

# **Appendix J Biodiversity Development Assessment Report (BDAR)**





Upper South Creek  
Advanced Water Recycling Centre  
Biodiversity Development Assessment Report

FINAL REPORT

Prepared for Sydney Water

24 September 2021

## Biosis offices

### NEW SOUTH WALES

#### Albury

Phone: (02) 6069 9200

Email: [albury@biosis.com.au](mailto:albury@biosis.com.au)

#### Newcastle

Phone: (02) 4911 4040

Email: [newcastle@biosis.com.au](mailto:newcastle@biosis.com.au)

#### Sydney

Phone: (02) 9101 8700

Email: [sydney@biosis.com.au](mailto:sydney@biosis.com.au)

#### Western Sydney

Phone: (02) 9101 8700

Email: [sydney@biosis.com.au](mailto:sydney@biosis.com.au)

#### Wollongong

Phone: (02) 4201 1090

Email: [wollongong@biosis.com.au](mailto:wollongong@biosis.com.au)

### VICTORIA

#### Ballarat

Phone: (03) 5304 4250

Email: [ballarat@biosis.com.au](mailto:ballarat@biosis.com.au)

#### Melbourne

Phone: (03) 8686 4800

Email: [melbourne@biosis.com.au](mailto:melbourne@biosis.com.au)

#### Wangaratta

Phone: (03) 5718 6900

Email: [wangaratta@biosis.com.au](mailto:wangaratta@biosis.com.au)

## Document information

**Report to:** Sydney Water

**Prepared by:** Callan Wharfe  
Matthew Hyde  
Nicola Trulock

**Accredited Assessor:** Callan Wharfe BAAS18138

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## Glossary

<b>BAM</b>	NSW Biodiversity Assessment Method
<b>BC Act</b>	NSW <i>Biodiversity Conservation Act 2016</i>
<b>BDAR</b>	Biodiversity Development Assessment Report
<b>Biosecurity Act</b>	NSW <i>Biosecurity Act 2015</i>
<b>BOS</b>	Biodiversity Offsets Scheme
<b>CEEC</b>	Critically Endangered Ecological Community
<b>CEMP</b>	Construction Environmental Management Plan
<b>CM Act</b>	<i>Coastal Management Act 2016</i>
<b>Coastal Management SEPP</b>	NSW State Environmental Planning Policy (Coastal Management) 2018
<b>CSSI</b>	Critical State Significant Infrastructure
<b>DA</b>	Development Application
<b>DBH</b>	Diameter at Breast Height
<b>DCDB</b>	Digital cadastral database
<b>DAWE</b>	Commonwealth Department of Agriculture, Water and Environment
<b>DoIW</b>	Directory of Important Wetlands
<b>DPIE</b>	NSW Department of Planning Industry and Environment
<b>DPI</b>	NSW Department of Primary Industries
<b>DTDB</b>	Digital topographic databases
<b>Ecosystem credit species</b>	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.
<b>EIS</b>	Environmental Impact Statement
<b>EP&amp;A Act</b>	NSW <i>Environmental Planning and Assessment Act 1979</i>
<b>EPBC Act</b>	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
<b>EES</b>	NSW Environment, Energy and Science Group
<b>GDE</b>	Groundwater Dependent Ecosystem
<b>GIS</b>	Geographic Information System
<b>IBRA</b>	Interim Biogeographic Regionalisation of Australia
<b>Impact area</b>	The area of direct impact resulting from the construction of the project.



<b>Impact assessment area</b>	Generally a 25 metre buffer of the impact area. This area has been broadly assessed for indirect impacts associated with the project, as well as to provide flexibility for potential future design refinements.
<b>LEP</b>	Local Environmental Plan
<b>LGA</b>	Local Government Area
<b>Locality</b>	Area located within 10 kilometres radius from the impact assessment area
<b>LPI</b>	NSW Land and Property Information
<b>MNES</b>	Matters of National Environmental Significance protected by a provision of Part 3 of the EPBC Act
<b>NSW</b>	New South Wales
<b>PCT</b>	Plant Community Type
<b>Project</b>	The Upper South Creek Advanced Water Recycling Facility and associated pipeline alignments
<b>Reference design</b>	Water Recycling Centre site at Kemps Creek, and associated pipeline alignments spanning from Warragamba to Wallacia, sized to treat an average dry weather flow of up to 100 Mega Litres (ML) per day, and to transport and release the equivalent volume through the pipelines.
<b>SALIS</b>	NSW Soil and Land Information System
<b>SEARS</b>	Secretary's Environmental Assessment Requirements
<b>SEPP</b>	NSW State Environmental Planning Policy
<b>SIS</b>	Species Impact Statement
<b>Species credit species</b>	A species credit species is one which cannot be reliably predicted by surrogate indicators such as presence of plant community type or other habitat constraints.
<b>SSI</b>	State Significant Infrastructure
<b>Study area</b>	The broader area in which the impact area and impact assessment area is located, including all areas of direct and indirect impact, and larger areas to provide context to the project.
<b>Subject land</b>	The area of direct impact for the proposed development, synonymous with impact area as defined above
<b>SWGC</b>	South West Growth Centre
<b>TEC</b>	Threatened Ecological Community
<b>USC AWRC</b>	Upper South Creek Advanced Water Recycling Centre
<b>WM Act</b>	NSW <i>Water Management Act 2000</i>
<b>WSAGA</b>	Western Sydney Aerotropolis Growth Area

## Certification and Declarations

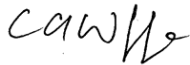
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I certify that this report has been prepared on the basis of the requirements of, and information provided under, the Biodiversity Assessment Method (DPIE 2020a) and s6.15 of the *Biodiversity Conservation Act 2016*.

In preparing this assessment I have acted in accordance with the Accredited BAM Assessor Code of Conduct.

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest.

**Signature:** Callan Wharfe



**Date:** 24 September 2021

**BAM Assessor Accreditation Number:** BA18138



## Executive summary

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Sydney Water is planning to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas. The proposed development will include a wastewater treatment plant in Western Sydney, known as the Upper South Creek Advanced Water Recycling Centre (AWRC). Together, this Water Recycling Centre and the associated treated water and brine pipelines, are referred to as, the project.

The project has been declared State Significant Infrastructure (SSI) with the Environmental Impact Statement (EIS) to be prepared by Sydney Water in accordance with the project specific *Secretary's Environmental Assessment Requirements* (SEARs SSI - 8609189) updated on 28 January 2021. As such the New South Wales (NSW) Biodiversity Offset Scheme (BOS) applies and a BDAR (this assessment), prepared by a NSW Biodiversity Assessment Method (BAM) Accredited Assessor, is required.

The project was declared a controlled action on 03 December 2020, with threatened species and ecological communities, migratory species, World Heritage properties and National Heritage places deemed the relevant 'controlling provisions' (EPBC Act referral 2020/8816). The project will be assessed under the Bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment between the Commonwealth of Australia and the State of NSW.

On 22 October 2020 the BAM (OEH 2017a) was updated and the BAM (DPIE 2020a) came into force. As such, this BDAR has been wholly prepared in accordance with BAM (DPIE 2020a)

The project comprises the following major components:

- A wastewater treatment plant with the capacity to treat up to 50 ML of wastewater per day, with ultimate capacity of up to 100 ML per day.
- A pipeline about 17 kilometre long from the AWRC to the Nepean River at Wallacia Weir, for the release of treated water.
- Infrastructure from the AWRC to release to excess treated water and wet weather flows South Creek.
- A pipeline about 5 kilometre long from the main treated water pipeline at Wallacia to a location between the Warragamba Dam and Warragamba Weir.
- A pipeline about 24 kilometre long that transfers brine from the AWRC to Lansdowne, in south-west Sydney, where it connects to Sydney Water's existing Malabar wastewater network.

The BAM (DPIE 2020a) was applied to the project to assess the landscape and site context, native vegetation and threatened species habitat present and potentially impacted. Desktop and field-based investigations were undertaken between February 2020 and January 2021 and involved a process of ongoing refinement of the project area and assessment of the biodiversity values present. Initial assessments included high level biodiversity constraints assessment and mapping to help define the project alignment, following by design workshops where biodiversity values were considered and avoided where possible. Fieldwork commenced based on the 50% design, which included confirmation of detailed desktop mapping of NSW Plant Community Types (PCTs), collection of BAM floristic plots, and habitat assessments targeting threatened flora and fauna species considered likely to occur. As design work progressed through to the 100% project design, field investigations were ongoing and included; PCT identification and distribution, completion of BAM plots, torted flora surveys for BAM candidate species in winter and spring 2020, and targeted survey for a range of BAM candidate fauna species between mid-2020 and January 2021.

The following PCTs were recorded as present within the project's impact area in a range of ecological condition states, noting some of the PCTs occur within Existing Certified lands in the South West Growth Centre and are therefore not the subject of impact assessment for this project. PCTs include:

- 724: Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion .
- 725: Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain.
- 781: Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion.
- 835: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion.
- 849: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion.
- 883: Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion.
- 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion.
- 1105: River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion.
- 1181: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion.
- 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley.

A number of threatened ecological communities listed under the NSW *Biodiversity Conservation Act 2016* (BC Act), and/or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were also recorded. These include:

- Cumberland Plain Woodland in the Sydney Basin Bioregion (BC Act - CEEC) (Cumberland Plain Woodland).
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (BC Act - EEC) (Freshwater wetlands on coastal floodplains).
- River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act - EEC) (River-flat Eucalypt Forest).
- Shale Gravel Transition Forest in the Sydney Basin Bioregion (BC Act - EEC) (Shale Gravel Transition Forest).
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (BC Act - EEC) (Swamp Oak Floodplain Forest).
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion (BC Act - EEC) (Cooks River/Castlereagh Ironbark Forest).
- Coastal Swamp Oak *Casuarina glauca* Forest of New South Wales and South East Queensland ecological community (EPBC Act - EEC) (Coastal Swamp Oak Forest).
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act - CEEC).
- Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion (EPBC Act - CEEC).



Following efforts undertaken to avoid and minimise impacts to biodiversity during the design phase of the project, residual unavoidable impacts to BC Act and EPBC Act listed biodiversity values, and PCTs providing habitat to listed threatened species, were reduced to the following direct impact as outlined in Table 1.

**Table 1 Biodiversity values impacted and total credit requirement**

Biodiversity value	Area (ha) / Count (indiv.)	Credit requirement
<b>Native vegetation (PCTs) – Ecosystem credits</b>		
<b>724: Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Shale Gravel Transition Forest TEC)</b>	1.58	40
<b>725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain</b>	0.01	1
<b>781: Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion (Freshwater wetlands on coastal floodplains TEC)</b>	0.02	0
<b>835: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (River-flat Eucalypt Forest TEC)</b>	4.56	162
<b>849: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Cumberland Plain Woodland TEC)</b>	4.83	117
<b>1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion</b>	1.38	19
<b>1105: River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion</b>	0.40	3
<b>1181: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion</b>	0.07	1
<b>1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Swamp Oak Floodplain Forest TEC)</b>	0.92	15
<b>Threatened species – Species credits</b>		
<b><i>Dillwynia tenuifolia</i></b>	0.05	2
<b>Downy Wattle <i>Acacia pubescens</i></b>	0.16	4
<b>Juniper-leaved Grevillea <i>Grevillea juniperina</i> subsp. <i>juniperina</i></b>	0.05	2
<b><i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population</b>	0.54	19
<b>Netted Bottle Brush <i>Callistemon linearifolius</i></b>	6 (assumed)	9
<b>Spiked Rice-flower <i>Pimelea spicata</i></b>	2.99	75
<b>Sydney Bush-pea <i>Pultenaea parviflora</i></b>	0.01	1
<b>Matted Bush-pea <i>Pultenaea pedunculata</i></b>	0.05	2

Biodiversity value	Area (ha) / Count (indiv.)	Credit requirement
Cumberland Plain Land Snail <i>Meridolum corneovirens</i>	8.96	259
Dural Land Snail <i>Pommerhelix duralensis</i>	1.45	27
Large Bent-winged Bat <i>Miniopterus orianae oceanensis</i>	1.56	41
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	3.48	137
Southern Myotis <i>Myotis macropus</i>	7.62	201

Impacts to Large-eared Pied Bat, Large Bent-winged Bat, Little Bent-winged Bat *Miniopterus australis* and Sooty Owl *Tyto tenebricosa* have been conservatively assessed as potential Serious and Irreversible Impacts (SAIL), due to direct impacts to low potential breeding habitat, and vegetation removal with the BAM prescribed breeding buffer of potential breeding habitat outside the project area. Species credit impact will not occur to Little Bent-winged Bat or Sooty Owl. Impacts to Cumberland Plain Woodland CEEC have also been assessed as potential SAIL.

A list of biodiversity related MNES considered likely, or to be at some risk of being significantly impacted by the project was provided in the revised SEARs (DPIE 2021), based on the Project Referral (Biosis 2020b) and the DAWE Reporting Tool and is provided below:

- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered).
- Regent Honeyeater *Anthochaera phrygia* (Critically Endangered).
- Swift Parrot *Lathamus discolor* (Critically Endangered).
- Macquarie perch *Macquaria australasica* (Endangered).

One additional MNES, Camden White Gum, known to occur in the vicinity of the project's impact area, and along the banks of the Nepean River where impacts associated with altered hydrology as a result of the project may occur, was also considered to be at risk of significant impact.

An assessment of impacts to EPBC Act listed Matters of National Environmental Significance (MNES) was undertaken for the suite of species and communities known and considered likely to occur within the project area. It was concluded that a significant residual impact was unlikely to occur to any MNES as a result of the project, in accordance with Significant Impact Guidelines 1.1 - Matters of National Environmental Significance (CoA 2013). As such offsetting in accordance with the EPBC Act Environmental Offsets Policy (CoA 2012) and the EPBC Act is not required.

Impacts to all MNES will however be offset in accordance with the NSW BOS through either direct establishment of Biodiversity Stewardship Sites to generate biodiversity credits to offset the project's impacts, through securing biodiversity credits from the open market, or from payment to the Biodiversity Conservation Fund.

Direct and indirect impacts have been assessed and are considered to have been reduced to an acceptable level for a project of this scale. Mitigation measures have been prescribed and Sydney Water is committed to their implementation, to ensure a reduction in impacts to biodiversity values, and to the security of the required biodiversity offsets in accordance with the NSW BOS.



# 1. Introduction

---

## 1.1 Project background

Sydney Water is planning to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas. The proposed development will include a wastewater treatment plant in Western Sydney, known as the Upper South Creek AWRC. Together, this Water Recycling Centre and the associated treated water and brine pipelines, will be known as the 'project'. An overview of the location of the proposed development is provided in Figure 1. Additional components of the project are provided below, and further described in Section 2.

Sydney Water is planning to deliver the project in stages, with Stage 1 comprising building and operating the Advanced Water Recycling Centre, and building all pipelines to their ultimate capacity.

The timing and scale of future stages will be phased to respond to drivers including population growth rate and the most efficient way for Sydney Water to optimise its wastewater systems.

## 1.2 Purpose of this assessment

The project has been declared SSI with the EIS to be prepared by Sydney Water in accordance with the project specific *Secretary's Environmental Assessment Requirements* (SEARs SSI - 8609189) updated on 28 January 2021. As such the BOS applies and a BDAR must be prepared by a BAM Accredited Assessor.

The purpose of this assessment was to apply the NSW BAM (DPIE 2020a) to the project, and provide a BDAR to support and inform the EIS for the project by addressing relevant NSW Planning SEARs.

