

Appin Mine Area 7

Longwalls 712 to 716

Biodiversity Management Plan

29 July 2026



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DOCUMENT CONTROL

Applicant: Illawarra Coal Holdings Pty Ltd

Mine: Appin Mine

Name of operator: Gear M Illawarra Met Coal Pty Ltd trading as GM³

Project approval: MP08_0150

Mining leases: Consolidated Coal Lease 767, Mine Lease 1698, Mine Lease 1433, Mine Lease 1832, Mine Lease 1847 and Mine Lease 1874

Document Title: Appin Mine Area 7
Longwalls 712 to 716 Extraction Plan
Biodiversity Management Plan

NAME OF PERSONS AUTHORISING THIS PLAN

NAME	TITLE	DATE
Gary Brassington	Director Sustainability and Government	February 2026

DOCUMENT REVISIONS

REVISION	DESCRIPTION OF CHANGES	DATE
1	New document for consultation	December 2025
2	Document updated following consultation	February 2026

PERSONS INVOLVED IN PREPARATION OF THIS PLAN

NAME	TITLE	EXP (YEARS)
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1. INTRODUCTION

1.1 Project Background

Illawarra Coal Holdings Pty Ltd (ICHPL) operates the Bulli Seam Operations (BSO) Appin Mine extracting hard coking coal used for steel production. On 22 December 2011 the Planning and Assessment Commission (PAC), under delegation of the Minister for Planning, approved BSO (MP 08_0150) under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act) to continue mining operations until 2041.

This Biodiversity Management Plan (BMP) supports the Longwalls 712 to 716 Extraction Plan for mining of coal in Appin Area 7 (AA7) mining domain. This BMP describes the monitoring and management of terrestrial and aquatic flora and fauna within the Extraction Plan Study Area. The relationship between this BMP and the other components of the Extraction Plan is shown in Figure 3 of the Extraction Plan Main Document.

1.2 Scope

The scope of this BMP includes the program of monitoring of terrestrial and aquatic biodiversity within the Longwall 712 to 716 Study Area and a trigger action response plan that includes management actions to be taken upon reaching a specified trigger level. This BMP has been prepared in accordance with the BSO Approval (MP 08_0150) Condition 5 (i), Schedule 3.

The Study Area for the Extraction Plan is defined in accordance with MSEC (2025) as the surface area predicted to be affected by the proposed mining of Longwalls 712 to 716 and encompasses the areas bounded by the following limits (Figure 1):

- A 35° angle of draw line from the maximum depth of cover, which equates to a horizontal distance varying between 555 m and 800 m around the limits of the proposed extraction areas for Longwalls 712 to 716, and
- The predicted limit of vertical subsidence, taken as the 20 mm subsidence contour, resulting from the extraction of the proposed Longwalls 712 to 716.

Additionally, features potentially sensitive to far field movements, which includes horizontal, valley closure and upsidence movements that may be outside the 20 mm subsidence zone or 35° angle of draw line have been assessed including:

- Watercourses (including Navigation Creek and its minor tributaries, and minor tributaries of Foot Onslow Creek and Apps Gully);
- Steep slopes; and
- Cliffs.

1.3 Objectives

The objectives of this BMP are to identify the biodiversity within the Longwalls 712 to 716 Study Area and to manage the potential impact and/or environmental consequences of the proposed mining to terrestrial and aquatic biodiversity.

Specific focus will be on threatened species, populations and their habitats; endangered ecological communities; and groundwater dependent ecological communities.

