 1 states that if the planted trees are native then they also must be considered as native vegetation and assigned to the most appropriate PCT. The BDAR is to be amended accordingly. Additional survey and assessment may be required. iii. Figure 4 is missing. iv. The BDAR has not satisfactorily outlined measure to avoid impacts, particularly to Illawarra Lowlands Grassy Woodland. Section 5.1.1 of the BDAR states: “An area of 0.33 hectares of low condition Illawarra Lowlands Grassy Woodlands (PCT 838) will be removed for open trenching due to the required HDD within the public lands northeast of the Wollongong Lawn Cemetery.”, but does not say why it was unable to be avoided There are large cleared areas immediately adjacent to these patches of vegetation, the proponent is to demonstrate that it has thoroughly considered modifying the path of the pipeline to avoid these patches. A clear description and assessment of all route options and relevant constraints that were considered, is to be included. v. The weather observations presented in Table 7 do not match with the weather observations for Albion Park on the BoM website. vi. An assessment of the potential for the pipeline to act as a weed, pest animal and pathogen movement corridor, and assessment of associated impacts along with a clear description of how this will be avoided, minimised and managed. 	<p>Section 3.2.8.</p>

Government Agency	Summary of Submission	Jemena Comment / Section Reference
	vii. Illawarra Lowlands Grassy Woodlands is considered a SAI entity. This must be addressed by the BDAR in accordance with the BAM and BAM Operational Manual - Stage 2. Further ILGW is listed as Critically Endangered under the EPBC Act, which has not been considered.	

3.2.1 Capacity of the proposed pipeline

The existing Port Kembla Lateral capacity is 32PJ/a.

In order to remain consistent with the Eastern Gas Pipeline (EGP), the proposed Port Kembla Lateral Looping pipeline has been designed and risk assessed to the maximum allowable operating pressure (MAOP) of the EGP as licenced under Licence 26, which the proposed pipeline will become operational under. The EGP design basis states a MAOP of 14.895 MPa; with the exception for assemblies (that can be later isolated and upgraded), the mainline was constructed and tested to allow a future increase in operating pressure to 16.55 MPa (corresponding to 80% SMYS for the selected linepipe).

As such, the maximum theoretical throughput for the Port Kembla Lateral Looping pipeline is 440PJ/a which is calculated based on a maximum operating pressure of 14.895MPa. This is lower than the pressure considered in the Preliminary Hazard Assessment (Worley, 2020a) and Pipeline Safety Management Study (Worley, 2020) in accordance with AS2885.6.

Irrespective of the basis of design of the proposed pipeline, the throughput will be determined by the capacity of the Port Kembla Gas Terminal and will operate at the pressure and flow rate supplied from the Port Kembla Gas Terminal. There is currently no plan to raise the pressure when the gas reaches the proposed Port Kembla Lateral Looping pipeline.

3.2.2 Justification for the proposed modification

The Port Kembla Gas Terminal is a separate project to be developed by Australian Industrial Energy (AIE) (GHD, 2019a) and was approved by NSW State government in 2019. The terminal will re-gasify the LNG for input to the NSW gas transmissions network. Since the approval was granted, AIE undertook further analysis of the market and identified that demand for gas would be seasonally dependant, with higher demand, particularly from retail customers in winter months. Following this analysis, AIE lodged a modification to the original development consent which sought to increase the capacity of the terminal and allow for this seasonality of gas demand.

In response to AIE's terminal and the increase in demand requirements, Jemena are working with AIE to provide a solution to allow for the transportation of gas from the terminal to the Eastern Gas Pipeline. The modification is required to increase capacity to the Eastern Gas Pipeline, to accommodate daily gas injection and maximum gas flows for the terminal, which in turn will increase the opportunities to supply gas through the existing east coast gas transmission network. The Eastern Gas Pipeline network is owned and operated by Jemena and comprises a 797 km mainline with the capacity to transport in excess of 350 terajoules of gas per day from Longford in Victoria to Hoskinstown, just outside the ACT and Wilton and Horsley Park near Sydney. The EGP transports natural gas to demand centres in Sydney, Canberra and Wollongong as well as regional centres such as Bairnsdale, Cooma, Nowra and Bomaderry.

Jemena have advanced plans for further upgrades to the Eastern Gas Pipeline to extend, increase capacity, and allow bi-directional flow to meet increasing demand between densely populated areas in Victoria and New South Wales in response to demand and the dynamics of the gas market.

3.2.3 Management of wastes during construction

The types of waste that may be generated during construction and operation could include contaminated and uncontaminated soils, contaminated and uncontaminated rinse water generated from decontamination of field equipment, and recyclable and non-recyclable material. As outlined in Section 4 and Section 7.9 of the Sampling Analysis and Quality Plan (Coffey, 2020), Coffey understands that geotechnically suitable material from open trenching will be reused as backfill and any surplus soils and spoil from HDD activities will be collected and disposed off-site at a suitably licensed waste disposal facility. Consumables and material that is not contaminated will be removed from site at the end of each day and material that cannot be recycled shall be placed in appropriate waste disposal containers. Material that can be recycled will be placed in appropriate recycling containers.

Contaminated material will be disposed of in accordance with relevant regulatory requirements. This includes rinse water that is suspected to be contaminated based on visual examination (i.e. presence of odours/sheen). Rinse water which does not appear to be contaminated will be released onsite in a grassed area.

There is uncertainty surrounding the quantity of waste material that will be generated during operations and construction as this will depend on the quantity of material able to be used as backfill and the amount of contaminated material which will need disposed of. This is unknown as the quantities of soils in some areas of environmental concern along the proposed route could not be estimated.

3.2.4 Preliminary Hazard Analysis

DPIE's Response to Submissions letter issued to Jemena on 18 June 2020 requested additional assessment of the risks to surrounding land users from the proposed pipeline in relation to the Pipeline Safety Management Study - Eastern Gas Pipeline-Mod-1 (Worley, 2020). As such, the comments raised by DPIE have been addressed in the updated assessment report, named Preliminary Hazard Analysis- NPG2 and Kembla Grange Tie-in-Facility (PHA – Worley, 2020a) provided in Appendix B.

A summary of Jemena's response to DPIE's request as referred to in the Response to Submissions letter are as follows:

- 1) Further information requested:
 - a) Detail regarding the operating pressures and MAOP for the proposed lateral looping pipeline, existing lateral pipeline and existing EGP – Section 3.2 in the updated PHA (Worley, 2020a) has been revised to include details of the operating pressure and MAOP as requested.
 - b) Details of the tie-in facilities, for example, whether there will be additional valves, flanges and/or pressure regulators – Section 3.3 of the updated PHA (Worley, 2020a) includes a description of the proposed tie-in facility at Kembla Grange. Section 2.3 of the updated PHA (Worley, 2020a) notes that the Cringila Facility is mentioned in the report, however as the Cringila Facility forms part of AIE's current infrastructure approval, it was not included in Jemena's preliminary hazard assessment. It's understood that it's AIE's intent to include the Cringila tie-in facility in the final hazard assessment once the detailed design is finalised. Jemena's modification is to adjoin the western boundary of the proposed AIE facility, which is included in the updated PHA (Section 3.3 Worley, 2020a)
 - c) Details of the looping pipeline going above ground, if any – Section 3.3 in the updated PHA (Worley, 2020a) has been revised to include details of the above ground pipework as requested.
 - d) Separation distance between the looping pipeline and the existing pipeline where they are in proximity in the same corridor – Section 5.2 in the updated PHA (Worley, 2020a) has been revised to include the separation philosophy as requested.
- 2) The Proponent submits a quantitative risk that considers all leak sizes from the pipeline and the risk of pipeline propagation if an incident occurs to a pipe, specifically a risk transect is to be provided to demonstrate the risk vs distance from the pipeline, in particular at the location close to BOC, residential, and other potentially sensitive occupants – A quantitative risk assessment has been completed, however it was agreed with DPIE in the meeting on 27 July 2020 (as noted in Table 1-1 in Section 1.4) that a risk transect was not required. This was concluded following a review of NGP1 risk contours, which showed the transect was not consistent along the pipe length, but rather would expand on the inner radius of a bend, and contract on the outer radius.
- 3) The individual risk results are to be compared against all the relevant risk criteria as published in HIPAP 4 – Section 9 in the updated PHA (Worley, 2020a) has been revised include details of the individual risk results compared against relevant risk criteria.
- 4) Based on the findings established in point 2, provide justification of whether the modification would comply with societal risks criteria – As agreed with DPIE in the meeting of 27 July 2020, Section 8 of the updated PHA (Worley, 2020a) notes that societal risk will only be considered in the study if the LSIR contours indicate areas of elevated risk (approaching LSIR criteria) for areas with elevated occupancy. Section 9 notes that LSIR is low and does not impact areas of high occupancy, and as such societal risk has not been explored.

3.2.5 Aboriginal cultural heritage

In regards to the limitations of the due diligence assessment noted by DPIE's Biodiversity and Conservation Division (BCD), Jemena notes:

- Low ground surface visibility - this is the case with most surveys in cleared grassed areas throughout the Illawarra region. The low potential assessment was based not just on ground surface visibility but on soil profiles, exposure and areas of disturbance.
- The survey team could not access some parts of the proposed easement (Biosis, 2020c) - the updated and final report includes areas that were inaccessible during the initial survey and surveyed at a later date.
- Formal Aboriginal community consultation was not conducted. Illawarra Local Aboriginal Land Council was involved in the survey but no formal consultation was conducted.

Jemena understand that if there are any changes to the impact footprint or the level of prior disturbance to the project footprint, Jemena will undertake further consideration and assessment of undertaking an Aboriginal cultural heritage assessment if required. Further prior to construction, Jemena commit to the development and implementation of a suitable field procedure that will outline the process for managing the discovery of any Aboriginal objects found during works, including stop work and reporting procedures. It is expected formal Aboriginal community consultation and archaeological assessment in accordance with DPIE's guidelines is likely to be required during the development of the field procedure to manage Aboriginal objects during construction.

As outlined in the Aboriginal Cultural Heritage Due Diligence Report (Biosis, 2020c), the proposed project will mostly follow the existing pipeline disturbed land, and the areas where this differs has undergone significant ground disturbances. The report advises that there is low to nil potential for the proposed works to harm Aboriginal objects and recommend no further Aboriginal cultural heritage assessment.

Further to note, Jemena intend on providing the Aboriginal Cultural Heritage Due Diligence Report (Biosis, 2020c) to the Local Aboriginal Community for comment and input to ensure the Cultural Significance of the area is properly considered in the assessment of the application.

3.2.6 Non-Aboriginal heritage and historic archaeology

The submission requests that a Historic Heritage and Archaeological Due Diligence Report be provided. Further clarification was received from DPIE (Jack Turner, email dated 6 July 2020), where Wollongong City Council (WCC) confirmed their request for Jemena to provide additional information to address Part 5.10 of the Wollongong Local Environmental Plan and any archaeological reports available, through a due diligence assessment or preliminary archaeological report that provides clear recommendations that there is no potential for impacts to the listed archaeological site (the former Berkeley House) and no additional requirement for a section 140 permit under the NSW Heritage Act 1977.

To address these concerns raised by WCC, an assessment of the potential impacts to listed heritage items within the vicinity of the project, specifically the site of former Berkeley House and associated areas of archaeological potential identified in previous archaeological reports available, was undertaken by Biosis and can be found in Appendix C (Biosis, 2020b). Given the project is located over 181m from the current established curtilage of former Berkeley House and the proposed works will avoid these area of high and moderate archaeological potential associated with the item, the assessment determined that there will be no detrimental direct or indirect impacts to the heritage significance of the locally listed former Berkeley House or the associated areas of archaeological potential.

For items other than the former Berkeley House, it is noted that the Scoping Report (GHD, 2019) identifies that there are no non-Aboriginal heritage items of State or local significance within a 200 metre radius of the proposed modification. As such, impact to non-aboriginal heritage is not anticipated and standard mitigation measure could be applied to the proposed modification for the management of potential impacts, including an unexpected finds

procedure. As such, it is not proposed a Historic Heritage and Archaeological Due Diligence Report be completed for the entire project.

3.2.7 Environment – Contamination

Jemena are in the process of finalising the assessment plan for the field investigation and assessment of potential contamination and acid sulphate soil for the project. Jemena have engaged Golder Associates to undertake a review of the Preliminary Site Investigation (Coffey, 2020a) and prepare a Field Survey Assessment Plan that incorporates field investigation scope and methodology for both geotechnical and contamination assessment, which will include boreholes, test puts and ground water monitoring bores and appropriate testing. The first phase of the field investigations are commenced in July 2020 and are anticipated to continue to November 2020. Following on from field investigations and assessment, appropriate recommendations for management in accordance with relevant guidelines will be implemented as part of the Construction Environment Management Plan.

3.2.8 Environment – Biodiversity

The WCC submission advises that there are a number of discrepancies that have been identified in the Biodiversity Development Assessment Report (BDAR – Biosis, 2020). As such, the discrepancies have been addressed in the updated BDAR (Biosis, 2020a) provided in Appendix D.

A summary of the changes are:

- Mapping of Native Vegetation Extent Figure 3 – The updated BDAR has been revised to include better aerial photo interpretation and assessment of vegetation extent.
- Assessment and classification of the planted native vegetation – In accordance with the BAM Operational Manual - Stage 1 (DPIE, 2018), in the updated BDAR, planted vegetation was assessed and assigned to an appropriate plant community type which best matches the floristic attributes and landscape position of the vegetation patch.
- Figure 4 – Figure 4 is included in the updated BDAR.
- Measures to avoid impacts to biodiversity values, particularly to Illawarra Lowlands Grassy Woodland – The updated BDAR includes further description of the actions undertaken to avoid and minimise project impacts, particularly in relation the site selection and planning of the route alignment.
- Weather observations – the updated BDAR includes incorporates amendments to weather observations to reflect Albion Park BOM data.
- Measures to avoid, minimise and manage potential impacts caused by weed, pest animal and pathogen movement – the updated BDAR has been revised to include the proposed ongoing maintenance regime of the pipeline following installation with regards to weed, pest and pathogen control as well as further details on the assessment and likelihood of occurrence of transport of weeds and pathogens from the site to adjacent vegetation.
- Illawarra Lowlands Grassy Woodlands is considered a Serious and Irreversible Impacts (SAIL) entity – Illawarra Lowlands Grassy Woodland was listed as an SAIL entity on 27/04/2020, after the finalisation of the BDAR (March, 2020). The updated BDAR addresses Illawarra Lowlands Grassy Woodlands as a SAIL in accordance with the BAM and BAM Operational Manual - Stage 2.
- Illawarra Lowlands Grassy Woodlands is listed as Critically Endangered under the EPBC Act – Illawarra Lowlands Grassy Woodland within the study area did not meet EPBC condition thresholds (pages 21 and 71 of the BDAR).

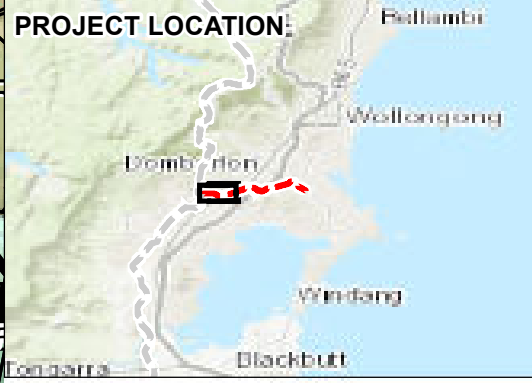
Further, the updated BDAR (Biosis, 2020) identifies where the project proposed works are to be undertaken on waterfront land (specifically Section 2.1.3 and 9.4 of the report) and details measures to reduce any potential indirect impacts to the mapped watercourses inclusive of stormwater and runoff controls during construction and operation of the development (Section 5.1 of the report).

4. Preferred Infrastructure

This section details the changes to the project subsequent to the public exhibition of the Modification Report. These changes are termed the preferred infrastructure in line with Responding to Submissions guideline.

The project will remain predominantly as described in the Modification Report with the following changes:

- The location of the end of line facility at Kembla Grange is dependent on the potential construction constraints identified during geotechnical investigations and further engagement with the landholder, which is ongoing. As such, Jemena have identified two potential options for the end of line facility which is shown as Option A and Option B in Figure 4-1. It's expected that following on from the outcome of the geotechnical investigations which is currently being undertaken, that the Jemena will proceed with the preferred option.
- Minor pipeline route alignments within the study area to allow for reduction of impact, stakeholder feedback and progression of project design (Figure 4-1) including:
 - Minor realignment of the proposed looping lateral along Wylie Road to follow existing pipeline and reduce impact to landholder (KP5.5);
 - Minor realignment of the proposed looping lateral proposed north of the Illawarra Railway on the eastern border of Wollongong Lawn Cemetery to avoid existing topographical constraints (~KP4.5);
 - Minor realignment of the proposed looping lateral north of the Illawarra Railway within the southern border of Wollongong Lawn Cemetery to avoid impacts to mapped Coastal Freshwater Lagoons of the Sydney Basin (~KP4); and
 - Minor realignment of the proposed looping lateral between Lathe Place and Waynote Place to account for the development of industrial warehouses on Lot 13 Waynote Place, Unanderra following on from engagement as detailed in Section 3.1 (~KP0.7).
- Minor amendments to the proposed workspace areas for construction to allow for reduction of impact, stakeholders feedback, access requirements and progression of project design (Figure 4-1), including:
 - Addition of proposed workspace area to allow for the end of line location options at Kembla Grange (KP5.6);
 - Extension of proposed workspace area to allow for minor realignment of the proposed looping lateral along Wylie Road to follow existing pipeline (KP5.5);
 - Refinement of proposed workspace north of the Illawarra Railway within the southern border of Wollongong Lawn Cemetery to allow for access around drainage feature, avoidance of mapped Coastal Freshwater Lagoons of the Sydney Basin, reduction of clearance of vegetation and construction requirements for HDD construction (~KP4); and
 - Reduction and refinement of proposed workspace areas between Lathe Place and Waynote Place to account for the development of industrial warehouses on Lot 13 Waynote Place, Unanderra following on from engagement as detailed in Section 3.1 (~KP0.7).



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Coordinate System: GCS GDA 1994
Datum: GDA 1994

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Port Kembla Looping Lateral Project
Pipeline Plan Map Series

Map1 of 3

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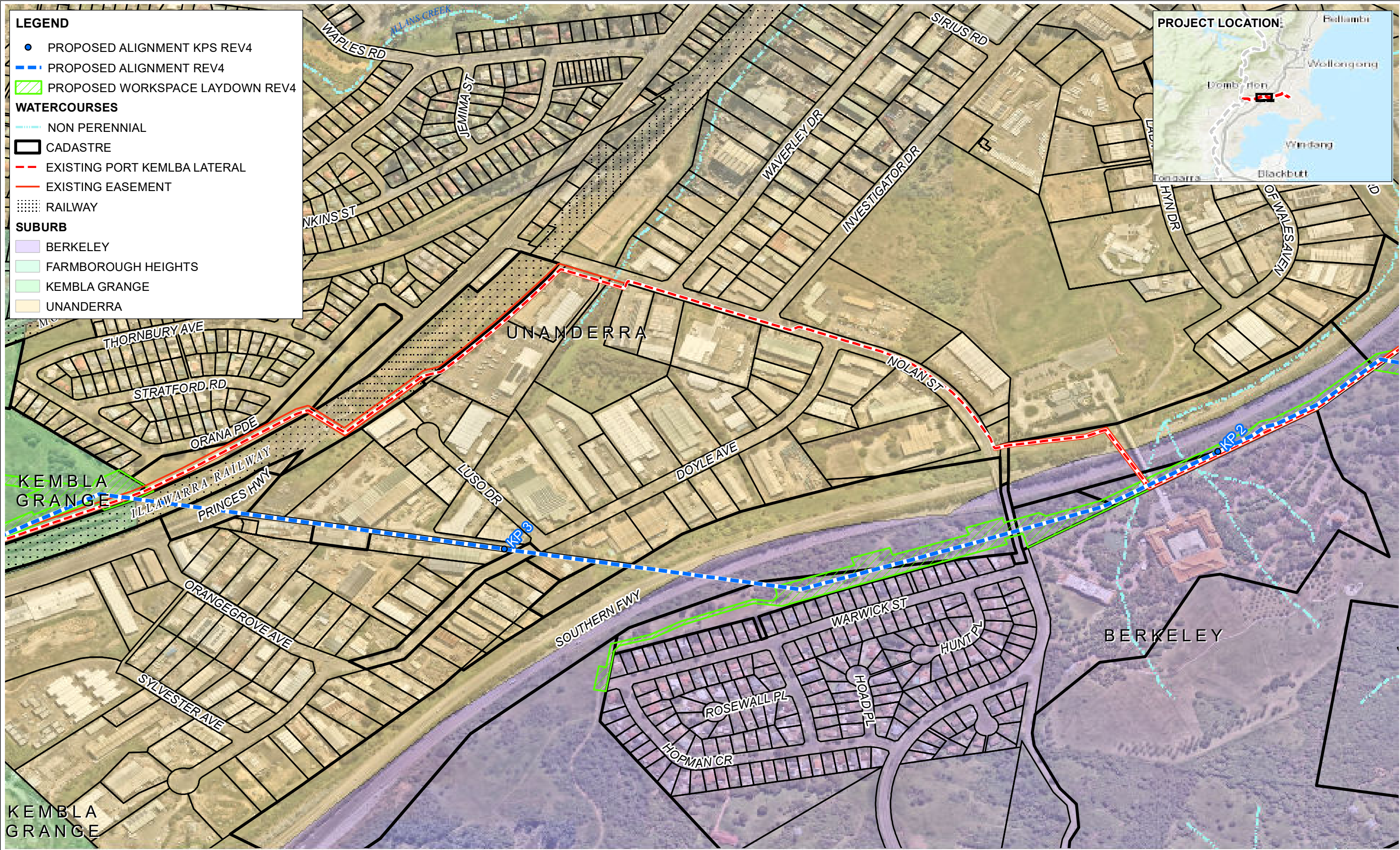
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Port Kembla Looping Lateral Project
Pipeline Plan Map Series

Map2 of 3

Date12/08/2020

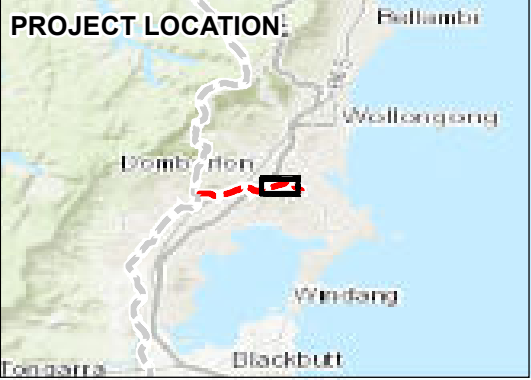
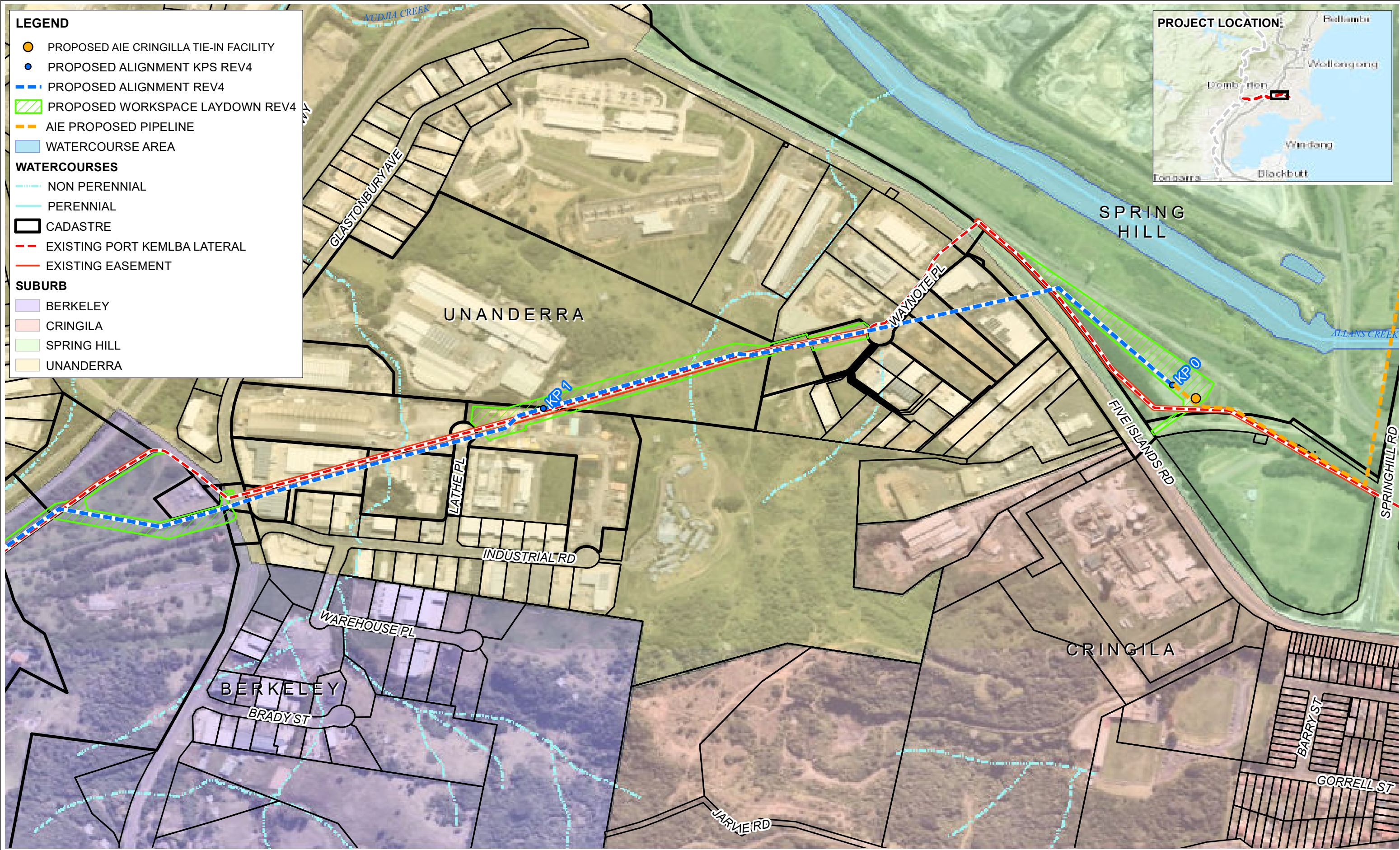
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Datum: GDA 1994

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Map3 of 3Doc No -Revision

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5. Conclusion

The Port Kembla Gas Terminal is a separate project to be developed by Australian Industrial Energy (AIE) (GHD, 2019a) which was approved by NSW State government in 2019. Jemena are working with AIE to provide a solution to allow for the transportation of gas from the terminal to the Eastern Gas Pipeline. The modification is required to increase capacity to the Eastern Gas Pipeline, to accommodate daily gas injection and maximum gas flows for the terminal, which in turn will increase the opportunities to supply gas through the existing east coast gas transmission network.

The key issues arising from the nine submissions received during public exhibition of the Modification Report generally were in relation to the assessment of the Modification Report, and in some cases requested for further information on the project. This report identifies the issues raised across the submissions and responds to those issues. It also provides an overview of amendments to the project description which are minor in nature and are in response to items raised within this report, detailed design and ongoing stakeholder engagement.

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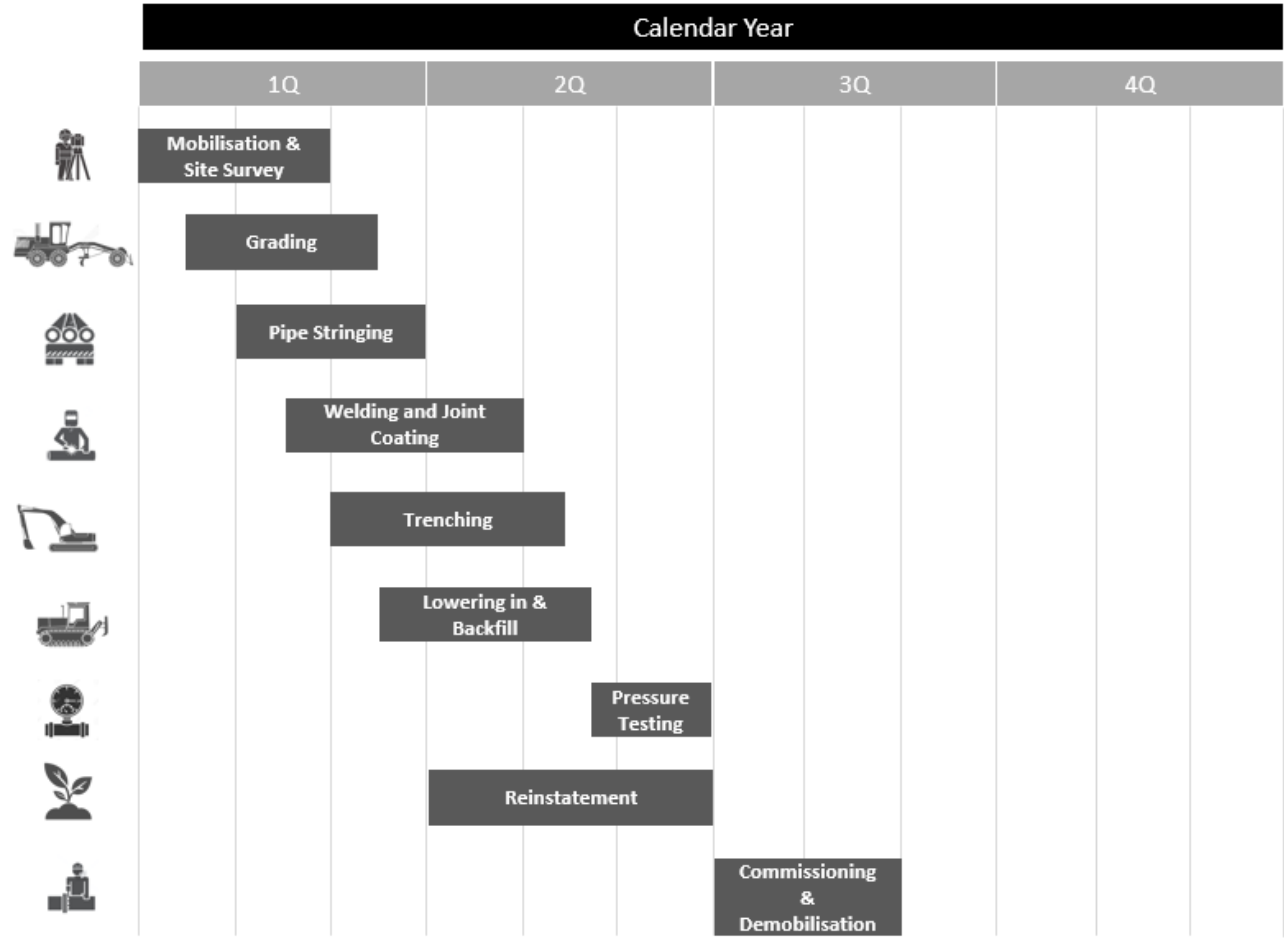
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Appendix A

Indicative Construction Schedule

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Port Kembla Lateral Looping Project – Indicative Construction Schedule



Appendix B

Pipeline Safety Management Study

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JEMENA

Port Kembla Lateral Looping NGP2 Pipeline FEED

**Preliminary Hazard Analysis- NPG2 and Kembla Grange Tie-
in Facility**



Document No 411010-00071 - SR-REP-0002

14 August 2020




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PROJECT 411010-00071 - SR-REP-0002 – Port Kembla Lateral Looping NGP2 Pipeline FEED

Rev	Description	Original	Review	WorleyParsons Approval	Date	Customer Approval	Date
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1. Executive Summary

Jemena is currently planning to upgrade its existing Port Kembla Lateral (PKL) pipeline capabilities to strengthen the security of gas supply for the east coast gas market. The Port Kembla Lateral Looping (PKLL) Project involves the construction of a 5.7 kilometres long, buried gas transmission pipeline from the proposed Port Kembla Gas Terminal (PKGT) pipeline discharge point at Cringila station to the Eastern Gas Pipeline (EGP). This pipeline will supply gas into the EGP via a new End of Line (EoL) Tie-in facility in the vicinity of Jemena's existing Kembla Grange MLV/Lateral Offtake facility.