Section 4 of this report lists the SEARs relevant to this biodiversity assessment, and where they are addressed in this report. Furthermore this BDAR will:

- Address the BAM (DPIE 2020a) 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 project.
- Consider and assess the project in accordance with other relevant legislation such as the Commonwealth EPBC Act.

The project was declared a controlled action on 03 December 2020, with threatened species and ecological communities, migratory species, World Heritage properties and National Heritage places deemed the relevant 'controlling provisions' (EPBC Act referral 2020/8816). The project will be assessed under the Bilateral agreement made under section 45 of the EPBC Act relating to environmental assessment between the Commonwealth of Australia and the State of NSW.

All biodiversity assessments have been undertaken in accordance with the BAM, and this BDAR has been prepared and reviewed by Biosis' BAM Accredited Assessors Callan Wharfe (BAAS 18138) and Nicola Trulock (BAAS 19058).

On 22 October 2020 the BAM (OEI 2017a) was updated and the BAM (DPIE 2020) came into force. However transitional arrangements, under Clause 6.31 of the *Biodiversity Conservation Regulation 2017*, are in place to

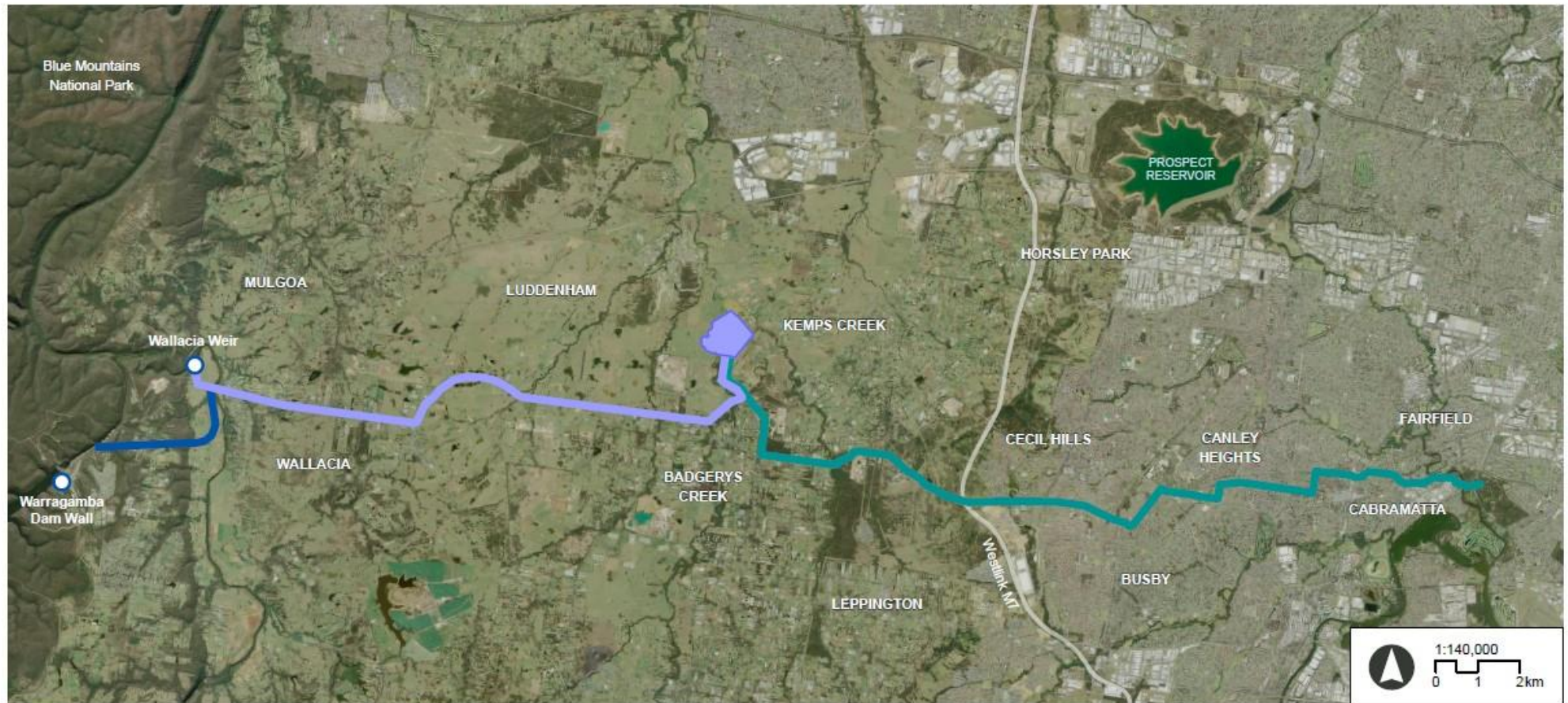
minimise the impact that amendments to the BAM may have on biodiversity assessments that were underway, such as this current assessment. These transitional arrangements allow proponents to submit a BDAR in accordance with 'BAM 2017', for a period of 12 months for state significant development or infrastructure. This transitional period has expired just before the submission of the EIS, but after the completion of the BAM assessment and BDAR, as such to ensure the currency of the assessment and report, this BDAR has been updated to meet the requirements of the BAM (DPIE 2020).

### **1.3 Impact area, impact assessment area, study area and subject land**

The following terms have been used in this BDAR:

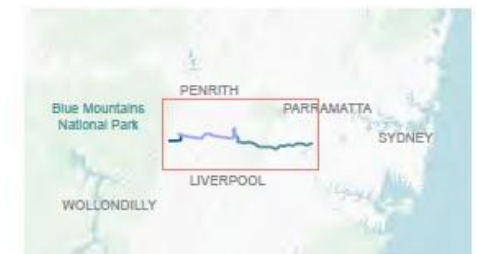
- **Impact area:** The area to be directly impacted by construction and operation of the project, including identified compound areas and access tracks. The impact area is generally 12.5 m either side of the pipeline alignments but is wider or narrower in certain areas. For the Water Recycling Centre site, this impact area comprises the entire 80 ha site.
- **Impact assessment area:** A wider area, generally 12.5 m either side of the impact area to allow for design flexibility after the EIS is approved.
- **Study area:** The broader area in which the impact area and impact assessment area is located, including all areas of direct and indirect impact, the required 500 m buffer on the impact area, and larger areas to provide context to the project.
- **Subject land:** The subject land is land to which Stage 1 of the BAM is applied to assess the biodiversity values of that land (DPIE 2020a). The subject land occurs within the study area, and within the current assessment is synonymous with the impact area, and is referred to as such throughout this BDAR.
- **Project alignment:** A general term for the pipeline route from Lansdowne to Warragamba, including the AWRC site, and all ancillary areas and access tracks.

Figure 2 and Figure 3 display the extent of the impact area and impact assessment area for the project.

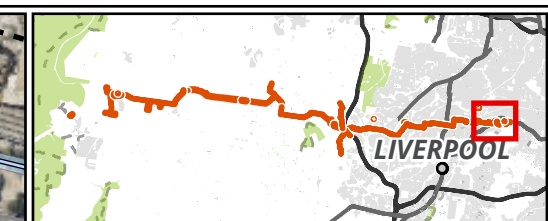


- Upper South Creek Advanced Water Recycling Centre
- Treated Water Pipeline
- Brine Pipeline
- Environmental Flows Pipeline

Projection: GDA 1994 MGA Zone 56  
 Project infrastructure locations are indicative and will be refined during design







- Legend**
- Impact assessment area
  - Impact area
  - Underbore
  - Biodiversity Stewardship Sites
  - Cumberland Plain Priority Conservation Lands
  - Riparian buffers - Local wetlands
  - Local wetlands
  - Riparian buffers- Estuaries
  - Estuaries
  - Coastal Wetlands
  - Coastal Wetlands Proximity Area
  - IBRA Region/Sub-region
- HydroLine stream order**
- 1
  - 3
  - 4-5
  - 6-9
- HydroLine stream order buffers**
- 1
  - 3
  - 4
  - 5
  - 7

**Figure 2.1 Site map**

0 80 160 240 320 400

Metres

Scale: 1:10,000 @ A3

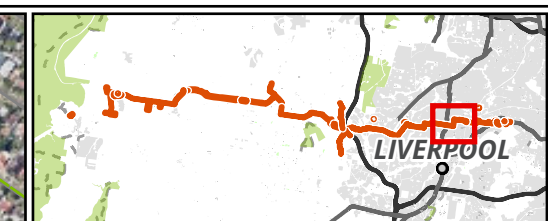
Coordinate System:

PCS: GDA 1994 MGA Zone 56



Matter: 31617, SSK  
 Date: 24 September 2021,  
 Prepared for: CW, Prepared by: SSK, Last edited by: Iharley  
 Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020





**Legend**

- Impact assessment area
- Impact area
- Underbore
- Riparian buffers- Estuaries
- Estuaries
- Coastal Wetlands
- Coastal Wetlands Proximity Area
- IBRA Region/Sub-region

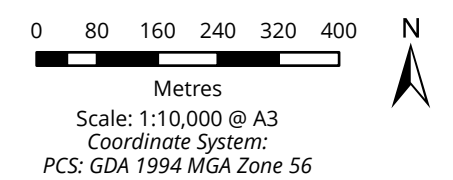
**HydroLine stream order**

- 1
- 2
- 3
- 4-5

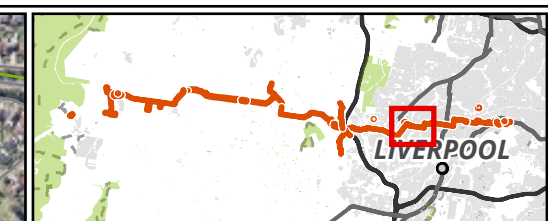
**HydroLine stream order buffers**

- 1
- 2
- 3
- 5

Figure 2.2 Site map







**Legend**

- Impact assessment area
- Impact area
- Underbore
- Coastal Wetlands
- Coastal Wetlands Proximity Area
- IBRA Region/Sub-region

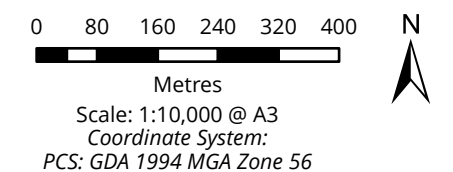
**HydroLine stream order**

- 1
- 2
- 3

**HydroLine stream order buffers**

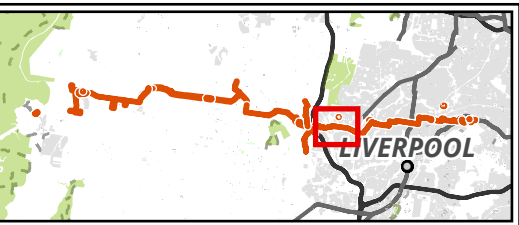
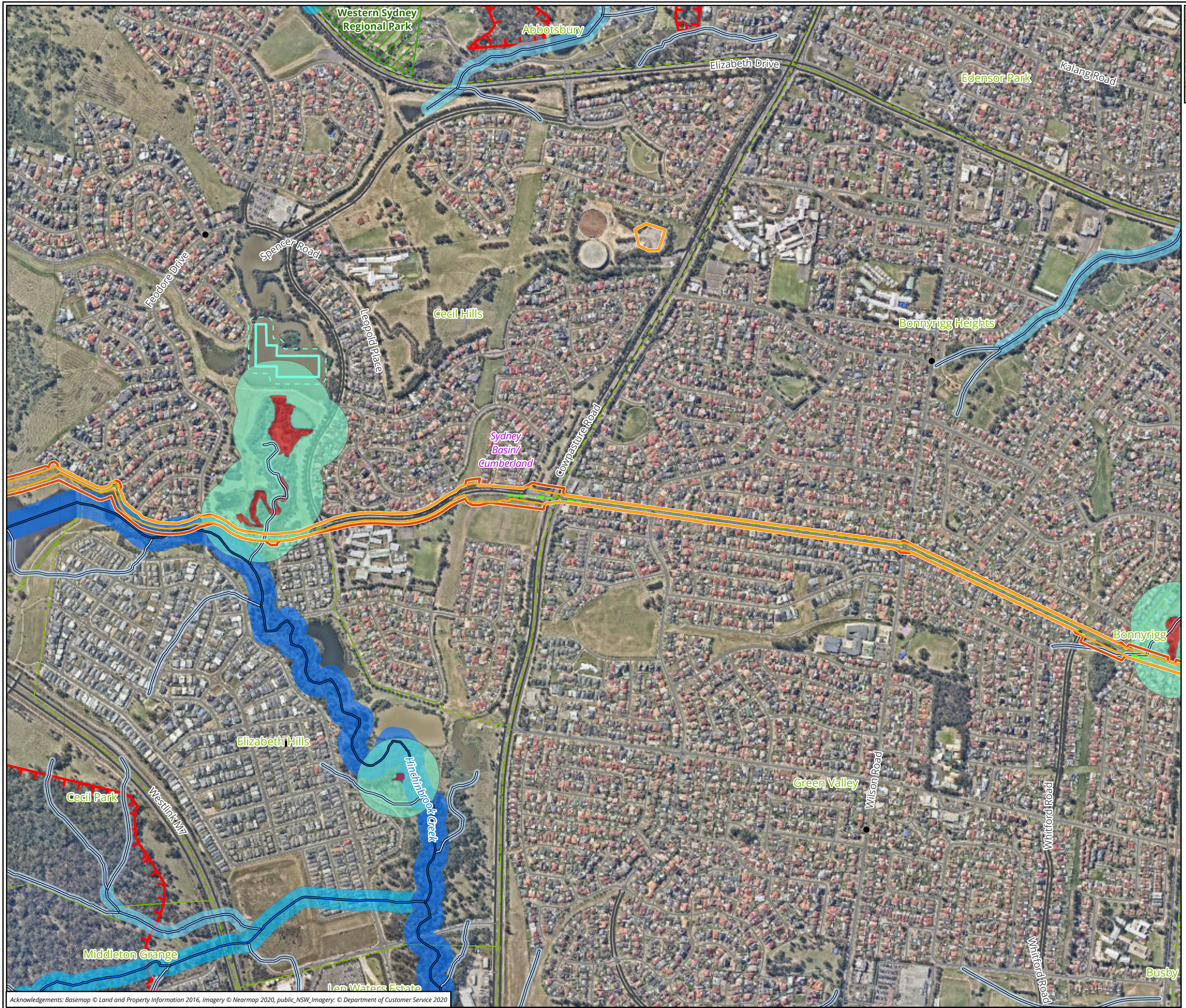
- 1
- 2
- 3

**Figure 2.3 Site map**



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**Legend**

- Impact assessment area
- Impact area
- Underbore
- Cumberland Plain Priority Conservation Lands
- Riparian buffers - Local wetlands
- Local wetlands
- Coastal Wetlands
- Coastal Wetlands Proximity Area
- IBRA Region/Sub-region

**HydroLine stream order**

- 1
- 2
- 3
- 4-5

**HydroLine stream order buffers**

- 1
- 2
- 3
- 4

**Figure 2.4 Site map**

0 80 160 240 320 400  
Metres

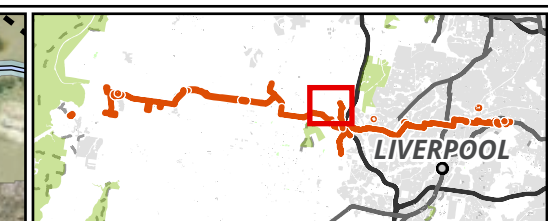
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Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020