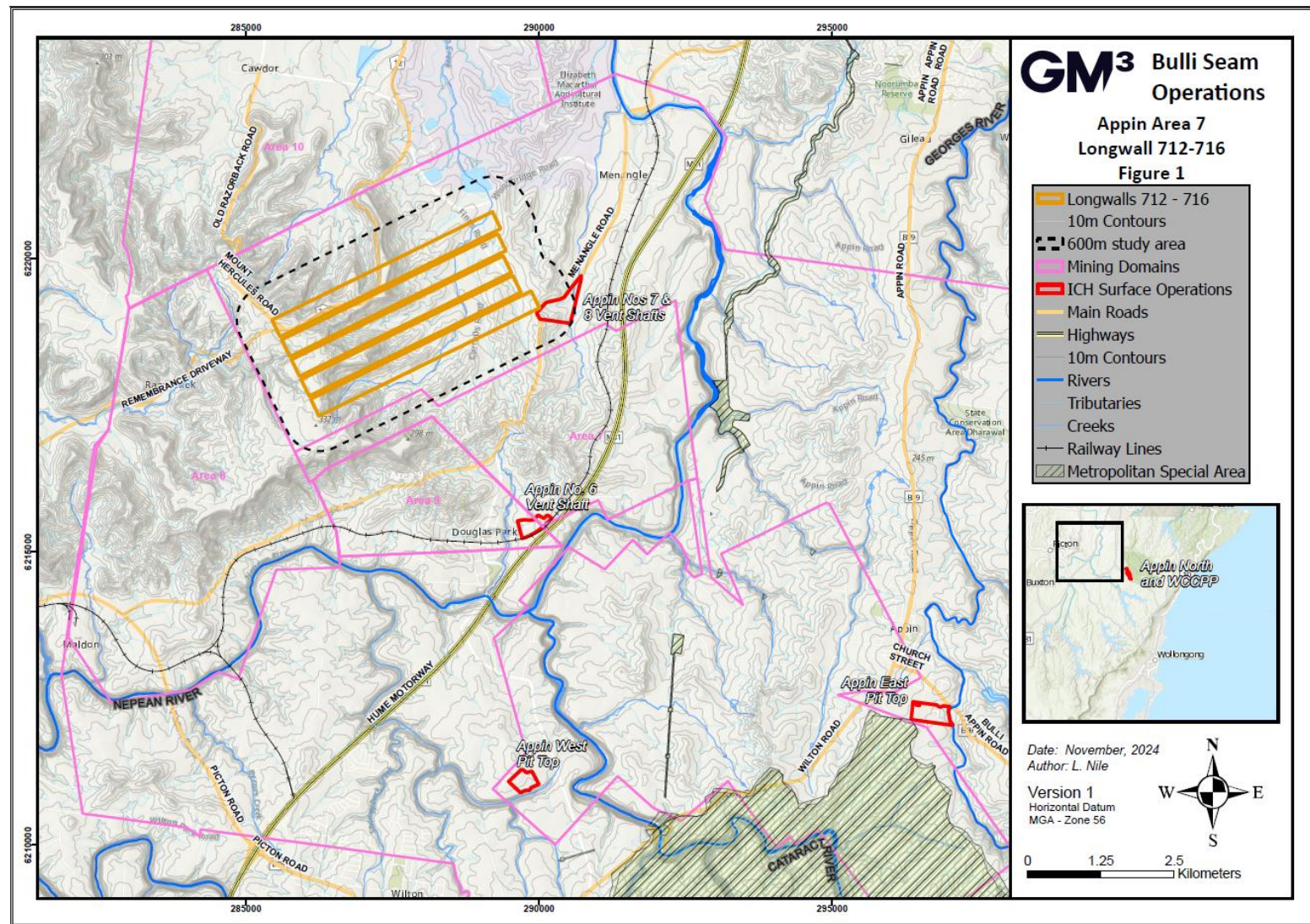
1.4 Consultation

This BMP will be developed in consultation with:

- Department of Planning, Housing and Infrastructure (DPHI);
- Conservation Programs, Heritage, and Regulation Group (CPHR) of the Department of Climate Change, Energy, the Environment and Water (DCCEEW); and
- Department of Primary Industries – DPI (Fisheries).

ICHPL will make the BMP and associated documentation publicly available on the GM³ website in accordance with Condition 11, Schedule 6 of the BSO Approval.

Figure 1: Appin Area 7 (Longwalls 712 to 716) Study Area



2. STATUTORY REQUIREMENTS

Extraction of coal from Longwalls 712 to 716 will be in accordance with the conditions set out in the BSO Approval, applicable legislation and the requirements of relevant licences and permits, including conditions attached to mining leases.