As part of the approvals process for the PKL pipeline, Jemena is required to complete a Level 2 (Semi Quantitative) Preliminary Hazard Analysis. The Department of Planning, Industry & Environment (DPIE) guideline "Multi-Level Risk Assessment" requires that incidents that have potential significant consequences beyond the site boundary must be quantified and demonstrated to be below the appropriate criteria.

A quantitative risk assessment has been undertaken for the new Port Kembla Lateral (PKL) pipeline, as well as the Kembla Grange tie-in facility. In conjunction with existing studies completed (namely HAZID, HAZOP and pipeline SMS review) this is intended to satisfy the requirements for a Level 2 Preliminary Hazard Analysis.

The results of the QRA modelling undertaken indicate that risk exposure associated with the PKL pipeline and the associated Kembla Grange tie-in facility will be below the fatality risk criteria specified in HIPAP-4.

2. Introduction

State Environmental Planning Policy No. 33 — Hazardous and Offensive Development (SEPP 33) was gazetted on 13 March 1992 and applies to any proposals which fall under the policy’s definition of ‘potentially hazardous industry’ or ‘potentially offensive industry’. Certain activities may involve handling, storing or processing a range of substances which in the absence of locational, technical or operational controls may create an off-site risk or offence to people, property or the environment. SEPP 33 ensures that only those proposals which are suitably located, and able to demonstrate that they can be built and operated with an adequate level of safety and pollution control, can proceed.

Jemena is currently planning to upgrade its existing Port Kembla Lateral (PKL) pipeline capabilities to strengthen the security of gas supply for the east coast gas market. The Port Kembla Lateral Looping (PKLL) Project involves the construction of a 5.7 kilometres long, buried gas transmission pipeline from the proposed Port Kembla Gas Terminal (PKGTT) pipeline discharge point at Cringila station to the Eastern Gas Pipeline (EGP). This pipeline will supply gas into the EGP via a new End of Line (EoL) Tie-in facility in the vicinity of Jemena’s existing Kembla Grange MLV/Lateral Offtake facility.

As part of the approvals process for the PKL pipeline, Jemena is required to complete a Level 2 (Semi Quantitative) Preliminary Hazard Analysis [3]. The Department of Planning, Industry & Environment (DPIE) guideline “Multi-Level Risk Assessment” requires that incidents that have potential significant consequences beyond the site boundary must be quantified and demonstrated to be below the appropriate criteria.

Figure 2-1 below illustrates the hazardous assessment process [3].

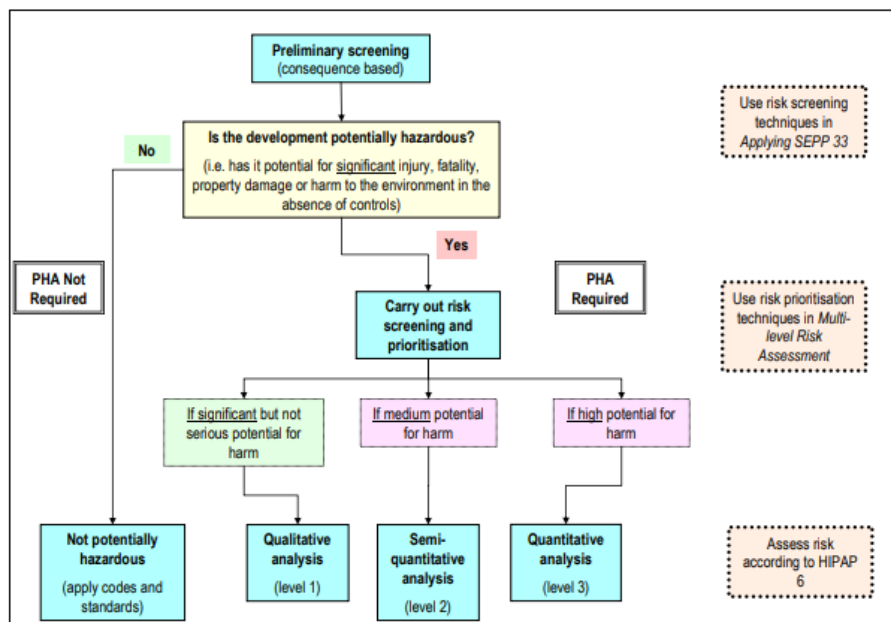


Figure 2-1 Hazardous Assessment Process

2.2 Objectives

The objective of this study is to undertake a Quantitative Risk Assessment (QRA), which in conjunction with existing studies completed (namely HAZID, HAZOP and pipeline SMS review) is intended to satisfy the requirements for a Level 2 Preliminary Hazard Analysis.

A Quantitative Risk Assessment (QRA) has been prepared consistent with the requirements of Hazardous Industry Planning Advisory (HIPAP) Paper No. 6 – Guidelines for Hazard Analysis (DPE, 2011) [2]. The key elements of this QRA are as follows:

- Identification of the nature and scale of all hazards at the facility, and the selection of representative incident scenarios;
- Analysis of the consequences of these incidents on people, property and the biophysical environment;
- Evaluation of the likelihood of such events occurring and the adequacy of safeguards;
- Calculation of the resulting risk levels of the facility; and
- Comparison of these risk levels with established risk criteria

2.3 Scope

The scope of this QRA includes:

- 5.7 km pipeline between Cringila station and Kembla Grange, described hereinafter as the PKL (Port Kembla Lateral).
- The Tie-in facility at Kembla Grange (covering two location options).

Note that for full context, elements of the Australian Industrial Energy (AIE) project scope (FSRU, pipeline to Cringila, and Cringila facility) are described within this report but are not the subject of the QRA.

2.4 Acronyms

Abbreviation	Definition
AIE	Australian Industrial Energy
AS	Australian Standard
DNVGL	Det Norske Veritas Germanischer Lloyd
DPIE	Department of Planning, Industry & Environment
EGP	Eastern Gas Pipeline
FEED	Front End Engineering Design
FSRU	Floating Storage and Regasification Unit
HAZID	Hazard Identification

Abbreviation	Definition
HAZOP	Hazard and Operability
HIPAP	Hazardous Industry Planning Advisory Paper
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
LSIR	Location Specific Individual Risk
MAOP	Maximum Allowable Operating Pressure
NSW	New South Wales
OGP	International Association of Oil and Gas Producers
P&ID	Piping and Instrumentation Diagram
PHA	Preliminary Hazard Analysis
PKCT	Port Kembla Coal Terminal
PKGP	Port Kembla Gas Project
PKGT	Port Kembla Gas Terminal
PKL	Port Kembla Lateral
QRA	Quantitative Risk Assessment
SEPP	State Environmental Planning Policy
SMS	Safety Management Study
UKOOA	United Kingdom Offshore Operators Association
VCE	Vapour Cloud Explosion

3. System Description

3.1 LNG Terminal Overall Description

The PKGT is planned to be developed at Port Kembla and will include a Floating Storage and Regasification Unit moored to an existing berth in the inner harbour (see Figure 3-1). LNG carriers (LNGC) will moor in a side-by-side configuration to offload the LNG to the FSRU where it will be regasified and sent to shore via marine loading arms and aboveground station piping and connected to an onshore pipeline that will tie-in to the existing Eastern Gas Pipeline (EGP) at Kembla Grange.

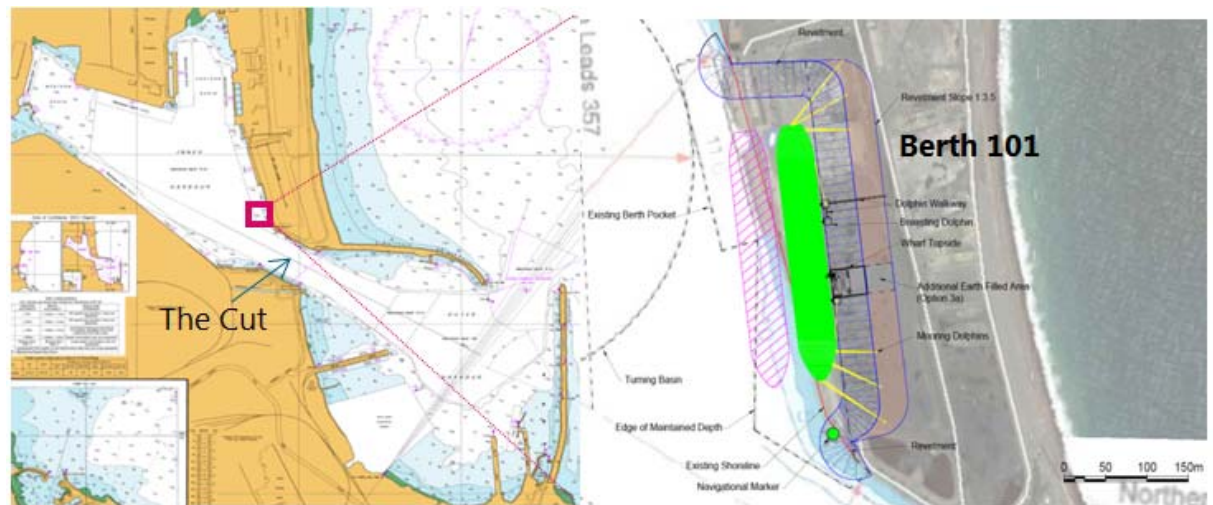


Figure 3-1 PKCT Berth 101 layout

3.2 Onshore Pipeline

An onshore gas pipeline connects the FSRU to the tie-in point at Cringila (NGP1 pipeline), which in turn is connected to the EGP via the PKL pipeline. The gas pipeline is a DN450 carbon steel pipeline and has a total length of 11,770m (6,100 m NGP1 and 5,670m PKL).

Licence 26 for the Eastern Gas Pipeline states a maximum allowable operating pressure (MAOP) of 14.895 MPa; with the exception for assemblies (that can be later isolated and upgraded), the DN 450 mainline was constructed and tested to allow a future increase in operating pressure to 16.55 MPa (corresponding to 80% SMYS for the selected linepipe). Jemena intends to maintain this design basis for the Port Kembla Lateral Looping pipeline.

PKL commences downstream of the monolithic isolation joint at the discharge of the Cringilla facility, with approximately 4m of the pipeline section above ground (refer Figure 3-2).

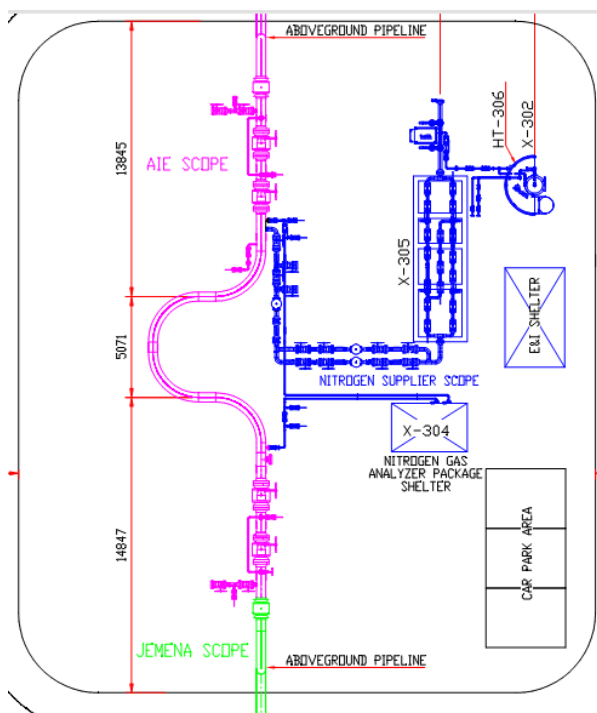


Figure 3-2- Cringilla Facility

Figure 3-3 and Figure 3-4 show the Pipeline routes for NGP1 and PKL respectively. PKL commences downstream of

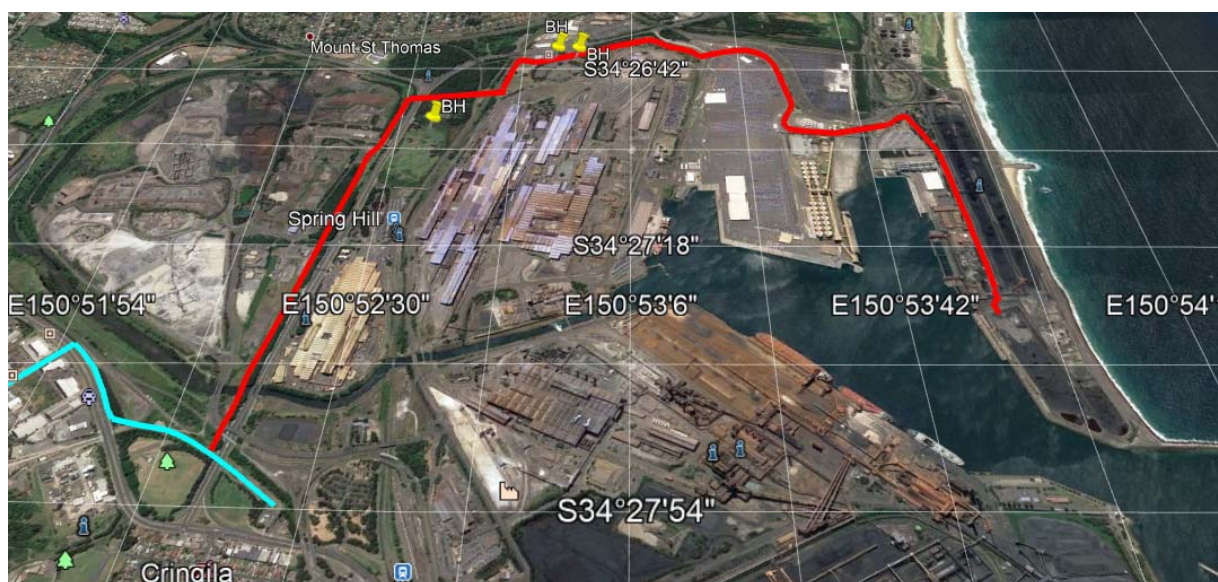


Figure 3-3- PKGT pipeline route - Berth 101 to Cringila (NGP1)

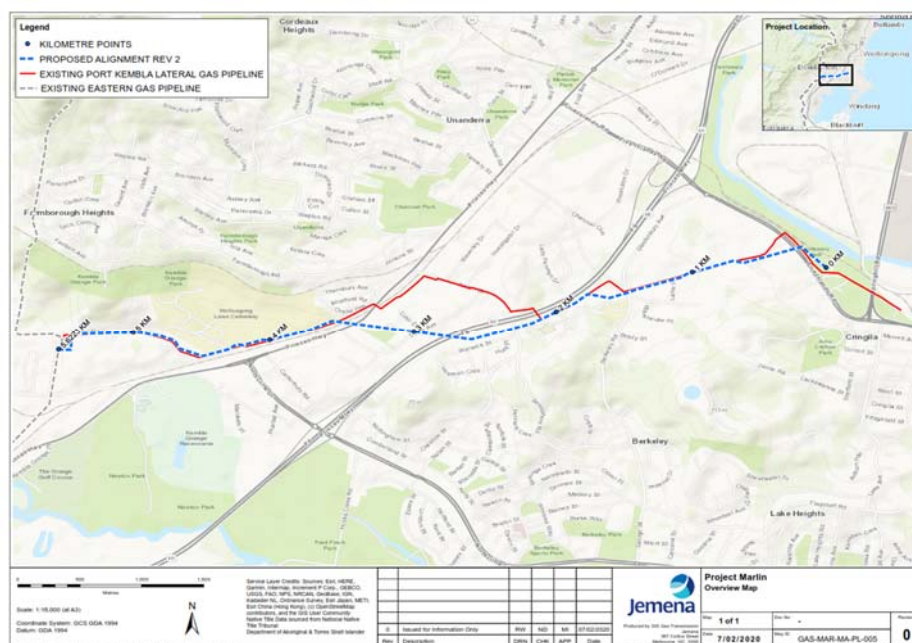


Figure 3-4- PKGT pipeline route – Cringila to Kembla Grange (PKL)

3.3 Kembla Grange Tie-in Facility

The PKL pipeline comes above ground near Jemena’s existing Kembla Grange MLV/Lateral Offtake facility and tie-in to the EGP. The tie-in facility at Kembla Grange includes a gas custody transfer meter, pigging facility and two shutdown valves to segregate the PKGT from the EGP during an emergency. There are two potential locations for the tie-in facility, which are shown in Figure 3-5 as Options A and B.



Figure 3-5 Potential locations for Tie-in facility at Kembla Grange

3.4 Location and Surrounding Land Use

Surrounding area of the proposed PKL pipeline route is a combination of industrial, residential and rural. A Safety Management Study (SMS) was carried out for the pipeline in line with the requirements of AS 2885.1 [4] and it was agreed in the workshop that based on the usage of land adjacent to the pipeline the overall location class along the pipeline length is Residential (T1), with secondary location class industrial (I) [11]

Figure 3-6 indicates the pipeline route and surrounding area within the measurement length of the pipeline, which is define as the radius of the 4.7 kW/m^2 radiation contour caused by a fire, resulting from a full-bore rupture of the pipeline, and extends 617.9m from the PKL.

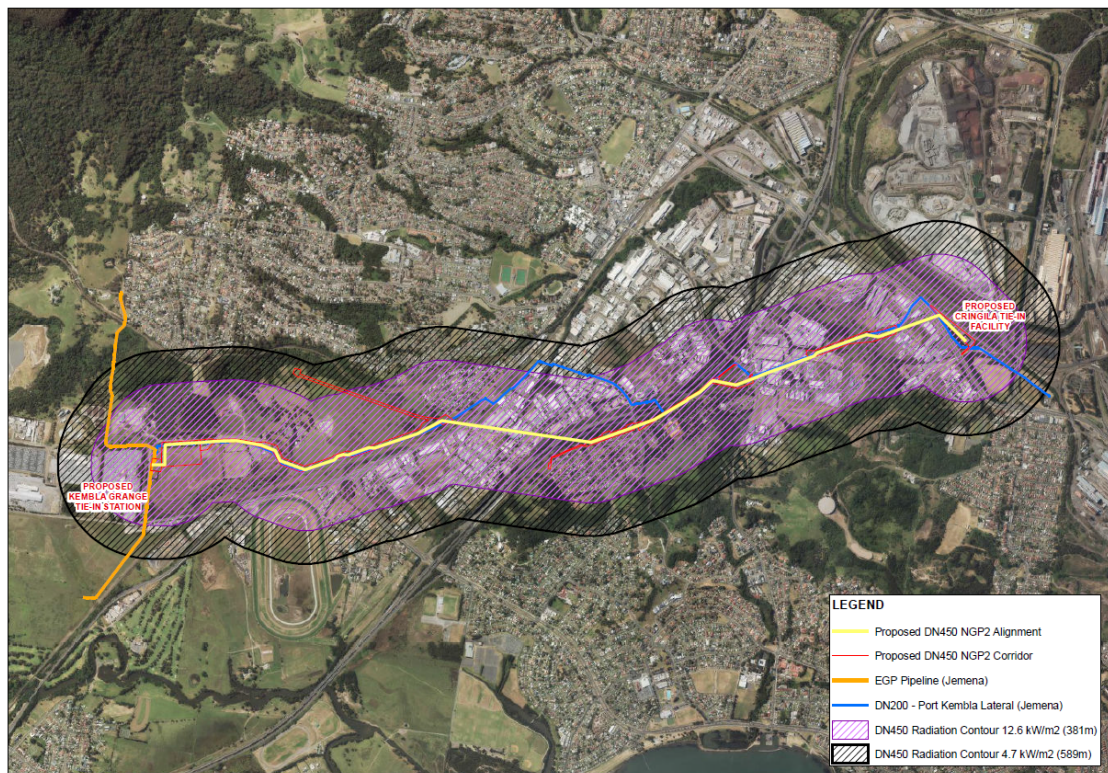


Figure 3-6 Surrounding area of the PKL pipeline within the Measurement Length

The Kembla Grange Tie-in facility at Kembla Grange as can be seen in Figure 3-6 is mainly surrounded by Rural area. There is industrial development to the west (predominantly a car yard), and public sporting facilities to the east (Sir Ian McLennan Oval).

4. Methodology

The QRA study has been carried out in accordance with the NSW HIPAP 6 guidelines for hazard and risk assessments [2]. The methodology is outlined in Figure 4-1 below.

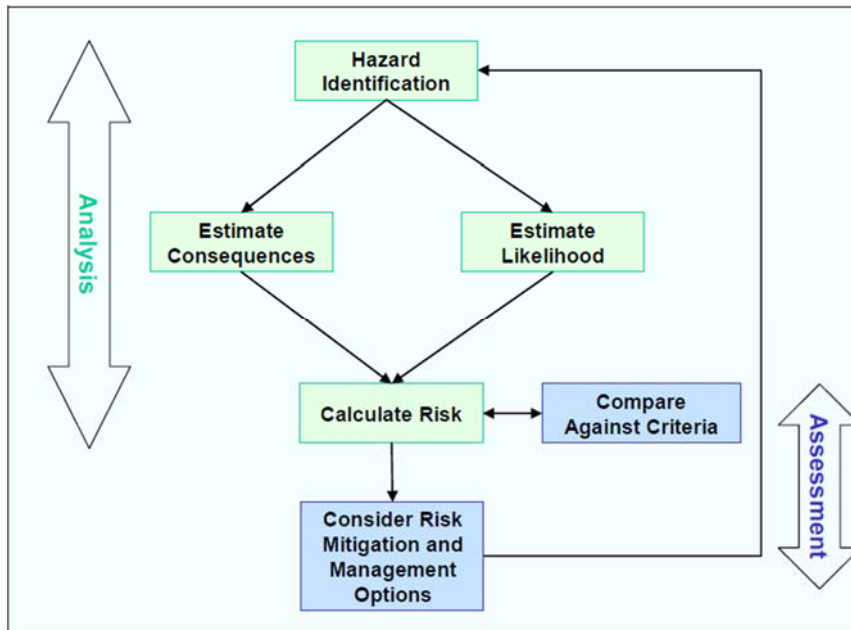


Figure 4-1: Hazard Analysis Methodology [2]

The methodology includes the following steps:

- Identification of Hazards (Section 5) – Review of possible accidents and the associated impacts that may occur based on previous accident experience or judgement where necessary.
- Consequences and Impact Analysis (Section 6) – Define the characteristic of the identified possible accidents.
- Frequency Analysis (Section 7) – Define the probability of the identified possible consequences.
- Risk Analysis (Section 8 and Section 9) – Define the acceptable risk levels and compare against the determined Location Specific Individual Risk contours.

5. Hazard Identification

A number of studies have been undertaken which have identified potential hazards associated with the new pipeline and tie-in facility, including:

- HAZID and HAZOP
- Pipeline Safety Management Study

The studies have identified a number of hazard causes which may lead to loss of containment events, including overpressurisation of the system, brittle failure, corrosion, and third-party impacts.

5.1 Loss of Containment Consequences

The only available hazardous material within the scope of this study is natural gas.

Natural gas is known to be a clean source of methane with very few contaminants. The natural gas composition used in this study is as presented in Table 5-1 and is calculated using composition of Rich LNG reported in Port Kembla BOD [10] adjusted with Nitrogen to achieve the AEMO Wobbe Index limitation of 51.9 MJ/Sm³.

Table 5-1: Natural Gas Composition

Component	NG Composition [mol%]
Methane	79.83
Ethane	12.38
Propane	4.44
n-Butane	0.98
n-Pentane	0.02
Nitrogen	2.34

Natural gas will form a flammable mixture on release, with a lower flammable limit of approximately 4%. Should releases rapidly ignite, a jet fire will form, which is highly directional and will generate significant levels of radiant heat due to efficient burning.

Delayed ignition will result in a flash fire, and if sufficient congestion is present, a vapour cloud explosion (VCE). VCEs occur due to rapid combustion of flammable gas which generates pressure effects due to the acceleration of the flame front by congestion or confinement. As both pipeline and Kembla Grange tie-in facility are located in open areas and the degree of confinement and congestion is very low, explosion is not considered a credible scenario in this study.

The composition of the re-gasified LNG is such that toxic impacts are not considered to be credible.

5.2 Escalation Potential

A specific query was raised by DPIE relating to the separation distance between the looping pipeline and the existing pipeline, when they are in proximity in the same corridor.

Guidance with respect to spacing has been taken from “Underground parallel pipelines domino effect: An analysis based on pipeline crater models and historical accidents”, published in the Journal of Loss Prevention in the Process Industries [9]. The concept is that inter-pipeline escalation can occur when a crater forms, exposing the adjacent pipeline to direct flame impingement following a release event.

The potential crater dimensions are based on the pipeline pressure, diameter, and the soil type. For an 18” (DN450) pipeline in sandy soil, and operating at up to 150 barg, the total crater width (centred on the pipeline) is approximately 13m, and in clay soil the crater width is approximately half of this (refer to Figure 5-1). Based on this data, the current proposed minimum separation between the existing pipeline and the new looping pipeline is 7m in sandy soil and 3.5m in clay soil, and the risk of inter-pipeline escalation has been excluded from this analysis.

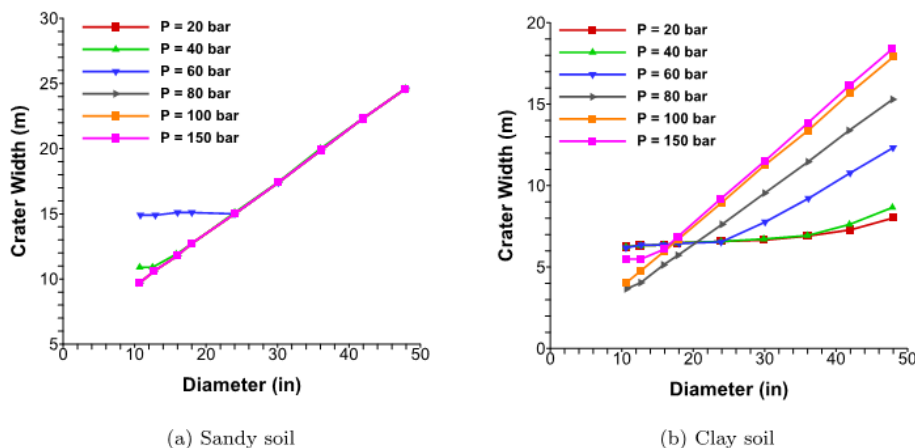


Figure 5-1 Pipeline Crater Width

6. Consequence Modelling Assumptions and Inputs

DNV GL PHAST Risk (also known as SAFETI) version 6.7 was used to model the possible identified consequences from releases of hazardous inventories and resulting risk contours.

The following section describes the assumptions, inputs and scenario development for the modelling undertaken.

6.1 Release Scenarios

The release cases modelled in this study are summarised in Table 6-1 below. All releases have been modelled at a pressure of 12,000kPag, and temperature of 10°C.

Table 6-1: Hazardous Inventories

Scenario ID	Scenario
1	Natural Gas pipeline from Cringila to Kembla Grange facility- PKL
2	PKL Inlet pipeline at Kembla Grange- (Above ground pipeline to the isolation valve, SDV-5001)
3	Metering and associated pipework
4	Pig Receiver
5	Tie-in to EGP (from SDV-5008 to the point pipe goes underground)

All releases have been modelled at initial process conditions until depleted, with the exception of full-bore pipe ruptures which are modelled based on the release rate at 30 seconds after release. Whilst isolation capability exists at both Kembla Grange and the Cringila Station, this has conservatively been ignored in the modelling.

6.2 Hole Size Distribution

The hole size distributions used in this study are consistent with the PHA for Port Kembla Gas Project (PKGP) [12] and as follows:

Table 6-2: Leak Size at Kembla Grange Facility

Leak Description	Leak Diameter (mm)
Small	10
Medium	25
Medium – Large	50
Large	100
Catastrophic (Full Bore)	Rupture

Table 6-3: Leak Size – Pipeline

Leak Description	Leak Diameter (mm)
Small	20
Medium	50
Large	100
Full Rupture	Full Bore Rupture

6.3 Leak Direction and Elevation

Three different release orientations were modelled. Directional probabilities are as follows:

- 50% for horizontal;
- 25% for vertical (up); and
- 25% for vertical (down).

A leak from the pipeline is assumed to have following orientation probabilities:

- 20% for vertical (up); and
- 80% for vertical (45° diagonal).

Releases from the Kembla Grange tie-in facility were modelled at an elevation of 1m, and releases from the buried NPG1 pipeline at an elevation of 0m. All risk impacts have been measured at a height of 1.65m above ground level.

6.4 Environmental Conditions

Environmental conditions and wind direction probabilities used in the consequence modelling are taken from the PKGP PHA [12] and summarised in Table 6-4 and Table 6-5 as follows.

Table 6-4: Weather Parameters

Weather ID	Wind Speed (m/s)	Pasquil Stability	Air Temperature (°C)	Relative Humidity (%)	Ground Temperature (°C)
Calm	1	F	5	68	17
Average	5	D	25	68	21
Windy	10	D	40	68	25

Table 6-5: Weather Probability Distribution

Weather ID	N	NE	E	SE	S	SW	W	NW	Occurrence
Calm – 1F	2.59%	5.80%	2.86%	3.49%	2.77%	3.83%	2.41%	1.55%	25.28%
Average – 5D	5.24%	12.64%	3.52%	5.86%	10.68%	7.53%	6.22%	2.47%	54.15%
Windy – 10D	0.78%	4.20%	0.72%	1.30%	5.49%	2.54%	4.64%	0.90%	20.57%

7. Frequency Analysis

7.1 Release Frequency

Release frequency has been estimated based on a parts count using issued P&IDs, and application of failure rates premised on historical data.

A parts count was undertaken using the Revision E of Piping and Instrumentation Diagrams (P&IDs) for Kembla Grange Tie-in facility [14], with the following assumptions applied:

- An additional 15% contingency was applied to all parts count in the frequency assessment to account for future minor changes to the P&IDs and design modifications.
- Pig receiver VSR-501 and associated piping are only in use during pigging operation which is assumed to be an 8-hour operation twice per year.
- Per DNV guidance, the failure frequency for the above ground sections of the pipeline within the boundary of the Kembla Grange is estimated to be 25% of the total failure frequency of the facility [8].

Release frequencies for each release scenario are summarised in Appendix A.

Consistent with NPG1 pipeline [12], the OGP [7] data has been used for the release frequency calculation of NPG2 pipeline within this QRA, which correlates release frequency based on pipeline wall thickness. For a wall thickness of 10-15mm, a release frequency of 0.081 per 1000km per year is recommended.

7.1 Ignition Probability

Given a release, the probability of ignition is dependent on a range of factors including:

- Release rate;
- Material state (liquid or gas);
- Material physical properties (flash point, density, flammability limits); and
- Ignition sources present (hot work, uncertified / old equipment, energy sources).

There are a range of correlations available for applying an ignition probability to a release, and most are based on the release rate and state. The ignition probabilities utilised in this QRA are based on the United Kingdom Offshore Operators Association (UKOOA) ignition correlations [5] which take into account the factors above as well as the nature of the surrounding area with respect to potential ignition sources.