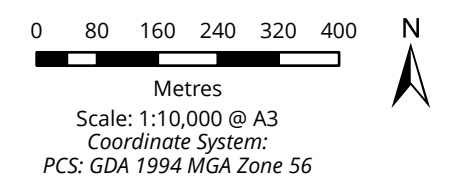
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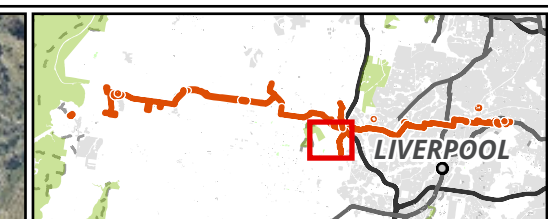
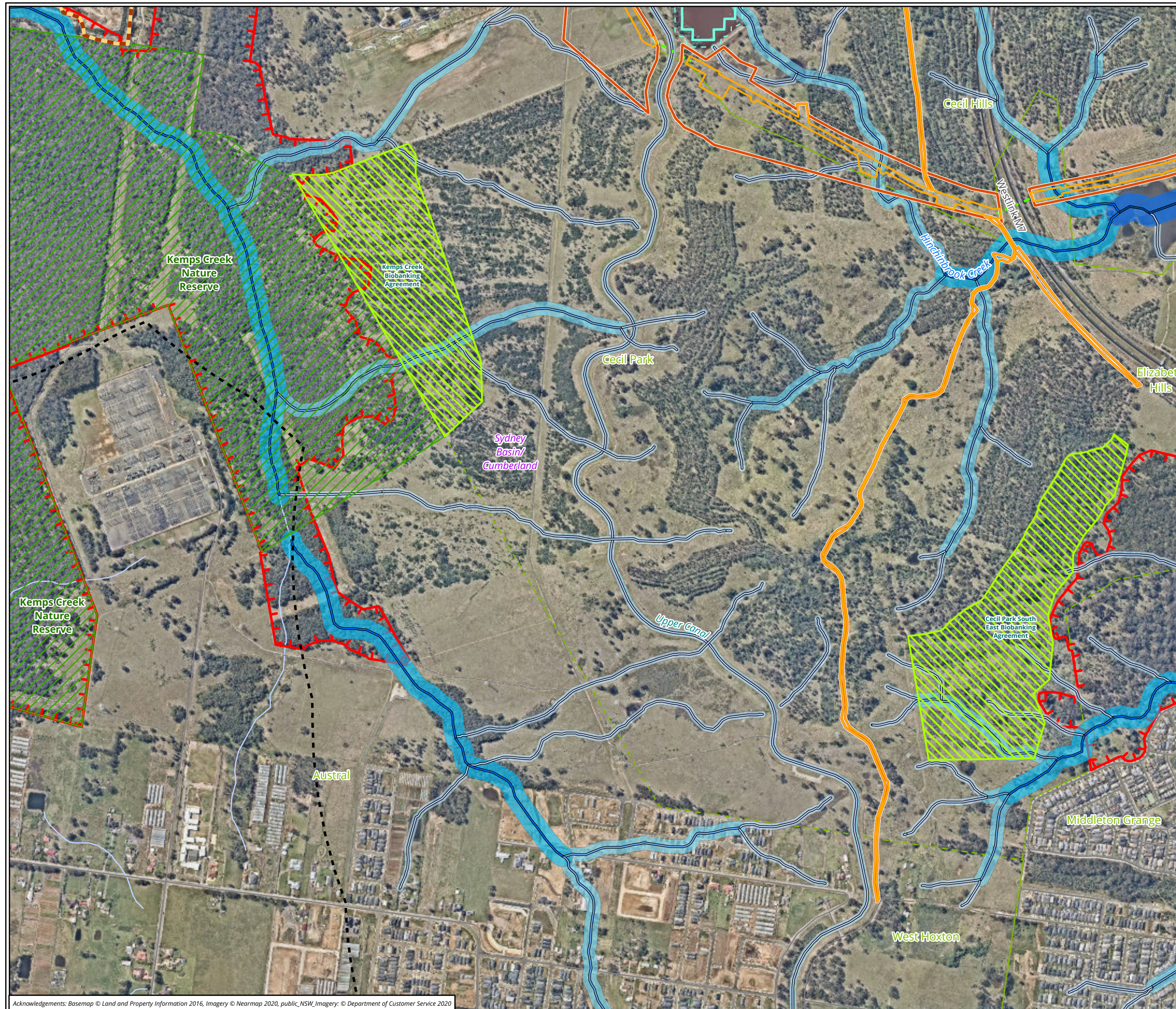
- Legend**
- Impact assessment area
  - Impact area
  - Underbore
  - Biodiversity Stewardship Sites
  - Cumberland Plain Priority Conservation Lands
  - Riparian buffers - Local wetlands
  - Local wetlands
  - ExcavationFace
  - IBRA Region/Sub-region
- HydroLine stream order**
- 1
  - 2
  - 3
- HydroLine stream order buffers**
- 1
  - 2
  - 3

**Figure 2.5 Site map**



Matter: 31617, SSK  
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Prepared for: CW, Prepared by: SSK, Last edited by: Iharley  
Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020





**Legend**

- Impact assessment area
- Impact area
- Underbore
- Biodiversity Stewardship Sites
- Cumberland Plain Priority Conservation Lands
- Riparian buffers - Local wetlands
- Local wetlands
- ExcavationFace
- IBRA Region/Sub-region

**HydroLine stream order**

- 1
- 2
- 3
- 4-5

**HydroLine stream order buffers**

- 1
- 2
- 3
- 4

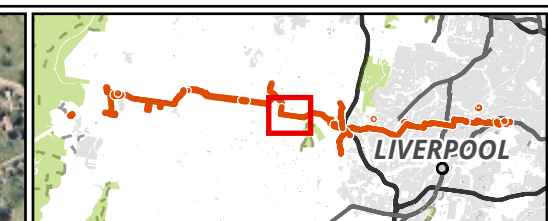
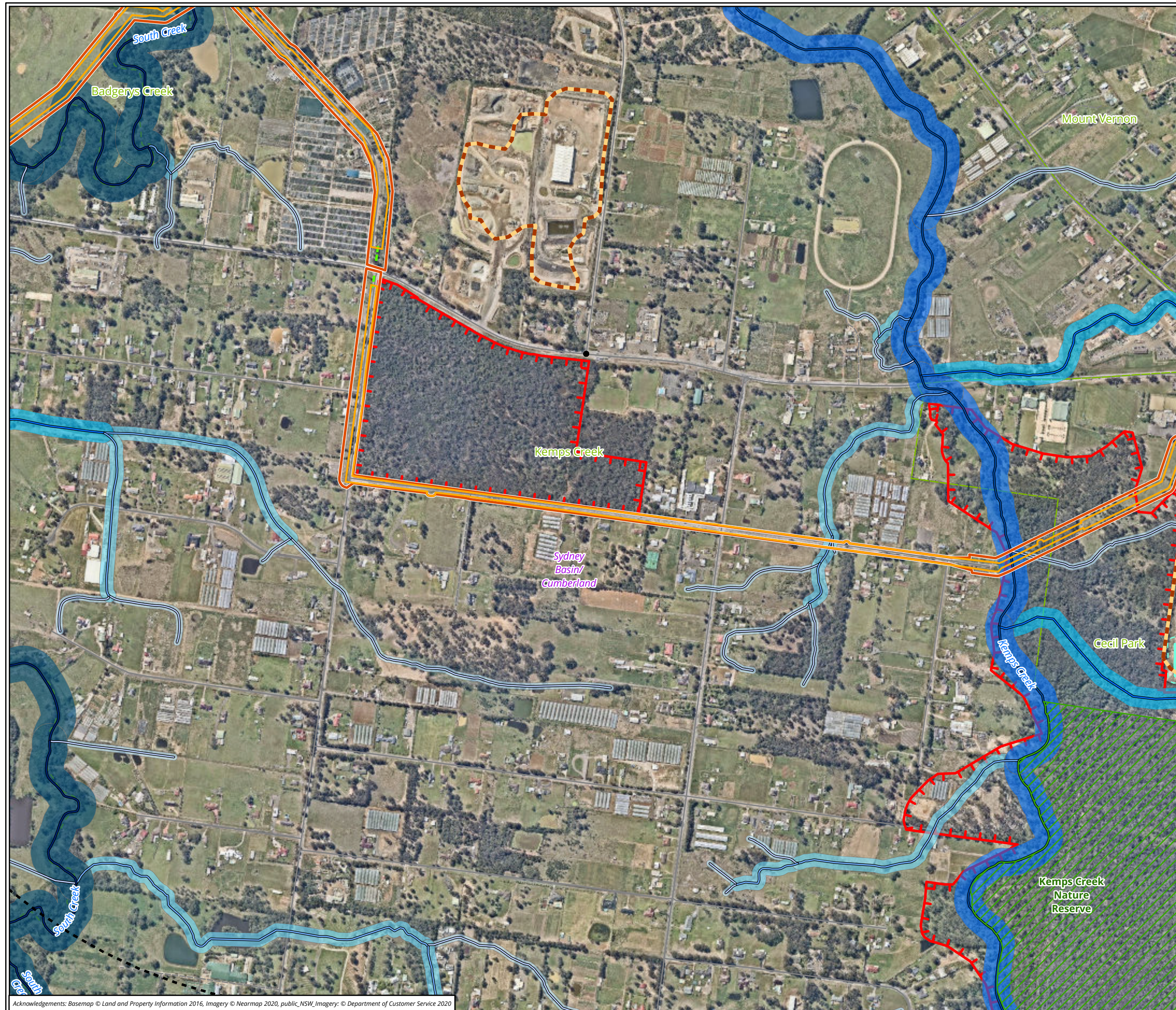
**Figure 2.6 Site map**



Scale: 1:10,000 @ A3  
 Coordinate System:  
 PCS: GDA 1994 MGA Zone 56

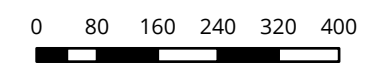






- Legend**
- Impact assessment area
  - Impact area
  - Underbore
  - Cumberland Plain Priority Conservation Lands
  - Riparian buffers - Local wetlands
  - Local wetlands
  - ExcavationFace
  - IBRA Region/Sub-region
- HydroLine stream order**
- 1
  - 2
  - 3
  - 4-5
  - 6-9
- HydroLine stream order buffers**
- 1
  - 2
  - 3
  - 4
  - 6

**Figure 2.7 Site map**

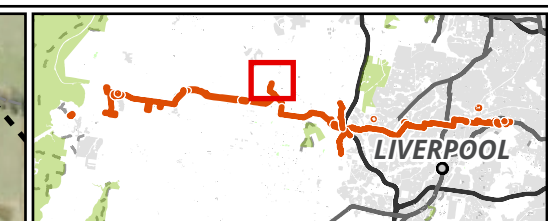


Metres  
 Scale: 1:10,000 @ A3  
 Coordinate System:  
 PCS: GDA 1994 MGA Zone 56



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 Date: 24 September 2021,  
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 Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020





- Legend**
- Impact assessment area
  - Impact area
  - Biodiversity Stewardship Sites
  - Cumberland Plain Priority Conservation Lands
  - Riparian buffers - Local wetlands
  - Local wetlands
  - IBRA Region/Sub-region
- HydroLine stream order**
- 1
  - 2
  - 4-5
  - 6-9
- HydroLine stream order buffers**
- 1
  - 2
  - 4
  - 6

**Figure 2.8 Site map**

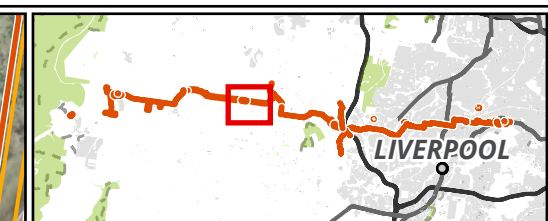


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Coordinate System:  
PCS: GDA 1994 MGA Zone 56



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Date: 24 September 2021,  
Prepared for: CW, Prepared by: SSK, Last edited by: Iharley  
Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020





**Legend**

- Impact assessment area
- Impact area
- Underbore
- Riparian buffers - Local wetlands
- Local wetlands
- IBRA Region/Sub-region