2.1 BSO Approval

Condition 5 (i), Schedule 3 of the BSO Approval requires the preparation of a BMP to manage the potential impacts and/or environmental consequences of the proposed mining on aquatic and terrestrial flora and fauna as shown in Table 1.

Table 1: Key Conditions of the BSO Approval MP 08_0150

No.	Condition Requirement	Section
C3.5(i)	The Proponent shall prepare and implement an Extraction Plan for first and second workings within each longwall mining domain to the satisfaction of the Planning Secretary. Each extraction plan must: include a Biodiversity Management Plan, which has been prepared in consultation with BCS and DPI (Fisheries), which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species, populations and their habitats; endangered ecological communities; and water dependent ecosystems, including (for Appin Areas 7, 8 and 9):	Section 6
	– Additional targeted surveys for threatened species, sufficient to identify any actions required to protect significant populations from potential impacts;	Section 6

This BMP also addresses the requirements detailed in Condition 6 Schedule 3 and Condition 2, Schedule 6 of the BSO Approval as shown in Table 2.

Due consideration has been given to all the BSO Approval Conditions in the preparation of this BMP, including those relating to auditing, rehabilitation and environmental management.

Table 2: Management Plan Requirements

Project Approval Conditions	Section
Condition 6, Schedule 3 The Proponent shall ensure that the management plans required under Condition 5 (g)–(l) above include: a) an assessment of the potential environmental consequences of the Extraction Plan, incorporating any relevant information that has been obtained since this approval;	Section 4 Section 7

b) a detailed description of the measures that would be implemented to remediate predicted impacts.	
Condition 2, Schedule 6 The Proponent shall ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include: (a) detailed baseline data; (b) a description of: - the relevant statutory requirements (including any relevant approval, licence or lease conditions); - any relevant limits or performance measures/criteria; - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures; (c) a description of the measures that would be implemented to comply with the relevant statutory, limits, requirements or performance measures/criteria; (d) a program to monitor and report on the: - impacts and environmental performance of the project; - effectiveness of any management measures (see c above); (e) a contingency plan to manage any predicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible; (f) a program to investigate and implement ways to improve the environmental performance of the project over time; (g) a protocol for managing and reporting any: - incidents; - complaints; - non-compliances with statutory requirements; and - exceedances of the impact assessment criteria and/or performance criteria; and (h) a protocol for periodic review of the plan.	Section 3 Section 2 Section 5 Section 5 to 8 Section 5 to 8 Section 6 Section 8 Section 10 Section 9 Section 10

2.2 Legislation and Guidelines

This BMP has been developed taking due account of the requirements of the following legislation and associated guidelines:

- Biodiversity Conservation Act, 2016 (BC Act).
- Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act).
- Fisheries Management Act, 1994 (FM Act).

2.3 Relevant Leases and Licences

The following licences or permits may be applicable to ICHPL operations in AA7:

- Mining Leases as per Table 3.

- Environment Protection Licence (EPL) 2504 which applies to BSO, including Appin and West Cliff Mines. A copy of the licence can be accessed at the NSW EPA website.
- All relevant Occupational Health, Safety, Environment and Community approvals.
- Any additional leases, licences and approvals resulting from the BSO Approval.

Table 3: Appin Mine Leases

MINING LEASE – DOCUMENT NUMBER	START	FINISH
CCL 767	29 OCT 1991	08 JUL 2029
ML 1433	24 JULY 1998	24 JULY 2043
ML 1698	26 JUN 2014	26 JUN 2035
ML 1832	9 AUG 2022	9 AUG 2043
ML 1874	20 FEB 2020	20 FEB 2045
ML 1892	4 SEP 2025	4 SEP 2046

3. BASELINE ASSESSMENT

A baseline Aquatic Biodiversity Assessment (Bioanalysis, 2009) and Terrestrial Flora and Fauna Assessment (Flora Search, 2009; Biosphere 2009) were undertaken in support of the BSO Environmental Assessment (EA). The Study Area for these assessments included the Longwalls 712 to 716 Study Area.