The ignition probabilities in this QRA were determined using the UKOOA ignition correlation no. 4 (Pipe Gas LPG Rural) for the releases at Kembla Grange facility and correlation no. 3 (Pipe Gas LPG Industrial) for release from buried PKL. The split between immediate and delayed ignition is based on Cox, Lees and Ang [6] as per Table 7-1.

Table 7-1: Probability of Immediate versus Delayed Ignition

Release Size	Rate (kg/s)	Fraction of Ignition Probability Attributed to Immediate Ignition	Fraction of Ignition Probability Attributed to Delayed Ignition
Minor	< 1	0.96	0.04
Major	1 – 50	0.88	0.12
Massive	> 50	0.70	0.30

The consequences of hydrocarbon fire events are as follows:

- Immediately ignited gas releases result in jet fires.
- Delayed ignition gas releases are modelled as flash fires.

Ignition probabilities for each release scenario are summarised in Appendix A.

7.2 Fatality Probability

For jet fires, it is assumed that fatality occurs as a result of exposure to a radiant heat. Table 7-2 provides typical effects of radiant heat exposure, as source from HIPAP 4 [1].

Table 7-2: Radiant Heat Consequences [1]

Radiation (kW/m ²)	Effect – People
2.1	<ul style="list-style-type: none"> ▪ Minimum level to cause pain after 1 minute
4.7	<ul style="list-style-type: none"> ▪ Pain in 15-20 seconds ▪ Injury after 30 seconds exposure (second degree burns minimum)
12.6	<ul style="list-style-type: none"> ▪ Significant chance of fatality with extended exposure ▪ High chance of injury
23	<ul style="list-style-type: none"> ▪ Likely fatality with extended exposure ▪ Chance of fatality with instantaneous exposure
35	<ul style="list-style-type: none"> ▪ Significant chance of fatality

Within the QRA, fatality due to exposure to radiant heat is premised on the following Probit equation for personnel located outdoors:

Probit = $-36.38 + 2.56 \ln(t \cdot q^{4/3})$, where

- t = exposure time, in seconds
- q = radiant heat load, in W/m²

OGP recommends a 30% chance of fatality for personnel exposed to 12.5 kW/m^2 radiant heat onshore, which corresponds to an exposure time of 30 seconds. As such, this value is used as the basis for the maximum exposure time within the QRA. Exposure is assumed to commence from the time of ignition (at time = 0 for early ignition events), which may be conservative when considering the delayed ignition of pool fire events, and the rapid depressurisation of large bore releases.

For flash fires, fatality is assumed to occur when persons are engulfed within the fire event, which is defined by the extent of the flammable cloud.

8. Risk Criteria

Risk has been measured in terms of Location Specific Individual Risk (LSIR), which is the level of risk that would be experienced by a person in a particular location for a full calendar year. LSIR criteria has been sourced from the NSW Department of Urban Affairs and Planning Hazardous Industry Planning Advisory Paper (HIPAP) No. 4 (Risk Criteria for Land Use Safety Planning), as presented in Table 8-1 below.

Table 8-1: Fatality Risk Criteria

Risk (pa)	Land Use
5E-07	Sensitive land use; e.g. hospitals, schools, child-care facilities, old age housing
1E-06	Residential area; including hotels, motels, tourist resorts
5E-06	Commercial development; including retails centres, offices and entertainment centres
1E-05	Active open space; including sporting complexes
5E-05	Industrial

Societal risk differs from individual risk by taking into account society's aversion to accidents which have the potential to result in multiple fatalities. A wide range of factors need to be taken into consideration when calculating societal risk including details of the population density and movement in public areas.

Societal risk will only be considered within this study if LSIR contours indicate areas of elevated risk (approaching LSIR criteria) on areas with potential for high occupancy.

9. RISK RESULTS

Risk Results are presented separately for PKL pipeline and the Kembla Grange tie-in facility as per following sections:

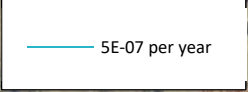
9.1 Risk Results for PKL Pipeline

Figure 9-1 to Figure 9-6 below show individual fatality risk contours for the PKL pipeline. They are presented in six sections to provide more details of the impact level on surrounding area.

Of the HIPAP-4 criteria listed in Section 8, risk at a level of $1E-06$ per annum or above was not recorded at any location along the pipeline, and only the lowest risk criterion of $5E-07$ per annum, corresponding to the exposure limit for sensitive land use, was recorded. It is not considered that any sensitive locations along the pipeline route are impacted at, or above this level. As the risk exposure along the pipeline is well below tolerable limits for LSIR exposure and does not impact on particular locations of high occupancy, no societal risk assessment has been undertaken.



Figure 9-1 Risk Contour PKL Pipeline- section1



5E-07 per year





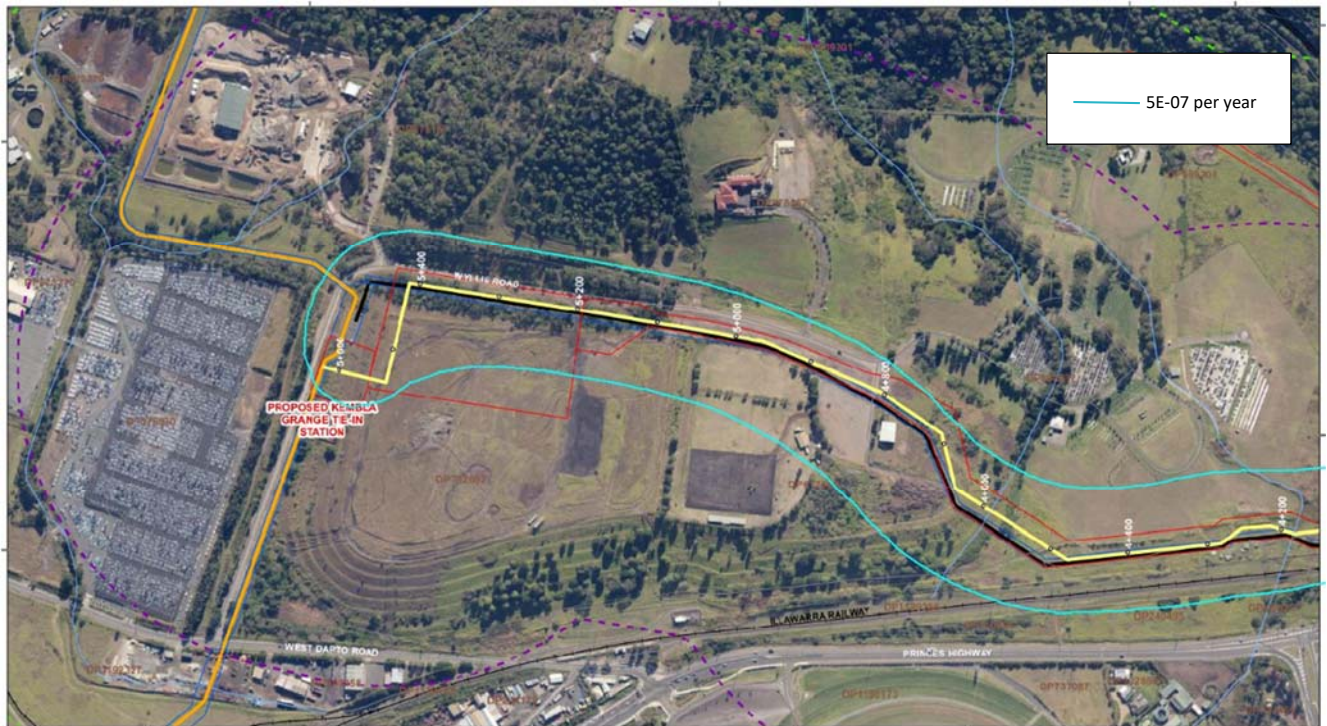


Figure 9-6 Risk Contour PKL Pipeline- section 6

9.2 Individual fatality risk contours for Kembla Grange Tie-in Facility

Figure 9-7 and Figure 9-8 show the individual fatality risk contours generated from the modelling conducted at the Kembla Grange Tie-in facility. When assessed against the HIPAP No 4 criteria, the following conclusions can be made:

- The highest HIPAP risk category produced from modelling is $1.0E-5$ per annum, corresponding to the criterion for sporting complexes and active open space.
- The $1E-05$ risk contour for active open space covers part of Wyllie road to the north and west of the site and covers some part of the car parking to the west in option B and does not reach it in option A; there is no active open space such as a sports complex within this risk contour.
- The $5E-06$ risk contour in both location options only covers part of the car park site to the west and does not include any commercial developments.
- The $1E-06$ risk contour for residential areas includes mainly open areas and few adjacent industrial sites; no residential land is within the extent of this risk contour for neither of location options.
- The $5E-07$ risk contours and for both locations A and B remain in open area and industrial lands and do not include any sensitive location such as aged care facilities, child care centres, etc.

As for the pipeline assessment, LSIR is well below the target criteria, and there are no locations of elevated occupancy near the Kembla Grange tie-in facility. As such, societal risk has not been assessed for this location.

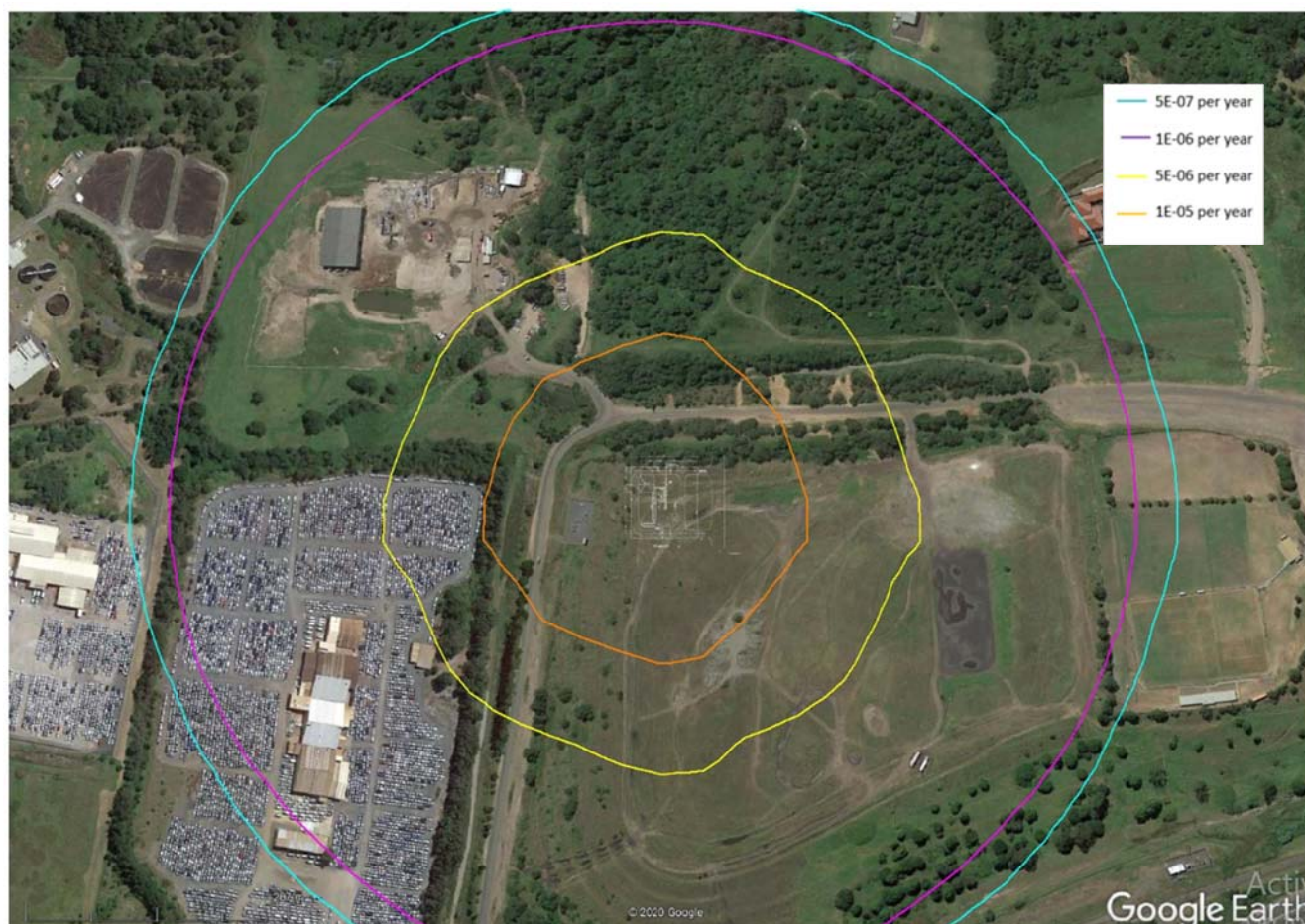


Figure 9-7 Risk Contours for Kembla Grange- Location A

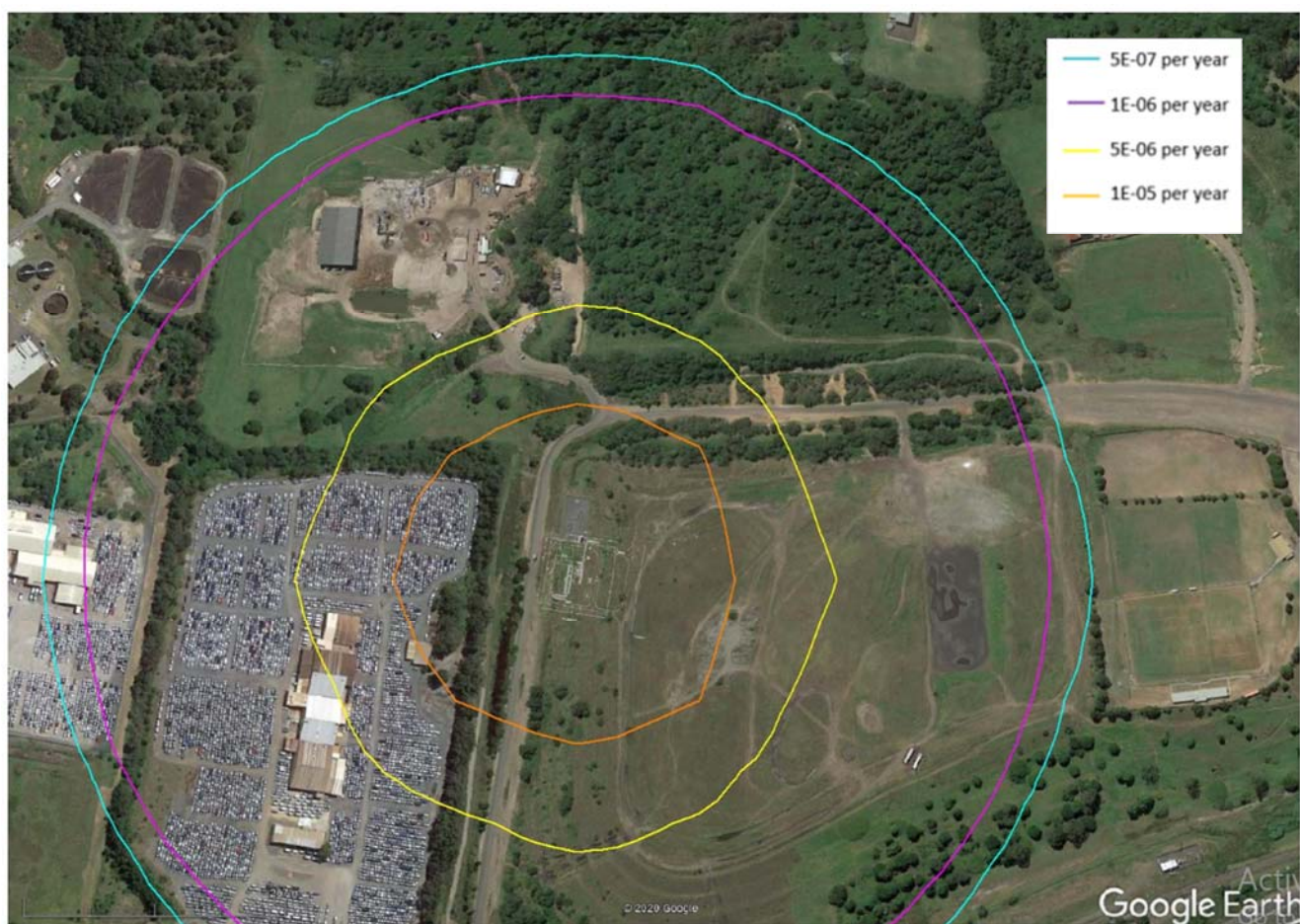


Figure 9-8 Risk Contours for Kembla Grange- Location B

10. CONCLUSION

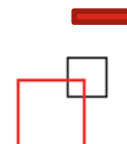
The results of the QRA modelling undertaken indicate that risk exposure associated with the PKL pipeline and the associated Kembla Grange tie-in facility will be below the fatality risk criteria specified in HIPAP-4.

11. REFERENCES

1. Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Safety Planning, January 2011
2. Hazardous Industry Planning Advisory Paper No 6 – Hazard Analysis, January 2011
3. Hazardous and Offensive Development Application Guidelines, Applying SEPP 33, January 2011
4. Pipelines – Gas and Liquid Petroleum – Part 1: Design and Construction, AS 2885.1 – 2012
5. IP Research Report, Ignition Probability Review, Model Development Lookup Correlations, January 2006
6. A.W. Cox, F.P. Lees and M.L. Ang, Classification of Hazardous Locations, IChemE, 1990
7. International Association of Oil and Gas Producers (OGP) Risk Assessment Data Directory, Report No 434-4, Riser and Pipeline Release Frequencies, March 2010
8. Det Norske Veritas, Offshore QRA – Standardised Hydrocarbon Leak Frequencies, Report No. 2008-1768 Rev. 1, December 2010
9. Underground parallel pipelines domino effect: An analysis based on pipeline crater models and historical accidents, Journal of Loss Prevention in the Process Industries, Vol. 43, September 2016
10. Port Kembla Gas Project Basis of Design, 401010-01496-PM-BOD-0001, Rev 0
11. Port Kembla Lateral Looping PKL Pipeline FEED, Pipeline Safety Management Study Workshop, 401010-00071-SR-REP-0001, Rev 0
12. Port Kembla Gas Project, Preliminary Hazard Analysis, 401010-01496-SR-REP-0002, Rev 0
13. Port Kembla Gas Terminal HAZID and HAZOP Studies Report, 401010-01496-SR-RPT-0003 Rev 0
14. EGP Pipeline Tie-in Facility P&ID, 401010-01496-PR-PID-5001&2, Rev E

Appendix A. Summary of Release Scenarios

Scenario	Hole Size (mm)	Release Rate (kg/s)	Release Frequency (p.a.)	Ignition Probability	Immediate Ignition Probability	Delayed Ignition Probability
PKL Inlet pipeline at Kembla Grange- (Above ground pipeline to the isolation valve, SDV-5001)	10	2.11	1.20E-03	1.63E-03	1.44E-03	1.96E-04
	25	13.19	1.30E-04	2.50E-03	2.20E-03	3.00E-04
	50	52.75	1.63E-05	7.58E-03	5.30E-03	2.27E-03
	100	211.00	7.21E-07	2.30E-02	1.61E-02	6.90E-03
	Rupture	889.00	1.74E-05	7.28E-02	5.10E-02	2.18E-02
Metering and associated pipework	10	2.11	2.23E-02	1.63E-03	1.44E-03	1.96E-04
	25	13.19	1.70E-03	2.50E-03	2.20E-03	3.00E-04
	50	52.75	9.32E-04	7.58E-03	5.30E-03	2.27E-03
	100	211.00	9.43E-06	2.30E-02	1.61E-02	6.90E-03
	Rupture	889.00	3.80E-04	7.28E-02	5.10E-02	2.18E-02
Pig Receiver	10	2.11	1.14E-02	1.63E-03	1.44E-03	1.96E-04
	25	13.19	1.18E-03	2.50E-03	2.20E-03	3.00E-04
	50	52.75	1.44E-04	7.58E-03	5.30E-03	2.27E-03
	100	211.00	3.54E-06	2.30E-02	1.61E-02	6.90E-03
	Rupture	889.00	6.60E-04	7.28E-02	5.10E-02	2.18E-02
Tie-in to EGP (from SDV-5008 to the point pipe goes underground)	10	2.11	3.67E-03	1.63E-03	1.44E-03	1.96E-04
	25	13.19	1.85E-04	2.50E-03	2.20E-03	3.00E-04
	50	52.75	1.43E-04	7.58E-03	5.30E-03	2.27E-03
	100	211.00	0.00E+00	2.30E-02	1.61E-02	6.90E-03
	Rupture	889.00	6.41E-05	7.28E-02	5.10E-02	2.18E-02



Appendix C

Former Berkeley House - Historic Heritage and Archaeological Due Diligence Report

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5 August 2020

Jodi Wood
Jemena
Stakeholder / Approvals Manager
Level 18, 175 Eagle Street
Brisbane NSW 4000

Dear Jodi,

Eastern Gas Pipeline Modification – Historical Heritage Letter of Advice

Our Ref: Matter 33553

Biosis Pty Ltd (Biosis) has been engaged by Jemena to prepare an historical heritage Letter of Advice (LoA) regarding potential impacts to listed heritage items, to support the Eastern Gas Pipeline (EGP) Port Kembla lateral modification between Kembla Grange and Cringila New South Wales (NSW) (the study area) (Figure 1, Figure 2).

The Port Kembla Gas Terminal has recently been approved as a critical State Significant Infrastructure project under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The project involves the development of a liquefied natural gas import terminal, pipeline and tie-in facility to the existing EGP lateral in Cringila. The pipeline is expected to span 6.8 kilometres with 1.8 kilometres of horizontal direct drilling (HDD) (Figure 3).

The Department of Planning, Industry and Environment, in consultation with Wollongong City Council (Council), has requested that additional information be provided to address Part 5.10 of the *Wollongong Local Environmental Plan 2009* (LEP) (outlined under the Wollongong Local Environmental Plan 2009 section below) and any archaeological reports available. It was suggested that this be undertaken through a due diligence assessment or preliminary archaeological report that provides clear recommendations that there is no potential for impacts to the listed archaeological site, Site of Former “Berkeley House” (Item number 6519, Wollongong LEP 2009), and no additional requirement for a Section 140 Excavation Permit under the *Heritage Act 1977* (Heritage Act).

This LoA will identify listed heritage items within the vicinity of the study area and assess any potential impacts of the proposed works to the Site of Former “Berkeley House” and associated areas of archaeological potential identified in Biosis (2015) and Niche (2013) only. This assessment will be prepared in accordance with the guideline *Statements of Heritage Impact* (Heritage Office & DUAP 1996) and *Wollongong Development Control Plan 2009* (DCP). This letter has been reviewed by Maggie Butcher (Consultant Archaeologist) and Samantha Keats (Consultant Archaeologist) for quality purposes.

Statutory heritage listings

A review of the following statutory instruments has been undertaken to identify the presence of any listed heritage items within the vicinity of the study area:

- State Heritage Register (SHR).
- Wollongong LEP 2009.
- Section 170 Heritage and Conservation Registers.
- Commonwealth Heritage List (CHL).
- National Heritage List (NHL).

This review identified three items of local heritage significance on the Wollongong LEP 2009 within the vicinity of the study area. There were no items identified on the SHR, Section 170 Heritage and Conservation Registers, CHL or NHL located within the vicinity of the study area. Details of the three local heritage items from the Wollongong LEP 2009 are summarised in Table 1, with wider results presented in Figure 4.

Table 1 Listed heritage items in the vicinity of the study area

Site number	Site name	Address / Property description	Listings		Significance	Distance to the study area
			Individual item	As a Conservation Area		
6319	Moreton Bay Fig	133 Farmborough Road, Farmborough Heights NSW, Lot 34, DP 19224	Wollongong LEP 2009	-	Local	260 m north of the study area
6429	Berkeley Pioneer Cemetery	Investigator Drive, Unanderra NSW, Lot 1, DP 195869	Wollongong LEP 2009	-	Local	705 m north of the study area
6519	Site of Former "Berkeley House"	23 Glastonbury Avenue and 191–195 Five Islands Road, Unanderra NSW, Lot 401, DP 845805 and Lot 210, DP 811435	Wollongong LEP 2009	-	Local	Over 181 m north of the study area

Wollongong Local Environmental Plan 2009

Part 5.10 of the Wollongong LEP 2009 states that development consent is required for:

- Demolishing or moving, or altering the exterior of (including, in the case of a building, making changes to its detail, fabric, finish or appearance) a heritage item, an Aboriginal object or a building, work, relic or tree within a heritage conservation area.

- Altering a heritage item that is a building by making structural changes to its interior, or by making changes to anything inside the item that is specified in Schedule 5 of the Wollongong LEP 2009 in relation to the item.
- Disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed.
- Disturbing or excavating an Aboriginal place of heritage significance, erecting a building on land or subdividing land on which a heritage item is located or that is within a heritage conservation area or on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.

However, development consent under this clause is not required:

- If the applicant has notified the consent authority of the proposed development, and the consent authority has advised the applicant in writing before any work is carried out that it is satisfied that the proposed development is of a minor nature or is for the maintenance of the heritage item, an Aboriginal object, Aboriginal place of heritage significance or archaeological site or a building, work, relic, tree or place within the heritage conservation area, and would have an adverse impact on the above.
- Where the development is in a cemetery or burial ground and the proposed development is the creation of a new grave or monument, or an excavation or disturbance of land for the purpose of conserving or repairing monuments or grave markers, and would not cause disturbance to human remains, relics, Aboriginal objects in the form of grave goods, or to an Aboriginal place of heritage significance.
- When the development is limited to the removal of a tree or other vegetation that the Council is satisfied is a risk to human life or property, or the development is exempt development.

The consent authority must, before granting consent under this clause in respect of a heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. This subclause applies regardless of whether a heritage management document is prepared under subclause (5) or a heritage conservation management plan is submitted under subclause (6).

The consent authority may, before granting consent to any development, require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect land on which a heritage item is located, or on land that is within a heritage conservation area, or on land that is within the vicinity of land referred to above.

The consent authority may require, after considering the heritage significance of a heritage item and the extent of change proposed to it, the submission of a heritage conservation management plan before granting consent under this clause.

The consent authority must, before granting consent under this clause to the carrying out of development on an archaeological site (other than land listed on the SHR or to which an interim heritage order under the Heritage Act applies), notify the Heritage Council of its intention to grant consent, and take into consideration any response received from the Heritage Council within 28 days after the notice is sent.

The consent authority must, before granting consent under this clause to the carrying out of development in an Aboriginal place of heritage significance consider the effect of the proposed development on the heritage significance of the place and any Aboriginal object known or reasonably likely to be located at the place by means of an adequate investigation and assessment (which may involve consideration of a heritage impact statement). Local Aboriginal communities must be notified, in writing or in such other manner as may be appropriate, about the application and take into consideration any response received within 28 days after the notice is sent.

The consent authority must, before granting consent under this clause for the demolition of a nominated State heritage item, notify the Heritage Council about the application, and take into consideration any response received from the Heritage Council within 28 days after the notice is sent.

The consent authority may grant consent to development for any purpose of a building that is a heritage item or of the land on which such a building is erected, or for any purpose on an Aboriginal place of heritage significance, even though development for that purpose would otherwise not be allowed by the *Wollongong LEP 2009*, if the consent authority is satisfied that the conservation of the heritage item or Aboriginal place of heritage significance is facilitated by the granting of consent, and the proposed development is in accordance with a heritage management document that has been approved by the consent authority. The consent authority must also be satisfied that the consent to the proposed development would require that all necessary conservation work identified in the heritage management document is carried out, and the proposed development would not adversely affect the heritage significance of the heritage item, including its setting, or the heritage significance of the Aboriginal place of heritage significance, and also that the proposed development would not have any significant adverse effect on the amenity of the surrounding area.

Wollongong Development Control Plan 2009

Under the Wollongong DCP 2009, development in the vicinity of a heritage item or conservation area (defined as land adjoining or located within the visual catchment of a heritage site) should not detract from the identified significance or setting of the heritage item or conservation area, and should give strong regard to any significant views to and from the heritage item or conservation area and any public domain area. Where subdivision is proposed in the vicinity of a heritage item or conservation area, the impact of future development of the lots should be considered. Where development is proposed adjacent to or within the vicinity of a heritage item or conservation area, the following must be considered:

- The character, siting, bulk, scale, height and external appearance of the development.
- The visual relationship between the proposed development and the heritage item or heritage conservation area.
- The potential for overshadowing of the adjoining heritage item or any building within a heritage conservation area.
- The colours and textures of materials proposed to be used in the development.
- The landscaping and fencing of the proposed development.
- The location of car parking spaces and access ways into the development.
- The impact of any proposed advertising signs or structures.
- The maintenance of the existing streetscape, where the particular streetscape has significance to the heritage site.

- The impact the proposed use would have on the amenity of the heritage site.
- The effect the construction phase will have on the wellbeing of a heritage building.

Development controls under the Wollongong DCP 2009 regarding the development of listed archaeological sites comprise:

- Any Development Application which proposes the disturbance or development of a heritage item listed in Schedule 5 of the Wollongong LEP 2009 as an 'archaeological site', or where the site is known, or is likely, to contain an archaeological site, is to undertake an Archaeological Assessment and to submit the assessment as part of the Heritage Impact Statement or Conservation Management Plan.
- Any development that involves the disturbance of archaeological sites shall not proceed without the appropriate approvals under the Heritage Act. The applicant should seek advice from Heritage NSW, Department of Premier and Cabinet, and Council's Heritage Officer in relation to these requirements.
- New development should be designed to avoid impacts on archaeological sites that are considered to be of heritage significance.
- Where new development will have direct or indirect impacts on an archaeological site, interpretive measures should be given careful consideration as part of the proposed development in order to mitigate the impacts of the proposal.
- Any disturbance of archaeological sites is to be conditional of Council's requirements and those of the NSW Heritage Council.

Site of Former "Berkeley House"

The locally significant Site of Former "Berkeley House" is an archaeological item located more than 181 metres north of the study area. Two previous archaeological assessments have been undertaken for the item, prepared by Biosis (2015) and Niche (2013). These assessments identified several areas of archaeological potential which extend outside of the heritage curtilage of the item, as seen in Figure 4. The statement of significance from the item's State Heritage Inventory listing is as follows:

Site of former "Berkeley House" is of significance for the Wollongong area for its associations with William Jenkins, original house owner, and Edmund Blacket who designed the original mansion built in 1839. The site is additionally of significance for its potential to add to further understanding of the history of Wollongong area through relics that are likely located within the site. The site retains significant associations with historic gates from the entrance of Berkeley House which were re-erected at the entry to the Berkeley Cemetery.

The following statement of significance is taken from Niche (2013):

Berkeley House at Unanderra was built in c. 1839 on Berkeley Estate, one of five early land grants issued in the Illawarra region in 1817. The house was originally a single storey dwelling believed to be designed by Edmund Blacket, Colonial architect, and presumably built using convict labour. The house was occupied by William Jenkins, an active and prominent member of the Illawarra community, and his family and renovated in 1860 to include a second storey. William Jenkins was a founder of the Illawarra Agricultural Society and benefactor to the local community, gifting land for various purposes, including a church and a school. Whilst above-ground remains of the house and its associated outbuildings have been largely removed, the Berkeley House

site has potential for substantial archaeological remains. Such remains would provide an important tangible link to the local history of the region. Their investigation would provide significant insights into the growth and development of a mid to late nineteenth century estate that was important for its economic contribution to the local area. It would also provide insights into the life of William Jenkins and his family and the convicts and staff they employed. The Berkeley House site is significant at a local level for its historical heritage values and rarity and may be of state significance for its research potential and associative value, depending on the condition and integrity of the archaeological remains.