**HydroLine stream order**

- 1
- 2
- 3
- 4-5
- 6-9

**HydroLine stream order buffers**

- 1
- 2
- 3
- 4
- 6

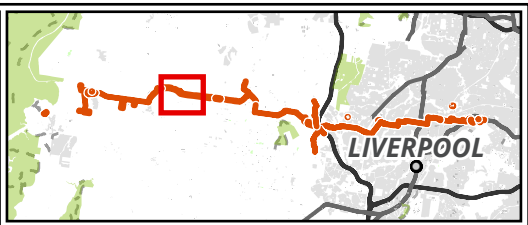
**Figure 2.9 Site map**



Scale: 1:10,000 @ A3  
 Coordinate System:  
 PCS: GDA 1994 MGA Zone 56







**Legend**

- Impact assessment area
- Impact area
- Underbore
- IBRA Region/Sub-region

**HydroLine stream order**

- 1
- 2
- 3
- 4-5

**HydroLine stream order buffers**

- 1
- 2
- 3
- 4

**Figure 2.10 Site map**

0 80 160 240 320 400 Metres

Scale: 1:10,000 @ A3  
Coordinate System:  
PCS: GDA 1994 MGA Zone 56

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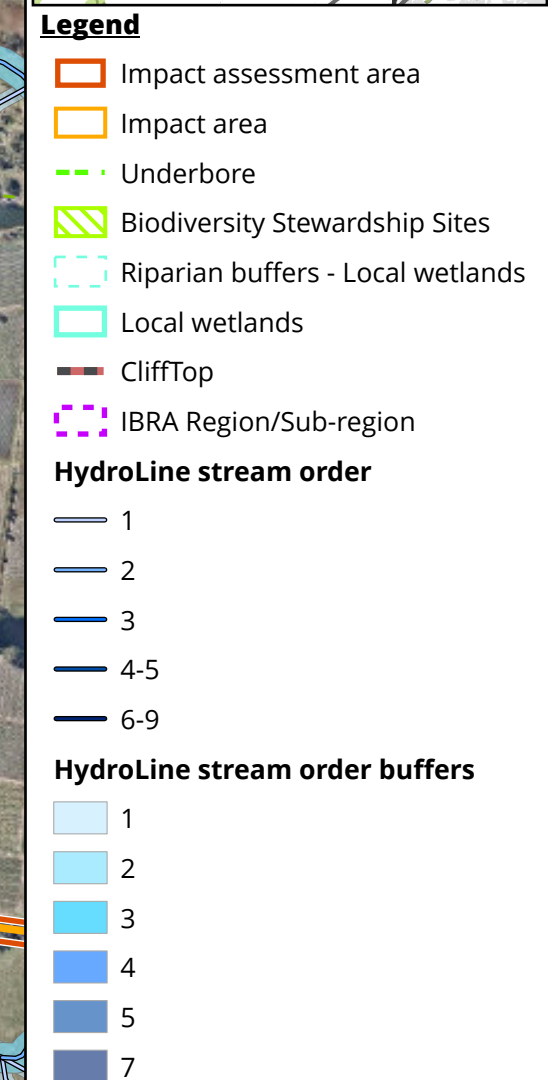
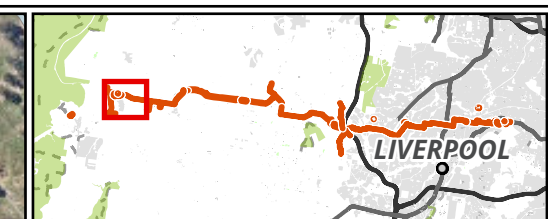
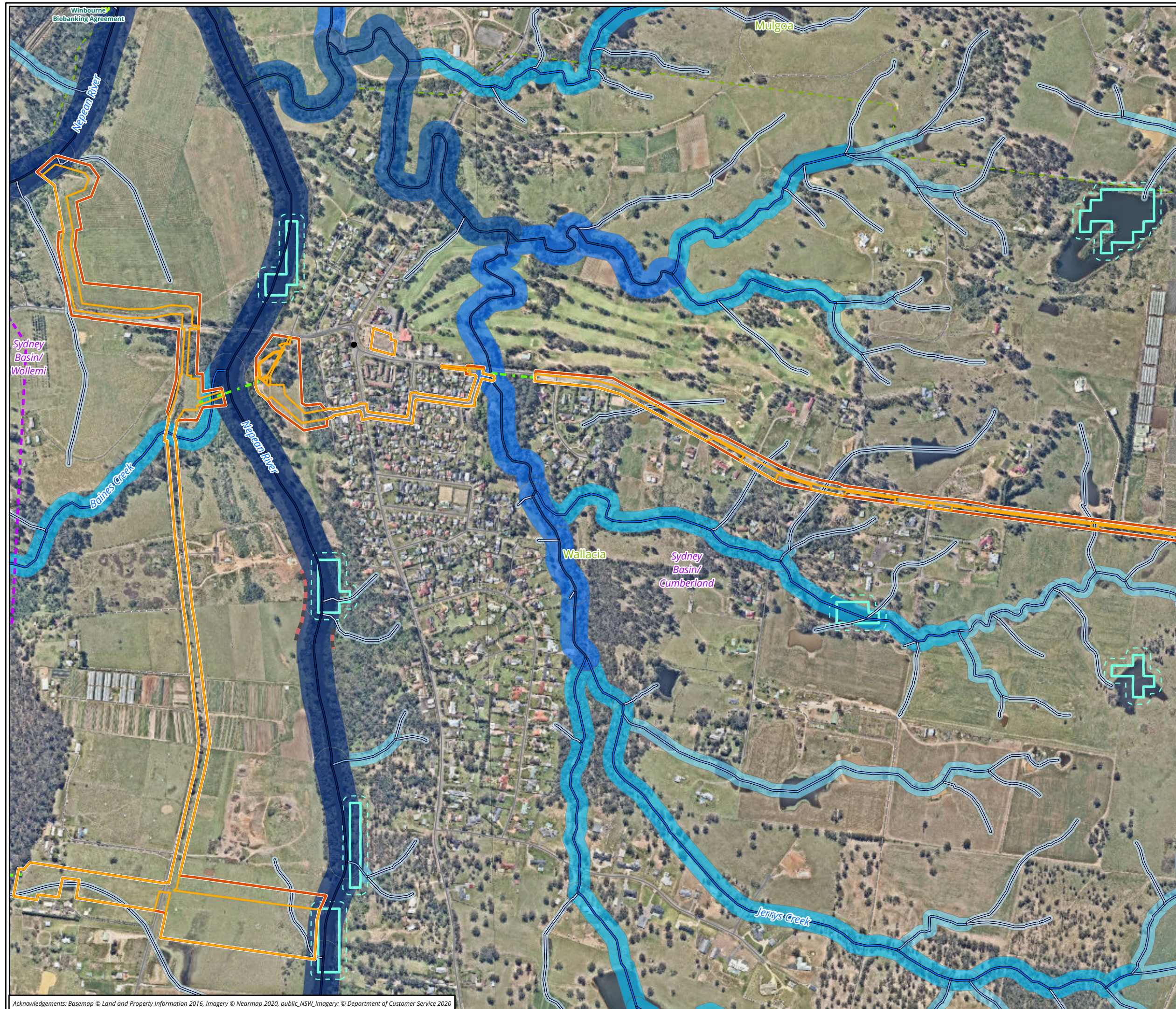
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Date: 24 September 2021,  
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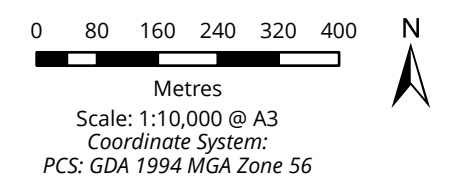






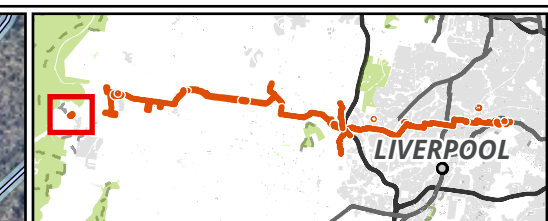


**Figure 2.12 Site map**



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 Prepared for: CW, Prepared by: SSK, Last edited by: Iharley  
 Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020





**Legend**

- Impact assessment area
- Impact area
- Underbore
- Riparian buffers - Local wetlands
- Local wetlands
- IBRA Region/Sub-region

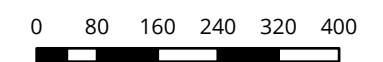
**HydroLine stream order**

- 1
- 2
- 3
- 6-9

**HydroLine stream order buffers**

- 1
- 2
- 3
- 9

**Figure 2.13 Site map**



Metres  
 Scale: 1:10,000 @ A3  
 Coordinate System:  
 PCS: GDA 1994 MGA Zone 56



Matter: 31617, SSK  
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 Prepared for: CW, Prepared by: SSK, Last edited by: Iharley  
 Location: P:\31600s\31617\Mapping\31617\_Working\31617\_BDAR2020



## 2. Project description

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Sydney Water is planning to build and operate new wastewater infrastructure to service the South West and Western Sydney Aerotropolis Growth Areas, known as the Upper South Creek AWRC. An overview of the location of the proposed infrastructure is provided in Figure 1. Further details of each component of the project are provided below.

### **Advanced Water Recycling Centre**

The Upper South Creek AWRC comprises:

- A wastewater treatment plant with the capacity to treat up to 50 ML of wastewater per day, with ultimate capacity of up to 100ML per day.
- The AWRC will produce:
  - High-quality treated water suitable for a range of uses including recycling and environmental flows.
  - Renewable energy, including through the capturing of heat for cogeneration.
  - Biosolids suitable for beneficial reuse.
  - Brine, as a by-product of reverse osmosis treatment.

### **Treated water pipelines**

The treated water pipelines comprise:

- A pipeline about 17 kilometre long from the AWRC to the Nepean River at Wallacia Weir, for the release of treated water.
- Infrastructure from the AWRC to South Creek to release excess treated water and wet weather flows.
- A pipeline about 5 kilometre long from the main treated water pipeline at Wallacia to a location between the Warragamba Dam and Warragamba Weir, to release high-quality treated water to the Warragamba River as environmental flows.

### **Brine pipeline**

The brine pipeline comprises:

- A pipeline about 24 kilometre long that transfers brine from the AWRC to Lansdowne, in south-west Sydney, where it connects to Sydney Water's existing Malabar wastewater network.

Sydney Water is planning to deliver the project in stages, with Stage 1 comprising:

- Building and operating the AWRC to treat an average dry weather flow of up to 50ML per day.
- Building all pipelines to their ultimate capacity, but only operating them to transport and release volumes produced by the Stage 1 Advanced Water Recycling Centre.

The timing and scale of future stages will be phased to respond to drivers including population growth rate and the most efficient way for Sydney Water to optimise its wastewater systems.

### 3. Legislative requirements

The project has considered, or been assessed against, the following relevant biodiversity legislation and government policy, as described in Table 2. Detailed assessment of the project in accordance with relevant legislation is included in Section 14.

**Table 2 Legislation relevant to the project**

Legislation / Policy	Description	Relevance to the current assessment
<b>Commonwealth Acts</b>		
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	<p>Australian Government's key piece of environmental legislation. The EPBC Act applies to developments and associated activities that have the potential to significantly impact on MNES protected under the Act.</p> <p>Under the EPBC Act, the minister may agree to undertake a strategic assessment on the impacts of actions under a policy, plan or program. An agreement was signed to undertake a strategic assessment of the Sydney growth centres on 11 November 2009.</p> <p>State Environmental Planning Policy (Sydney Region Growth Centres) 2006 was gazetted and granted biodiversity certification of the areas covered by the SEPP. This removes the need for threatened species assessment under the NSW <i>Environmental Planning and Assessment Act 1979</i> (EP&amp;A Act) for areas that have been certified.</p> <p>In December 2011, the Australian Government environment minister endorsed the program document Sydney Growth Centres Strategic Assessment: Program report. The endorsement of this program allows the minister to consider giving approval to actions that are taken in accordance with the endorsed program.</p> <p>In February 2012, the minister approved classes of actions associated with implementing the Sydney Growth Centres Strategic Assessment: Program report.</p>	<p>MNES relevant to the current project include nationally threatened species and ecological communities, migratory species, and world heritage places. Threatened species and ecological communities protected by the EPBC Act and present within the impact area and impact assessment area are outlined in Sections 7 and 8, and summarised in Section 9. Significant Impact Criteria (SIC) assessments are provided in Appendix 6.</p> <p>Strategic assessment and subsequent approval of the Sydney Growth Centres Strategic Assessment: Program report has resulted in removal of the need for impacts to MNES, occurring on areas of Existing Certified land within the project's impact area (and impact assessment area), MNES to be assessed under the EPBC Act.</p>



Legislation / Policy	Description	Relevance to the current assessment
<b>NSW Acts</b>		
<i>Environmental Planning and Assessment Act 1979 (EP&amp;A Act)</i>	Provides the overarching structure for planning in NSW and is supported by other statutory environmental planning instruments (EPIs).	Determines the approval pathway for the project, and prescribes the consideration of relevant EPIs.
<i>Biodiversity Conservation Act 2016</i>	Key piece of legislation providing for the protection and conservation of biodiversity in NSW through the listing of threatened species and communities and key threatening processes.	Mandates the application of the NSW BOS and BAM to state significant projects.
<i>Fisheries Management Act 1994 (FM Act)</i>	Provides for the protection and conservation of aquatic species and their habitat throughout NSW.	The BAM focusses on impacts to terrestrial ecology and thus excludes items listed under the FM Act.
<i>Biosecurity Act 2015</i>	Outlines biosecurity risks and impacts, and prescribes requirements for the management of risk to reduce the severity of impacts.	Biosecurity risks relevant to the current assessment include weeds, pest animals and pathogens that are known to occur, or potentially occur, within the impact area and/or impact assessment area. Further details of biosecurity risks present within the impact area and impact assessment area are provided in Section 14.2.
<i>National Parks and Wildlife Act 1974 (NPW Act)</i>	The intent of the NPW Act is to allow for conservation of the State's natural and cultural heritage; fostering public appreciation, understanding and enjoyment of their State's natural and cultural heritage; and managing any lands reserved for the purposes of conserving and fostering public appreciation and enjoyment of the State's natural and/or cultural heritage.	Four areas of land protected by the NPW Act occur within the vicinity of the study area, these include; Blue Mountains National Park, Burratorang State Conservation Area, Kemps Creek Nature Reserve and Western Sydney Regional Park.  An assessment of potential implications of the NPW Act is outlined in Section 14.4.
<i>Water Management Act 2000 (WM Act)</i>	The WM Act provides for the sustainable and integrated management of the state's water.	The project is exempt from the requirement to apply for a section 89 water use approval, section 90 water management work approval or a section 91 controlled activity approval as per section 5.23 of the EP&A Act. Similarly, the project is exempt from requiring approval under section 91 of the Act once aquifer interference provisions commence. A licence under section 56 of the WM Act for water access is likely to be required.



Legislation / Policy	Description	Relevance to the current assessment
<b>NSW EPIs</b>		
SEPP No 19 – Bushland in Urban Areas 1986	The aim of the SEPP is to protect and preserve bushland in urban area because of its ecological, social and aesthetic values.	<p>The majority of the study area is subject to SEPP No 19 – Bushland in Urban Areas 1986 with the exception of Western Sydney Parklands.</p> <p>Under Part 6 Subclause 2 (c)(i) development consent is not required for the disturbance of bushland is being disturbed for the purposing of constructing, operating or maintaining sewerage pipelines.</p>
SEPP (Sydney Region Growth Centres) 2006 and the Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006	This SEPP allows for the co-ordinated release of urban development in the North West and South West Growth Centres (as well as other area not relevant to the current assessment). Aligned with this SEPP, the Order to confer biodiversity certification on those growth centre areas designates land that has been assessed and approved for development in accordance with the former NSW <i>Threatened Species Conservation Act 1995</i> (TSC Act) and the EPBC Act.	<p>Approximately 10 kilometre of the central portion of the project alignment occurs within land subject to the SEPP and the Order to confer biodiversity certification. Land within this location has been declared as either 'Existing Certified' or 'Existing Non Certified' under the SEPP and Order.</p> <p>In areas of Existing Certified land, assessment of impact in accordance with the BC Act and EPBC Act are not required due to their inclusion in previous biodiversity certification assessments under the former TSC Act and Strategic Assessment under the EPBC Act.</p> <p>Area of Existing Non Certified land require assessment under the BC Act and EPBC Act.</p> <p>An assessment of the project in relation to the requirements of the Order to confer biodiversity certification on the SEPP (Sydney Region Growth Centres) 2006 is included in Section 14.1.1.</p>
SEPP (Western Sydney Aerotropolis) 2020	The aims of this Policy are to facilitate development in the Western Sydney Aerotropolis in accordance with the objectives and principles of the Western Sydney Aerotropolis Plan, as well as to ensure development is compatible with the long-term growth and development of the Western Sydney Airport (including in relation to the operation of the Airport 24 hours a day) and other critical transport infrastructure. Furthermore the SEPP aims to protect, maintain and enhance, and to minimise the impact of development on, trees and vegetation, soil quality and the health of waterways and to	<p>The impact area and impact assessment area occur on land zoned as the following under SEPP (Western Sydney Aerotropolis) 2020:</p> <ul style="list-style-type: none"> <li>• Agribusiness (AGB)</li> <li>• Enterprise Zone (ENT)</li> <li>• Environment and Recreation Zone (ENZ)</li> <li>• Infrastructure (SP2).</li> </ul> <p>Relevant planning controls include those relating to areas mapped as supporting high biodiversity values, areas requiring additional flood planning, and the presence of wildlife buffer zones.</p>