Supplementary field surveys for Aquatic Biodiversity (Stantec, 2025 – Appendix A) and Terrestrial Biodiversity (Niche, 2025 – Appendix B) were undertaken for the purposes of this Extraction Plan.

3.1 Terrestrial Biodiversity

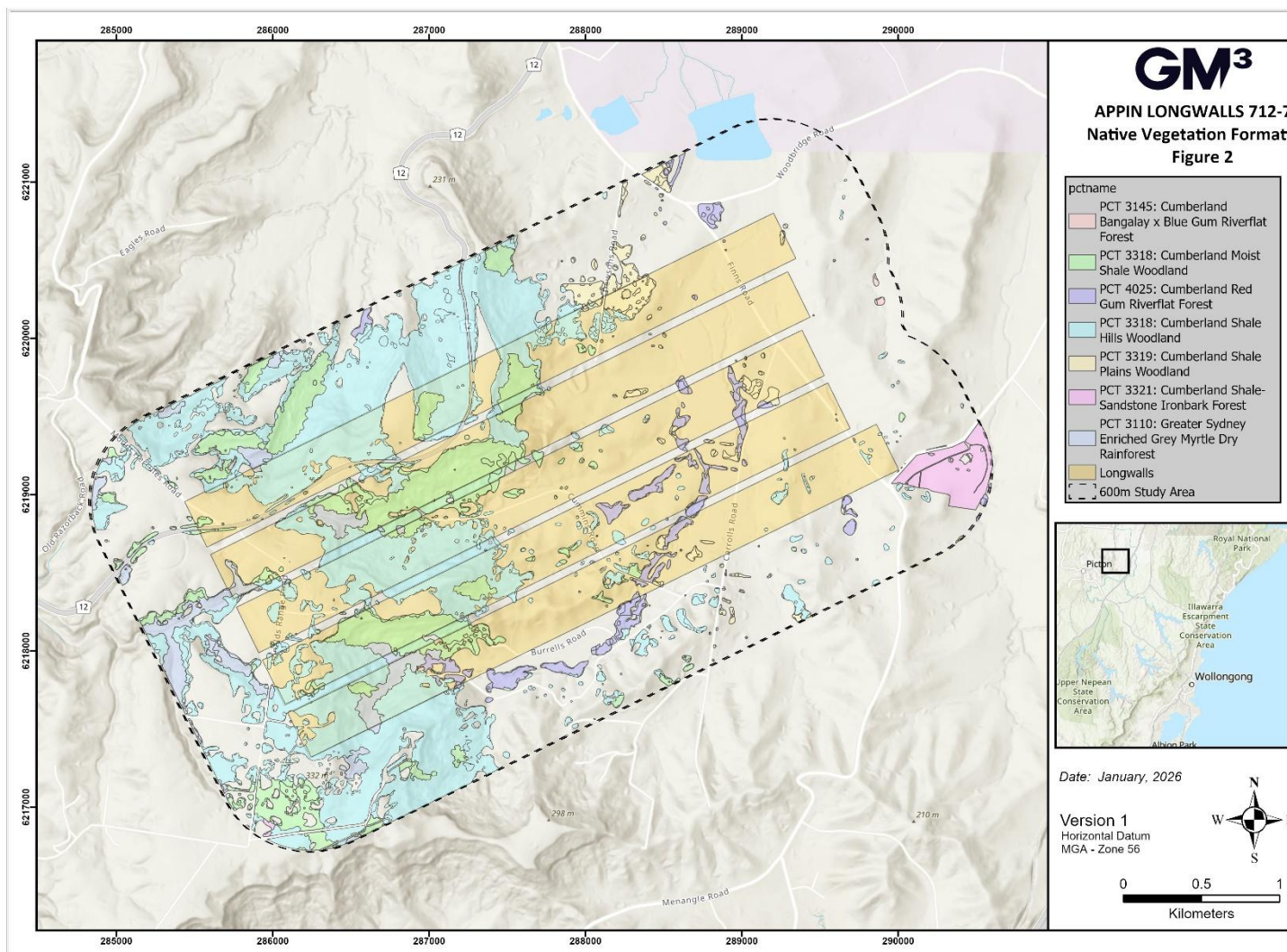
Niche (2025) identify seven Threatened Ecological Communities (TEC) within the Study Area. A total of 33 threatened plant species listed on the EPBC Act and/or BC Act have been previously recorded or have potential habitat within a 10 km radius of the Study Area. Of the 33 threatened species obtained in the database searches, nine species were known to occur or considered to have a Moderate to High likelihood of occurrence in the Study Area. No other threatened flora has been recorded within the Study Area.