Brief history

Berkeley House is located in one of the first five land grants made in the Illawarra. The grant was made on 24 January 1817 to Robert Jenkins, and consisted of 1,000 acres (404.7 hectares) (McDonald McPhee Pty Ltd 1991, p.21). The property was named Berkeley, after the village of Berkeley in Gloucestershire, England, Jenkins' home (James Meehan field notes in Barwick 1988, p.9). Following the death of Robert Jenkins in May 1822, control of the property passed to his wife Jemima Jenkins, who acquired further land for the Berkeley Estate, eventually totalling at 3,280 acres (1,327 hectares). Jemima gifted the Berkeley Estate to her son William Warren Jenkins upon his marriage, which at this time was used as a cattle run with an overseers headquarters near Unanderra (Barwick 1988, p.10).

William Jenkins engaged the architect Edmund Blacket in order to construct a residence on the estate. A single storey house was constructed by convict labour using handmade bricks of clay sourced from the estate, completed by 1839. The estate was also divided up into 80 tenant farms, initially raising cattle for slaughter but later transitioning to dairying in the 1850s. In 1860, the house was expanded through the construction of a second storey. (Hooke et al. 1978, p.5, 'Advertising' 1860).

Part of the Berkeley Estate was subdivided into approximately 30 farms and sold by auction in 1890 (Batt, Rodd & Purves & Dymock, D. L & MacCabe & Ewing & Gibbs, Shallard & Co. 1890). Approximately 165 acres (66.8 hectares) of farmland surrounding the house was retained by Robert Thomas Jenkins until his death on December 1913. Mr H. H. Waldon purchased the property, and during his ownership of the property Berkeley House fell into disrepair ('REMINISCENCES OF ILLAWARRA.' 1924). Berkeley House remained in a state of disrepair until it was demolished in 1940 once under ownership of the Halloran Company (Hooke et al. 1978, p.5). Since this time, the site of Berkeley House and its grounds has remained a brown field's site which has slowly been encroached upon by neighbouring developments including industrial properties, substations and transmission lines.

Archaeological remains

The Biosis (2015) archaeological assessment identified one area of high archaeological potential and one area of moderate archaeological potential associated with the remains of Berkeley House and immediate grounds. The area of high archaeological potential was anticipated to contain the remains of Berkeley House, remains of the demolished rear portions of Berkeley House, small features such as wells, privies or small buildings, and part of the estate avenues and house gardens. The area of moderate archaeological potential is likely to contain the remains of a number of outbuildings, small features such as well, privies or small buildings, as well as part of the estate avenues, and a possible enclosure. These areas of archaeological potential extend outside of the heritage curtilage for Site of Former "Berkeley House". These areas of archaeological potential are presented in Figure 4.

Impact assessment

This LoA impact assessment identifies the level of impact to the local heritage item, Site of Former "Berkeley House", and associated areas of high and moderate archaeological potential assessed in Biosis (2015) and

Niche (2013) which may arise from the proposed development. Mitigation measures will be discussed. These measures must be taken to avoid or reduce those impacts. This section of the report has been prepared in accordance with the Heritage Manual guideline *Statements of Heritage Impact* (Heritage Office & DUAP 1996).

Heritage values

As has been noted above, the locally listed Site of Former “Berkeley House” holds heritage significance for its association with the original house owner William Jenkins, Colonial architect Edmund Blacket, and for its construction using convict labour. The item also holds significance for its research potential through its archaeological remains to contribute to knowledge of the history of Wollongong area, and insights into the life of William Jenkins, his family, and the convicts and staff they employed. The Berkeley House site is significant at a local level for its historical heritage values and rarity. Depending on the condition and integrity of the archaeological remains present, the site may be of state significance for its research potential and associative value.

Proposed works

The proposed EPG modification works would include:

- Construction and installation of an 18 to 22 inch diameter carbon steel gas pipeline 5.6 kilometres in length.
- Connection to the Port Kembla Gas Terminal at AIE’s proposed Cringila facility.
- Tie-in facility at Kembla Grange, connecting the proposed pipeline to the existing EGP.

The proposed pipeline would be installed using a combination of open trenching and HDD techniques, with approximately 1.8 kilometres being installed using HDD. The construction footprint will comprise of a 20 metre wide pipeline construction Right of Way, which will accommodate plant, equipment and lay down areas; there will some additional areas outside of the construction Right of Way, but still within the study area boundary (Figure 3). The operational easement will vary depending on location, but will generally be between 6 metres and 10 metres. The new pipeline will be located within or adjacent to the existing easement where possible; however, there may be some instances where the new alignment diverges from the existing alignment, which may not run adjacent.

The proposed pipeline alignment will also predominantly follow the route of the Port Kembla lateral except for four areas where the route has to deviate due to insufficient room within the existing easement or due to industrial development having taken place along the pipeline easement since the original line was installed. The total length of these four areas is approximately 1.6 kilometres. The existing Port Kembla Lateral was constructed in a similar 20 metre Right of Way approximately 15 years ago and the operational easement varies between 6 and 10 metres wide. The new looping pipeline will be co-located or immediately adjacent to the existing easement, and will be buried to a similar depth of the existing of 1.2 metres.

The proposed pipeline in the locality of Site of Former “Berkeley House” is entirely within Jemena’s existing easement where land has previously been disturbed, and is located over 181 metres north of the areas of archaeological potential associated with Site of Former “Berkeley House”.

Discussion of heritage impacts

The discussion of impacts to heritage can be centred upon a series of questions which must be answered as part of an impact assessment which frame the nature of impact to a heritage item. The Heritage Manual

guideline *Statements of Heritage Impact* includes a series of questions in relation to indicate the criterion which must be answered (Heritage Office & DUAP 1996) (Table 2).

Table 2 Responses to relevant questions from the Heritage Manual guideline Statements of Heritage Impact

Questions to be considered	Response
New development adjacent to a heritage item	
How is the impact of the new development on the heritage significance of the item or area to be minimised?	The EPG modification project is located over 181 m south of the current established curtilage of Site of Former “Berkeley House”, and 170 m south of the most southern point of archaeological potential as assessed by Biosis (2015). The proposed works will avoid encroaching on the heritage curtilage of the item as well as avoiding the area of high and moderate archaeological potential associated with the item.
Why is the new development required to be adjacent to a heritage item?	The proposed pipeline alignment will predominantly follow the route of the Port Kembla lateral except for four areas where the route has to deviate due to insufficient room within the existing easement or due to industrial development having taken place along the pipeline easement since the original line was installed. The existing Port Kembla Lateral was constructed in a similar 20 m Right of Way approximately 15 years ago and the operational easement varies between 6-10 m wide. The new looping pipeline will be co-located or immediately adjacent to the existing easement, and will be buried to a similar depth of the existing of 1.2 m. This alignment allows for the least amount of disturbance to the community and current use of the surrounding land. In this section of the study area, the proposed pipeline alignment is contained to the existing easement, which is already disturbed from the current in-use pipeline, and therefore minimises any potential impacts.
How does the curtilage allowed around the heritage item contribute to the retention of its heritage significance?	The current heritage curtilage for Site of Former “Berkeley House” is specifically for the location of Berkeley House. The heritage curtilage does not include the entirety of the areas of high and moderate archaeological potential, as assessed by Biosis (2015) and Niche (2013).
How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?	Current views from Site of Former “Berkeley House” contain existing above-ground infrastructure such as electrical power lines and poles. As the EPG modification methodology consists largely of open trenching and HDD drilling, there may be some very minor temporary impacts to views to and from the item during the program of works. At the completion of the works and during its subsequent operation, there will not be any impacts to views as the infrastructure will be located below the ground surface. The views to and from the item will not be affected by the finished works.
Is the development sited on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why	The archaeological assessment conducted by Biosis (2015) assessed the curtilage of Site of Former “Berkeley House” and its immediate vicinity. The proposed works are outside of this area, located over 181 m south of the heritage curtilage of Site of Former “Berkeley House” and 170 m south of the associated areas of moderate and high archaeological potential. There is no risk of disturbance to any

Questions to be considered	Response
were they rejected?	known and potentially significant archaeologist deposits associated with the Site of Former "Berkeley House".

Based upon the discussion of impacts to heritage items, impact to these items can be quantified under three main categories which are dependent on the proposed impacts, nature of the heritage item and its associated curtilage:

- Direct impacts, where the completion of the proposed development will result in a physical loss or alteration to a heritage item which will impact the heritage value or significance of the place. Direct impacts can be divided into whole or partial impacts: whole impacts will result in the removal of a heritage item as a result of the development; and partial impacts will normally constitute impacts to a curtilage or partial removal of heritage values.
- Indirect impacts, where alterations to the environment or setting of a heritage item which will result in a loss of heritage value. This may include permanent or temporary visual, noise or vibration impacts caused during construction and after the completion of the development. Indirect impacts diminish the significance of an item through altering its relationship to its surroundings; this in turn impacts its ability to be appreciated for its historical, functional or aesthetic values.
- Cumulative impacts, where minimal or gradual effects from a single or multiple developments impact upon heritage values. A cumulative impact would constitute a minimal impact being caused by the proposed development which over time may result in the partial or total loss of heritage value to the study area or associated heritage item.
- No impact, where the project does not constitute a measurable direct or indirect impact to the heritage item.

Assessment of impacts

A discussion, assessment and mitigation of impacts to heritage items located within or adjacent to the study area is presented in Table 3.

Table 3 Assessment of impacts

Heritage item	Significance	Discussion	Assessment	Mitigation measures
Site of Former "Berkeley House" (Item no. 6519, Wollongong LEP 2009)	Local	The EPG modification project is located over 181 m south of the current established curtilage of Site of Former "Berkeley House". The proposed works will avoid entering the heritage curtilage of the item. As the EPG modification consist largely of open trenching and HDD drilling, views to and from the item will not be affected by the finished works. In this section of the study area, the proposed works will be confined to the existing	No impact	Unexpected finds protocol.

Heritage item	Significance	Discussion	Assessment	Mitigation measures
		easement which has already been disturbed by the construction of the current pipeline; this will avoid any direct physical impacts to potential archaeological deposits associated with the item. There may be some temporary impacts to views to and from the item during the program of works, but these are considered negligible due to the inaccessible location of the item and works, and the sub-surface nature of the heritage item.		
Areas of archaeological potential as assessed by Biosis (2015)	Potentially local or State	The EPG modification project is located 170 m south of the most southern point of archaeological potential as assessed by Biosis (2015). The proposed works will avoid the area of high and moderate archaeological potential associated with the item. In this section of the study area, the proposed works will be located in areas that have previously been disturbed within the extent of existing easements; this will avoid any direct physical impacts to potential archaeological deposits associated with the item that could not have been identified through historical research.	No impact	Unexpected finds protocol.

Statement of heritage impact

The study area for the proposed EPG modification project is located over 181 metres of the locally listed heritage item, Site of Former “Berkeley House”, and associated areas of moderate and archaeological potential associated with the item, as assessed by Biosis (2015) and Niche (2013). This item is listed as significant for its associative, research and historical heritage values, and, depending on the condition and integrity of the archaeological remains present, the site may be of state significance for its research potential and associative value.

The proposed EPG modification works would include construction and installation of an 18 to 22 inch diameter carbon steel gas pipeline 5.6 kilometres in length, connection to the Port Kembla Gas Terminal at AIE’s proposed Cringila facility and a tie-in facility at Kembla Grange, connecting the proposed pipeline to the existing EGP. The proposed pipeline would be installed using a combination of open trenching and horizontal directional drilling techniques, with approximately 1.8 kilometres being installed using HDD. The construction footprint will comprise of a 20 metres wide pipeline construction Right of Way, which will accommodate plant, equipment and lay down areas; there will some additional areas outside of the construction Right of Way, but still within the study area boundary (Figure 3). The operational easement will vary depending on location. The new pipeline will be located within or adjacent to the existing easement

where possible; however, there may be some instances where the new alignment diverges from the existing alignment, which may not run adjacent. The pipeline will predominantly follow the route of the Port Kembla lateral except for four areas where the route has to deviate due to insufficient room within the existing easement or due to industrial development having taken place along the pipeline easement since the original line was installed.

The EPG modification study area is located over 181 metres south of the current established curtilage of Site of Former “Berkeley House”. The proposed works will not enter the heritage curtilage of the item, and as such will not have any direct impacts on the item. Furthermore, as the EPG modification consist of the installation of an underground steel gas pipeline by open trenching and HDD drilling, the finished works will not result in indirect visual impacts to the item. There may be some temporary impacts to views to and from the item during the program of works; this impact is considered to be negligible and will not impact the item’s heritage significance.

The EPG modification study area is located 170 metres south of the most southern point of archaeological potential as assessed by Biosis (2015). The proposed works will avoid these areas of high and moderate archaeological potential associated with the item. As such, the works will not have a direct impact on these areas. There will not be any indirect impacts to these areas of archaeological potential as a result of the proposed works.

Recommendations

This recommendation has been formulated to respond to client requirements and the significance of the Site of Former “Berkeley House” and associated areas of archaeological potential assessed in Biosis (2015) and Niche (2013). They are guided by the ICOMOS *Burra Charter* with the aim of doing as much as necessary to care for the place and make it useable and as little as possible to retain its cultural significance (Australia ICOMOS 2013).

Recommendation 1 No approvals required for Site of Former “Berkeley House” or known areas of archaeological potential

This LoA has assessed that there will be no detrimental direct or indirect impacts to the heritage significance of the locally listed Site of Former “Berkeley House” or the associated areas of archaeological potential as identified in Biosis (2015) and Niche (2013). Therefore, no approvals are required for the proposed works in relation to these items.

Please contact me if you have any enquiries.

Yours sincerely

A handwritten signature in blue ink, appearing to be 'Charlotte Allen'.

Charlotte Allen
Project Archaeologist

References

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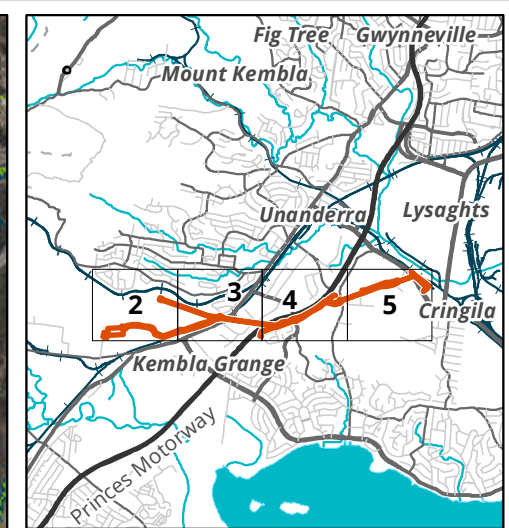
Hooke, K, Barwick, K, & Bayley, W 1978, *istory of Berkeley, New South Wales. Wollongong, N.S.W.*, Illawarra Historical Society.

McDonald McPhee Pty Ltd 1991, *City of Wollongong Heritage Study*, Wollongong City Council, Wollongong.

'REMINISCENCES OF ILLAWARRA.' 1924, *Illawarra Mercury (Wollongong, NSW: 1856 - 1950)*, p. 1.



Figure 1 Location of the study area



Legend

Study area

Figure 2.1 Study area detail

0 250 500 750 1,000

Metres

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

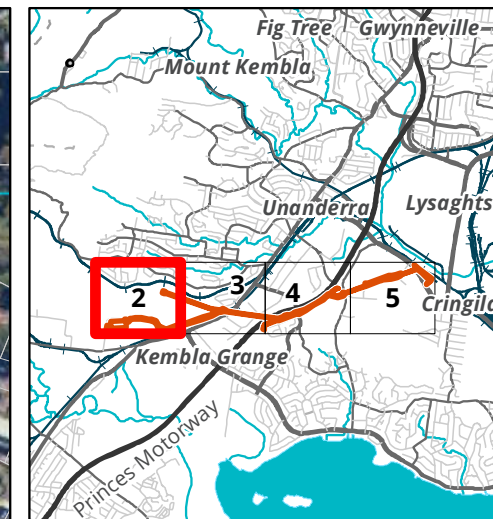
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Matter: 33553
 Date: 13 July 2020,
 Checked by: CLA, Drawn by: LH, Last edited by: Iharley
 Location: P:\33500s\33553\Mapping\33553 LOA F2 StudyArea overview



Legend

- Study area
- Lot

Figure 2.2 Study area detail

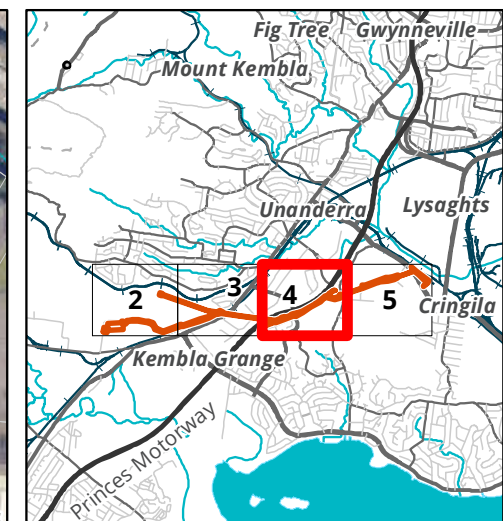


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Legend



-  Study area
-  Lot

Figure 2.4 Study area detail

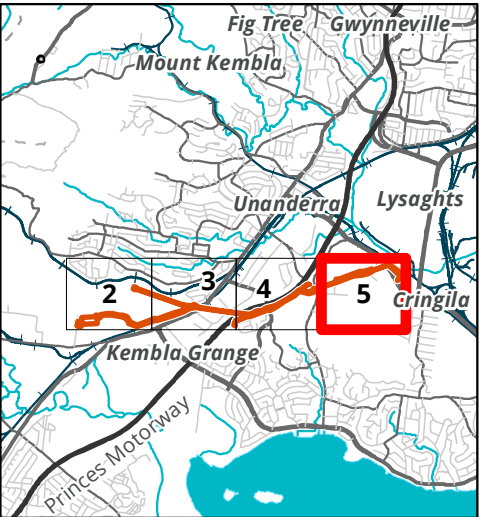


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Legend



-  Study area
-  Lot

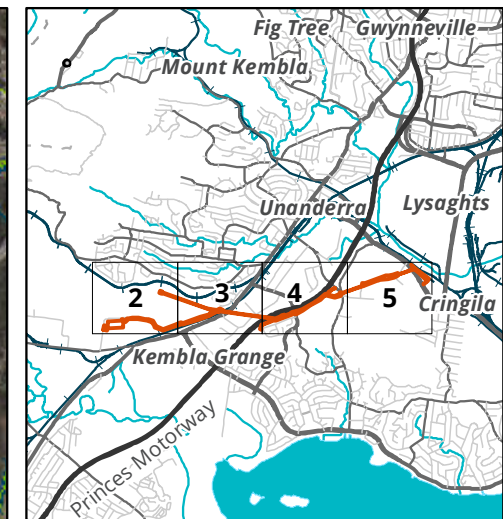
Figure 2.5 Study area detail



Metres
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Coordinate System: GDA 1994 MGA Zone 56



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- Legend**
- Study area
 - Proposed pipeline
 - Proposed easement - HDD
 - Proposed easement - Open trenching
 - Soil stripping
 - Proposed laydown area

Figure 3.1 Proposed development

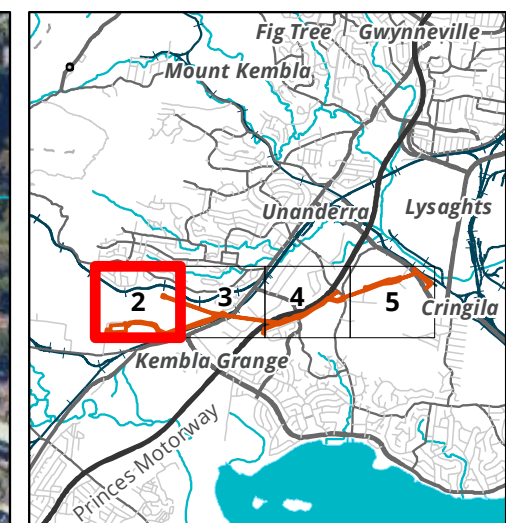
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Coordinate System: GDA 1994 MGA Zone 56



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Location: P:\33500s\33553\Mapping\33553 LOA F3 ProposedDevelopment overview



Legend

- Study area
- Proposed pipeline
- Proposed easement - Open trenching
- Soil stripping
- Proposed laydown area

Figure 3.2 Proposed development

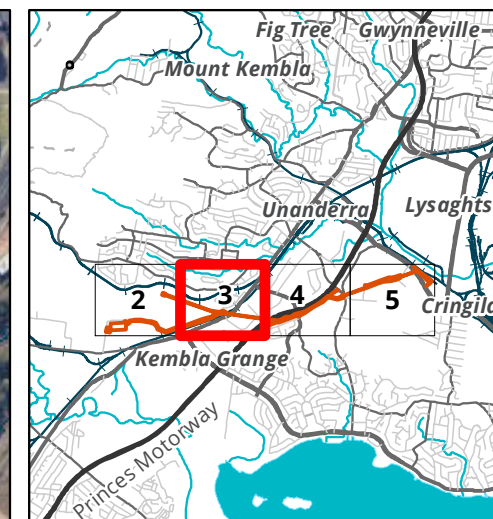
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Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56



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Location: P:\33500s\33553\Mapping\33553_LOA_F3_ProposedDevelopment



Legend

- Study area
- Proposed pipeline
- Proposed easement - HDD
- Proposed easement - Open trenching
- Soil stripping
- Proposed laydown area

Figure 3.3 Proposed development

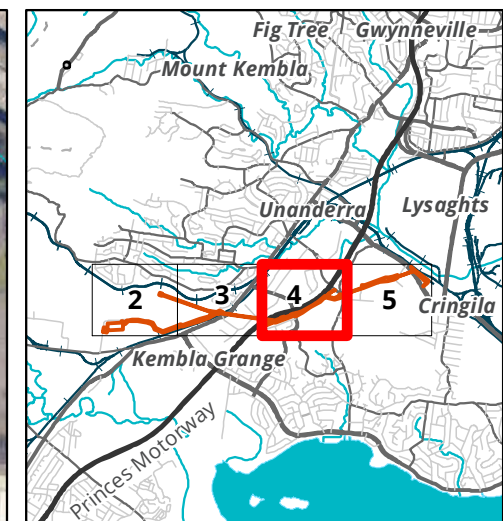
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Location: P:\33500s\33553\Mapping\33553_LOA_F3_ProposedDevelopment



Legend

- Study area
- Proposed pipeline
- Proposed easement - HDD
- Proposed easement - Open trenching
- Proposed laydown area

Figure 3.4 Proposed development

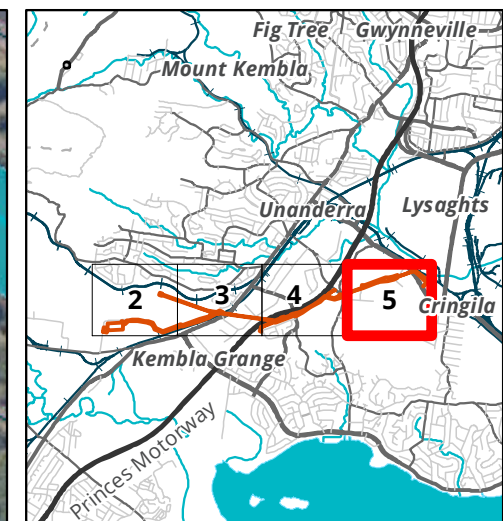


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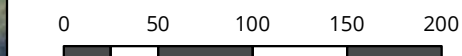
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- Legend**
- Study area
 - Proposed pipeline
 - Proposed easement - HDD
 - Proposed easement - Open trenching
 - Proposed laydown area

Figure 3.5 Proposed development



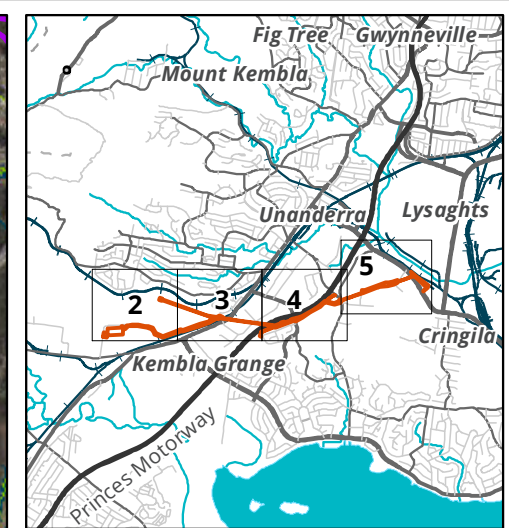
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Legend

- Study area
- Sydney Water Section 170
- Heritage Items

LEP - Listed items

- Conservation Area - General
- Conservation Area - Landscape
- Item - Archaeological
- Item - General
- Item - Landscape

Archaeological Potential

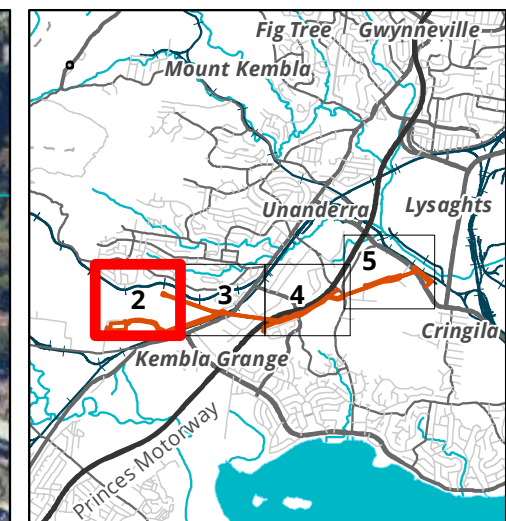
- High
- Moderate
- Low

Figure 4.1 Listed heritage items and areas of archaeological potential

0 250 500 750 1,000
Metres
Scale: 1:20,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Location: P:\33500s\33553\Mapping\33553_LOA_F4_HerItems_ArchPotent_overview



Legend

Study area

Archaeological Potential

High

Moderate

Low

Figure 4.2 Listed heritage items and areas of archaeological potential

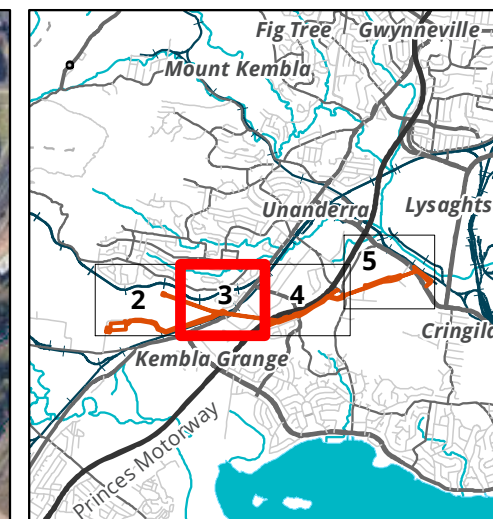
0 50 100 150 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Location: P:\33500s\33553\Mapping\33553_LOA_F4_HerItems_ArchPotent



Legend

Study area

LEP - Listed items

Item - Landscape

Archaeological Potential

High

Moderate

Low

Figure 4.3 Listed heritage items and areas of archaeological potential

0 50 100 150 200

Metres

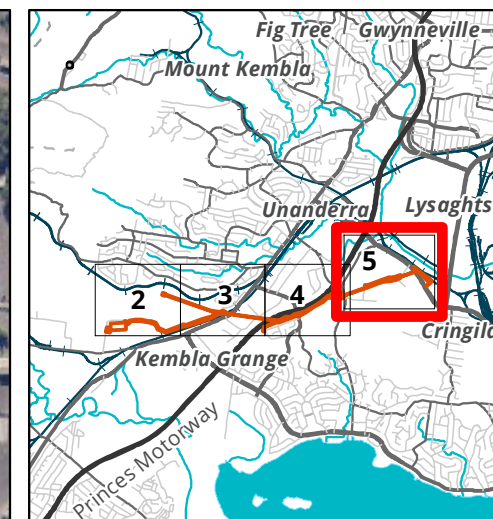
Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

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Legend

Study area

LEP - Listed items

Item - Archaeological

Archaeological Potential

High

Moderate

Low

Figure 4.5 Listed heritage items and areas of archaeological potential

0 50 100 150 200

Metres
Scale: 1:5,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

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Appendix D

Updated Biodiversity Development Assessment Report

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Port Kembla Lateral Looping Project Biodiversity Development Assessment Report

FINAL REPORT

Prepared for Jemena

15 July 2020

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- Bianca Klein and Byron Dale (assistance in the field).
- Anne Murray (mapping).

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Glossary

BAM	NSW Biodiversity Assessment Method
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
BDAR	Biodiversity Development Assessment Report
Biosecurity Act	NSW <i>Biosecurity Act 2015</i>
BOS	Biodiversity Offsets Scheme
CEMP	Construction Environmental Management Plan
CSSI	Critical State Significant Infrastructure
DA	Development Application
DBH	Diameter at Breast Height
DCDB	Digital cadastral database
DEE	Commonwealth Department of the Environment and Energy
DoIW	Directory of Important Wetlands
DPIE	NSW Department of Planning Industry and Environment
DPI	NSW Department of Primary Industries
DTDB	Digital topographic databases
Ecosystem credit species	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development.
EES	NSW Environment, Energy and Science (formerly OEH)
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
IBRA	Interim Biogeographic Regionalisation of Australia
LEP	Local Environmental Plan
LGA	Local Government Area
Locality	Area located within 10 kilometres radius from the study area
LPI	NSW Land and Property Information
Matters for further consideration	Impacts that are considered to be complicated or severe that will require further consideration by the consent authority (OEH 2014).
Matters of NES	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act

PCT	Plant Community Type
SAII	Serious and Irreversible Impact
SALIS	NSW Soil and Land Information System
study area	The broader area in which the subject site is located, including all direct and indirect impacts
subject site	The area of direct impact for the proposed development
TEC	Threatened Ecological Community
WM Act	NSW <i>Water Management Act 2000</i>

Summary

Jemena proposes to accommodate 5.6 kilometres of pipeline to connect Port Kembla's newly proposed gas terminal to the existing Eastern Gas Pipeline (EGP). The existing EGP stretches 797 kilometres from Longford, Victoria to Horsley Park, New South Wales (NSW). The newly proposed pipeline will consist of an 18 to 22 inch carbon steel Gas pipeline running from Australian Industrial Energy (AIE) proposed a Cringila facility to a Jemena tie-in facility located in Kembla Grange to connect into the existing EGP (the project). The development requires 1.8 kilometres of Horizontal Direct Drilling (HDD) and 5 kilometres of open trenching over a total easement width of 5 metres. Additional areas facilitating temporary workspaces are also included within the proposed footprint, the proposed impact areas combined are referred to as the 'subject land' hereon in. An area of 5 metres either side of the subject land was also assessed and is referred to as the 'study area'.

The project involves the development of a liquefied natural gas (LNG) import terminal and includes a pipeline and tie-in facility to the existing EGP lateral in Cringila. The Port Kembla Gas Terminal is NSW's first LNG import terminal which, once constructed, would have the capacity to supply more than 70 per cent of NSW's current annual gas demand.

The project will be assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Biosis understands that a Modification Report is being prepared for the project to support a State Significant Infrastructure (SSI) application (SSI-9973-Mod-1) for the modification of the EGP which recently transitioned to an SSI project. The project will be assessed under section 5.12 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Jemena are seeking a modification of the Minister's approval to the EGP, proposing to modify the project in accordance with section 5.25 of the EP&A Act.