Legislation / Policy	Description	Relevance to the current assessment
	contribute to the conservation of biodiversity, and to recognise and protect the ecological and cultural value of Wianamatta-South Creek.	
SEPP (Vegetation in non-rural areas) 2017	The aims of this SEPP are to protect the biodiversity values of trees and other vegetation in non-rural areas of the State, and to preserve the amenity of non-rural areas of the State through the preservation of trees and other vegetation.	<p>The impact area occurs on land mapped under SEPP (Vegetation in Non-Rural Areas) 2017 based on location in the Bankstown, Fairfield, Liverpool and Penrith LGA's as per Part 1, Section 5 of the SEPP. This SEPP is not relevant to the project within the Wollondilly LGA.</p> <p>Under Part 2, Section 8(1) of SEPP (Vegetation in Non-Rural Areas) 2017, the proposed vegetation clearance does not require an authority under the SEPP as it is of a kind authorised under Section 60O(b)(iii) of the NSW Local Land Services Act 2013 via assessment and approval under Part 5 of the EP&amp;A Act.</p>
SEPP (Coastal Management) 2018	The aim of this Policy is to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the Coastal Management Act 2016, including the management objectives for each coastal management area.	<p>The impact assessment area and impact area is located on land mapped as Proximity Area for Coastal Wetlands as defined by the Coastal Management SEPP, and adjacent to land mapped as Coastal Wetlands. The current project design will result in the removal of vegetation and disturbance to soil within the proximity area for coastal wetland.</p> <p>Assessment of the project against the requirements of the SEPP are included in Section 14.1.5.</p>
SEPP (Koala Habitat Protection) 2020	This SEPP aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to support a permanent free-living population over their present range and reverse the current trend of koala population decline.	The Liverpool and Wollondilly LGAs are listed under Schedule 1 as areas to which the SEPP applies. However, the SEPP does not apply as the project is being assessed under Part 5 of the EP&A Act.
Cumberland Plain Conservation Plan	The Cumberland Plain Conservation Plan has been developed to meet requirements for strategic biodiversity certification under the BC Act and strategic assessment under the EPBC Act. The plan area covers approximately 200,000 hectares and sits primarily within the Interim Biogeographic Regionalisation of Australia (IBRA) Cumberland subregion, as well as some minor areas of the Sydney Cataract	<p>The advanced water recycling centre site, and approximately 12 kilometres of pipelines occur within the extent of the Western Sydney Aerotropolis nominated area included in the Cumberland Plain Conservation Plan.</p> <p>This overlapping land has been assessed as part of the Cumberland Plain Assessment Report (Open Lines and Biosis 2020) and if approved will be subject to biodiversity certification under</p>



Legislation / Policy	Description	Relevance to the current assessment
	<p>and Wollemi IBRA subregions. The area includes parts of eight local government areas, including:</p> <ul style="list-style-type: none"> <li>• Wollondilly, Camden, Campbelltown, Liverpool, Fairfield, Penrith, Blacktown and Hawkesbury</li> </ul> <p>The nominated areas seeking approval through the plan under the BC Act and EPBC Act are:</p> <ul style="list-style-type: none"> <li>• Greater Macarthur Growth Area</li> <li>• Greater Penrith to Eastern Creek Investigation Area</li> <li>• Western Sydney Aerotropolis</li> <li>• Wilton Growth Area. (DPIE 2020)</li> </ul>	<p>the BC Act and strategic approval under the EPBC Act. The Cumberland Plain Conservation Plan also sets out future controls and commitments relevant to the nominated areas. Whilst the expected future biodiversity certification and strategic approval of part of the impact area and impact assessment has been considered, along with potential future controls and commitments, as the Cumberland Plain Conservation Plan is yet to be approved, the project has been undertaken entirely independently from that plan, and any expected future outcomes.</p>



## 4. Secretary's Environmental Assessment Requirements

Project SEARs were issued on 28 August 2020, with the requirements relevant to the current biodiversity assessment, and where they have been addressed in this BDAR, outlined in Table 3 below.

**Table 3 Terrestrial biodiversity SEARs**

SEARs Key Issue	Project SEARs matter to be addressed	Location where SEARs are addressed in this BDAR
<b>Planning Secretary's Environmental Assessment Requirements</b>		
8	An assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with the BC Act, the BAM and documented in a BDAR.	Section 5 to Section 13
	The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM and including:	Section 9 and Section 11
	a) Impacts to Commonwealth listed species and ecological communities, where relevant.	Section 14
	b) Impacts of changes to the operational regime of any reservoirs.	The operational regime of any reservoirs are not being altered by the project and as such, this item is not addressed further.
9	A strategy to offset any residual impacts of the project in the medium to long term.	Section 15
10	An assessment of the impacts on groundwater dependent ecosystems.	Section 0
11	Assessment of any impacts on the Lansdowne Reserve biobanking site (sic).	Section 11.2
13	Assessment of aquatic, riverine and riparian biodiversity and ecology that addresses all direct, indirect, and prescribed impacts of the project on Key Fish Habitat and associated flora and fauna, riparian zones, threatened species, populations, and communities for the construction and operation of the asset.	Assessment of impacts to terrestrial flora, fauna and ecological communities associated with riparian areas are included in Section 11. Assessment of impacts to aquatic and riverine ecology, and Key Fish Habitat are included in the project's Aquatic Ecological assessment (CTE 2021).
<b>Attachment 1 – Guidelines for preparing assessment documentation relevant to the EPBC Act for proposals being assessed under the NSW Assessment Bilateral.</b>		
	In the circumstance that a proposal has been determined to be a 'controlled action' requiring full assessment, the decision will identify which MNES protected under the EPBC Act have triggered for assessment. These are called the controlling provisions. Proponents	Controlling provisions addressed in this BDAR include: <ul style="list-style-type: none"> <li>listed threatened species and communities</li> </ul>



SEARs Key Issue	Project SEARs matter to be addressed	Location where SEARs are addressed in this BDAR
	<p>are only required to provide an assessment of protected matters under the controlling provisions that have been triggered. Following is the full list of possible controlling provisions:</p> <ul style="list-style-type: none"> <li>• World Heritage Properties (sections 12 and 12A)</li> <li>• National Heritage Places (sections 15B and 15C)</li> <li>• listed threatened species and communities (sections 18 and 18A)</li> <li>• listed migratory species (sections 20 and 20A)</li> </ul>	<ul style="list-style-type: none"> <li>• listed migratory species</li> </ul> <p>These items are addressed in Section 7, 8, 9 and 11.</p>
<b>General Requirements</b>		
5	The title of the action, background of the action and current status.	Section 1
9	<p>The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including:</p> <ul style="list-style-type: none"> <li>• a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long term relevant impacts;</li> <li>• a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;</li> <li>• analysis of the significance of the relevant impacts; and</li> <li>• any technical data and other information used or needed to make a detailed assessment of the relevant impacts.</li> </ul>	Sections 9 and 11
10	<p>For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action including:</p> <ul style="list-style-type: none"> <li>• a description, and an assessment of the expected or predicted effectiveness of the mitigation measures;</li> <li>• any statutory policy basis for the mitigation measures;</li> <li>• the cost of the mitigation measures;</li> <li>• an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;</li> <li>• the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.</li> </ul>	<p>Sections 9, 10 and 11</p> <p>Note: There are not expected to be significant residual impacts to MNES as a result of the project.</p>
11	Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	<p>Section 15</p> <p>Note: There are not expected to be significant residual impacts to MNES as a result of the project.</p>
12	<p>For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any:</p> <ul style="list-style-type: none"> <li>• conservation advice or recovery plan for the species or community,</li> </ul>	Section 9



SEARs Key Issue	Project SEARs matter to be addressed	Location where SEARs are addressed in this BDAR
	<ul style="list-style-type: none"> <li>relevant threat abatement plan for a process that threatens the species or community</li> <li>wildlife conservation plan for the species</li> <li>management plan for Ramsar wetland</li> <li>management plan for a World Heritage property or National Heritage place;</li> <li>Marine Bioregional Plan;</li> <li>any strategic assessment.</li> </ul>	
<b>Biodiversity (threatened species and communities and migratory species)</b>		
14	<p>The EIS must identify each EPBC Act listed threatened species and community and migratory species likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.</p> <p>Based on consideration of available information, the proposed action is likely to have a significant impact on the following matters of national environmental significance:</p> <ul style="list-style-type: none"> <li>Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest – critically endangered.</li> <li>Regent Honeyeater (<i>Anthochaera phrygia</i>) – critically endangered.</li> <li>Swift Parrot (<i>Lathamus discolor</i>) – critically endangered.</li> <li>Macquarie perch (<i>Macquaria australasica</i>) – endangered.</li> </ul>	<p>Section 9 and Appendix 6</p> <p>Note: Macquarie Perch is addressed in the project's Aquatic Ecological assessment (CTE 2021).</p>
15	<p>For each of the EPBC Act listed threatened species and communities and migratory species likely to be impacted by the action the EIS must provide a separate:</p> <p>a) description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans.</p>	Section 9
	<p>b) details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements.</p>	Sections 7, 8 and 9
	<p>c) description of the relevant impacts of the action having regard to the full national extent of the species or community's range.</p>	Section 9.2
	<p>d) description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action.</p>	Section 9.6 and Section 10



SEARs Key Issue	Project SEARs matter to be addressed	Location where SEARs are addressed in this BDAR
	e) identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account.	Section 9.7
	f) a description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established.	Section 9.8 and Section 15
	g) details of how the current published NSW Biodiversity Assessment Method (BAM) has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts.	Section 9 and Section 15
	h) details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the FBA [sic] and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites.	Section 15
16	Any significant residual impacts not addressed by the BAM may need to be addressed in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy. <a href="http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy">http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy</a> .	n/a



## 5. Biodiversity assessment methods

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The following methods were undertaken in implementing Stage 1 of the BAM for assessment of landscape and site context of the project, the presence and condition of native vegetation within the impact area and impact assessment area, and the presence of threatened species and/or their habitats. These key aspects provide the context and content of the assessment of biodiversity impacts associated with the project.

### 5.1 Landscape and site context methods

Section 3 of the BAM (DPIE 2020a) outlines the requirements for assessment of landscape context relevant to the project. The requirements for this assessment are desktop based, provide background information for the assessment, and help to determine the suite of threatened species potentially present within the assessment area. This is based on landscape scale ecological attributes such as the amount and proportion of native vegetation present in the BAM prescribed 500 metre buffer area on the development footprint, and the patch size of each vegetation zone present within the impact area.

The results of the assessment of landscape and site context are presented in Sections 6.1 and 6.2.

#### 5.1.1 Landscape context

Sources of information used in the assessment of landscape context for the project included relevant databases, spatial data, literature and previous reports. These sources include:

- Interim Biogeographic Regionalisation of Australia (IBRA) Version 7.
- NSW (Mitchell) Landscapes Version 3.0.
- Soil landscapes of the Sydney 1:100000 Sheet (Chapman and Murphy 1989).
- Soil Landscapes of the Penrith 1:100000 Sheet (Bannerman and Hazelton 1990).
- *Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands* (Tozer et al., 2010).
- *Remnant Vegetation of the western Cumberland subregion, 2013 Update* VIS\_ID 4207 (DPIE 2015a).
- *The Native Vegetation of the Sydney Metropolitan Area - Version 3.1* (DPIE 2016a).
- Hydrology – 1:25,000 Hydro Line and Hydro Area datasets of the LPI's NSW Digital Topographic Database.
- Directory of Important Wetlands.
- Catchment Boundaries of New South Wales dataset.
- Western Sydney Hydrogeological Landscapes: May 2011 (First Edition) (State of NSW 2011).
- DPIE Biodiversity Values Map.
- Acid Sulfate Soils Risk mapping (State of NSW 1998).
- *State Environmental Planning Policy (SEPP) (Sydney Region Growth Centres) 2006*.
- SEPP (Coastal Management) 2018.
- SEPP (Koala Habitat Protection) 2019.
- 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 (DPIE 2021a).
- BioNet Threatened Species Profile Database (DPIE 2020b).
- Previous ecological assessment reports, conservation plans and policies were reviewed include:
  - *Western Sydney Lands – Badgerys Creek Flora and Fauna Assessment* (Arcadis 2019).
  - *Upper South Creek Water Recycling Plant Ecological Constraints Assessment* (AECOM 2019).
  - *Wylde MTB Ecological Assessment* (Eco Logical Australia 2019).
  - *Upper South Creek Advanced Water Recycling Centre – Preliminary Constraints Assessment* (Biosis 2020).
  - *Cumberland Plain Recovery Plan 2011* (DECCW 2011).
  - *Draft Cumberland Plain Conservation Plan 2020* (DPIE 2020c).
  - *Draft Cumberland Plain Assessment Report* (Open Lines and Biosis 2020).

### 5.1.2 Native vegetation cover

Native vegetation cover in the 500 metre buffer was assessed using GIS based on the most suitable vegetation mapping, in this case using the following mapping projects:

- *Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands* (Tozer et al., 2010).
- *Remnant Vegetation of the western Cumberland subregion, 2013 Update* VIS\_ID 4207 (DPIE 2015).
- *The Native Vegetation of the Sydney Metropolitan Area - Version 3.1* (OEH 2016).

Areas which were not mapped as native vegetation within these mapping projects, yet met the visual interpretation criteria of native vegetation on aerial imagery (i.e. texture and pattern values), were incorporated into the total native vegetation within the assessment area. However it should be noted that these areas were not assigned to specific PCTs when they occurred outside the project's impact area or impact assessment area.

### 5.1.3 Patch size

Patch size was calculated for vegetation within the impact area as per the BAM (DPIE 2020a) 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 (or  $\leq 30$  metres for non-woody ecosystems) is considered to be of the same patch.

The extent of native vegetation, threatened ecological communities and vegetation integrity within the impact area and impact assessment area was determined using the results of site investigations, a desktop based preliminary constraints assessment (Biosis 2020) and Section 4.3.2 of the BAM (DPIE 2020a).

## 5.2 Native vegetation assessment methods

Section 4 of the BAM (DPIE 2020a) outlines the requirements for assessment of native vegetation, TECs and vegetation integrity relevant to the project. Native vegetation assessment combines background desktop review with field assessment of the extent, type and condition of native vegetation present within the project area. The results of the assessment of native vegetation also provide further context to the potential presence of threatened species.



The native vegetation assessment was conducted between 2 April 2020 and 11 November 2020 under the terms of Biosis' Scientific Licence issued by the EES under the *National Parks and Wildlife Act 1974* (SL100758, expiry date 31 March 2021). Fauna surveys were conducted under approval 11/355 from the NSW Animal Care and Ethics Committee (expiry date 31 January 2023). The BAM field assessment was carried out by Nicola Trulock (BAAS 19058) (Consultant Botanist) with assistance from Heather Lee-Kiorgaard (Botanist) and Heather Duff (Botanist).

The results of the assessment of native vegetation are presented in Section 7.

### 5.2.1 Background review

Regional vegetation mapping (Tozer et al. 2010, DPIE 2015a, DPIE 2016a) and existing site reports (AECOM 2019, Biosis 2020, Open Lines and Biosis 2020) as well as database searches 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 impact area and impact assessment area.

### 5.2.2 Detailed desktop PCT mapping

Initial vegetation extent polygons for the project's desktop PCT mapping were prepared by Biosis' GIS technical staff, following which an appropriately qualified and experienced botanist assigned PCT and vegetation condition based upon the following general rules:

- Assign PCT using all available data sources including soils layer, geology layer, LiDAR derived layers, watercourses, slope/topography, aspect, and existing mapping.
- Assign a condition class to be confirmed by field assessment, where possible.
- Consider expected density of tree and shrub layer when assigning condition.
- Map areas of derived native grassland (DNG) and potential DNG throughout.

The defining characteristics of condition classes used as rulesets to describe vegetation within the impact area and impact assessment area during desktop vegetation mapping are outlined in Table 4 below.