A total of 58 threatened fauna species listed on the EPBC Act and or BC Act have been previously recorded or have potential habitat within a 10 km radius of the Study Area. Of the 58 threatened species obtained in the database searches, 28 of these species were determined to have a moderate or high likelihood of occurrence within the Study Area. However, the biodiversity survey undertaken (Niche, 2025) did not identify any threatened fauna within the Study Area.

3.1.1 Vegetation Communities

The natural environment of the Longwalls 712 to 716 Study Area contains flora and fauna habitats, which include remnant stands of open woodland, riparian scrub in drainage lines, closed

grassland and fringing aquatic vegetation near constructed dams in grazed paddocks (Figure 2)
Figure 2 – Vegetation Communities



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Seven Plant Community Types (PCTs) have been mapped as occurring within the Study Area by DPIE (2013) and Niche (2025). Several TECs were also identified in the Longwalls 712 to 716 Study Area. Table 4 describes the communities present and their conservation status. Further descriptions of the vegetation communities are detailed in Niche (2025).

Figure 2 – Vegetation Communities

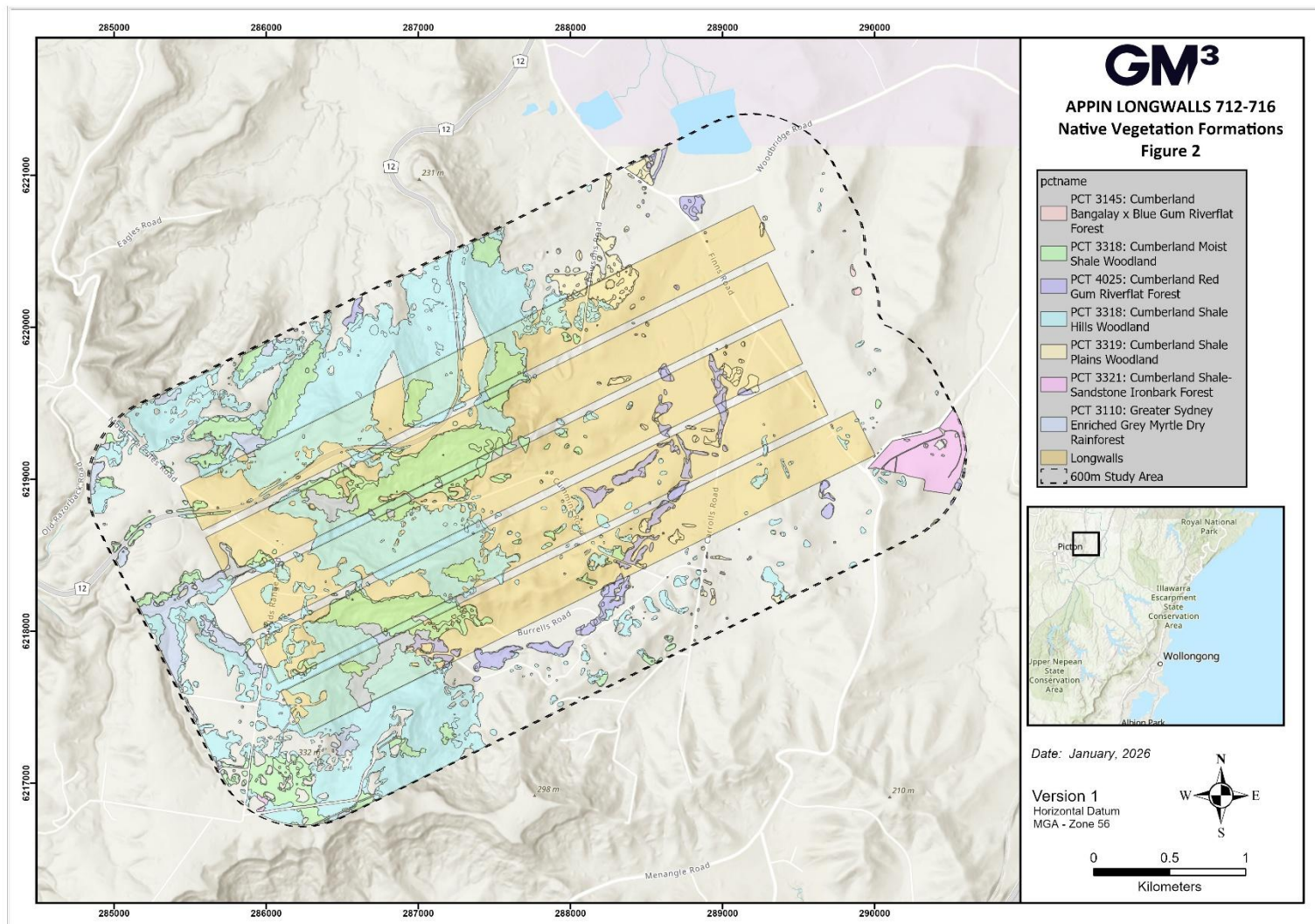


Figure 3: Threatened Flora and Fauna Occurrences