The proposed modification does not seek to significantly alter the nature or scale of the approved EGP. The Modification Scoping Report prepared by GHD in November 2019 (Ref: Eastern Gas Pipeline, 12517829) included a Preliminary Environmental Assessment to identify potential environmental impacts that may arise as a result of the proposed modification. As such, Jemena require an assessment of impacts to biodiversity in accordance with section 7.9 of the NSW *Biodiversity Conservation Act 2016* (BC Act) in the form of a Biodiversity Development Assessment Report (BDAR). This BDAR has been prepared to outline the ecological assessment in accordance with the NSW Biodiversity Assessment Method (BAM).

Field investigation, undertaken in accordance with the BAM, recorded three hectares of native vegetation within the study area, representing two threatened ecological communities. Avoidance of native vegetation, threatened ecological communities and threatened species habitat has been undertaken to restrict impacts to 0.37 hectares of naturally occurring native vegetation consisting of two Threatened Ecological Communities (TECs):

- 0.04 hectares of *Coastal Freshwater Wetlands on coastal floodplains of the New South Wales North Coast, Sydney Basin and South East Corner* (Endangered, BC Act).
- 0.33 hectares of *Illawarra Lowlands Grassy Woodland in the Sydney Basin bioregion* (Illawarra Lowlands Grassy Woodland) (Endangered, BC Act)

Illawarra Lowlands Grassy Woodland is a candidate Serious and Irreversible Impact (SAIL) entity in accordance with Section 10.2 of the BAM. As such, an SAIL assessment was prepared for this TEC and is provided in Section 7.1.1.

The project will also impact 0.9 hectares of planted native vegetation, unlikely to provide resources for threatened species.

No threatened species were recorded within the study area.

As a result of impacts to naturally occurring native vegetation, and in accordance with Section 10.3 of the BAM, offsets are required to be secured for the proposed development.

The project is not considered likely to result in a significant impact to species or communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and as such a referral to the Minister of the Environment and Energy is not required.

Stage 1 – Biodiversity assessment

1 Introduction

Biosis Pty Ltd was commissioned by Jemena to undertake a biodiversity assessment of the SSI project. The purpose of this assessment was to apply the NSW BAM (OEH 2019) to the project, and provide Jemena with a BDAR to facilitate project approval.

1.1 Project background

Jemena plans to develop the 5.6 kilometres of proposed lateral pipeline and tie in facility located in Kembla Grange (the study area) (Figure 1). The project will be assessed under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Biosis understands that a Modification Report is being prepared for the project to support a SSI application (SSI-9973-Mod-1) for the modification of the EGP which recently transitioned to an SSI project. The project will be assessed under section 5.12 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Jemena are seeking a modification of the Minister's approval to the EGP, proposing to modify the project in accordance with section 5.25 of the EP&A Act.

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1.2 Purpose of this assessment

This BDAR, prepared and reviewed by BAM Accredited Assessors will:

- Address the BAM and the BOS.
- Identify how the proponent proposes to avoid and minimise impacts to biodiversity.
- Identify any potential impact that could be characterised as serious and irreversible.
- Describe the offset obligations required to compensate for any unavoidable biodiversity impacts resulting from the proposed development.
- Consider and assess the proposal in accordance with other relevant legislation such as the Commonwealth EPBC Act.

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared and reviewed by Accredited Assessor Bianca Klein (BAAS18050), and reviewed by Accredited Assessor Jane Raithby-Veall (BAAS 18134)

1.3 The subject land

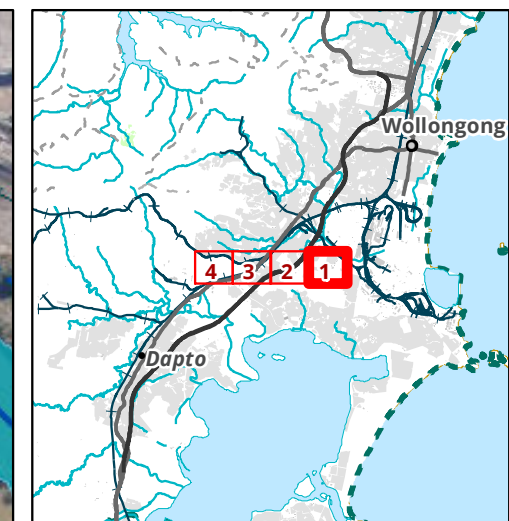
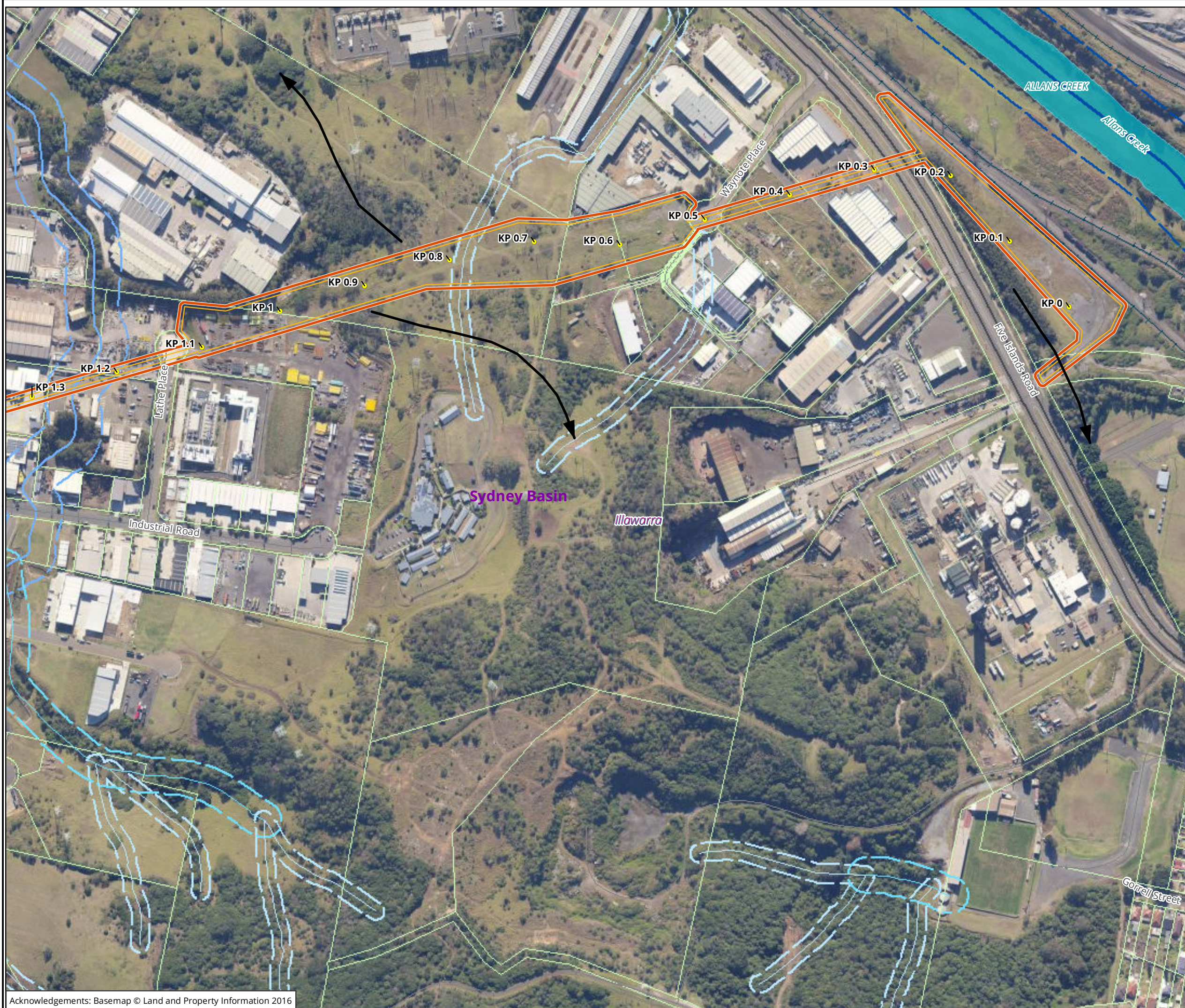
The subject land is defined as the total area of proposed disturbance, encompassing the proposed development footprint and all areas that could be disturbed during construction (e.g. plant laydown, access tracks, open trenching). Figure 1 displays the entire disturbance footprint for all works required. The subject land includes the entire footprint inclusive of the HDD works and temporary work areas. The eastern boundary of the subject land falls within BlueScope Steel lands adjacent to Five Islands Road 180 metres north-west of Centenary Park, Cringila. Spring Hill neighbours the northern extent and Cringila the southern extent of this boundary with

Wollongong Central Business District (CBD) approximately 5 kilometres north. The western extent of the subject land lies adjacent to Wylie Road, Kembla Grange, 330 metres south-east of Bingo Recycling Centre, the western extent will consist of a tie-in facility that will lie next to an existing gas tie-in facility, at Farmborough Heights which lies 1 kilometre north of the western extent of the subject land with Brownsville directly south 1.7 kilometres.

The subject land is located in the Wollongong City Council Local Government Area (LGA) and the South East Local Land Services (LLS) Region. The study area covers multiple land use zones under the *Wollongong Local Environmental Plan 2009* (LEP) due to its lineal extent, these consist of IN2 – Light Industrial, IN3 – Heavy Industrial, RE1 – Public Recreation, SP1 – Special Activities and SP2 – Infrastructure. The current land use consists of industrial lands, road easements, farmlands and large infrastructure. The terrain is undulating covering multiple landscapes these consist of; alluvial plains, flood plains, terraces and valley flats. There is a single watercourse running directly through the western extent of the study area.

1.4 The study area

The study area encompasses the subject land inclusive of a five metre buffer to allow for areas in close proximity of the subject land that could be indirectly impacted by the project including adjacent areas downslope where, for example, there may be minor changes to hydrology through alteration to overland flow patterns.



Legend

- Study area
- Subject land
- Kilometre point
- ➔ Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Hydrology

- Natural watercourse

Strahler stream order

- 1
- 2
- 3
- 5

Strahler order buffered areas

- 1
- 2
- 3
- 5

Figure 1.1 Site map

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert



Matter: 31485
Date: 27 February 2020
Checked by: BD, Drawn by: LW, Last edited by: lwilson
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Legend

- Study area
- Subject land
- Kilometre point
- ➔ Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Hydrology

- Canal-Drain

Strahler stream order

- 1
- 2
- 3

Strahler order buffered areas

- 1
- 2
- 3

Figure 1.2 Site map

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert



Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location: P:\31400s\31485\Mapping\31485_F1_SiteMap



Legend

- Study area
- Subject land
- Kilometre point
- ➔ Habitat connectivity
- Property boundary
- IBRA**
- Region
- Subregion
- Strahler stream order**
- 1
- Strahler order buffered areas**
- 1

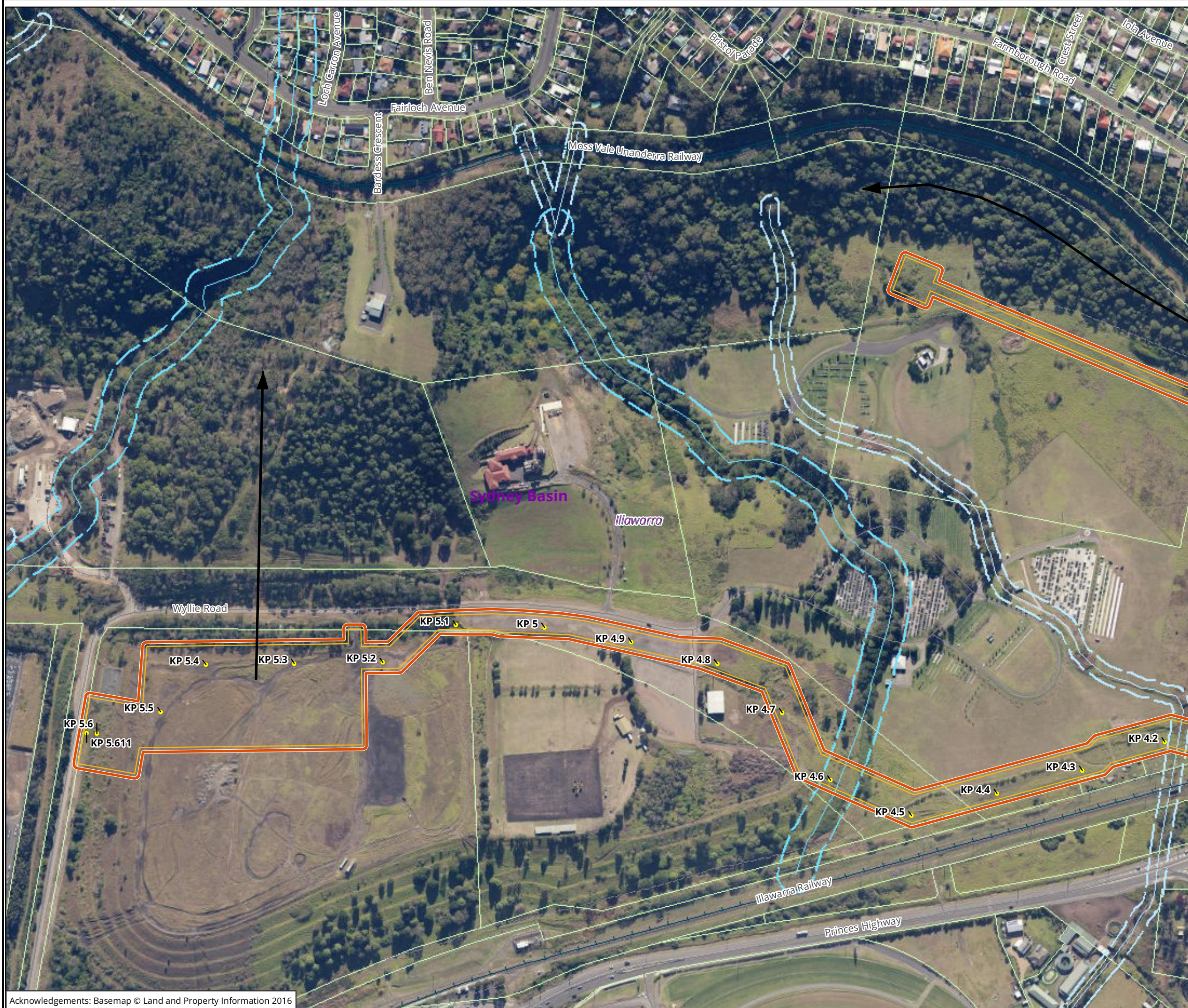
Figure 1.3 Site map

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert



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Legend

- Study area
- Subject land
- Kilometre point
- ➔ Habitat connectivity
- Property boundary

IBRA

- Region
- Subregion

Strahler stream order

- 1
- 2

Strahler order buffered areas

- 1
- 2

Figure 1.4 Site map

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert



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Location: P:\31400s\31485\Mapping\31485_F1_SiteMap

1.5 Sources of information

Sources of information used in the assessment include; relevant databases, spatial data, literature and previous site reports. In order to provide a context for the study area, records of flora and fauna from within 10 kilometres (the locality) were collated from the following databases:

- Commonwealth Department of Agriculture Water and Environment (DAWE) Protected Matters Search Tool for matters protected by the EPBC Act.
- BioNet Atlas of NSW Wildlife, for species, populations and ecological communities listed under the BC Act.
- PlantNET (The Royal Botanic Gardens and Domain Trust).
- BirdLife Australia, the New Atlas of Australian Birds 1998-2015.

Other sources of biodiversity information relevant to the study area were sourced from:

- The NSW Plant Community Types (PCTs), as held within the BioNet Vegetation Classification database (OEH 2019).
- Relevant vegetation mapping, such as *South East Local Land Services Biometric Vegetation Map, 2014. VIS_ID 4211* (DPE 2014).

Mapping was conducted using hand-held (uncorrected) GPS units (GDA94), mobile tablet computers running Collector for ArcGIS and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 5 metres) and dependent on the limitations of aerial photo rectification and registration.

Basemap data was obtained from NSW Land and property information (LPI) 1:25,000 digital topographic databases (DTDB), with cadastral data obtained from LPI digital cadastral database (DCDB).

The following spatial datasets were utilised during the development of this report:

- Catchment Boundaries of NSW dataset.
- Mitchell Landscapes Version 3.0.
- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- Directory of Important Wetlands (DoIW).
- State Environmental Planning Policy (SEPP) Coastal Management 2018.
- Spatial data associated with Illawarra Regional Native Vegetation Map (OEH 2016a).

Mapping has been produced using a Geographic Information System (GIS). The following maps and data have been prepared:

- Digital mapping with aerial photography showing 1:1000 or finer.
- Site map as described in subsection 4.2.1.1 of the BAM.
- Location map as described in subsection 4.2.1.2 of the BAM.
- Landscape map with features including 1500 metre buffer, as described in section 4.2.1.3 of the BAM.

1.6 Legislative requirements

The project has been assessed against relevant biodiversity legislation and government policy, including:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Environmental Planning and Assessment Act 1979*
- *Biodiversity Conservation Act 2016*
- *Biosecurity Act 2015*
- State Environmental Planning Policy (Koala Habitat Protection) 2019
- Wollongong City Council Local Environmental Plan 2009 (LEP)

2 Landscape Context

This chapter describes the landscape and site context of the subject land, describing the landscape features present within the subject land and within a 1500 metre buffer, as required by the BAM (OEH 2019). Figure 2 shows the location of the subject land and landscape features (IBRA region and subregion, hydrology, habitat connectivity, Strahler order and Mitchell landscapes) within the 1500 metre buffer.

2.1 Landscape features

2.1.1 Bioregions

The study area occurs within the Sydney Basin IBRA bioregion and the Illawarra IBRA subregion. The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53% of NSW and is one of two bioregions contained wholly within the State. The bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. The bioregion is bordered to the north by the Brigalow Belt South and North Coast bioregions, to the south by the South East Corner Bioregion and to the west by the South Eastern Highlands and South Western Slopes bioregions. The Sydney Basin Bioregion is one of the most species diverse in Australia. This is a result of the variety of rock types, topography and climates in the bioregion (OEH 2016a).

2.1.2 NSW (Mitchell) Landscape

The study area occurs within the Kiama Coastal Slopes and Lake Illawarra Alluvial Plains Mitchell Landscape.

The Kiama Coastal Slopes is comparable to the Dapto-Wollongong slopes but with higher relief, steep slopes and higher rainfall. Maximum elevation 250 metres, relief 160 metres. Well-structured red-brown loam with gradational profiles is widespread on the Gerringong volcanics of trachyte, latite and tuff. Sandstone is less common but tends to form steep slopes with texture-contrast soils marginal to the adjacent escarpment. The study area has been extensively cleared but originally had a wide distribution of rainforest, evident though remnant plants such as; Cabbage Palm *Livistona australis*, Scentless Rosewood *Synoum glandulosum*, Brush Cherry *Syzygium australe*, Black Apple *Planchonella australis*, Plum Pine *Podocarpus elatus* amongst Turpentine *Syncarpia glomulifera*, Grey Ironbark *Eucalyptus paniculata* and River Oak *Casuarina cunninghamiana* along the streams.

The Lake Illawarra Alluvial Plains have been highly cleared with a general elevation of up to 40 metres. The soils differ dependant on sediment type and elevation however, sandy loam with high organic content and humic podsols occur, noting that these soils are highly variable. Vegetation communities within the landscape originally had Forest Red Gum *Eucalyptus tereticornis*, Woollybutt *Eucalyptus longifolia*, White Stringybark *Eucalyptus globoidea*, Thin-leaved Stringybark *Eucalyptus eugenioides*, Cabbage Gum *Eucalyptus amplifolia* where low hills and rises occur. Extensive stands of Swamp Oak *Casuarina glauca*, Prickly Paperbark *Melaleuca styphelioides* and decorative paperbark *Melaleuca* spp. occur on brackish ground near creeks (Mitchell 2002).

2.1.3 Soil

The subject land falls within three soil landscapes predominantly within the Gwynneville soil landscape (Residual – Regw) with two sections falling within the Fairy Meadow soil landscape (swfa) and the Disturbed Terrain of the Wollongong/Port Hacking 1:100,000 soil landscape map (Hazelton & Tille 1990).

The Gwynneville soil landscape is characterised as foot slopes of the Illawarra Escarpment and isolated rises of the Wollongong Plain. The landscape generally has local relief of 10 to 70 metres, with slopes ranging from 3 to 25%. This landscape also includes broad to moderately (250 metres to 850 metres) rounded ridges and gently to

steeply inclined slopes. Soils within this landscape consist of shallow brown podzolic soils and xanthozems on upper slopes, lithosols on simple slopes and shallow brown earths on midslopes and lower slopes. Some of the ridges or steeper slopes allow for structural benches and occasional rock outcrops to occur. Limitations of the landscapes include extreme erosion hazards large land slips and local flooding.

The Fairy Meadow soil landscape is characterized by alluvial plains, floodplains, valley flats and terraces below the Illawarra Escarpment with minimal slop predominately cleared with low forest and woodland regions. The landscape is made up of gently undulating alluvial plains including floodplains, valley flats and minor terraces. The landscape provides >20m relief to surrounding landscapes. Floodplains and terraces contain pockets of sandy loams and alluvial loam soils. Whilst valley flats consist of sandy clay loams which can be highly variable.

The disturbed terrain soil landscape is a highly variable landscape, it has been created by human activity to a minimum depth of at least 100 centimetres. Most of the terrain has been previously levelled clearing all top soil and vegetation to be replaced with fill material. Fill material can be highly impermeable with low fertility and may contain toxic material and is generally used for commercial and industrial complexes, quarries and waste disposal sites.

2.1.4 Native vegetation extent

Vegetation within the study area and within the 1500 metre buffer area was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping (Figure 3). Table 1 provides the list of PCTs identified from existing vegetation mapping, and the current assessment, as occurring within the study area and within the 1500 metre buffer (Figure 4). Conservation status of the communities is also provided. PCTs within the subject land and study area are consistent; no PCTs occur within the one and not the other.

Table 1 PCTs identified within the study area and 1500m buffer

PCT – mapped (DPE 2014) and Biosis 2019	Conservation Status	Subject land	Study area	1500 m buffer
781 Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Endangered BC Act	Yes	Yes	Yes
838 Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	Endangered BC Act Critically Endangered EPBC Act	Yes	Yes	Yes
1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion	Endangered BC Act Critically Endangered EPBC Act	No	No	Yes
906 Lilly Pilly - Sassafras - Stinging Tree subtropical/warm temperate rainforest on moist fertile lowlands, southern Sydney Basin Bioregion	Endangered BC Act Critically Endangered EPBC Act	No	No	Yes
1326 Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion	Endangered BC Act Critically Endangered EPBC Act	No	No	Yes

PCT – mapped (DPE 2014) and Biosis 2019	Conservation Status	Subject land	Study area	1500 m buffer
1126 Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion	Endangered BC Act Vulnerable EPBC Act	No	No	Yes
1245 Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion	N/A	No	No	Yes
Urban/native and Exotic	-	Yes	Yes	Yes

2.1.1 Cleared areas

Parts of the study area mapped as planted natives and exotic grasses with no native over storey or mid storey cover and less than 50% cover of native groundcover have been defined as cleared land. Similarly areas within the 1500 metre buffer that showed no mid-storey or canopy cover on aerial imagery were not considered as native vegetation due to the urban context of the surrounding area. Roads, buildings and other infrastructure were also considered as cleared lands. A total of 2469.48 hectares of cleared land occurs within the study area and 1500 metre buffer.

2.1.2 Differences between mapped vegetation extent and aerial imagery

There were significant differences between the mapped vegetation extent and that visible on the aerial imagery. Through the western extent of the project within the Wollongong Lawn Cemetery grounds, vegetation previously mapped (DPE 2014) as cleared was found by Biosis to contain patches of threatened ecological communities (TECs). The first vegetation community, associated with PCT 781; *Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* (Endangered Ecological Community [EEC], BC Act) referred to as Coastal Freshwater Wetlands was found to meander through a known watercourse that tracks through the Wollongong Lawn Cemetery. It is likely that the wetlands community had been opportunistic and thrived through a built up drainage swale. Weed species were found to be present within the wetland vegetation at moderate to high levels in places. The second threatened vegetation community, associated with PCT 838; *Illawarra lowlands grassy woodland in the Sydney Basin Bioregion* (Critically Endangered Ecological Community [CEEC], BC Act) referred to as Illawarra lowlands grassy woodlands had patches throughout the cleared land northeast of the Wollongong Lawn Cemetery, although it wasn't well connected it had previously been mapped as cleared (OEH 2016a).

2.1.3 Rivers and streams

The study area is located within the southeast Local Land Services Region and the Lake Illawarra catchment. The closest river-mouth is the Lake Illawarra entrance located approximately 8 kilometres to the south-east of the study area with the closest major waterbody being Lake Illawarra, located approximately 1 kilometre to the south-east of the site.

Several drainage lines and creek lines are associated with the study area. In the western portion of the study area, two unnamed drainage lines intersect the study area and Gibson's Creek is located one kilometre to the south. In the eastern portion, three drainage lines intersect the study area, while Allen's creek being just 200 metres directly north of the northern extent of the study area. In all cases, these watercourses have been altered from their natural positions due to modern urban developments (Figure 1).

There are no Key Fish Habitats as mapped by the NSW Department of Primary Industries (DPI) within the study area (DPI 2013).

2.1.4 Wetlands

The study area does not contain areas mapped as important wetlands in accordance with the Directory of Important Wetlands of Australia (DoIW 2004). Lake Illawarra is located 1.5 kilometres southeast of the study area the size of the wetland is 3227 hectares providing for a 15000 hectare catchment region. The major watercourses are also situated approximately 1.5-2.5 kilometres south of the study area. The wetland predominantly consists of shallow estuarine waters that are heavily influenced by tidal movements. There are also no wetlands of international importance (Ramsar sites) within proximity to the subject land.

A small coastal freshwater wetland is situated within a drainage line though the western extent of the study area, the wetland is approximately 1280 metres squared and is in low condition due to the opportunistic weeds that have also taken advantage of the drainage line.

2.1.5 Connectivity features

The lateral footprint generally has sparse vegetation features that have been broken up through major developments. A major highway runs through the study area, all areas of the footprint have been meticulously chosen to minimise the environmental impact. Patches of urban native and exotic vegetation border the eastern side of the highway where the eastern extent of the footprint runs parallel with the Nein-Tien temple. This patch of vegetation provided the greatest habitat for smaller birds and had the highest abundance of fauna. The urban native and exotic vegetation community was isolated due to development bordering all sides. Previously cleared small vehicle tracks and power line easements provide another level of disturbance to which the pipeline easement follows. A high abundance of weeds throughout the study area disrupts the native vegetation understorey, a large stripe of urban native and exotic vegetation. Throughout the western extent of the study area a train line borders the footprint, minor watercourses and a dam provides adequate foraging habitat for migratory species, the watercourse run through large open grasslands with isolated patches of woodland bordering the vegetation, this vegetation provided reasonable foraging for predatory birds. No intact vegetation was discovered throughout the whole study area, no hollow-bearing trees were found, and all vegetation has a poor understorey and is isolated due to development and prior or current land use patterns, therefore the study area has been considered to have poor connectivity to its surrounds.

2.1.6 Areas of geological significance

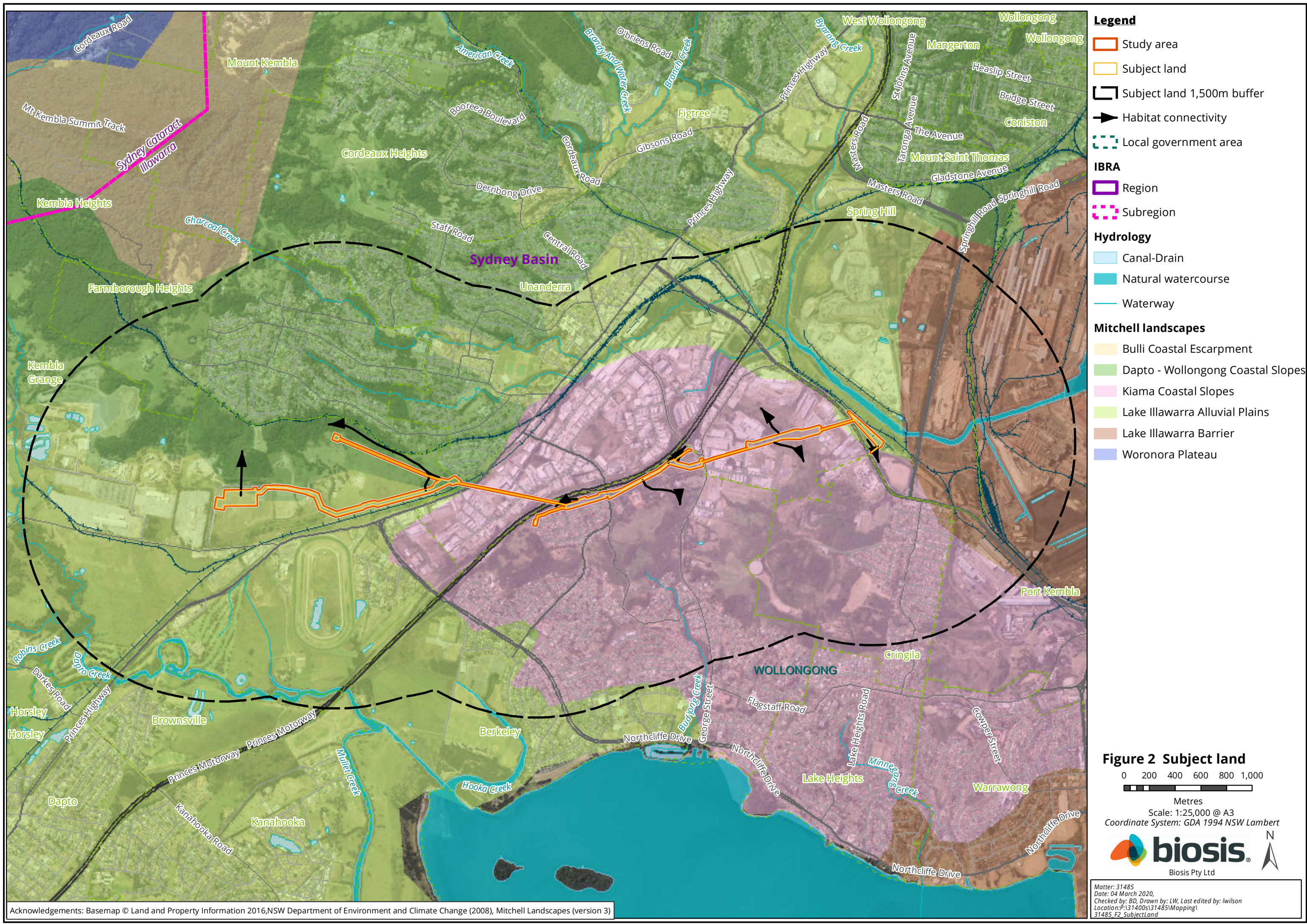
There were no recorded karst, caves, crevices, cliffs or other areas of geological significance within the study area or within the 1500 metre buffer area surrounding the study area.

2.1.7 Biodiversity Values Map

The biodiversity values mapping showed no areas of Biodiversity Values within the study area (OEH 2020a).

2.1.8 Soil hazard features

The south-west edge of the study area is mapped as class 5 acid sulfate soils, class 5 soils are considered soils with proximity to class 1-4 soils but do not trigger further assessment. Acid sulfate soils are not typically found in class 5 areas but are located within 500 metres of a higher class acid sulfate areas. As the class 5 area is unlikely to contain acid sulfate soils, no further assessment was considered necessary (Stone et. al. 1998).



2.2 Site context

The site context was assessed using a site-based method undertaken 17 January 2020. The habitats and vegetation within the study area are a small subset of those in the wider landscape.