**Table 4 Vegetation condition classes for desktop mapping**

Condition class	Defining characteristics
<b>Intact</b>	Native vegetation that was in good condition and has maintained structural integrity, it may be composed of: <ul style="list-style-type: none"> <li>• A diversity of vegetation layers with a tree density close to natural.</li> <li>• Low levels of evidence of historical disturbance.</li> <li>• Vegetation cover will be +/- uniform and there are fewer visible gaps where the "forest floor" can be seen from the aerial imagery.</li> <li>• Older (taller) regrowth woodland where it can be expected that native understorey strata have also regenerated.</li> </ul>
<b>Thinned</b>	This vegetation is modified and likely to be highly variable. It may be composed of: <ul style="list-style-type: none"> <li>• Woodlands that have a partly cleared canopy resulting in a more open structure than intact vegetation.</li> <li>• Vegetation that has been under-scrubbed (shrub layer removed) or is dominated by exotic species in the understorey.</li> <li>• Younger and scattered/patchy regrowth vegetation.</li> </ul>
<b>Scattered trees</b>	A single tree or small group of trees surrounded by native or exotic grassland, or areas of



Condition class	Defining characteristics
	cultivation. It may be composed of: <ul style="list-style-type: none"> <li>• Vegetation where one or more structural layers may be absent (e.g. shrubs and/or grasses/forbs).</li> <li>• Scattered shrubs and/or regrowth juvenile / semi-mature trees.</li> <li>• Grasslands in between scattered trees/shrubs where species are predominantly native (i.e. DNG).</li> </ul>
<b>Derived native grassland (DNG)</b>	Grassland areas where the native species are dominant
<b>Urban native/ exotic</b>	Non-grassland vegetation in urban and rural area comprising: <ul style="list-style-type: none"> <li>• Planted non-indigenous street trees and landscaped areas.</li> <li>• Orchards and areas of intensive cropping.</li> <li>• Areas of exotic vegetation.</li> <li>• Other vegetation that does not conform to one of the above four categories.</li> </ul>

Following detailed desktop mapping of vegetation within the impact area and impact assessment area, the mapping was validated in the field by Biosis' botanists as part of the field investigation detailed below.

### 5.2.3 Field investigation

The impact area and impact assessment area were surveyed in accordance with the BAM (DPIE 2020a), which involved:

- The validation, identification and mapping of PCTs according to the structural definitions of *The Native Vegetation of the Sydney Metropolitan Area* (DPIE 2016a), the *Remnant Vegetation of the western Cumberland subregion, 2013 Update* (DPIE 2015a), and the BioNet Vegetation Classification database (DPIE 2021a).
- Confirmation and mapping of vegetation condition states, assigned during desktop work, to determine vegetation zones.
- Completion of floristic plots within each vegetation zone in accordance with Section 4 of the BAM (OEH 2017).
- The identification of native and exotic plant species, according to the Flora of NSW (Harden 1992, 1993, 2000, 2002) and PlantNET (RBGDT 2021) with reference to recent taxonomic changes.
- Incidental observations using the "random meander" method (Cropper 1993).
- 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 impact area and impact assessment area.
- Identification of flora and fauna habitat features that may contribute to elements of suitable habitat for threatened species.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).

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

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



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  $\pm 5$  metres) and dependent on the limitations of aerial photo rectification and registration.

A total of 30 BAM Plots were over the duration of the survey period, 21 of which have remained relevant to the current assessment and have been used to determine Vegetation Integrity (VI) scores for the vegetation impacted by the project, further detail is provided in Section 7.2.

Survey limitations are described in Appendix 1.

### 5.3 Threatened species assessment methods

Section 5 of the BAM (DPIE 2020a) outlines the requirements for the assessment of threatened species for a project, which are grouped into two categories; 'ecosystem credit species' and 'species credit species'.

Ecosystem credit species are those where the likelihood of occurrence of a species, or elements of a species' habitat, can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection. Targeted survey is not required for these species (DPIE 2020a).

Species credit species are those where the likelihood of occurrence of a species, or elements of suitable habitat for the species, cannot be confidently predicted by vegetation surrogates and landscape features and can be reliably detected by survey (DPIE 2020a). If elements of suitable habitat for species credit species are present within a project site, targeted surveys are required.

In some circumstances, a species requires assessment for both ecosystem credits and species credits. This occurs where part of the habitat is assessed as a species credit (e.g. breeding habitat, or mapped locations identified as important area that is used by a species). The remaining part of the habitat is assessed as an ecosystem credit (e.g. foraging habitat, unmapped locations used by a species) (DPIE 2020a)

#### 5.3.1 Steps for identifying habitat suitability for, and presence of, threatened species

The following steps are outlined in the BAM as required for the identification of habitat suitability for threatened species:

- Identify threatened species for assessment through:
  - Analysing the results of the assessment of landscape context, site context and native vegetation assessment are used to determine the full suite of threatened species that may require assessment in accordance with the BAM.
  - The list is then generated by the BAM calculator following input of the above information, with separate lists generated for the current project for the Cumberland and Wollemi IBRA subregions.
  - Assessing databases such as the Commonwealth Department of Agriculture, Water and Environment (DAWE) Protected Matters Search Tool, and BioNet Atlas of NSW Wildlife, to ascertain the potential for species not generated by the BAM Calculator to occur within the impact areas or impact assessment area.
- Assessment of the habitat constraints and vagrant species on the subject land via:
  - The BAM Calculator and BioNet Threatened Species Data Collection, to determine whether specific species' habitat constraints were present/absent from the impact area or impact assessment area, and any species considered vagrant were noted and addressed as such.



- Identify candidate species credit species for further assessment by:
  - Habitat data collected during field investigations was assessed to determine the presence/absence of habitat and microhabitat features, and the level of habitat degradation present within the impact area and impact assessment area.
  - Database records to ascertain the relevance of existing records and their proximity to the impact area and impact assessment area. This was particularly relevant to those species only generated by the calculator based on their occurrence in the Wollemi IBRA subregion. The impact area and impact assessment area intersect the Wollemi IBRA subregion by only 2-3 kilometres at the far western extent of the project, with only one area of impact occurring in the subregion, adjacent to Warragamba Dam. However the subregion spans an area of approximately 130 kilometres north, and approximately 180 kilometres north-west of the project alignment, and hence the impact area and impact assessment area occur outside the geographic extent of occurrence of some species generated by the BAM Calculator.
  - Developing a suite of ‘candidate species’ requiring further assessment was developed. Full details of this assessment are included in Appendix 2.
- Determine presence or absence of a candidate species credit species, through:
  - Targeted threatened species surveys of the impact area and impact assessment were undertaken in accordance with Section 5.3 of the BAM. Further details are provided in Section 8.2 below.
  - Threatened flora species surveys which were carried out by Nicola Trulock, Heather Lee-Kiorgaard (Botanist) and Heather Duff (Botanist), with threatened fauna surveys conducted by Matthew Hyde (Consultant Zoologist), Adam Baus (Project Zoologist) and Kayla Asplet (Project Zoologist).
  - Assessment of four species through the use of species expert reports in accordance with Section 5.3 of the BAM. Further details are provided in Sections 5.3.2 and 8.3.
- Determine the area or count, and location of suitable habitat for a species credit species:
  - Following the completion of the assessment of presence or absence of threatened species within the impact area and impact assessment area the area (or count), and location of suitable habitat for a species credit species was established. Further details are provided in Section 8.2 and illustrated on Figure 10 and Figure 11.
- Determine the habitat condition within the species polygon for species assessed by area, via:
  - Habitat condition for species polygons which were assessed based on ecological condition assessed for the development of vegetation zones. Further details are provided in Section 8.2.

### 5.3.2 Species expert reports

Section 5.3 of the BAM outlines that an expert report may be obtained instead of undertaking a species survey for a project, where the expert report is prepared by a person who, in the opinion of the Environment Agency Head, possesses specialised knowledge based on training, study or experience to provide an expert opinion in relation to the biodiversity values to which an expert report relates (DPIE 2020a).

Species experts were utilised where impacts to threatened species were uncertain. This was either due to survey requirements which could not be met, due to seasonal or replicate survey requirements, or where a species’ habitat was considered to potentially occur across large portions of the impact area and impact assessment



area, and it was determined more efficient to have the species assessed by an expert, than undertake the required survey effort to accurately determine presence/absence.

Species experts were used for the assessment of presence of, and potential impacts to, four threatened species as part of the current assessment. Species subject to expert report, and details of the species experts who prepared the assessments are outlined in Table 5. Each of the species experts used for the project has been approved to provide expert reports for the subject species by the Secretary of the Department of Planning, Industry and Environment.

**Table 5 Species subject to assessment by experts**

Threatened species	Threatened species expert	Species expert approval start/end dates
Spiked Rice-flower <i>Pimelea spicata</i>	Elizabeth Norris	08 July 2020 – 07 July 2026
Cumberland Plain Land Snail <i>Meridolum corneovirens</i>	Dr Stephanie Clark	15 May 2018 – 14 May 2024
Dural Land Snail <i>Pommerhelix duralensis</i>	Dr Stephanie Clark	15 May 2018 – 14 May 2024
Green and Golden Bell Frog <i>Litoria aurea</i>	Dr Francis Lemckert	12 November 2018 – N/A

Species expert reports are provided in Appendix 6, with a summary of the findings provided in Section 8.3.



## 6. Landscape context

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This chapter describes the landscape context, site context and landscape features present within the impact area and impact assessment area, and within a 500 metre buffer along each side of the centre line of a linear shaped development, as required by the BAM (DPIE 2020a).

The BAM defines a linear shaped development as, development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length.

Figure 3 displays the location of the impact area and impact assessment area and landscape features within the 500 metre buffer.

The project predominantly occurs within the Cumberland Plain with the western end extending towards the Blue Mountains Plateau. This area predominantly contains patches of low to moderate quality native vegetation throughout suburban and peri-urban areas with high condition patches of vegetation at the eastern and western ends in undeveloped areas. High condition patches of vegetation at the eastern end of the project alignment are contiguous with vegetation conserved in the riparian corridors of Prospect Creek and Georges River. High condition patches of vegetation at the western end of the project alignment are contiguous with the Greater Blue Mountains World Heritage Area and the Warragamba Dam Special Area. Moderate condition patches within the central section of the project alignment form contiguity with vegetation conserved in Western Sydney Parklands and Kemps Creek Nature Reserve.

The broader study area has a long history of pastoral and agricultural farming, specifically, cattle, poultry, bee keeping and market gardens, supplying the Sydney market with products from 1800 to the mid-20th century. The majority of the study area remains peri-urban whilst suburban and urban development predominates to the east. The northern section of Kemps Creek currently contains land used for commercial agriculture including cattle grazing. The land use history has contributed to the condition of the vegetation and current infestations of priority, agricultural and environmental weeds through clearing, under-scrubbing, logging, pasture improvement and introduction of exotic species.

Existing land uses throughout the extent of the impact area and impact assessment area include:

- Conservation and recreation in reserves and parks including Lansdowne Reserve, Lennox Reserve, Cabravale Memorial Park and Western Sydney Parklands.
- Residential and commercial development and supporting infrastructure throughout Lansdowne, Cabramatta, Elizabeth Hills, Cecil Hills and some sections of Kemps Creek and Wallacia.
- Peri-urban development between Wallacia and Luddenham and primary production, including commercial grazing, commercial nursery and market gardens from Kemps Creek to Luddenham in addition to the west of Wallacia.
- Conserved bushland and water infrastructure in the vicinity of Warragamba, including the Warragamba Special Area.



## 6.1 Landscape features

The following landscape features, as defined by the BAM, are relevant to the project.

### 6.1.1 Bioregions

The impact area and impact assessment area occur within the Sydney Basin IBRA bioregion and the Cumberland and Wollemi IBRA subregions. 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 North Coast and Brigalow Belt South 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 (DPIE 2016a).

The Cumberland IBRA subregion occurs on the coastal side of the Lapstone monocline and is characterised by low rolling hills and wide valleys in the rain shadow area of the Blue Mountains. Underlying geology is predominantly formed from Triassic Wianamatta group shales and sandstones with occasional volcanic intrusions, in addition to Tertiary river gravels, sands and Quaternary alluvium along ancient and current waterways. Vegetation of the Cumberland IBRA subregion consists of dry and wet sclerophyll forests on sandstone and transitional slopes and hills, dry sclerophyll woodlands on plains and shale hills, alluvial forests on riverflats and wetlands in lagoons, swamps and floodplains (DPIE 2016a).

The Wollemi IBRA subregion occurs across the Great Dividing Range and is characterised by a mountainous landscape comprising sandstone plateaus, steep cliff faces, benched rock outcrops and deep gorges. Underlying geology consists of Hawkesbury Sandstone and quartz sandstones of the Narrabeen Group with occasional volcanic diatremes. Vegetation of the Wollemi IBRA subregion consists of dry sclerophyll forests on exposed slopes and ridgetops, wet sclerophyll forests on protected slopes, within deep gorges and adjacent to waterways, upland swamps in soaks and drainage depressions and heaths on windswept ridges on skeletal soils (DPIE 2016a).

### 6.1.2 NSW (Mitchell) Landscape

The impact area and impact assessment area span multiple Mitchell Landscapes associated with the Sydney Basin Bioregion including Cumberland Plain, Georges River Alluvial Plain, Hawkesbury-Nepean Channels and Floodplains and the Kurrajong Fault Scarp.

The majority of the impact area and impact assessment area occur on the Cumberland Plain component of the SB Cumberland landscape. This landscape is characterised by low rolling hills and valleys and underlying geology consists of Triassic shales and lithic sandstones interspersed with a small number of volcanic vents, Tertiary river gravels and sands and Quaternary alluvium along major streams. General elevation is between 30 and 120 metres and local relief is 50 metres. Soils consist of uniform red to brown clays around volcanic hills and red and brown texture-contrasts soils on crests, grading to harsh yellow soils in valleys.

Associated vegetation is influenced by location within the rain shadow of the Blue Mountains and consists of dry sclerophyll woodlands and pockets of dry sclerophyll forests throughout with forested wetlands occurring on poorly drained valley floors (Mitchell 2002).

The eastern extent of the impact area and impact assessment area and adjacent waterways occurs on the Georges River Alluvial Plain component of the SB Cumberland landscape within the Sydney Basin. The topography is characterised by the channel, floodplain and terraces of the Georges River on Quaternary and Tertiary alluvial sediments. Soils are predominantly a mixture of yellow brown to orange clayey sand with some limited gravel intrusions on elevated terraces. General elevation is between 0 to 30 metres and local relief is 10



metres. Associated vegetation consists of forested wetlands on floodplains and along waterways and estuarine swamps and small pockets of mangroves or saltmarsh on estuary sands (Mitchell 2002).

The Hawkesbury – Nepean Channels and Floodplains component of the SB Cumberland landscape within the impact area and impact assessment area occurs in the vicinity of perennial waterways and historic floodplains with corresponding topography. Underlying geology consists of Quaternary sand and gravel with general elevation of 0 to 20 metres and local relief <10 metres. Soils comprise sands upstream of the Warragamba River junction with the remainder of the landscape consisting of undifferentiated alluvial sands to sandy loams or clay loams. Associated vegetation consists of forested wetlands on river flats, reed dominated wetlands on river beds and lower banks, sedgeland in large swamps and lagoons and in tidal areas, small pockets of mangroves and saltmarsh in intertidal zones (Mitchell 2002).

The western extent of the impact area and impact assessment area occurs within the Kurrajong Fault Scarp component of the SB Wollemi landscape between Wallacia and Warragamba. The topography is characterised by dissected and broken slopes with abundant rock outcrops spanning across the Lapstone monocline and Kurrajong fault scarp. Underlying geology consists of Tertiary Quartz sandstone and shale with general elevation of 100 to 250 metres and local relief of 100 metres. Soils are predominantly yellow brown sands interspersed with occasional yellow texture-contrast soils. Associated vegetation consists of dry sclerophyll forests throughout, dry sclerophyll woodlands on transitional zones with other Mitchell landscapes and swamps behind fault blocks on deep sands (Mitchell 2002).

### 6.1.3 Soil

The dominant geology in the impact area and impact assessment area comprises Wianamatta Group shales throughout the eastern and central extents intersected with Bringelly Shale, Alluvial Valley Deposits, Alluvial Floodplain Deposits, Alluvium and Ashfield Shale near riparian corridors and associated tributaries. The western end of the impact assessment area is underlain by Hawkesbury Sandstone intersected by Rickabys Creek Gravel and Colluvial talus deposits in the vicinity of riparian corridors (DECC 2002).