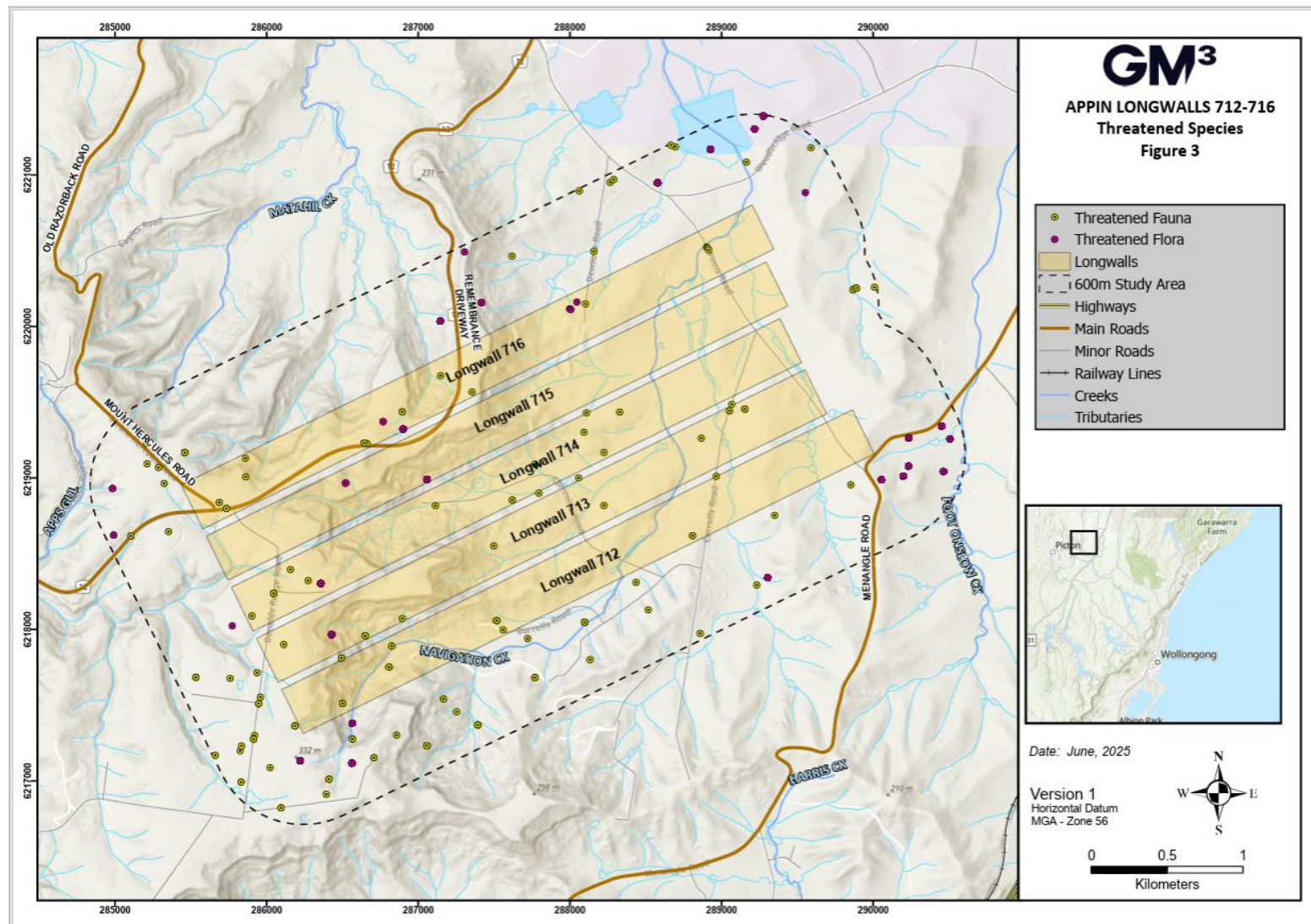


Table 4: Longwall 712 to 716 Study Area Vegetation Communities

Plant Community Type Niche Mapping (2021)	BC Act Status	EPBC Act Status	Area Occupied within Study Area (ha)
PCT 3110: <i>Greater Sydney Enriched Grey Myrtle Dry</i> TECs: • <i>Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions</i> • <i>Western Sydney Dry Rainforest and Moist Woodland on Shale</i> • <i>Western Sydney Dry Rainforest and Moist Woodland on Shale</i>	E	CE	35.02
PCT 3145: <i>Cumberland Bangalay x Blue Gum Riverflat Forest</i> TECs: • <i>Elderslie Banksia Scrub Forested</i> • <i>Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion</i> • <i>River-Flat Eucalypt Forest on the Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions</i> • <i>River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern.</i>	E	CE	0.40
PCT 3318: <i>Cumberland Moist Shale Woodland</i> TECs: • <i>Equivalent: Moist Shale Woodland in the Sydney Basin Bioregion</i> • <i>Western Sydney Dry Rainforest and Moist Woodland on Shale</i>	E	CE	122.28
PCT 3319: <i>Cumberland Shale Hills Woodland</i> TECs: • <i>Cumberland Plain Woodland in the Sydney Basin Bioregion</i> • <i>Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest</i>	CE	CE	370.96