2.2.1 Native vegetation cover

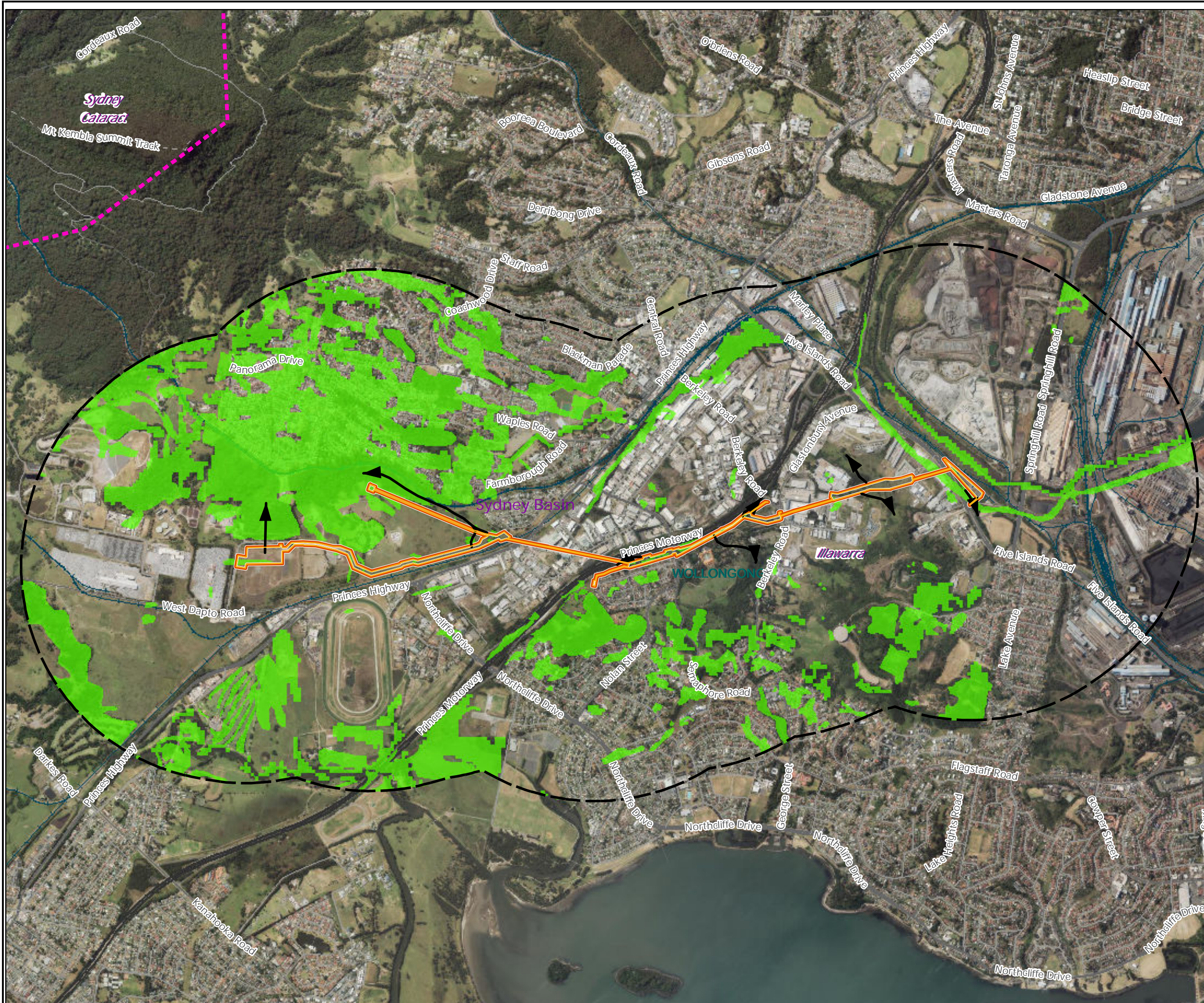
Native vegetation cover was assessed using GIS based on the most suitable vegetation mapping, in this case the *South East Local Land Services Biometric Vegetation Map, 2014. VIS_ID 4211* (DPE 2014), and aerial imagery interpretation to ensure any areas not previously mapped as native vegetation are included in the calculations where appropriate.

Native vegetation cover within the 1500 metre buffer was found to be 22.46%.

2.2.2 Patch size

Patch size was assessed as per the BAM (OEH 2017a) using a select process in ArcGIS. All intact vegetation that has a gap of less than 100 metres from the next area of moderate to good condition native vegetation is considered to be of the same patch.

Vegetation within the study area meeting this criteria was mapped sequentially and it was found to form part of a small patch of connecting vegetation with a patch size less than five hectares.



- Study area
- Subject land
- Subject land 1,500m buffer
- Habitat connectivity
- Native vegetation
- Region
- Subregion

Figure 3 Native vegetation and habitat connectivity

0 200 400 600 800 1,000
Metres
Scale: 1:25,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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3 Native vegetation

The extent of native vegetation, TECs and vegetation integrity within the study area was determined using the results of site investigations and Chapter 5 and Appendix 6 of the BAM (OEH 2017a).

3.1 Methods

3.1.1 Background review

Regional vegetation mapping (DPE 2014) and database searches (section 1.5) were reviewed to inform the site investigations. Based on the results of the background review and the requirements of the BAM with respect to this BDAR, appropriate surveys were designed for the study area and impact area.

3.1.2 Field investigation

The biodiversity assessment was conducted 17 January 2020 under the terms of Biosis' Scientific Licence issued by NSW Environment Energy and Science (EES) under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2020). The fauna survey was conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2020). The field investigation was carried out by Accredited Assessor Bianca Klein (BAAS # 18050) and Byron Dale.

The study area was surveyed in accordance with the BAM (OEH 2017a), which involved:

- The identification and mapping of PCTs according to the structural definitions of South East Land Services Biometric Vegetation map (DPE 2014).
- Undertaking floristic plots within each vegetation zone in accordance with Section 5 of the BAM (OEH 2017a)
- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, 1993, 2000, 2002) with reference to recent taxonomic changes.
- Targeted searches for plant species of conservation significance according to the *NSW Guide to surveying Threatened Plants* (OEH 2016b).
- Incidental observations using the “random meander” method (Cropper 1993).
- Identifying fauna habitats, assessing their condition and assessing their value to threatened fauna species.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- An assessment of the natural resilience of the vegetation of the site.
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the study area.

The conservation significance of plant species and PCTs was determined according to:

- BC Act for significance within NSW
- EPBC Act for significance within Australia

Detailed mapping of PCTs was conducted using hand-held (uncorrected) tablet units (Samsung Galaxy Tab 3) using Collector for ArcGIS and aerial photo interpretation. Areas of native vegetation for which a PCT could validly be assigned were identified and delineated in the field, and their condition determined. Identification of PCTs within the study area was confirmed with reference to the community profile descriptors (and diagnostic species tests) held within the (2016a) mapping project and NSW BioNet Vegetation Classification database (OEH 2020b). Locations of floristic plots surveyed are shown on Figure 5.

3.2 Results

3.2.1 Vegetation description

The majority of the study area is located within an urban landscape, supporting three hectares of native vegetation, all with moderate to high levels of disturbance. Two native PCTs were identified, described further in Section 3.2.3 below.

Patches of planted native vegetation were also identified within the study area. In accordance with the *BAM Operational Manual - Stage 1* (OEH 2018), planted vegetation was assigned to an appropriate PCT, which best matches the floristic attributes and landscape position of the vegetation patch. These are also described further in Section 3.2.3 below.

Parts of the study area that were found to be devoid of native vegetation were mapped as cleared vegetation (Figure 4). These areas did not support a native over storey or mid storey cover and less than 50% of the groundcover consisted of native species.

3.2.2 Native vegetation extent

Figure 4 provides a map of the native vegetation extent recorded within the study area and impact area, as assessed during field investigations undertaken in January 2020. The figure includes all areas of native vegetation (native ground cover and areas with canopy). Areas not shown as native vegetation cover within Figure 4, and which do not provide habitat for threatened species, were not included for further assessment in accordance with Section 5.1.1.5 of the BAM (OEH 2017a). Non native vegetation which is likely to provide habitat for threatened species was assessed.

3.2.3 Plant community types

The following naturally occurring PCTs were assessed as present within the study area:

- PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion (Table 2).
- PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (Table 3).

Table 2 and Table 3 below provide detailed descriptions of the two naturally occurring PCTs/TECs recorded within the study area. PCTs recorded within the study area are shown on Figure 4.

Table 2 Vegetation type – Coastal Freshwater Wetlands

PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	
Common name	Coastal Freshwater Wetlands
Vegetation formation	Freshwater Wetlands
Vegetation class	Coastal Freshwater Lagoons
Extent within subject	0.04 ha


PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	
land	
Condition	This community at the subject land was recorded in a low condition state.
Description	Within the subject land this community consisted of a range of sedges, grasses and rushes occurring in low-lying depressions. No trees or shrubs were present. The most common native species were Marsh Club-rush <i>Bolboschoenus fluviatilis</i> and Tall Sedge <i>Carex appressa</i> , with Bulrush <i>Typha orientalis</i> and Couch <i>Cynodon dactylon</i> present in lower density. Blackberry <i>Rubus fruticosus</i> was present in the northern extent of the patch.
Survey effort	One BAM plot/transect (Figure 5)
Justification of PCT	<p>The community is consistent with the descriptive attributes of PCT 781 as detailed in the NSW BioNet database(OEH 2019) due to:</p> <ul style="list-style-type: none"> • PCT occurrence within the Sydney Basin bioregion. • Floristic composition. • The range of sedges and rushes common to drainage impeded habitats. • The landscape position being, 10 metres above sea level.
TEC Status	<p>EPBC Act: Not listed</p> <p>BC Act: <i>Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions</i> – Endangered (DPE 2004).</p>
Estimate of percent cleared value of PCT in NSW	74 % (OEH 2017b).
PCT 781 within the subject land	

Table 3 Vegetation type - Forest Red Gum - Thin-leaved Stringybark Grassy Woodland

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
Common name	Illawarra Lowlands Grassy Woodlands
Vegetation formation	Grassy Woodlands
Vegetation class	Coastal Valley Grassy Woodlands

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion	
Extent within subject land	0.33 ha
Condition	This naturally occurring community at the subject land was recorded in a low condition state..
Description	This community was present in poor condition and consisted mainly as acacia scrub with a mixed native and exotic understorey species assemblage. The vegetation lacked a distinct canopy and supported a midstorey layer up to 8 m tall of mature and regenerating Black Wattle <i>Acacia mearnsii</i> . The midstorey was sparse with exotic species including Lantana, Blackberry and African Boxthorn <i>Lycium ferocissimum</i> present. The groundcover supported a mix of native and exotic species such as Tall Sedge, Weeping Grass <i>Microlaena stipoides</i> , Kidney Weed <i>Dichondra repens</i> and Kikuyu <i>Cenchrus clandestinus</i> .
Survey effort	One BAM plot/transect (Figure 5)
Justification of PCT	<p>The community is consistent with the descriptive attributes of PCT 838 as detailed in the NSW BioNet database (OEH 2019) due to:</p> <ul style="list-style-type: none"> • Occurrence within the Sydney Basin bioregion. • Structure of the community, being an open woodland with a predominantly grassy understorey. Although in poor condition, this community is a remnant of the community following historical clearing. • Occurrence on lower slopes in coastal rain shadow valleys within the landscape below 350 m elevation. • The study area supported clay loam soils.
TEC Status	<p>EPBC Act: Not listed. The condition of the community within the subject land did not meet the minimum condition thresholds specified in the Conservation Advice for the EPBC listed TEC (Threatened Species Scientific Committee 2016) as:</p> <ul style="list-style-type: none"> • The patch is less than 0.5 ha and • Less than 30% of total perennial understorey vegetative cover is comprised of native species. <p>BC Act: <i>Illawarra lowlands grassy woodland in the Sydney Basin Bioregion</i> – Critically Endangered Ecological Community (NSW Threatened Species Scientific Committee 2000).</p>
Estimate of percent cleared value of PCT in NSW	85 % (OEH 2017b).

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

PCT 838



Two additional native vegetation types were present; consisting of planted native plants, the composition and landscape positions of which did not align with the definition of naturally occurring PCTs in NSW (OEH 2019).

Planted native vegetation communities

PCT 1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion

One patch of vegetation occupying 0.2 hectares in the eastern extent of the subject land consisted of a monoculture of Swamp Oak *Casuarina glauca* planted in straight lines (Appendix 5, Plate 1) along Five Islands Road. Lantana *Lantana camara* was present in moderate density in the understorey. The species assemblage of this community resembles that of disturbed Swamp Oak Floodplain Forest EEC; however due to the planted nature of this community and its occurrence along a roadside, not within a periodically inundated landscape position, it does not meet the definition of the EEC. This patch of vegetation is not contiguous with any patches of naturally occurring native vegetation, it did not support habitat for threatened species such as hollow-bearing trees or nests, or any forage resources, and the soil profile has undergone historic disturbance. One BAM floristic plot was completed in this vegetation type (Figure 5 and Appendix 3).

PCT 1326 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion

One patch of vegetation occupying 0.01 hectares, immediately south of the planted PCT 1232 vegetation, in the eastern extent of the study area consisted of an isolated stand of Spotted Gum *Corymbia maculata* (Figure 4). Lantana and Bitou Bush *Chrysanthemoides monilifera* were prominent. Exotic grasses made up the majority of the groundcover. The species assemblage of this community somewhat resembles that of disturbed Illawarra Lowlands Grassy Woodland EEC, however due to the planted nature of this community and its occurrence along a roadside, not being contiguous with other patches of remnant vegetation, it does not meet the definition of this community. The vegetation supports negligible habitat for threatened species, with no hollow-bearing trees or nests present, and limited forage resources. This patch of vegetation is not proposed to be impacted.

PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

A linear patch of planted native vegetation within the subject land, comprising 0.9 hectares, occurs on the fill embankment within the Princes Motorway road corridor, from adjacent to the landscaped grounds and parking area of the Fo Guang Shan Nan Tien Temple, to the rear of the residential houses on Warwick Street, Berkley. The vegetation consists of a mix of locally occurring and non-locally occurring eucalypts including Forest Red

Gum *Eucalyptus tereticornis*, Spotted Gum and Lemon-scented Gum *Corymbia citriodora* (Figure 4). Sweet Pittosporum *Pittosporum undulatum*, Small-leaved Privet *Ligustrum sinense* and Chinese Celtis *Celtis sinensis* were common in the midstorey (Plate 2). The species assemblage of this community somewhat resembles that of disturbed Illawarra Lowlands Grassy Woodland EEC, however the vegetation was replanted following the construction of the motorway and occurs on fill soil, and non-local canopy species make up a substantial portion of the community. The species assemblage and landscape position does not align with the description of the Illawarra Lowlands Grassy Woodland EEC. The vegetation supports negligible habitat for threatened species, with no hollows or nests recorded within the subject land. The vegetation is also considered to support highly limited forage resources due to its disturbed and weedy nature, and its occurrence adjacent to a major motorway. The vegetation does not support habitat for threatened flora due to historical soil disturbance. One BAM floristic plot was completed in this vegetation type (Figure 5 and Appendix 3).

3.2.4 Threatened ecological communities

Vegetation within the study area was found to represent two TECs listed under the NSW BC Act. Figure 6 shows the TECs recorded within the study area as detailed in Table 2 and Table 3 above.



Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)

Hydrology

- Natural watercourse

Strahler stream order

- 1
- 2
- 3
- 5

Strahler order buffered areas

- 1
- 2
- 3
- 5

Plant Community Type (PCT)

- PCT1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (planted)
- PCT1326 - Woollybutt - White Stringybark - Forest Red Gum grassy woodland on coastal lowlands, southern Sydney Basin Bioregion and South East Corner Bioregion (planted)

Figure 4.1 Vegetation of the study area

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 08 July 2020
Checked by: BD, Drawn by: LW, Last edited by: IWilson
Location: P:\31400s\31485\Mapping\31485_F4_Vegetation



Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)
- Hollow-bearing tree

Hydrology

- Canal-Drain

Strahler stream order

- 1
- 2
- 3

Strahler order buffered areas

- 1
- 2
- 3

Plant Community Type (PCT)

- PCT1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (planted)
- PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion (planted)

Figure 4.2 Vegetation of the study area

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 08 July 2020
Checked by: BD, Drawn by: LW, Last edited by: IWilson
Location: P:\31400s\31485\Mapping\31485_F4_Vegetation



Legend

- Study area
- Subject land
- Kilometre point
- Floristic plot (20x50m)
- Strahler stream order
 - 1
- Strahler order buffered areas
 - 1
- Plant Community Type (PCT)
 - PCT1232 - Swamp Oak floodplain swamp forest, Sydney Basin Bioregion and South East Corner Bioregion (planted)
 - PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion
 - PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion

Figure 4.3 Vegetation of the study area

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert



Matter: 31485
Date: 08 July 2020
Checked by: BD, Drawn by: LW, Last edited by: IWilson
Location: P:\31400s\31485\Mapping\31485_F4_Vegetation



Legend

- Study area
- Subject land
- K Kilometre point
-) Floristic plot (20x50m)
- Strahler stream order
 - 1
 - 2
- Strahler order buffered areas
 - 1
 - 2
- Plant Community Type (PCT)
 - PCT 781 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion
 -
 - PCT 838 - Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion
 -

Figure 4.4 Vegetation of the study area

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 08 July 2020
Checked by: BD, Drawn by: LW, Last edited by: IWilson
Location: P:\31400s\31485\Mapping\31485_F4_Vegetation

3.3 Vegetation integrity assessment

3.3.1 Vegetation zones

PCTs within the subject land were assessed and stratified, based on broad condition state, into vegetation zones. This resulted in four vegetation zones identified within the impact area, two of which consist of non-naturally occurring planted native vegetation communities. Table 4 describes each of the zones.

Table 4 Vegetation zones mapped within the impact area

Vegetation zone	Vegetation type	Condition	Area (ha)	Plots surveyed
VZ1	PCT 781	Low	0.04	One
VZ2	PCT 838	Low	0.33	One
V3	PCT 838	Planted	0.9	One
V4	PCT 1232	Planted	0.2	One

3.3.2 Vegetation integrity

Vegetation integrity was assessed using data obtained from undertaking BAM plots, as per the methodology outlined in Section 5.3.4 of the BAM (OEH 2017a). Plot data was collected via:

- A 20 metre x 50 metre quadrat and 50 metre transect for assessment of site attributes and function.
- A 20 metre x 20 metre quadrat, nested within the larger quadrat for full floristic survey to determine composition and structure of the PCT.

The minimum number of BAM plots per vegetation zone was determined using Table 6 of the BAM (OEH 2017a). A total of four BAM plots were completed within the impact area, including in the two patches of planted native vegetation not further assessed in the BAM Calculator. An assessment of vegetation integrity was undertaken using benchmark data collected as outlined in Subsection 5.3.3 of the BAM.

No additional local data was used for this assessment.

A list of flora species was compiled, and records of all flora species will be submitted to EES for incorporation into the Atlas of NSW Wildlife, in accordance with Biosis licence requirements. These species have been included in Appendix 2.

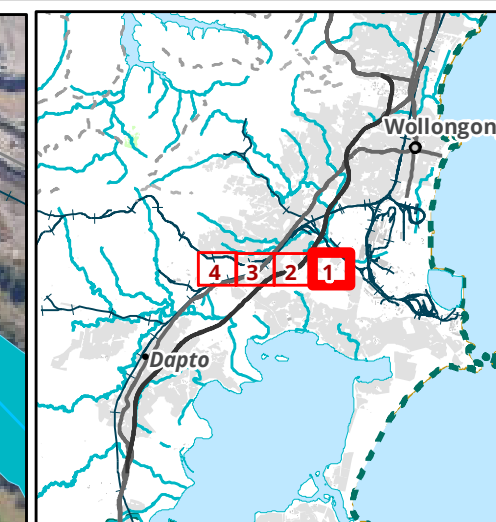
3.3.3 Vegetation integrity score

Plot data were entered into the BAM calculator to determine vegetation integrity scores. Plot data are presented in Appendix 2. Vegetation integrity scores for the vegetation zones are provided in Table 5. Impacts to vegetation zones VZ1 and VZ2 trigger the requirement for offsets. Impacts to PCT 781 Coastal Freshwater Wetlands are proposed to occur over a short timeframe; given the ground disturbance during the installation of the pipeline, after which the land will be rehabilitated to allow for natural regeneration of the wetland. Thus, total clearance of the vegetation has not been assumed for this vegetation community. The vegetation composition and structure scores were reduced in the BAM Calculator by an amount reasonably representative of the proposed impacts and rehabilitation of the disturbed vegetation. This included a reduced species richness and cover of shrubs and grass and grass-like plants following completion of the project.

In accordance with the assessment of impacts to planted native vegetation in the BAM, VZ3 and V4 do not require offsets, as the vegetation is not contiguous with remnant naturally occurring vegetation, supports negligible habitat for threatened species, with no hollow-bearing trees or nests present. Compounded by its non-natural occurrence along major roads through an industrial area has led to the conclusion that it does not require offsetting in accordance with the BAM.

Table 5 Vegetation zone integrity scores

PCT (No)	Vegetation zone	Composition condition score	Structure condition score	Function condition score	Vegetation integrity score	Future vegetation integrity score	Offset required
781	VZ1	62	88.9	-	74.2	42.5	Yes
838	VZ2	5	50.1	39.8	21.5	0	Yes
838	VZ3	13	43.8	74.7	34.9	0	No
1232	VZ4	11.2	22.5	29.8	19.6	0	No



Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Figure 5.1 Vegetation zones and survey effort

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 06 March 2020
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
Location: P:\31400s\31485\Mapping\31485_F5_SurveyEffort



Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Figure 5.2 Vegetation zones and survey effort

0 40 80 120 160 200

Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

biosis
Biosis Pty Ltd

Matter: 31485
Date: 06 March 2020
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
Location: P:\31400s\31485\Mapping\31485_F5_SurveyEffort



Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Vegetation Zone (VZ)

- VZ1
- VZ2

Figure 5.3 Vegetation zones and survey effort

0 40 80 120 160 200

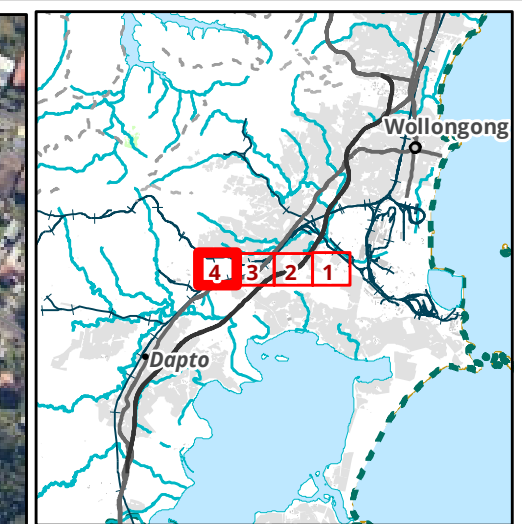
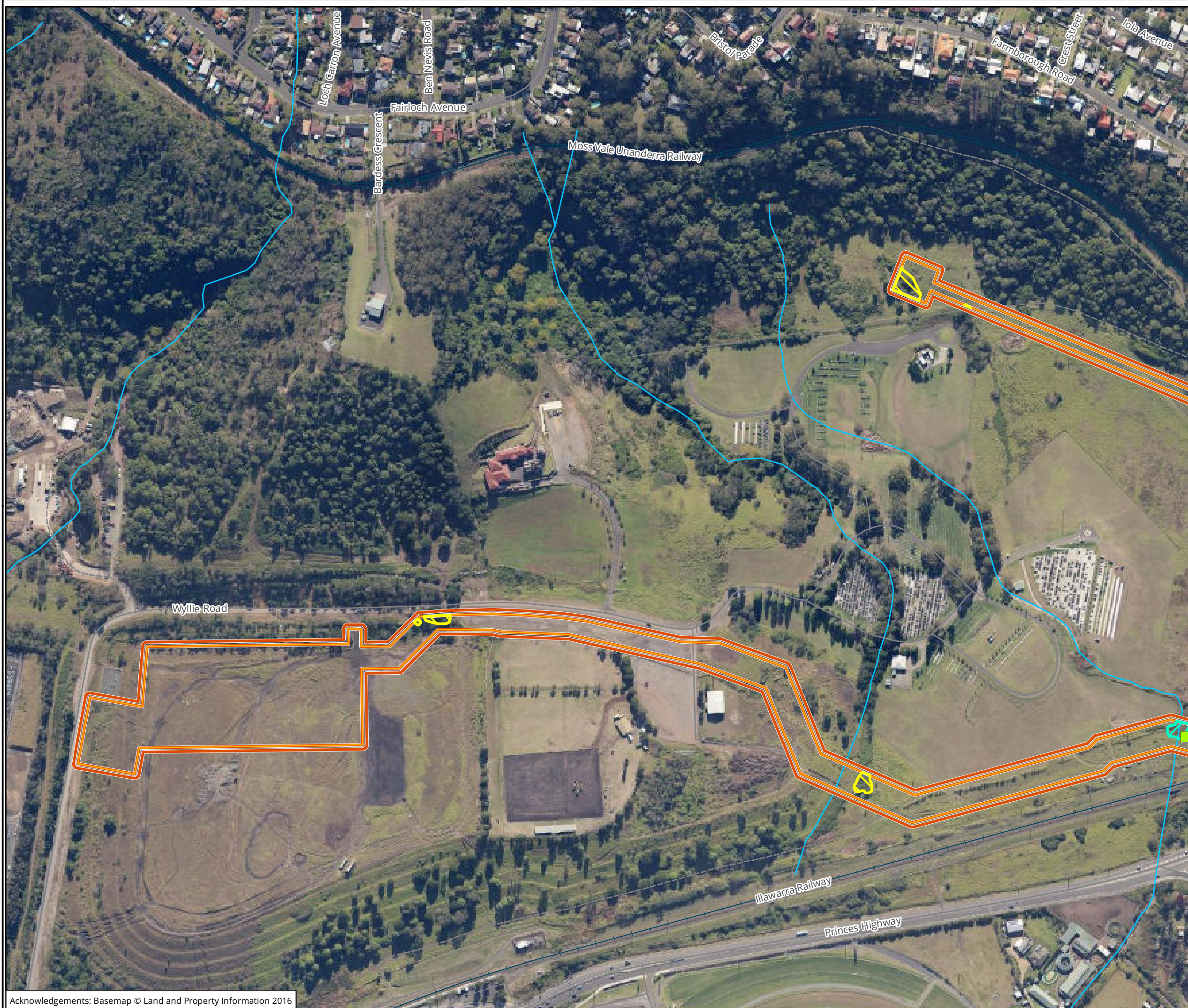
Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert



Matter: 31485
Date: 06 March 2020
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
Location: P:\31400s\31485\Mapping\31485_F5_SurveyEffort



Legend

- Study area
- Subject land
- Floristic plot (20x50m)

Vegetation Zone (VZ)

- VZ1
- VZ2

Figure 5.4 Vegetation zones and survey effort

0 40 80 120 160 200

Metres

Scale: 1:4,000 @ A3

Coordinate System: GDA 1994 NSW Lambert

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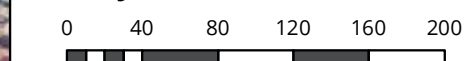
Matter: 31485
Date: 06 March 2020
Checked by: BD, Drawn by: LW, Last edited by: jshepherd
Location: P:\31400s\31485\Mapping\31485_F5_SurveyEffort



Legend

- Study area
- Subject land
- Kilometre point

Figure 6.1 TECs within the study area



Metres
Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert



Matter: 31485
Date: 27 February 2020
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location: P:\31400s\31485\Mapping\31485_F6 TECs



Legend

- Study area
- Subject land
- Kilometre point

Figure 6.2 TECs within the study area

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert



Matter: 31485
Date: 27 February 2020
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location: P:\31400s\31485\Mapping\31485_F6 TECs



Legend

- Study area
- Subject land
- Kilometre point

Threatened Ecological

Community (TEC)

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered Ecological Community, BC Act)

Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion' (Critically Endangered EPBC Act, Endangered Ecological Community, BC Act)

Figure 6.3 TECs within the study area

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

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Matter: 31485
Date: 27 February 2020,
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location: P:\31400s\31485\Mapping\31485_F6 TECs



Legend

- Study area
- Subject land
- Kilometre point

Threatened Ecological

Community (TEC)

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered Ecological Community, BC Act)

Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion' (Critically Endangered EPBC Act, Endangered Ecological Community, BC Act)

Figure 6.4 TECs within the study area

0 40 80 120 160 200
Metres

Scale: 1:4,000 @ A3
Coordinate System: GDA 1994 NSW Lambert

biosis
Biosis Pty Ltd

Matter: 31485
Date: 27 February 2020
Checked by: BD, Drawn by: LW, Last edited by: lwilson
Location: P:\31400s\31485\Mapping\31485_F6 TECs

4 Threatened species

4.1 Predicted species

A list of predicted species (ecosystem credit species) expected to occur within the subject land was refined as per Section 6 of the BAM. Impacts to these species require assessment, however a targeted survey is not required as these species are assumed to occur, based on the occurrence of the PCTs and patch sizes. Table 6 lists the ecosystem credit species predicted to occur in the study area.

The potential for a species to occur within the subject land was assessed in accordance with Sections 6.3 and 6.4 of the BAM. Species with geographical or habitat restrictions not matching that within the subject land were not required to be surveyed. Targeted searches were undertaken for remaining species.

In addition to predicted species, species previously recorded within a 5 kilometre radius of the study area were also reviewed. Predicted species and those previously recorded were considered with respect to their habitat requirements and potential to be impacted by the proposal. These assessments are included Appendix 2.

Table 6 Threatened predicted species (ecosystem credit species) with potential to occur

Species name	Common name
<i>Anthochaera phrygia</i>	Regent Honeyeater
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow
<i>Botaurus poiciloptilus</i>	Australasian Bittern
<i>Calidris ferruginea</i>	Curlew Sandpiper
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo
<i>Circus assimilis</i>	Spotted Harrier
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork
<i>Epthianura albifrons</i>	White-fronted Chat
<i>Glossopsitta pusilla</i>	Little Lorikeet
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle
<i>Hieraaetus morphnoides</i>	Little Eagle
<i>Irediparra gallinacea</i>	Comb-crested Jacana
<i>Ixobrychus flavicollis</i>	Black Bittern
<i>Lathamus discolor</i>	Swift Parrot
<i>Limicola falcinellus</i>	Broad-billed Sandpiper
<i>Limosa limosa</i>	Black-tailed Godwit

Species name	Common name
<i>Lophoictinia isura</i>	Square-tailed Kite
<i>Micronomus norfolkensis</i>	Eastern Coastal Free-tailed Bat
<i>Miniopterus orianae oceanensis</i>	Large Bent-winged Bat
<i>Miniopterus australis</i>	Little Bent-winged Bat
<i>Neophema pulchella</i>	Turquoise Parrot
<i>Oxyura australis</i>	Blue-billed Duck
<i>Pandion cristatus</i>	Eastern Osprey
<i>Petroica boodang</i>	Scarlet Robin
<i>Petroica phoenicea</i>	Flame Robin
<i>Phascolarctos cinereus</i>	Koala
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox
<i>Rostratula australis</i>	Australian Painted Snipe
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat
<i>Stictonetta naevosa</i>	Freckled Duck
<i>Tyto novaehollandiae</i>	Masked Owl
<i>Xenus cinereus</i>	Terek Sandpiper

Planted vegetation present within the subject land, adjacent to Five Islands Road and the Princes Motorway is not considered to support habitat for the above threatened species. Both patches are subject to historical and ongoing disturbance and are considered highly unlikely to provide regular resources to locally occurring threatened species, including blossom resources for nectivorous species.