The impact area and impact assessment area occur on the following soil landscapes of the *Soil Landscapes of the Penrith 1:100,000 Sheet map* (Bannerman & Hazelton 1990):

- Berkshire Park Alluvial soil landscape
- Blacktown Residual soil landscape
- Gynea Erosional soil landscape
- Hawkesbury Colluvial soil landscape
- Luddenham Erosional soil landscape
- Richmond Alluvial soil landscape
- South Creek Alluvial soil landscape

The Berkshire Park Alluvial soil landscape is characterised by gently undulating low rises on Tertiary terraces of the Hawkesbury-Nepean River system. Soils are weakly pedal and mottled orange heavy clays and clayey sands with occasional ironstone nodule intrusions. Soils exhibit low fertility, are strongly acidic, hardsetting, impermeable and are subject to localised high erodibility. Vegetation associated with this soil landscape has been mostly cleared with only isolated pockets of dry sclerophyll forest remaining.

The Blacktown Residual soil landscape is characterised by gently undulating rises (<5%) over Wianamatta Group and Hawkesbury shales with local relief of 30 metres. Soils are shallow to moderately deep and comprise red and brown podzolic soils on crests, upper slopes and well-drained areas and yellow podzolic soils and soloths on lower slopes and poorly drained areas. The soil quality is known to exhibit low fertility, poor drainage and is not



susceptible to erosion. Vegetation associated with this soil landscape consists of wet and dry sclerophyll forests in areas exposed to moderate to high rainfall and grassy woodlands in areas exposed to moderate to low rainfall.

The GyMEA Erosional soil landscape is characterised by undulating to rolling rises and low hills with broad convex crests and moderately inclined sideslopes (10 to 25%) over Hawkesbury Sandstone with local relief of 20 to 80 metres and localised rock outcrops (<25%). Soils are shallow to moderately deep and comprise yellow earths and earthy sands on crests and insides of benches, shallow siliceous sands on leading edges of benches, localised gleyed podzolic soils and yellow podzolic soils on shale lenses and siliceous sands and leached sands along drainage lines. Soils have low fertility, are strongly acidic, highly permeable and are moderate to highly erodible. Vegetation associated with this soil landscape consists of dry sclerophyll woodland and open forests.

The Hawkesbury Colluvial soil landscape is characterised by rugged, rolling to very steep hills with narrow crests and ridges, narrow incised valleys with steep sideslopes and rocky benches (>25%) on Hawkesbury Sandstone with local relief of 40 to 200 metres and rock outcrops (>50%). Soils are shallow discontinuous lithosols or siliceous sands on rock outcrops, earthy sands and yellow earths on the inside of benches, joints and fractures, localised yellow and red podzolic soils on shale lenses and yellow earths along drainage lines. Soils exhibit low fertility, are strongly, highly permeable and are highly susceptible to erosion. Vegetation associated with this soil landscape consists predominantly of dry sclerophyll forests with pockets of wet sclerophyll forest or rainforest in less exposed areas.

The Luddenham Erosional soil landscape is characterised by undulating to rolling low hills with narrow ridges, hillcrests and valleys (5 to 20%) over Wianamatta Group shales and Minchinbury Sandstone with local relief of 50 to 80 metres. Soils are shallow to moderately deep and comprise dark podzolic soils or massive earthy clays on crests, moderately deep red podzolic soils on upper slopes and moderately deep yellow podzolic soils and prairie soils on lower slopes and drainage lines. Soils exhibit low to moderate fertility, have low permeability and are susceptible to minor gully and moderate sheet erosion. Vegetation within this soil landscape has been extensively cleared with pockets of dry sclerophyll woodlands and forests remaining.

The Richmond Alluvial soil landscape is characterised by mainly flat quaternary terraces of the Nepean and Georges Rivers (<1%) on Quaternary Alluvium with local relief of <3 metres. Soils are poorly structured orange to red clay loams, clays and sands with occasional presence of ironstone nodules. Soils exhibit low to very low fertility, are sodic, impermeable and are highly susceptible to erosion. Vegetation associated with this soil landscape has been extensively cleared with pockets of remnant riparian forest and wetlands.

The South Creek Alluvial soil landscape is characterised by floodplains, valley flats and drainage depressions (>5%) on the flat, incised channels of the Cumberland Plain with local relief of 10 metres. Soils consist of deep layered sediments over bedrock comprising structured plastic clays or structured loams in or adjacent to drainage lines, red and yellow podzolic soils on terraces usually in combination with patchy structured grey clays, leached clay and yellow solodic soils. Soils exhibit low fertility, are strongly acidic, have hardsetting surfaces, poor drainage and are susceptible to very high to extreme erosion. Vegetation associated with this soil landscape consists of riparian forests and wetlands.

#### **6.1.4 Native vegetation extent**

Vegetation within the impact area, impact assessment area and within the 500 metre buffer area was assessed using aerial photographic interpretation, field survey results and existing vegetation mapping. Table 6 provides the list of PCTs identified from existing vegetation mapping, and the current assessment, as occurring within the impact area, impact assessment area and within the 500 metre buffer. Conservation status of the communities is also provided.



It should be noted that where native vegetation occurs within the 500 metre buffer, but outside the impact area and/or impact assessment area, which has not been previously mapped by existing aerial mapping projects, the vegetation has only been assigned as 'native vegetation', rather than being attributed to a specific PCT.

**Table 6 PCTs mapped within the study area and buffer**

PCT – (mapped OEH 2013, Tozer et al., 2010, OEH 2016a and Biosis 2020)	Conservation status	Location		
		Impact area	Impact assessment area	500 m buffer
<b>PCT 724: Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (Castlereagh Shale - Gravel Transition Forest).</b>	Critically Endangered (EPBC Act), Endangered (BC Act)	Yes	Yes	Yes
<b>PCT 725: Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (Castlereagh Ironbark Forest).</b>	Critically Endangered (EPBC Act), Endangered (BC Act)	Yes*	Yes	Yes
<b>PCT 781: Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion (Coastal Freshwater Wetland).</b>	Endangered (BC Act)	Yes	Yes	Yes
<b>PCT 835: Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Cumberland River-flat Forest).</b>	Critically Endangered (EPBC Act)**, Endangered (BC Act)	Yes	Yes	Yes
<b>PCT 849: Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Cumberland Shale Plains Woodland).</b>	Critically Endangered (EPBC Act and BC Act)	Yes	Yes	Yes
<b>PCT 850: Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (Cumberland Shale Hills Woodland)</b>	Critically Endangered (EPBC Act and BC Act)	No	No	Yes
<b>PCT 883: Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion (Castlereagh Scribbly Gum Woodland).</b>	Endangered (EPBC Act) and Vulnerable (BC Act)	Yes*	Yes	Yes
<b>PCT 920: Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion (Eastern Mangrove Forest)</b>	N/A	No	No	Yes
<b>PCT 1067: Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion (Castlereagh Swamp Woodland)</b>	Endangered (BC Act)	No	No	Yes



PCT – (mapped OEH 2013, Tozer et al., 2010, OEH 2016a and Biosis 2020)	Conservation status	Location		
		Impact area	Impact assessment area	500 m buffer
<b>PCT 1081: Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion (Sydney Hinterland Transition Woodland).</b>	N/A	-	-	Yes
<b>PCT 1083: Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion (Coastal Sandstone Ridgetop Woodland).</b>	N/A	Yes	Yes	Yes
<b>PCT 1105: River Oak open forest of major streams, Sydney Basin Bioregion and South East Corner Bioregion (River Oak Open Forest).</b>	N/A	Yes	Yes	Yes
<b>PCT 1181: Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion (Hinterland Sandstone Gully Forest).</b>	N/A	Yes	Yes	Yes
<b>PCT 1234: Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (Estuarine Swamp Oak forest)</b>	Endangered (EPBC Act and BC Act)	No	No	Yes
<b>PCT 1395: Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion (Cumberland Shale - Sandstone Ironbark Forest).</b>	Critically Endangered (EPBC Act and BC Act)	No	No	Yes
<b>PCT 1800: Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley (Cumberland Swamp Oak Riparian Forest).</b>	Endangered (EPBC Act and BC Act)	Yes	Yes	Yes
<b>Previously un-mapped native vegetation</b>	Unknown	No	No	Yes

\*PCT occurs on Existing Certified land within the impact area only.

\*\* River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria was listed as a CEEC under the EPBC Act in December 2020, after the projects referral decision. As such the listing is not relevant to the current assessment. Refer to Section 9 for more information.

### 6.1.5 Cleared areas

Cleared areas within the impact area, impact assessment area and 500 metre buffer area include land covered by industrial, commercial and residential development in addition to supporting infrastructure such as sealed and unsealed roads, carpark areas and waterways. Areas within the impact assessment area which are dominated by exotic vegetation including; sports fields, residential and commercial gardens, public open spaces, agricultural pasture and a commercial nursery.

### 6.1.6 Differences between mapped vegetation extent and aerial imagery

A number of differences were found to occur between the field validated mapped vegetation extent and that visible on the aerial imagery or previous mapping projects, *The Native Vegetation of the Sydney Metropolitan Area* (DPIE 2016a), *Remnant Vegetation of the western Cumberland subregion*, 2013 Update VIS\_ID 4207 (OEH 2013) and *Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands* (Tozer et



al., 2010). Noticeable differences are highlighted below, with the assessment contained herein considering the field validated and mapped vegetation extents, over non-field validated mapped areas in all locations where field access was possible.

### **Differences between mapped vegetation extent and The Native Vegetation of the Sydney Metropolitan Area (OEH 2016)**

The mapping project, *The Native Vegetation of the Sydney Metropolitan Area* (DPIE 2016a) covers the study area from Lansdowne through to the eastern section of Western Sydney Parklands. There are a number of notable inconsistencies between the existing mapping and field validated vegetation including the following:

- Vegetation within the BioBank site at Lansdowne was mapped as Castlereagh Shale-Gravel Transition Forest (PCT 724) whereas field validation has determined that it is intact Cumberland Shale Plains Woodland (PCT 849).
- Vegetation adjacent to Prospect Creek near Willowbank Crescent at Canley Vale was mapped as Urban Exotic/Native whereas field validation has determined that it is thinned Cumberland Swamp Oak Riparian Forest (PCT 1800).
- Field validated thinned Cumberland Swamp Oak Riparian Forest (PCT 1800) occurring either side of Beckenham Street, Canley Vale, was not included in the mapping project.
- Small patches of scattered Cumberland Shale Plains Woodland (PCT 849) and Cumberland Riverflat Forest (PCT 835) along Chancery, Vale and Bareena Streets at Canley Vale, were not included in the mapping project.
- Patches of Cumberland Shale Plains Woodland (PCT 849) were mapped at Cabravale Memorial Park whereas field validation determined the patches to be thinned Castlereagh Shale-Gravel Transition Forest (PCT 724).
- Patches of vegetation along Cabramatta Road were mapped as Urban Exotic/Native whereas field validation determined the presence of Cumberland Shale Plains Woodland (PCT 849), Cumberland Riverflat Forest (PCT 835), Cumberland Swamp Oak Riparian Forest (PCT 1800) and a small patch of Coastal Freshwater Wetland (PCT 781).
- The patch of Coastal Freshwater Wetland (PCT 781) mapped as occurring to the north of North Liverpool Road was determined by field validation to be Urban Exotic/Native vegetation.
- Patches of thinned and scattered Cumberland Shale Plains Woodland (PCT 835) and Cumberland Riverflat Forest (835) recorded along North Liverpool and Frederick Road between Green Valley and Cecil Hills were not included in the mapping project.
- Patches of thinned Cumberland Riverflat Forest (PCT 835) recorded along Feodore Road and Stirling Street at Cecil Hills were not included in the mapping project. In addition, Coastal Freshwater Wetland (PCT 781) mapped adjacent to Feodore Road was determined by field validation to be Cumberland Riverflat Forest (PCT 835).
- Patches of Cumberland Shale Plains Woodland (PCT 849) and Cumberland Riverflat Forest (PCT 835) mapped within Western Sydney Parklands to the west of Stirling Street at Cecil Hills were determined by field validation to be thinned Cumberland Riverflat Forest (PCT 835) and Cumberland Swamp Oak Riparian Forest (PCT 1800).
- Patches of Plantation (native and/or exotic) mapped throughout the remainder of Western Sydney Parklands to the west of the M7 were determined by field validation to be thinned Cumberland Shale Plains Woodland (PCT 849) and Cumberland Riverflat Forest (PCT 835).



### **Differences between mapped vegetation extent and Remnant Vegetation of the western Cumberland subregion, 2013 Update VIS\_ID 4207 (OEH 2013)**

The mapping project, *Remnant Vegetation of the western Cumberland subregion, 2013 Update VIS\_ID 4207* (DPIE 2015a) covers the study area from the western section of Western Sydney Parklands through to the western boundary of the Cumberland IBRA subregion, west of the Nepean River at Wallacia. There are a number of notable inconsistencies between the existing mapping and field validated vegetation including the following:

- Vegetation within the western side of Western Sydney Parklands and along Rifle Range Road are mapped as Cumberland Shale Hills Woodland (PCT 850) whereas field validation has determined that the patches are thinned and scattered Cumberland Shale Plains Woodland (PCT 849).
- Vegetation within Lot 5 DP1114311 on the corner of Western Road and Cross Street at Kemps Creek was mapped as Castlereagh Ironbark Forest (PCT 725) whereas field validation determined that the north-western section of the lot comprises Castlereagh Scribbly Gum Woodland (PCT 883).
- Vegetation to the south of the AWRC site was mapped as Cumberland Riverflat Forest (PCT 835) and Cumberland Shale Plains Woodland (PCT 849) whereas field validation determined that it was Urban Exotic/Native and Cumberland Riverflat Forest (PCT 835).
- Patches of thinned and scattered Cumberland Swamp Oak Riparian Forest in the AWRC site at Kemps Creek were not included in the mapping project.
- Patches of field validated Cumberland Shale Plains Woodland (PCT 849) and Coastal Freshwater Wetland (PCT 781) in Lot 5 DP860456 were not included in the mapping project.
- Patches of mapped Castlereagh Shale - Gravel Transition Forest (PCT 724) and Cumberland Shale Hills Woodland (PCT 850) along Elizabeth Drive between Kemps Creek and Bringelly were field validated as thinned and scattered Cumberland Shale Plains Woodland (PCT 849).
- Patches of vegetation in riparian areas adjacent to Elizabeth Drive between Bringelly and Luddenham were mapped as Cumberland River-flat Forest (PCT 835) whereas field validation determined that Cumberland Swamp Oak Riparian Forest (PCT 1800) lined the creeks and Cumberland River-flat Forest (PCT 835) occurred further inland.
- Vegetation within Lot 5 DP655046 mapped as Cumberland Shale Plains Woodland (PCT 849) was field validated to be a combination of Castlereagh Ironbark Forest (PCT 725) throughout the majority and Cumberland Shale Plains Woodland (PCT 849) to the south of the lot.
- Vegetation lining Park Road between Luddenham and Wallacia mapped as Cumberland Shale Plains Woodland (PCT 835) and Cumberland Shale Hills Woodland (PCT 850) were field validated as thinned and scattered Castlereagh Shale - Gravel Transition Forest (PCT 724) and Cumberland Shale Plains Woodland (PCT 849).
- Vegetation mapped as Cumberland River-flat Forest (PCT 835) lining Jerry's Creek near 40 Park Road was field validated as Coastal Freshwater Wetland (PCT 781), Cumberland Swamp Oak Riparian Forest (PCT 1800) and Cumberland River-flat Forest (PCT 835).
- Patches of Cumberland Shale Hills Woodland (PCT 850), Cumberland River-flat Forest (PCT 835) and Shale Sandstone Transition Forest (PCT 1395) mapped within Blaxlands Crossing Reserve at Wallacia was field validated as thinned River Oak Open Forest (PCT 1105) along the banks of the Nepean River and thinned Cumberland River-flat Forest (PCT 835) further inland.