4.2 Species credit species

Appendix 2 provides the lists of species credit species that are predicted to occur within the subject land based on the presence of the PCTs within a patch size of less than five hectares. The potential for a species to occur within the subject land was assessed in accordance with Sections 6.3 and 6.4 of the BAM. Species with geographical or habitat restrictions not matching that within the subject land were not required to be surveyed. An assessment of the habitats present within the subject land and study area, potential occurrence, and potential for impact, for all species credit species is provided in Appendix 2. It should be noted that the two patches of planted native vegetation within the subject land were subject to the assessment of habitat suitability for threatened species.

After detailed habitat assessments were undertaken, only a single species required assessment. One species credit fauna species, Green and Golden Bell Frog *Litoria aurea* (Endangered BC Act, Vulnerable EPBC Act), was assessed as having a moderate likelihood of occurrence within the subject land. Areas mapped as PCT 781 Coastal Freshwater Wetlands were considered potential Green and Golden Bell Frog habitat, however following targeted surveys not detecting this species, breeding habitat was considered to be absent.

Three species credit flora species were assessed as having a moderate likelihood of occurrence within the subject land; Square Raspwort *Haloragis exalata* subsp. *exalata* (Vulnerable, BC Act and EPBC Act), *Lespedeza juncea* subsp. *sericea* (endangered population, BC Act) and Illawarra Zieria *Zieria granulata* (Endangered, BC Act and EPBC Act).

Targeted surveys were undertaken and did not record these species (Section 4.3).

4.3 Threatened species surveys

4.3.1 Fauna habitat assessment and field investigation

Fauna habitat assessments were undertaken to determine whether the vegetation to be impacted by the proposed development contained microhabitats suitable to support threatened fauna species predicted to occur within the study area. The habitat assessments focussed on the presence of the following features within the study area:

- Hollow-bearing trees.
- Large rock outcrops.
- Buildings, culverts or infrastructure for microbat roosting.
- Availability of flowering shrubs and feed tree species.
- Condition of native vegetation and the presence of exotic species.
- Condition of pools, watercourses and waterbodies.
- Quantity and type of ground litter and logs.
- Searches for indirect evidence of fauna.
- Evidence of previous and ongoing disturbance.

Following habitat assessments, a single species credit species, the Green and Golden Bell Frog was considered to potentially breed in PCT 781 Freshwater Coastal Wetlands within the subject land. Due to the absence or degraded nature of suitable habitat no other species were considered to be found within the subject land. Further information is provided below in 4.3.2 and Appendix 2.

4.3.2 Targeted Surveys

Targeted flora and fauna surveys were undertaken on 17 January 2020 for the species listed in as candidates in Appendix 2. Targeted surveys for the Green and Golden Bell Frog of the study area were undertaken 3 February – 7 February 2020. Weather observations for each survey date are shown in Table 7. Surveys were undertaken in accordance with Department of Environment and Climate Change (DECC 2008).

The subject land supports one ephemeral dam, and a drainage line with small ephemeral ponds.

The ephemeral dam found in the Wollongong Lawn Cemetery located in the western extent of the study area was surveyed as part of the targeted surveys. The dam supported moderate breeding habitat for the Green and Golden Bell Frog with little water and dense Cumbungi *Typha orientalis*. The dam was isolated from watercourses and had poor connectivity to its surrounds. No rocky areas or partially covered areas to provide refuge habitat were found within the dam and it was surrounded by fringing emergent vegetation predominately made up of long Kikuyu grass *Cenchrus clandestinus*.

The drainage swale with small ephemeral ponds found in the western extent to the east of the Wollongong Lawn Cemetery towards the Princes highway provided potential breeding habitat for the Green and Golden

Bell Frog. The drainage swale contained Coastal Freshwater Wetland vegetation that was partially dry at the time of survey. The drainage swale runs east, through multiple waterbodies and watercourses that are linked to Mullet Creek. Due to the connectivity and partially open habitat, the Coastal Freshwater Wetland provided moderate breeding habitat for the species.

The targeted surveys consisted of four consecutive nights following rainfall, the targeted surveys comprised of 5 minutes of call playback followed by a 10 minute listening period, and the survey site was finished by an active 15 minute survey. The targeted surveys were undertaken at each potential site.

Table 7 Weather observations during flora and fauna surveys (Albion Park, NSW)

Survey undertaken	Survey date	Temperature (°C)		Rain (mm)
		Min.	Max.	
Threatened flora survey	17/01/2020	18.7	22.9	17.8
Green and Golden Bell Frog survey	3/02/2020	21.5	33.6	10.4
	4/02/2020	15.0	23.0	0
	5/02/2020	15.6	25.7	0
	6/02/2020	19.1	25.3	2.6

Information from the Australia Government Bureau of Meteorology website.

No Green and Golden Bell Frogs were recorded within the study area, however one dam and the Coastal Freshwater Wetlands are considered to provide potential dispersal habitat for the species, providing areas of connectivity and do not restrict movement of the species.

4.3.3 Flora habitat assessment and field investigation

An assessment of habitat requirements for threatened flora species likely to occur within the subject land was undertaken and is described further in Appendix 2. Threatened flora habitat within the impact area consisted of disjunct and isolated patches of low condition Illawarra Lowlands Grassy Woodland (PCT 838).

Three species assessed to have a moderate likelihood of occurring within the subject land are known to tolerate disturbed environments, including the condition of the vegetation within the subject land described in Table 2. Targeted surveys were undertaken for Square Raspwort, *Lespedeza juncea* subsp. *sericea* and Illawarra Zieria. These species were thoroughly searched for using targeted meanders in areas of potential habitat. Due to the small patch sizes, it was not practical to undertake targeted transects. The approved survey period in accordance with the BAM for the above listed species fell within the time of survey.

No threatened flora species were recorded during the field survey as detailed above.

Stage 2 – Impact assessment (biodiversity values)

5 Avoid and minimise impacts

This section identifies the potential impacts of the proposal on the biodiversity values of the study area and subject land, and includes measures taken. Additional recommendations to assist the final design of the development to further avoid and minimise impacts on biodiversity within and surrounding the subject land and study area.

5.1 Actions to avoid/minimise project impacts

The principle means to reduce impacts on biodiversity values within the study area is to avoid and/or minimise the removal of native vegetation and fauna habitat. Additional recommendations include measures to mitigate residual impacts after all measures to avoid and minimise impacts have been considered.

Steps undertaken to avoid and minimise impacts to biodiversity are broken down into site selection and planning, construction and operation.

5.1.1 Site selection and planning

The pipeline alignment has been selected, in-part, to minimise impacts to all associated biodiversity values and allow for the proposed linear development to tie into the EGP facility, and the yet to be built proposed Cringila tie-in facility. The location of the HDD has been re aligned to minimise disturbance to PCT 838 and other areas of native vegetation wherever possible. The purpose of HDD is to under bore the Princes Highway and urban development. The proposed pipeline alignment will predominantly follow the route of the existing Port Kembla lateral, which was constructed approximately 15 years ago. Since its installation, industrial development as occurred along the existing alignment, limiting the potential of the proposed pipeline to completely follow the existing easement. Therefore, this has further constrained the possible locations of the proposed HDD entry and exit points. As such, impacts to PCT 838 (and low condition Illawarra Lowlands Grassy Woodlands TEC) are unavoidable on the northern side of Princes Highway, and the Illawarra Railway. Where impacts to vegetation are unavoidable, Jemena propose to keep the disturbance footprint required to facilitate underboring works to an absolute minimum. The open trenching alignment utilises as much urban native and exotic vegetation as possible and allows for the alignment with existing services corridors.

Due to the scale and linear nature of the project, complete avoidance of impacts to threatened species and TECs was not possible. The project will likely impact on:

- 0.33 hectares of low condition Illawarra Lowlands Grassy Woodland (CEEC, BC Act).
- 0.04 hectares of low condition Coastal Freshwater Wetlands (EEC, BC Act).

The disturbance footprint of the project occurs on a variety of different vegetation communities. An area of 0.33 hectares of low condition Illawarra Lowlands Grassy Woodlands (PCT 838) will be removed for open trenching due to the required HDD within the public lands northeast of the Wollongong Lawn Cemetery.

An area of 0.04 hectares of low condition Coastal Freshwater Wetlands (PCT 781) was unable to be avoided and will be partly open trenched for the pipeline. The open trenching requires a 20 metre footprint to allow for; machinery, excavation and open trenching.

5.1.2 Construction

Direct and indirect impacts to biodiversity values retained within the subject land and adjoining the subject land may occur if adequate mitigation and management measures are not in place during construction of the proposed development.

Mitigation measures recommended to avoid and minimise further indirect impacts to vegetation and habitats during the construction phase of the proposed development include:

- Installation of appropriate exclusion fencing around trees and vegetation to be retained in the study area. This would include appropriate signage such as 'No Go Zone' or 'Environmental Protection Area'.
 - The radius of the tree protection zone (TPZ) is calculated for each tree by multiplying its diameter at breast height (DBH) by 12. ($TPZ = DBH \times 12$) in accordance with the Standards Australia Committee (2009).
 - A TPZ should not be less than 2 metres nor greater than 15 metres, except where crown protection is required (Commonwealth of Australia 2009).
- All material stockpiles, vehicle parking and machinery storage will be located within cleared areas proposed for clearing, and not in areas of native vegetation that are to be retained.
- Any habitat trees inclusive of large nesting material to be removed is inspected prior to clearing by an appropriately qualified ecologist to avoid and minimise the potential for injuries to fauna that may be occupying hollows.
 - Habitat trees with nests require a pre-clearance assessment 24 hours prior to felling.
- Where appropriate native vegetation cleared from the study area should be mulched for re-use on the site, to stabilise bare ground.
- Wet down areas to reduce dust generation during construction.
- Sedimentation and erosion control measures including silt fencing, sediment traps, etc. to prevent sediment-laden stormwater exiting the construction areas and to prevent scouring and erosion of land beyond the development footprint. All erosion and sediment control measures are to be constructed and installed in accordance with relevant guidelines, are to be regularly maintained for the duration of the construction period and are to be carefully removed at completion of works.
 - Implementation of temporary stormwater controls during construction and to ensure that discharges to the drainage channels are consistent with existing conditions.
- Weed and pathogen management including weed hygiene protocols for personnel, machinery and construction materials entering and exiting construction areas to minimise risk of weed and pathogen introduction and spread.
- Waste management to ensure food scraps and other organic waste that may attract introduced predators (e.g. fox, cats) or other pests (e.g. rats) is not stored for prolonged periods within the construction site.
- If bush rock or boulders are encountered during site preparation, these should be moved into adjacent habitats within the study area, and should not be removed from the site.

5.1.3 Operation

The following recommendations are made to mitigate impacts resulting from 'operation' of the proposed development:

- Install appropriate fencing to ensure no access to areas of vegetation outside of the subject land.
- Stormwater controls should direct all water flowing from the subject land away from surrounding vegetation.
- On-going treatment of exotic species from within retained vegetation should be undertaken to assist resilience and vegetation quality.
 - The EGP Operations Environment Management Plan (OEMP) (OEMP Plan GTS-500-PA-EV-003) will be amended to include the Port Kembla Looping Lateral. The EGP Pest and Weed Management Plan (GTS-500-PA-EV-003) forms part of the OEMP, and will also be reviewed and updated to include Port Kembla Looping Lateral.
- Revegetation of areas proposed to be temporarily impacted by the project is recommended. Only native grass and shrub species naturally associated with the impacted PCT are to be planted.
- Restrict slashing of PCT 781 that occurs within the subject land avoiding additional slashing to surrounding native vegetation.

6 Assessment of unavoidable impacts

Assessment of direct and indirect impacts unable to be avoided has been undertaken in accordance with the BAM (OEI 2017a). The following direct and indirect impacts are unable to be avoided in progressing the proposed development.

6.1 Direct impacts to flora and fauna

Direct impacts arising from the project include:

- Removal of 0.33 hectares of low condition Illawarra Lowlands Grassy Woodlands (PCT 838).
- Partial removal of 0.04 hectares of low condition Freshwater Coastal Wetlands (PCT 781).
- Removal of 0.56 hectares planted native vegetation.

These impacts will be permanent and will occur from the outset of the project. Mitigation measures outlined in Section 5 above will help to minimise the potential impacts to biodiversity values that remain present within the study area.

6.2 Indirect impacts

Potential indirect impacts arising from the project are outlined and addressed in Table 8 below.

Table 8 Assessment of indirect impacts

Indirect impact	Assessment / likelihood of occurrence
Inadvertent impacts on adjacent habitat or vegetation.	All contractors will be inducted and notified about the sensitivity of the adjacent vegetation (see Section 5.1 above).
Reduced viability of adjacent habitat due to edge effects.	The native wetland patches are quite susceptible to weed encroachment. Areas of native vegetation adjacent to areas of removal will be prepared with the mitigation measures provided in Section 5.1 to reduce the potential for this impact.
Reduced viability of adjacent habitat due to noise or dust spill.	Noise impacts from increased traffic shall be minimised through the use of low speed limits, and exempt hours of construction works. Increased levels of dust could be expected to result during the construction phase of the development. Dust suppression should be undertaken during all construction phases and all stockpiles should be covered at all times. Measures to reduce the potential for these impacts are provided in Section 5.1.
Loss of breeding habitats.	The removal of native trees, including hollow-bearing trees, and shrubs from the subject land could remove potential nest sites for bird species. Measures to mitigate potential impacts to native fauna species are provided in Section 5.1.
Transport of weeds and pathogens from the site to adjacent vegetation.	Site access points during construction should be restricted to single gates if feasible to minimise the transportation of weeds throughout the site. Mitigation measures are provided in Section 5.1 and include directing

Indirect impact	Assessment / likelihood of occurrence
	surface water away from surrounding native vegetation and watercourses. Measures outlined in the EGP Pest and Weed Management Plan (GTS-500-PA-EV-003) will be implemented during construction and operation stages of the pipeline, minimising the spread and potential facilitation of pest animal movement along the pipeline corridor. It is also recommended that measures are undertaken for the control of pest fauna species including Wild Rabbit <i>Oryctolagus cuniculus</i> and European Fox <i>Vulpes vulpes</i> in accordance with the <i>South East Regional Strategic Pest Animal Plan 2018-2023</i> (South East Local Land Services 2018).
Rubbish dumping.	The project will result in an increased risk of rubbish dumping during the construction and operation phases. All contractors are to dispose of waste appropriately. Given the type of development proposed and part of the subject lands residing on public land, rubbish dumping is more likely to occur, fencing and appropriate rubbish dedicated areas are to be implemented on site within the study area.
Fragmentation of movement corridors.	The project is not likely to fragment existing habitat connectivity for mobile species, however fragmentation of less mobile fauna species may occur. Mitigation actions to limit habitat fragmentation are provided in Section 5.1.

6.3 Prescribed impacts

Assessment of prescribed biodiversity impacts are outlined and addressed in Table 9 below.

Table 9 Assessment of prescribed impacts

Prescribed impact	Assessment / likelihood of occurrence
Impacts of development on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other features of geological significance.	The proposal will not result in this impact. There is no habitat associated with karst, caves, crevices, cliffs or other features of geological significance to be affected.
Impacts of development on the habitat of threatened species or ecological communities associated with rocks.	There were no threatened species or ecological communities recorded within the subject land that are strictly associated with rock.
Impacts of development on the habitat of threatened species or ecological communities associated with human made structures.	The proposal will not result in this impact. There are no human made structures within the subject land or adjacent to the subject land that could be affected by the proposal.
Impacts of development on the habitat of threatened species associated with non-native vegetation.	No threatened species habitat was associated with non-native vegetation.
Impacts of development on the connectivity of different areas of habitat of threatened	The proposal will not result in this impact. There are no habitats that facilitate movement of a species across its range within the subject

Prescribed impact	Assessment / likelihood of occurrence
species that facilitates the movement of those species across their range.	land.
Impacts of the development on movement of threatened species that maintains their life cycle	The proposal will not result in this impact. The subject land does not represent an area that would interrupt movement of species.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including subsidence or upsidence resulting from underground mining or other development)	<p>The project footprint inhibits a small watercourse that provides water to a small dam outside of the footprint. The project will also be removing Coastal Freshwater Wetland vegetation (PCT 781).</p> <p>The dam doesn't sit in within the footprint but has been subject to assessment due to its potential to provide dispersal and basking habitat for Green and Golden Bell frog.</p> <p>The Coastal Freshwater Wetland is considered potential Green and Golden Bell Frog habitat.</p> <p>Targeted surveys were completed and no Green and Golden Bell frogs were recorded.</p>
Impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	The proposal has the potential to increase the frequency of vehicle strikes to fauna in the area; however, the design of low vehicle speeds, dedicated vehicle tracks and worker awareness will reduce the likelihood of vehicle strike.

6.4 Impacts to groundwater dependent ecosystems

The subject land does not contain any groundwater dependent ecosystems (GDEs), including aquatic, terrestrial and subterranean ecosystems as mapped in the *GDE Atlas* (BOM 2019). The study area measures to reduce any potential indirect impacts to the mapped watercourses inclusive of stormwater and runoff controls during construction and operation of the development (see Section 5.1).

6.5 Adaptive management strategy

The proposed development will not result in impacts relating to karst, caves, crevices, cliffs and other geological features of significance, subsidence and upsidence, wind turbine strikes or vehicle strikes and as such as an Adaptive Management Strategy is not considered necessary.

7 Impact summary

7.1 Thresholds for assessment and offsetting

This section outlines the thresholds for assessment and offsetting in accordance with Section 10 of the BAM.

7.1.1 Serious and irreversible impacts

As of 27 April 2020, *Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion* was newly listed as an entity at risk of serious and irreversible impacts (SAIL) in accordance with Section 10 of the BAM:

Section 10.2 of the BAM requires the BDAR to assess whether the proposed development will result in a SAIL to any candidate listed TEC or species.

Illawarra Lowlands Grassy Woodland EEC

The Illawarra Lowlands Grassy Woodland EEC (PCT 838) is listed under NSW legislation as Endangered. The EEC is listed in the BioNet Threatened Biodiversity Data Collection as a SAIL in NSW. Given the absence of definitive impact thresholds stated for the community, the potential for a SAIL will be determined by the consent authority, guided by the additional assessment regarding this EEC in Table 10.

A total of 0.5 hectares of Illawarra Lowlands Grassy Woodland EEC is present within the study area, 0.33 hectares of which will be impacted. The community exists in poor condition, lacking characteristic canopy species, and the mid-storey being made up of disturbance tolerant, coloniser acacia species.

Table 10 Assessment of SAIL for Illawarra Lowlands Grassy Woodland EEC

Information required (BAM Section 10.2.2)	Response
a. the action and measures taken to avoid the direct and indirect impact on the potential entity for a SAIL.	Measures undertaken by the proponent to avoid and minimise impact to the EEC (PCT 838) are provided in Section 5.1 above. The development design has been sited to avoid 33% of the mapped PCT 838 vegetation within the study area. Unavoidable impacts following all measures to avoid and minimise impacts will result in the removal of 0.33 ha of EEC vegetation in low condition.
b. the area (ha) and condition of the threatened ecological community (TEC) to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone.	Direct removal of 0.33 ha of low condition PCT 838 (VI score of 21.5). The 0.33 ha of the EEC that will be impacted exists in low condition, with high levels of weed cover and a depauperate understorey and ground layer. The EEC occurs only in VZ2. Of note is that the condition of the EEC within the study area is poor and does not meet minimum condition thresholds of the corresponding EPBC Act listed community based on its isolated nature, small patch size and depauperate groundcover species assemblage.
c. a description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guideline for determining an SAIL.	No threshold for impacts to Illawarra Lowlands Grassy Woodland EEC have been published to date.
d. the extent and overall condition of the potential TEC within an area of 1000ha,	According to <i>Southeast NSW Native Vegetation Classification and Mapping - SCVI. VIS_ID 2230</i> (OEH 2011), 41.68 ha of the EEC is present within the 1000

Information required (BAM Section 10.2.2)	Response
<p>and then 10,000ha, surrounding the proposed development footprint.</p>	<p>ha area surrounding the study area. This was calculated using GIS methods, filtering the SCIV mapping database to only include 'Illawarra Lowlands Grassy Woodland' vegetation within the EEC mapping data. The SCIV database was used as it provides the best coverage of the Illawarra region and relatively up to date mapping of the EEC.</p> <p>Within a 10,000 ha area, the community comprises approximately 438.46 ha. The overall condition across all areas is expected to be varied due to the majority occurring on privately owned land. Large areas of the EEC have been cleared, with most remnants existing as small, fragmented patches (NSW Threatened Species Scientific Committee 2000). In 2002, NSW National Parks and Wildlife Service completed a review of the EEC and found that approximately 5% of the vegetation comprising the EEC was considered to have demonstrated only 'light' levels of disturbance, 31% 'moderate' and 22% 'heavy', with 43% present only as scattered trees (NPWS 2002). The EEC proposed for impact is considered to demonstrate heavy levels of disturbance based on the absence of canopy trees.</p> <p>Ongoing threats to the EEC include further clearing, weed invasion and grazing.</p>
<p>e. an estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration</p>	<p>The study area occurs in the Illawarra IBRA subregion. An estimate of the area of EEC extant in the subregion is 2,939 ha (OEH 2011). This was calculated by filtering for the EEC within the spatial coverage of the SCIV mapping database. The proposed development will result in the removal of 0.33 ha of poor condition EEC vegetation, equating to 0.01% of the EEC in the subregion. The small scale of poor condition EEC proposed for impacted is not likely to significantly alter the extent and overall condition of the EEC remaining in the IBRA subregion.</p>
<p>f. an estimate of the area of the candidate TEC that is in the reserve system within the IBRA region and the IBRA subregion</p>	<p>The majority of the remaining areas of EEC is present on private land. Approximately 275 ha is present in reserves including the following: Morton National Park, Illawarra Escarpment State Conservation Area, Yatteyattah Nature Reserve, Macquarie Pass National Park, Conjola National Park, Eurobodalla National Park and Murramarang National Park. The condition of the ecological community in these reserves is not known (Threatened Species Scientific Committee 2016). Over 70% of the remaining extent of the ecological community occurs in the Illawarra subregion; approximately 16% is in the Jervis subregion, with small amounts in each of Ettrema and Bateman subregions (NPWS 2002). The majority of the areas of extant EEC occur as isolated patches on private property within the Illawarra region (NSW Threatened Species Scientific Committee 2000).</p> <p>To determine an estimated area of EEC in the IBRA region and subregion, and NSW reserve systems, existing vegetation datasets (OEH 2011, DPIE 2018, NPWS 2013, DPE 2014, OEH 2016a, DPIE 2019a, OEH 2009 and DPIE 2019b) were filtered according to area of mapped equivalent PCT 838 and PCT 1326 vegetation. The aim of compiling these datasets was to capture as much of the area within the IBRA region as possible; 84% coverage was obtained using this method.</p> <p>Mapped areas of the EEC within reserve systems amount to 432.1 ha (OEH</p>

Information required (BAM Section 10.2.2)	Response
<p>g. the development, clearing or biodiversity certification proposal's impact on:</p> <ul style="list-style-type: none"> • abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns. • characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants, • the quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC. 	<p>2011) which represents 14.7% of the EEC within the subregion. Mapped areas of the EEC in reserves within the Illawarra IBRA subregion amount to 79.7 ha.</p> <ul style="list-style-type: none"> • The proposal is not expected to result in negative affects to abiotic factors critical to the long term survival of the EEC (see Section 5.1). Flow patterns of water into surrounding habitats will be maintained or re-instated and any runoff from the proposed development will be managed appropriately and detailed in the site management plans. • An area of 0.33 ha of low condition EEC is proposed to be cleared to facilitate the construction and operation of the gas pipeline. The midstorey is predominantly comprised of Lantana, and the groundcover comprised of a mix of common native and exotic species, not constituting functionally important species. As such, clearance of 0.33 ha of poor condition EEC vegetation will not impact on functionally important species of the EEC. • The low condition EEC proposed for removal does not support characteristic and functionally important species of the community. The proposed installation of a pipeline within poor condition EEC vegetation is unlikely to alter fire/flooding regimes or increase the harvesting of plants of retained EEC vegetation in the long term. Following installation of the pipeline via open trenching, the top soil will be re-instated and rehabilitated with characteristic native groundcover species. • Implementation of the project's OEMP as well as the project's Pest and Weed Management Plan will ensure that the presence of invasive flora and fauna species is not exacerbated within the retained EEC vegetation as a result of the project.
<p>h. direct or indirect fragmentation and isolation of an important area of the potential TEC.</p>	<p>The EEC currently exists as a highly fragmented patch, subject to disturbances including weed infestation. Therefore the patch is not considered to be an important area of the EEC, overall. The proposal will slightly increase fragmentation through the removal of acacia scrub and groundcover species. Representative groundcover species will be re-planted to rehabilitate the area following pipeline installation.</p>
<p>i. the measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion.</p>	<p>In addition to the required credit offset, the proponent will contribute to the improvement of condition of the EEC to be retained within the study area and immediate surrounds, through the ongoing management of pests and weeds by a qualified contractor. The project's Pest and Weed Management Plan will specify measures to be implemented.</p>

7.2 Impacts requiring offsets

7.2.1 Impacts to native vegetation (ecosystem credits)

As outlined in Section 10.3.1 of the BAM, the accredited assessor is required to determine an offset for all impacts of the proposed development on PCTs that are associated with vegetation integrity scores of:

- ≥ 15 where the PCT is representative of an endangered or critically endangered ecological community
- ≥ 17 where the PCT is associated with threatened species habitat (as represented by ecosystem credits), or is representative of a vulnerable ecological community
- ≥ 20 where the PCT is not representative of a TEC or associated with threatened species habitat.

Planted vegetation present within the subject land, adjacent to Five Islands Road and the Princes Motorway is not considered to support habitat for threatened species. Both patches are subject to historical and ongoing disturbance and are considered highly unlikely to provide regular resources to locally occurring threatened species, including blossom resources for foraging nectivorous species. Furthermore, historical disturbance to the soil profile has resulted in a lack of habitat for threatened flora. The patches of vegetation do not represent naturally occurring native vegetation communities, nor are they contiguous with areas of naturally occurring native vegetation. As such, it is considered that impacts to this planted and disturbed roadside vegetation are not likely to result in more than a negligible impact to threatened species, or their habitat. Therefore a requirement for offsetting impacts via retirement of ecosystem credits for the planted and artificial PCTs is not considered appropriate.

On this basis, offsets are required for VZ1 and VZ2, as they have vegetation integrity scores greater than 15 and consist of naturally occurring PCTs (Table 10).

The offset requirement for the proposal was calculated using the BAM Calculator. Table 10 provides a summary of the ecosystem credit offsets required for impacts from proposed development at the subject land.

Table 11 Offsets required for the proposed development (ecosystem credits)

Vegetation zone	Vegetation	Area (ha)	Impact	Vegetation integrity score	Offset required?	Credit requirement
VZ1	PCT 781 - Low	0.04	Clearance	74.2	Yes	1
VZ2	PCT 838 - Low	0.33	Clearance	21.5	Yes	4
VZ3	PCT 838 - Planted	0.9	Clearance	34.9	No	0
VZ4	PCT 1232 - Planted	0.2	Clearance	19.6	No	0

7.2.2 Impacts to threatened species (species credits)

As outlined in Section 4.2, no species credit species were recorded or assumed present within the subject land.

8 Biodiversity credits

Offsetting through the transfer and retirement of biodiversity credits, or paying into the BCT Offset Fund, is required for the current assessment for impacts to two vegetation zones at the subject land. A biodiversity credit report are provided on the following pages.

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018953/BAAS18050/20/00018954	Jemena Gas Pipeline	18/06/2020
Assessor Name	Report Created	BAM Data version *
	13/07/2020	29
Assessor Number	BAM Case Status	Date Finalised
	Open	To be finalised
Assessment Revision	Assessment Type	
1	Part 5 Activities	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Potential SAI	Ecosystem credits
Coastal freshwater wetland								
1	781_Moderate	31.7	0.0	0.25	High Sensitivity to Potential Gain	2.00		1
							Subtotal	1



BAM Credit Summary Report

Forest Red Gum - Thin-leaved Stringybark grassy woodland on coastal lowlands, southern Sydney Basin Bioregion								
2	838_Low	21.5	0.3	0.25	High Sensitivity to Potential Gain	2.00	TRUE	4
							Subtotal	4
							Total	5

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Potential SAI	Species credits
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9 Assessment against biodiversity legislation

9.1 Environment Protection and Biodiversity Conservation Act 1999

An assessment of the impacts of the proposed development on Matters of National Environmental Significance (MNES), against heads of consideration outlined in Commonwealth of Australia (2013) was prepared to determine whether referral of the proposed development to the Commonwealth Minister for the Environment is required. Matters of NES relevant to the proposed development are summarised in Table 11.

Table 12 Assessment of the proposed development against the EPBC Act

Matter of NES	Project specifics	Potential for significant impact
Threatened species	EPBC listed threatened species previously recorded within the locality include 6 flora species and 11 fauna species. Targeted surveys were undertaken for the Green and Golden Bell Frog due to a moderate likelihood for the species. No individuals were identified. Additional threatened species listed under the EPBC Act were considered to have a low likelihood of occurrence and were not detected during targeted survey. Occurrence of threatened fauna is considered to be on a transient basis only and no significant or restricting habitat was identified within the subject land for these species.	The project will not result in a significant impact to any MNES.
Threatened ecological communities	There are no EPBC Act listed TECs within the subject land or study area.	No potential for impact.
Migratory species	Three migratory species have previously been recorded within the locality. Field surveys did not record any migratory species within the study area.	OEH mapping presented no direct impact is expected to any Migratory listed species.
National Heritage Place	There are no wetlands of international importance within proximity to the subject land.	No potential for impact.
Wetlands of international importance (Ramsar sites)	There are no wetlands of international importance within proximity to the subject land.	No potential for impact.

On this basis, the EPBC Act is unlikely to be triggered and referral of the proposed development to the Australian Government Minister for the Environment will not be required.

9.2 Environmental Planning and Assessment Act 1979

9.2.1 Wollongong City Council Local Environmental Plan 2009

The study area covers multiple land use zones under the *Wollongong Local Environmental Plan 2009* (LEP) due to its lineal extent, these consist of IN2 – Light Industrial, IN3 – Heavy Industrial, RE1 – Public Recreation, SP1 – Special Activities, SP2 – Infrastructure.

The objectives of management for IN2 zoned land under the LEP are:

- *To provide a wide range of light industrial, warehouse and related land uses.*
- *To encourage employment opportunities and to support the viability of centres.*
- *To minimise any adverse effect of industry on other land uses.*
- *To enable other land uses that provide facilities or services to meet the day to day needs of workers in the area.*
- *To support and protect industrial land for industrial uses.*
- *To encourage appropriate forms of industrial development which will contribute to the economic and employment growth of Wollongong.*

The objectives of management for IN3 Heavy Industrial zoned land under the LEP are:

- *To provide suitable areas for those industries that need to be separated from other land uses.*
- *To encourage employment opportunities.*
- *To minimise any adverse effect of heavy industry on other land uses.*
- *To support and protect industrial land for industrial uses.*
- *To facilitate the ongoing sustainability of steel making and steel product manufacturing that will contribute to the economic and employment growth of Wollongong.*

The objectives of management for RE1 Public Recreation zoned land under the LEP are:

- *To enable land to be used for public open space or recreational purposes.*
- *To provide a range of recreational settings and activities and compatible land uses.*
- *To protect and enhance the natural environment for recreational purposes.*
- *To cater for the development of a wide range of uses and facilities within open spaces for the benefit of the community.*

The objectives of management for SP1 Special Activities zoned land under the LEP are:

- *To provide for special land uses that are not provided for in other zones.*
- *To provide for sites with special natural characteristics that are not provided for in other zones.*
- *To facilitate development that is in keeping with the special characteristics of the site or its existing or intended special use, and that minimises any adverse impacts on surrounding land.*

The objectives of management for SP2 Infrastructure zoned land under the LEP are:

- *To provide for infrastructure and related uses.*
- *To prevent development that is not compatible with or that may detract from the provision of infrastructure.*

- *To provide for key transport corridors*

Assuming the avoidance and minimisation measures to reduce impacts to ecological values outlined in Section 5 are implemented, the proposed development does not contradict the objectives of the LEP for land within the study area.

9.2.2 Coastal Management State Environmental Planning Policy

The project is subject to the Coastal Management State Environmental Planning Policy (SEPP) and the consent authority required to assess the project under the EP&A Act. The Northern extent of the subject lands is deemed to form a part of the 'coastal environment area', under Division 3 Section 13 of the Coastal Management SEPP. The objectives of which include the following:

- *1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following—*
 - *(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,*
 - *(b) coastal environmental values and natural coastal processes,*
 - *(c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,*
 - *(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,*
 - *(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,*
 - *(f) Aboriginal cultural heritage, practices and places,*
 - *(g) the use of the surf zone.*
- *2) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that—*
 - *(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or*
 - *(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or*
 - *(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.*
- *3) This clause does not apply to land within the Foreshores and Waterways Area within the meaning of Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.*

The project is unlikely to have an adverse effect on the above, therefore this policy allows the proposed development to be carried out with consent under the EP&A Act.

9.2.3 Koala Habitat Protection SEPP

The subject land is located within the Wollongong Council LGA. The Wollongong City Council is listed under the Koala Habitat Protection and is therefore subject to the requirements laid out by the policy. Specifically

before a consent authority may grant consent to a proposed development, it must satisfy itself whether or not the land is a potential koala habitat.

The proposed works do not meet the requirements under Part 3.1 Tier 1 - Low or no direct impact development of the Koala Habitat Protection Guidelines, and therefore require a Koala Plan of Management (KPoM). Two feed tree species, Forest Red Gum and Spotted Gum, listed within Appendix A of the policy were found to be present within the study area. However, these constitute less than 15% of the total number of trees in the upper or lower strata of the tree component.

9.3 Biosecurity Act 2015

The Biosecurity Act provides for the identification, classification and control of priority weeds with the purpose of determining if a biosecurity risk is likely to occur. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes the introduction, presence, spread or increase of a pest into or within the State or any part of the State. A pest plant has the potential to; harm or reduce biodiversity or out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.

A total of four priority weeds for the South East Local Land Services Region were recorded in the subject land and are listed in Table 12 along with their associated Duty. A general biosecurity duty is relevant to all priority weeds in the State. The objective of this duty is to prevent, eliminate or minimise any biosecurity risk the priority weed may pose.

Table 13 Priority weeds recorded at the subject land

Scientific name	Common name	General biosecurity duty
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	General biosecurity duty Prohibition on dealings - Must not be imported into the State or sold Biosecurity zone – applicable to all land within NSW except for land within 10 kilometres of the mean high water mark between Cape Byron in the north and Point Perpendicular in the south. The study area falls within the excepted land, therefore immediate eradication of the weed is not required.
<i>Lantana camara</i>	Lantana	General biosecurity duty Regional Recommended Measure: Land managers should mitigate the risk of new weeds establishing
<i>Lycium ferocissimum</i>	African Boxthorn	General biosecurity duty Prohibition on dealings - Must not be imported into the State or sold
<i>Rubus fruticosus</i> agg. species	Blackberry	Prohibition on dealings - Must not be imported into the State or sold.

9.4 Water Management Act 2000

A controlled activity approval under the *Water Management Act 2000* (WM Act) is required for the following types of activities undertaken on waterfront land:

- the erection of a building or the carrying out of a work (within the meaning of the EP&A Act), or
- the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or
- the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or
- the carrying out of any other activity that affects the quantity or flow of water in a water source.

Waterfront land means the bed of any river, lake or estuary, and the land within 40 metres of the river banks, lake shore or estuary mean high water mark.

Development works are proposed within 40 metres of the top of the bank along five Strahler one watercourses, two Strahler 2 watercourses and one Strahler 3 watercourse within the subject land (Figure 1).

Therefore, a DPI controlled activity permit under s91 of the WM Act may be required for the proposal. A controlled activity approval exemption may apply if the project is a registered pipeline licensee under the *Pipelines Act 1967*.

10 Conclusion

Mitigation of impacts to native vegetation, TECs and fauna habitat have been provided to restrict proposed impacts associated with the project. The partial removal of 0.04 hectares of PCT 781- Coastal Freshwater Wetlands, the permanent removal of 0.33 hectares of PCT 838 - Illawarra Lowlands Grassy Woodland and habitat it supports from the subject land.

The project will result in the removal of a total of 0.37 hectares of native vegetation, plot data was entered into the BAM calculator to determine vegetation integrity score, and is presented in Appendix 3. The vegetation integrity scores for vegetation surveyed are such that five ecosystem credits are required to offset the impacts to both vegetation communities.

The project will also impact 0.9 hectares of planted native vegetation. The vegetation supports negligible habitat for threatened species, with no hollow-bearing trees or nests present, which compounded by its non-natural occurrence along major roads through an industrial area, has led to the conclusion that it does not require offsetting in accordance with the BAM. The western extent of the subject land provided potential habitat for the Green and Golden Bell Frog. After four consecutive nights of targeted surveys for the species, no species were recorded at the site and no additional offsets are required for offset of habitat for the species.

No threatened fauna species were recorded at the subject land, however potential foraging and dispersal habitat for 11 threatened species was present (Table 5). Mitigation measures to avoid direct impacts and mitigate potential indirect impacts to native fauna are provided in Section 5.1 of this report.

There were no threatened flora species recorded within the subject land or listed as predicted species credit species in the BAM calculator.

MNES are not likely to be significantly impacted by the proposed development and as such, a referral of the project to the Commonwealth is not required.

The project should proceed as planned whilst implementing the recommended mitigation measures listed herein.

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Appendices

Appendix 1 Survey methods

Appendix 1.1 Nomenclature

The flora taxonomy (classification) used in this report follows the most recent Flora of NSW (Harden 1992, Harden 1993, Harden 2002). All doubtful species names were verified with the on-line Australian Plant Name Index (Australian National Botanic Gardens 2007). Flora species, including threatened species and introduced flora species, are referred to by both their common and then scientific names when first mentioned. Subsequent references to flora species cite the common names only, unless there is no common name, for which scientific name will be used. Common names, where available, have been included in threatened species tables and the complete flora list in Appendix 23.

Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the DEE (Commonwealth of Australia 2009). In the body of this report vertebrates are referred to by both their common and scientific names when first mentioned. Subsequent references to these species cite the common name only.

Appendix 1.2 Permits and licences

The flora and fauna assessment was conducted under the terms of Biosis' Scientific Licence issued by EES (SL100758, expiry date 31 March 2020). The BAM Assessment and quality review of the BDAR was carried out by Accredited Assessors Bianca Klein (BAAS18050) and Byron Dale.

Appendix 1.3 Limitations

Field surveys were undertaken in accordance with the BAM. Ecological surveys provide a sampling of flora and fauna at a given time and season. Factors influencing detectability of species during survey include species dormancy, seasonal conditions, ephemeral status of waterbodies, and migration and breeding behaviours of some fauna. In many cases, these factors do not present a significant limitation to assessing the overall biodiversity values of a site.

The field survey was conducted in summer during rainy weather, which is a suitable time to determine the presence of most threatened species.

Surveys undertaken, combined with habitat assessments and desktop analysis are considered sufficient to reach the conclusions herein in regards to this and all other species' likelihood of occurrence within the study area.

Database searches, and associated conclusions on the likelihood of species to occur within the study area, are reliant upon external data sources and information managed by third parties.

Appendix 2 BAM Candidate species assessment

Table A. 1 Threatened flora species assessment

Species	Conservation status		BAM Predicted SCS	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
	EPBC	BC							
<i>Cynanchum elegans</i> White-flowered Wax Plant	E	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present, however in poor condition, not likely to support this species.	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree scrub and Forest Red Gum open forest and woodland.
<i>Haloragis exalata</i> subsp. <i>exalata</i> Square Raspwort	V	V	Yes	Moderate	Yes	Unlikely	Yes	Habitat for this species was present. Habitat included freshwater wetland areas. Targeted surveys were undertaken in January 2020; within the approved survey period for the species. This species was thoroughly searched for using targeted meanders in areas of potential habitat. . No individuals were recorded.	Requires protected and shaded damp situations in riparian habitat. It has been recorded in disturbed environments including along roadsides.
Chorizema parviflorum (population)	-	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not	All known sites of this endangered population occupy woodland or forest dominated by Forest Red

Species	Conservation status		BAM Predicted SCS	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
	EPBC	BC							
								likely to support this species.	Gum and/or Woollybutt <i>Eucalyptus longifolia</i> .
<i>Lespedeza juncea</i> subsp. <i>sericea</i> (population)	-	E	Yes	Moderate	Yes	Unlikely	Yes	Habitat for this species was present. Targeted surveys were undertaken in January 2020; within the approved survey period for the species. This species was thoroughly searched for using targeted meanders in areas of potential habitat. No individuals were recorded.	This endangered population is known from a single population of approximately 200 plants located within 6 kilometres of the subject land. It is associated with Forest Red Gum woodland, but has also been recorded within exotic grassland.
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not likely to support this species.	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.
<i>Pimelea spicata</i> Spiked Rice-flower	E	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not likely to support this species.	In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. The Illawarra populations usually occur in one of two communities - a woodland or a coastal grassland.

Species	Conservation status		BAM Predicted SCS	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
	EPBC	BC							
									Woodland sites are dominated by Forest Red Gum with a groundcover dominated by Kangaroo Grass <i>Themeda triandra</i> .
<i>Pterostylis gibbosa</i> Illawarra Greenhood	E	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Forest Red Gum woodland was present in poor condition, not likely to support this species.	All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, this species grows in woodland dominated by Forest Red Gum and Woollybutt.
<i>Wilsonia rotundifolia</i> Round-leafed Wilsonia	-	E	Yes	Low	No	Unlikely	No	Habitat was not present within the subject land. Saline or brackish environments were absent.	Grows in mud in coastal saltmarsh and inland saline or brackish lake beds.
<i>Zieria granulata</i> Illawarra Zieria	E	E	Yes	Moderate	Yes	Unlikely	Yes	Habitat for this species was present. Targeted surveys were undertaken in January 2020; within the approved survey period for the species. This species was thoroughly searched for using targeted meanders in areas of potential habitat. No individuals were recorded.	The typical habitat is dry ridge tops and rocky outcrops on shallow volcanic soils. Less frequently found on the moist slopes of the Illawarra escarpment and in low-lying areas. Associated vegetation includes Forest Red Gum woodland. Much of the natural habitat for the species has been removed and many sites now occupy road verges

Species	Conservation status		BAM Predicted SCS	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description*
	EPBC	BC							
									and paddock edge.

* Habitat descriptions have been adapted by qualified ecologists from the DEE Species Profile and Threats (SPRAT) Database, DPIE Threatened Species online profiles and the NSW Scientific Committee final determinations for listed species, references within the above table are provided within the report reference list.

Table A. 2 Threatened fauna species assessment

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
<i>Burhinus grallarius</i> Bush Stone-curlew	-	EN	Yes	Low	No	Nil	No	Bush-stone Curlew depends on vegetation with an open understorey, and fallen debris for cover and foraging. The grasslands within the study area displayed a density and height, the species requires grasslands to be patchy and sparse. The woodlands throughout the dry sclerophyll forests throughout the subject land had a thick understorey dominated by Lantana. There are no records of the Bush-stone curlew within 10 kilometres of the study area.	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber, the species is largely nocturnal, being especially active on moonlit nights, the species feed on insects and small vertebrates, such as frogs, lizards and snakes. Nests on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
<i>Calyptorhynchus lathamii</i> Glossy Black-Cockatoo	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Breeding habitat for the species consists of large hollow-bearing eucalyptus trees with a minimum diameter of 14 cm (ACT Government 2013, DPE 2017a). No hollow-bearing trees containing hollows large enough to support breeding occur within the study area.	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (<i>Allocasuarina littoralis</i>) and Forest Sheoak (<i>A. torulosa</i>) are important foods. Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill.
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	Yes	Low	No	Nil	No.	The subject land has low topographic relief, there is also no rocky areas containing caves within 2 kilometres of the study area, eliminating the study area as foraging habitat. The proposed development is unlikely to have more than a low impact on individuals utilising these resources.	Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.
<i>Heleioporus australiacus</i> Giant Burrowing Frog	V	V	Yes	Low	No	Nil	No	The species is not known to occur within previously disturbed areas with the species being absent from	Found in heath, woodland and open dry sclerophyll forest on a variety of soils except those that are clay

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								agricultural land. It has also been reported as being potentially unwilling or unable to burrow into soil covered by grasses and crops (Penman, Mahony, & F Lemckert 2004). Impacts to the remnant woodland vegetation within the study area are minor and these areas are considered to be too isolated to be utilised by frogs dispersing from breeding areas.	based. Breeding habitat of this species is generally soaks or pools within first of second order streams. With a home range of approximately 0.4 hectares.
<i>Isoodon obesulus</i> <i>obesulus</i> Southern Brown Bandicoot (eastern)	EN	EN	Yes	Low	No	Nil	No – lacks required habitat.	The habitat assessment did not identify any suitable habitat features (i.e. intact heath understorey) for Southern Brown Bandicoot within the subject land or study area.	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.
<i>Lathamus discolor</i> Swift Parrot	CE	EN	Yes	Low	No	Nil	No – not mapped as important habitat by OEH.	The habitat assessment did not identify the presence of lerp within the subject land or study area. However, the species may be encountered in the area foraging during winter migratory efforts.	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
									grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.
<i>Limicola falcinellus</i> Broad-billed Sandpiper	-	V	Yes	Low	No	Nil	No – not mapped as important habitat by OEH.	The study area was over 2 kilometres from harbours, embayments, lagoons and sandbank, no potential habitat for foraging was found within the subject lands. Therefore minimal to no impact on the species will occur.	Occurs in sheltered parts of coasts, such as estuaries, harbours, embayments and lagoons, which have shell or sandbanks nearby.
<i>Limosa limosa</i> Black-tailed Godwit	-	V	Yes	Low	No	Nil	No – not mapped as important habitat by OEH.	Black-tailed Godwit forages in sheltered bays, estuaries, and lagoons, sometimes found in wet fields. Roosting on low banks of mud, sand and shell bars. None of these landforms are present in the study area. There is a small depression toward the western extent of the study area, but this is choked with dense vegetation and is 3 kilometres from any coastal estuary.	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the coast, and inland, it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
<i>Litoria aurea</i> Green and Golden Bell Frog	V	EN	Yes	Medium	Yes	Nil	Yes – targeted surveys were undertaken, no species were found.	Green and Golden Bell Frogs have been recorded within 2 kilometres of the study area, but the few watercourses and waterbodies found within the subject land are choked with vegetation, have no connectivity to areas considered to be good habitat. The Green and Golden Bell frog prefers waterbodies that provide small amounts of vegetation that are unshaded and have nearby rocks to bask in the diurnal sun (Pyke & White 1996). These features were not displayed within any of the potential watercourses.	The species is found in marshes, dams and stream sides, particularly those containing bullrushes or spikerushes. Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks, although the species has also been recorded from highly disturbed areas including disused industrial sites, brick pits, landfill areas and cleared land. Breeding usually occurs in summer. Tadpoles, which take approximately 10-12 weeks to develop, feed on algae and other vegetative matter. Adults eat insects as well as other frogs, including juveniles of their own species.
<i>Lophoictinia isura</i> Square-tailed Kite	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required	Square-tailed Kite will breed within large eucalypts located near waterbodies, or watercourses for foraging resources. None of the preferred vegetation types were discovered within the study area. One stick nest was	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by <i>Eucalyptus longifolia</i> , <i>Corymbia maculata</i> , <i>E. elata</i> ,

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
							habitat.	discovered within the subject land but it did not support the correct breeding requirements for the species and was located next to a heavily trafficked highway, that was over 2-3 kilometres from any watercourse or waterbody.	or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km ² . They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.
<i>Hieraaetus morphnoides</i> Little Eagle	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Little Eagle will breed on a watercourse or scrub mallee (Michael Morcombe 2002) for foraging resources. One stick nest was discovered within the subject land but it did not support the correct breeding requirements as it was too small for the species and was located next to a heavily trafficked highway.	The Little Eagle is most abundant in lightly timbered areas with open areas nearby providing an abundance of prey species. It has often been recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas. The Little Eagle nests in tall living trees within farmland, woodland and forests.
<i>Calidris ferruginea</i> Curlew Sandpiper	CE	EN	Yes	Low	No	Nil	No – No important habitat mapped by OEH.	Suitable habitat was not present within the study area. No wetland, inland lakes or lagoons occurred within the study area. Farm dams may	Inhabits sheltered intertidal mudflats. Also non-tidal swamps, lagoons and lakes near the coast. Infrequently recorded inland.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								occasionally support visitations by individuals but would not support a population.	
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	White-bellied Sea-eagle nests on cliff ledge, headland or top of large tree near coast or river. Nests usually insight of water. None of the breeding requirements have been found within the study area. Forages along beaches, swamp, floodplains, mangroves and lagoons, breeding pairs scares around major coastal cities (Michael Morcombe 2002).	A migratory species that is generally sedentary in Australia, although immature individuals and some adults are dispersive. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes. It hunts over open terrestrial habitats. Feeds on birds, reptiles, fish, mammals, crustaceans and carrion. Roosts and makes nest in trees.
<i>Miniopterus australis</i> Little Bent-winged Bat	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	The subject land did not contain any habitat features suitable for roosting (i.e. culverts, caves, tunnels or tree hollows). The species may utilise the subject land for foraging on occasion, travelling from higher quality habitats.	Occurs from Northern Queensland to the Hawkesbury River near Sydney. Roost sites encompass a range of structures including caves, tunnels and stormwater drains. Young are raised by the females in large maternity colonies in caves in summer.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
									Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. The Little Bentwing bat forages for small insects (such as moths, wasps and ants) beneath the canopy of densely vegetated habitats.
<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	The subject land did not contain any habitat features suitable for roosting (i.e. culverts, caves, tunnels or tree hollows). The species may utilise the subject land for foraging on occasion, travelling from higher quality habitats.	Occurs from Victoria to Queensland, on both sides of the Great Dividing Range. Forms large maternity roosts (up to 100,000 individuals) in caves and mines in spring and summer. Individuals may fly several hundred kilometres to their wintering sites, where they roost in caves, culverts, buildings, and bridges. They occur in a broad range of habitats including rainforest, wet and dry sclerophyll forest, paperbark forest and open grasslands. Has a fast, direct flight and forages for flying insects (particularly moths) above the tree canopy and along waterways.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
<i>Myotis macropus</i> Southern Myotis	-	V	Yes	Low	No	Nil	No – no required habitat found within study area.	Southern Myositis colonies will roost in caves, bridges, tree hollows or tunnels. None of the watercourses or waterbodies within the subject land had habitat connectivity to the species breeding requirements. All water bodies were choked with vegetation limiting foraging efforts.	Scattered, mainly coastal distribution extending to South Australia along the Murray River. Roosts in caves, mines or tunnels, under bridges, in buildings, tree hollows, and even in dense foliage. Colonies occur close to water bodies, ranging from rainforest streams to large lakes and reservoirs. They catch aquatic insects and small fish with their large hind claws, and also catch flying insects.
<i>Neophema chrysogaster</i> Orange-bellied Parrot	CE	CE	Yes	Low	No	Nil	No	The Orange-bellied Parrot requires sheltered habitats, no more than 3 kilometres from the coast, these include; bays, lagoons, estuaries, coastal dunes and saltmarshes, none of which are present within the subject land, closest records are near Shellharbour, some 15 kilometres away near wetlands and saltmarshes.	A single breeding population of fewer than 200 individuals occurs in a narrow coastal strip of south-west Tasmania. Adult birds depart Tasmania for the mainland in February. The first adults begin leaving the mainland for Tasmania in September with the last birds having departed by November. It is a coastal species inhabiting saltmarshes, sedgeplains, coastal dunes, pastures, shrublands and moorlands, generally within 10 km of the coast.

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
<i>Ninox strenua</i> Powerful Owl	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Living or dead trees with hollows greater than 20cm diameter are required for breeding habitat. The study area and subject land do not provide suitable roosting habitat for Powerful Owl. The species may utilise the study area for opportunistic foraging	The Powerful Owl occupies wet and dry eucalypt forests and rainforests. It may inhabit both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm. It has a large home range of between 450 and 1450 ha.
<i>Pandion cristatus</i> Eastern Osprey	-	V	Yes	Low	No	Nil	No – mapped as not important habitat from OEH.	Eastern Osprey requires breeding habitat near the sea, nests are located within view of the coastline on headlands coastal cliffs and estuaries with close proximity to the coast. Generally builds nests in dead	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found 100 km inland along larger rivers. It is water-dependent, hunting for fish in clear, open water. The Osprey occurs in

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								trees. None of the breeding habitat features were found within the study area.	terrestrial wetlands, coastal lands and offshore islands. It is a predominantly coastal species, generally using marine cliffs as nesting and roosting sites. Nests can also be made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.
<i>Petaurus norfolcensis</i> Squirrel Glider	-	V	Yes	Low	No	Nil	No – no required habitat found within study area.	Squirrel glider prefers Blackbutt-Bloodwood forest with a heath understorey and an acacia midstorey. The species requires hollow abundant vegetation for refuge or breeding sites, no hollows were discovered within the study area.	Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range. Requires abundant hollow-bearing trees and a mix of eucalypts, banksias and acacias. Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked.
<i>Phascolarctos cinereus</i> Koala	V	V	Yes	Low	No	Nil	No – no required habitat found within	The small patch of Forest Red Gum vegetation has poor connectivity to its surrounds isolated by the heavily trafficked highway and the	In NSW the Koala mainly occurs on the central and north coasts with some populations in the western region. Koalas feed almost

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
							study area.	Nien-Tien Temple, the understorey is made up of dense lantana. The closest Koala record is in Cordeaux Heights approximately 4 kilometres away and is over 10 years old.	exclusively on eucalypt foliage, and their preferences vary regionally. Primary feed trees include Eucalyptus robusta, E. tereticornis, E. punctata, E. haemostoma and E. signata. They are solitary with varying home ranges.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	Grey-headed Flying fox is a nomadic species. No camps (communal breeding/roosting sites) were identified during the habitat assessment although there is a known camp within 5 kilometres of the study area, The study area did not contain the preferred vegetation needed for foraging. The proposed development is unlikely to significantly impact on foraging resources within the area.	Occurs along the NSW coast, extending further inland in the north. This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Roosts in large colonies, commonly in dense riparian vegetation.
<i>Sminthopsis leucopus</i> White-footed Dunnart	EN	EN	Yes	Low	No	Nil	No – no required habitat found within study area	White-footed Dunnart requires vegetation with an open understorey, fallen timber and ground debris. The study area displayed minimal areas where these attributes had aligned. There has been no recorded	The White-footed Dunnart is found in a range of different habitats across its distribution, including coastal dune vegetation, coastal forest, tussock grassland and sedge land, heathland,

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								sightings of the species within 10 kilometres of the study area.	woodland and forest. They shelter in bark nests in hollows under standing or fallen timber, burrows in the ground, piles of logging debris, in the 'skirts' of grass trees <i>Xanthorrhoea</i> spp. and cycads <i>Macrozamia</i> spp. and rock crevices
<i>Tyto novaehollandiae</i> Masked Owl (Breeding)	-	V	Yes	Low	No	Nil	No – classed as an ecosystem credit due to the absence of required habitat.	The Masked owl breeds in moist eucalypt forests and woodlands, the species relies on medium sized hollows with close proximity to open habitat, for foraging, no hollows were found near the farmlands, grasslands to the western extent of the study area. The Masked owl has a home range of approximately 500 – 100 hectares. The study area's invasive footprint would have minimal to no impact on the species foraging resources.	The Masked Owl is found in range of wooded habitats that provide tall or dense mature trees with hollows suitable for nesting and roosting. It is mostly seen in open forests and woodlands adjacent to cleared lands. Prey includes hollow-dependent arboreal marsupials and terrestrial mammals.
<i>Anthochaera phrygia</i> Regent Honeyeater (Important)	-	V	Yes	Low	No	Nil	No - No mapped as not important habitat by	No vegetation within the subject land is suitable for nesting/breeding habitat. Furthermore, there are only four known key breeding	Regent Honeyeaters are semi-nomadic, occurring in temperate eucalypt woodlands and open forests. Most records are from box-

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
areas)							OEH.	regions remaining: north-east Victoria (Chiltern area), and in NSW at Bundarra-Barraba, Capertee Valley and the Hunter Valley districts (Commonwealth of Australia 2016). The subject land is not designated within these important habitat areas. Key foraging eucalypt species utilised for foraging were also absent from the study area.	ironbark eucalypt forest associations and wet lowland coastal forests. Nectar and fruit from mistletoes are also eaten. This species usually nest in tall mature eucalypts and sheoaks.
<i>Xenus cinereus</i> Terek Sandpiper	CE	CE	Yes	Low	No	Nil	No - No mapped as not important habitat by OEH.	The Terek Sandpiper has two main breeding sites both of which are located on the central coast of NSW. The Terek Sandpiper favours estuaries, embayments and lagoons all of which are not found within the study area.	Mainly found on saline intertidal mudflats in sheltered estuaries, embayments, harbours and lagoons.
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo (Breeding)	-	V	Yes	Low	No	Nil	No - No supportive habitat found within the study area.	Breeding habitat for the species consists of old-growth or mature eucalyptus forest and woodlands with hollows at least 10 cm in diameter, 9 m above the ground. No hollow-bearing trees containing hollows large enough to support breeding occur within the study area (DPE 2017b, DPE	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more

Species	Conservation status		Predicted species credit species	Potential occurrence in subject land	Survey required/undertaken	Potential for impact	BAM Candidate species	Candidate species rationale	Habitat description
	EPBC	BC							
								2018).	open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.

Appendix 3 Flora

Appendix 3.1 BAM plot field data

Table A. 3 Flora species recorded in the study area from BAM plots

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
<i>Acacia mearnsii</i>	Black Wattle									N	20	10	C				
<i>Ageratina adenophora</i>	Crofton Weed									E	1	10	G				
<i>Allocasuarina littoralis</i>	Forest SheOak					N	3	2	M								
<i>Araujia sericifera</i>	Moth Vine	HTE	0.1	5	G	HTE	0.1	1	G	HTE	2	40	G				
<i>Aster subulatus</i>	Wild Aster													E	0.1	20	G
<i>Bidens pilosa</i>	Cobbler's Pegs	E	1	50	G												
<i>Bolboschoenus fluviatilis</i>	Marsh Club-rush													N	5	50	G
<i>Carex appressa</i>	Tall Sedge									N	20	10	G	N	75	100	G
<i>Casuarina glauca</i>	Swamp Oak	N	90	100	C												
<i>Celtis sinensis</i>	Chinese Celtis	E	0.5	2	M	E	10	30	M								
<i>Cenchrus clandestinus</i>	Kikuyu	E	0.5	10	G					HTE	5	20	G				
<i>Centaurium erythraea</i>	Common Centaury													E	0.1	20	G
<i>Centella asiatica</i>	Indian Pennywort													N	0.1	30	G

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
<i>Conyza bonariensis</i>	Fleabane													E	0.1	5	G
<i>Corymbia maculata</i>	Spotted Gum					N	20	8	C								
<i>Cupaniopsis anacardioides</i>	Tuckeroo	N	0.1	1	M												
<i>Cynodon dactylon</i>	Couch													N	5	30	G
<i>Cyperus brevifolius</i>	Mullumbimby Couch													E	1	20	G
<i>Dichondra repens</i>	Kidney Weed	N	0.1	40	G	N	0.5	20	G	N	0.5	50	G				
<i>Ehrharta erecta</i>	Panic Veldt Grass					HTE	1	30	G								
<i>Einadia hastata</i>	Berry Saltbush	N	0.1	10	G												
<i>Eucalyptus tereticornis</i>	Forest Red Gum					N	15	3	C								
<i>Geitonoplesium cymosum</i>	Scrambling Lily					G	0.1	1	G								
<i>Gratiola</i> spp.	Hedgehyssop													N	0.1	50	G
<i>Hypochaeris radicata</i>	Catsear													E	0.1	10	G
<i>Juncus kraussi</i>	Common Rush													N	2	30	G
<i>Lantana camara</i>	Lantana	HTE	15	50	M	HTE	10	30	M	HTE	20	20	M				
<i>Ligustrum sinense</i>	Small-leaved Privet					HTE	0.1	2	M	HTE	0.1	3	M				
<i>Lycium ferocissimum</i>	African Boxthorn													HTE	2	30	M
<i>Microlaena stipoides</i>	Weeping Grass	N	1	30	G					N	25	200	G				

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
<i>Ochna serrulata</i>	Mickey Mouse Plant					E	3	20	G								
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive					HTE	8	20	M								
<i>Oplismenus aemulus</i> var. <i>aemulus</i>	Basket Grass					N	0.1	10	G								
<i>Pandorea pandorana</i>	Wonga Wonga Vine					N	1	10	G	N	0.5	30	G				
<i>Paspalum dilatatum</i>	Paspalum													HTE	15	50	G
<i>Phalaris aquatica</i>	Bulbous Canary-grass									E	0.1	5	G	E	1	20	G
<i>Pittosporum undulatum</i>	Sweet Pittosporum					N	10	10	M	N	0.1	3	M				
<i>Plantago lanceolata</i>	Lamb's Tongues													E	0.2	40	G
<i>Ranunculus</i> spp.	Buttercup													-	0.1	30	G
<i>Rubus fruticosus</i> sp. agg.	Blackberry									HTE	5	20	M	HTE	20	10	M
<i>Rumex crispus</i>	Curled Dock													E	2	10	G
<i>Sida rhombifolia</i>	Paddy's Lucerne					E	1	50	G	E	0.1	10	G				
<i>Tagetes minuta</i>	Stinking Roger																
<i>Trifolium repens</i> var. <i>repens</i>	White Clover													EE	0.1	50	G

Scientific name	Common name	Plot 1				Plot 2				Plot 3				Plot 4			
		N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum	N. E or HTE	Cover	Abundance	Stratum
<i>Typha orientalis</i>	Cumbungi													N	2	10	G
<i>Verbena bonariensis</i>	Purpletop									E	0.1	2	G	E	1	10	G

Appendix 4 Fauna

Table A. 4 Fauna species recorded at the subject land

Common name	Scientific name
Mammals	
European Hare	<i>Lepus europaeus</i>
Birds	
Australian Raven	<i>Corvus coronoides</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Brown Treecreeper	<i>Climacteris picum</i>
Letter-winged Kite	<i>Elanus scriptus</i>
Rufous Whistler	<i>Pachycephala rufiventris</i>
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>
Spotted turtle-dove	<i>Streptopelia chinensis</i>
Noisy Miner	<i>Manorina melanocephala</i>
Striated Pardalote	<i>Pardalotus striatus</i>
Australian Magpie	<i>Cracticus tibicen</i>
Welcome Swallow	<i>Hirundo neoxena</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
Amphibians	
Eastern Froglet	<i>Crinia signifera</i>

Appendix 5 Plates



Plate 1 Planted native vegetation - monoculture of Swamp Oak



Plate 2 Planted native vegetation adjacent to the Princes motorway