### **Differences between mapped vegetation extent and Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands (Tozer et al., 2010)**

The mapping project, *Native Vegetation of Southeast NSW: A Revised Classification and Map for the Coast and Eastern Tablelands* (Tozer et al. 2010) covers the study area from the Sydney coastal regions through to Warragamba Dam and the Greater Blue Mountains Area to the west. This mapping project was used to cover the extent between the western end of Bents Basin Road through to the Greater Blue Mountains Area for the purposes of this project. There are a number of notable inconsistencies between the existing mapping and field validated vegetation including the following:

- Vegetation within the impact area at Warragamba Dam is mapped as Hinterland Sandstone Gully Forest (PCT 1181) whereas field validation has determined that it is thinned Coastal Sandstone Ridgetop Woodland (PCT 1083) and thinned River Oak Open Forest (PCT 1105) lining the banks of the Warragamba River.
- Mapped Hinterland Sandstone Gully Forest (PCT 1181) on the western edge of Lot 821 DP586115 extends further to the east into the impact area than displayed in the mapping project.
- Field validated patches of thinned and scattered Cumberland River-flat Forest (PCT 835) in the eastern side of Lot 821 DP586115 and along the roadside interface of Bents Basin Road are not included in the mapping project.
- The small patch of mapped Cumberland River-flat Forest (PCT 835) mapped to the north-west of Lot 1 DP1154130 was field validated as thinned River Oak Open Forest (PCT 1105) adjacent to the Nepean River and as Cumberland River-flat Eucalypt Forest (PCT 835) further inland.

#### **6.1.7 Rivers and streams**

The study area is located within the Greater Sydney Local Land Services (LLS) Region and the Georges River and Hawkesbury River catchments. The closest major waterway to the eastern end of the impact assessment area is Prospect Creek, a fourth stream order waterway (Strahler 1964), of which the river mouth is located approximately 1.6 kilometres to the south. The nearest major waterway to the western end of the impact assessment area is the Nepean River, a seventh stream order waterway (Strahler 1964) with the river mouth located approximately 70 kilometres to the north-east.

The impact assessment area spans the inner west and western extents of the Cumberland Plain which is characterised by undulating hills, shale plains and dissected by drainage lines. The Cumberland Plain is within a rain shadow between the Blue Mountains and the Sydney Central Business District with mean annual rainfall between 700 to 900 millimetres. Undulating hills throughout the area form low ridgelines which direct overland flow into receiving waterways, drainage lines and depressions in the landscape. Thirty-five waterways flow through the study area, of which the majority are within the Hawkesbury-Nepean Catchment, whereas Prospect Creek falls within the Georges River Catchment (NSW LPI 2016). These waterways are listed below in accordance with the project design feature they occur along and the corresponding Strahler Stream Order (Strahler 1964):

- Treated Water Pipeline:
  - Nepean River (seventh stream order waterway) including one tributary (first stream order waterway).
  - South Creek (sixth stream order waterway).
  - Badgery's Creek (fourth stream order waterway) including one unnamed tributary (third stream order waterway).
  - Cosgroves Creek (fourth stream order waterway) including two unnamed tributaries (second stream order waterways) and one unnamed tributary (first stream order waterway).



- Baines Creek (third stream order waterway).
  - Oaky Creek (third stream order waterway).
  - Two tributaries of Mulgoa Creek (first stream order waterways).
  - Jerrys Creek (fourth stream order waterway) including five tributaries (first stream order waterways).
- Environmental Flows Pipeline:
  - Warragamba River (ninth stream order waterway).
  - Megarrity's Creek (third stream order waterway).
- Brine Pipeline:
  - Kemps Creek (fourth stream order waterway) including one unnamed tributary (second stream order waterway) and three unnamed tributaries (first stream order waterways).
  - Prospect Creek (fourth stream order waterway).
  - Green Valley Creek (second stream order waterway).
  - Hinchinbrook Creek (second stream order waterway) including an unnamed tributary (third stream order waterway) and an unnamed tributary (first stream order waterway).
  - Clear Paddock Creek (first stream order waterway).
  - Upper Canal (first stream order waterway).
  - Two unnamed creeks (first stream order waterways).

The Treated Water Pipeline is to be underbored beneath the bed of most major waterways which intersect with the impact area and impact assessment area including Prospect Creek, The Upper Canal, Badgery's Creek and the Nepean River at Blaxland's Crossing.

The following waterways within and adjacent to the impact area and impact assessment area are identified as Key Fish Habitats as mapped on the Wollondilly and Sydney Key Fish Habitat Maps published by the NSW Department of Primary Industries (DPI) (DPI 2013):

- Warragamba River:
  - Middle Gully Creek
  - Megarrity's Creek
- Nepean River:
  - Baines Creek
- Badgery's Creek
- South Creek
- Kemps Creek
- Hinchinbrook Creek
- Prospect Creek

Key Fish Habitats relevant to the project are further described in project's aquatic ecological assessment (CTE 2021).



### 6.1.8 Wetlands

Patches of vegetation mapped as Proximity Area for Coastal Wetland under *State Environmental Planning Policy (Coastal Management) 2018* (SEPP Coastal Management) occur within the impact assessment area including:

- Vegetation lining the banks of Prospect Creek including a small waterbody in Lansdowne Reserve, Lansdowne.
- Vegetation lining the banks of Clear Paddock Creek north of North Liverpool Drive in Fairfield.
- Vegetation between Doujon Lake and Feodore Drive in Cecil Hills.

Vegetation mapped as Coastal Wetland under SEPP Coastal Management occurs immediately adjacent to the impact area and impact assessment area at Prospect Creek.

Prospect Creek is also mapped on the Coastal Environment Area Map and Coastal Use Area Map under SEPP Coastal Management.

Of these wetland areas, the small waterbody in Lansdowne Reserve is mapped as Reservoir in the NSW Wetlands layer (DPIE 2010). Additional areas mapped as Reservoir under the NSW Wetlands layer (DPIE 2010) include:

- Liverpool Offtake Reservoir within Western Sydney Parklands approximately 480 metres east of the International Shooting Centre at Cecil Park.
- Tadpole Lake, forming an enlarged section of Kemps Creek to the immediate north of the AWRC site at Kemps Creek.
- A small dam in Lot 63 DP1087838 located north of Elizabeth Drive in Badgery's Creek.
- Warragamba River below Warragamba Dam at Warragamba.

None of the above wetland features are included in the DoIW of Australia (DoIW 2004) or are classified as a Ramsar wetland. The impact assessment area is not located within the vicinity of any wetlands included on the List of Wetlands of International Importance developed under the Ramsar convention.

Mapped wetlands at Prospect Creek consist of Cumberland Swamp Oak Riparian Forest (PCT 1800) lining the upper banks and small widely separated pockets of reedland/sedgeland along the lower banks.

Mapped wetlands (DPIE 2010) along Clear Paddock Creek between Elizabeth Drive and St John's Park at Fairfield consist of Cumberland Swamp Oak Riparian Forest (PCT 1800) lining the upper banks and Coastal Wetlands (PCT 781) lining the lower banks. Coastal Wetlands in this section of the waterway are largely dominated by Broadleaf Cumbungi *Typha orientalis* and scattered pockets of Common Rush *Juncus usitatus* along the lower banks.

### 6.1.9 Connectivity features

Primary connectivity features which occur directly within or adjacent to the impact assessment area are predominantly formed from intact bushland conserved within protected areas (Figure 4). Secondary connectivity features include the riparian corridors of the 35 waterways which intersect with the impact area and impact assessment area. These connectivity features provide abundant breeding, foraging and dispersal resources for terrestrial and arboreal mammals, flying mammals, avifauna, amphibians and invertebrates and may form areas of permanent residency for some species.

Tertiary connectivity features include small patches of remnant and secondary PCTs scattered across the landscape which form stepping stone connectivity suitable for highly mobile avifauna and flying mammals. Dispersal potential for flora species and less mobile fauna species is predominantly restricted to within the impact area and adjoining primary and secondary connectivity features; however highly mobile fauna species are likely to utilise tertiary connectivity corridors to disperse through the landscape.



The most notable connectivity features relevant to the project are described below in further detail, and shown on Figure 4.

The Greater Blue Mountains, listed as a World Heritage Area in 2000 and also registered on the National Heritage List on 21 May 2007, is located to the immediate west of the impact area and impact assessment area. The Greater Blue Mountains Heritage Area consists of 1.03 million hectares of native vegetation conserved in eight protected areas separated by a transportation and urban corridor. The Greater Blue Mountains World Heritage Area spans elevations from less than 100 metres above sea level (asl) to 1,300 metres asl.

The Warragamba Special Area occurs to the east of the Greater Blue Mountains Heritage Area on the eastern bank of the Warragamba River adjacent to Warragamba Dam. The Warragamba Special Area has restricted public entry as it contains water storages and the surrounding land forms part of the drinking water catchment. The Warragamba Special Area covers approximately 260,000 hectares of remote, intact remnant native vegetation and protects the catchment of Lake Burragorang. The Special Area contains high botanical diversity, and an abundance of high quality breeding and foraging habitat for threatened fauna species (NPWS 2003).

The central section of the project alignment crosses Western Sydney Parklands, which spans 27 kilometres (north-south) and covers an area of approximately 5280 hectares. Western Sydney Parklands contains vegetation communities relevant to the current assessment, specifically conserved and regenerating Cumberland Plain Woodland (PCT 849), Cumberland River-Flat Eucalypt Forest (PCT 835) and Cumberland Swamp Oak Riparian Forest (PCT 1800). Additional vegetation communities not relevant to the study area include Western Sydney Dry Rainforest and Moist Woodland on Shale (listed as Endangered, BC Act and Critically Endangered, EPBC Act). Furthermore three BioBank sites are located proximal to the project alignment within Western Sydney Parklands.

The eastern section of the project alignment contains a BioBank site located in the eastern section of Lansdowne Reserve. The BioBank site contains high condition Cumberland Plain Woodland in addition to a large population of Downy Wattle and Native Pear. The interior, less disturbed sections of the BioBank site contain large areas of intact biological soil crust and the groundcovers include a diverse array of native grasses, sedges, herbs and forbs.

#### **6.1.10 Areas of geological significance**

There were no recorded karst formations within the study area or within the 500 metre buffer area surrounding the study area. The western end of the study area in the vicinity of Warragamba Dam and the Greater Blue Mountains Area across the Warragamba River contained cliffs and other rock formations which contained deep overhangs and caves. The remainder of the study area contained no caves, crevices, cliffs or other areas of geological significance.

Further detail on areas of geological significance is provided in the project EIS and technical specialist report.

#### **6.1.11 Biodiversity Values Map**

Biodiversity values mapped within the Biodiversity Values Map (DPIE 2020d) have been matched to vegetation communities or threatened species habitat based on coincidence with location and extent of threatened ecological communities (TEC) and/or threatened species habitat within published mapping projects and NSW BioNet. There are multiple areas of Biodiversity Values mapped (DPIE 2020d) within the study area as follows:

- Cumberland Plain Woodland within Lansdowne Reserve at Lansdowne.
- Swamp Oak Floodplain Forest along Prospect Creek at Lansdowne.
- Shale Gravel Transition Forest at Cabravale Memorial Park.
- Green Valley Creek riparian corridor between Cabramatta West and Mount Pritchard.



- Patches of Cumberland River-flat Eucalypt Forest in the vicinity of the Clear Paddock Creek riparian corridor near North Liverpool Road between Green Valley and Bonnyrigg.
- A small patch of coastal wetland near a tributary of Hinchinbrook Creek at Feodore Drive in Cecil Hills.
- Riparian lands and patches of Cumberland Plain Woodland within Western Sydney Parklands between Kensington Close, Cecil Hills and Range Road, Cecil Park.
- Two small patches of Cumberland Plain Woodland and protected riparian land in Lot 11 DP1146142 and Lot 27 DP29832 at Kemps Creek.
- A Patch of Cumberland Plain Woodland along Cross Street at Kemps Creek.
- Protected riparian land at Lot 1 DP88836, Lot 2 DP587135, Lot 2 DP88836, Lot 21 DP258414, Lots 30, 31, 32, 33, 34 and 37 DP258414, Lot 741 DP810111 and Lot 5 DP860456 at Kemps Creek.
- Patches of Cumberland Plain Woodland at Lot 1 DP587135 and Lot 55 DP734584 at Kemps Creek.
- Patches of Shale Gravel Transition Forest along Clifton Avenue, Kemps Creek.
- Protected riparian lands of Badgery's Creek at Badgery's Creek.
- Patches of Cumberland Plain Woodland in Lot 101 DP848215 at Badgery's Creek.
- Protected riparian lands of Cosgroves and Oaky Creek between Badgery's Creek and Luddenham.
- Patches of Cumberland Plain Woodland on private land along The Northern Road between Elizabeth Drive and Park Road, Luddenham.
- Patches of Cumberland Plain Woodland and Shale Gravel Transition Forest along Park Drive between Luddenham and Wallacia.
- The riparian corridors of Baines Creek, Jerry's Creek and the Hawkesbury-Nepean River at Wallacia.
- Patches of Shale Sandstone Transition Forest between Bents Basin Road and Warragamba River, Warragamba.

#### **6.1.12 Soil hazard features**

Vegetated parts of the study area within the vicinity of Lansdowne Reserve and surrounds are mapped as being Class 3, 4 and 5 Acid Sulfate Soils and the banks of Prospect Creek are mapped as Class 1 Acid Sulfate Soils on the Bankstown and Fairfield LEPs.

Further detail on soil hazard features is provided in project EIS and technical specialist report.

## **6.2 Site context**

The site context was assessed using both desktop (GIS) and site-based methods implementing the BAM (DPIE 2020a). Site assessments were undertaken over the course of field campaigns between April 2020 to January 2021 by Biosis ecologists. The habitats and vegetation within the impact area and impact assessment area are a small subset of those in the wider landscape.

Table 7 outlines the results of the assessment of site context.



**Table 7 Native vegetation cover (%) within the 500 metre buffer and relevant patch sizes**

Site context attribute	Cumberland IBRA subregion	Wollemi IBRA subregion
<b>Native vegetation cover (%)</b>	20 % (>10-30%)	78 % (>70%)
<b>Patch size classes relevant to the project</b>	>100 ha	>100 ha

Patch size for each vegetation zone located within the impact area was mapped in accordance with Section 4.3.2 of the BAM using the following steps:

1. Identify vegetation zones that will be included in the same patch (i.e. vegetation zones located within 100 metres of one another for intact native woody vegetation and within 30 metres of one another for intact native non-woody vegetation).
2. Identify the boundary of any adjoining intact native vegetation which extends beyond the limit of the subject land.
3. Digitise each patch using separate polygons where multiple patches exist.
4. Calculate the area of each patch in hectares.

Vegetation within the impact area was mapped sequentially by implementing the above ruleset, with all vegetation zones being found to form a patch >100 hectares in area.

Further detail on patch sizes for each vegetation zone area provided in Section 7.2.1.