PCT 3320: <i>Cumberland Shale Plains Woodland</i> TECs: • <i>Cumberland Plain Woodland in the Sydney Basin Bioregion</i> • <i>Shale Gravel Transition Forest in the Sydney Basin Bioregion</i>	CE	CE	39.70

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest			
PCT 3321: <i>Cumberland Shale-Sandstone Ironbark Forest</i>	CE	CE	0.38
PCT 4025: <i>Cumberland Red Gum Riverflat</i>	E	CE	31.03

Notes: Endangered = E, Critically Endangered = CE.

3.1.2 Threatened Flora

No threatened flora species were recorded in the supplementary surveys (Niche, 2025). Figure 3 shows known occurrences of threatened species previously recorded in the locality.

Thirty three (33) threatened plant species listed on the EPBC Act and/or BC Act have been previously recorded or have potential habitat within a 10 km radius of the Study Area. Of the 33 threatened species, nine species have a moderate to high likelihood of occurrence in the Study Area:

- *Cynanchum elegans* (White-flowered Wax Plant),
- *Eucalyptus benthamii* (Camden White Gum),
- *Epacris purpurascens* var. *purpurascens*,
- *Grevillea parviflora* (Small-flower Grevillea),
- *Persoonia bargoensis* (Bargo Geebung),
- *Pultenaea pedunculata* (Matted Bush-pea),
- *Pomaderris brunnea* (Brown Pomaderris),
- *Pimelea spicata* (Spiked Rice-flower),
- *Pterostylis Saxicola* (Sydney Plains Greenhood)

A detailed list of threatened flora species with a likelihood of occurring within the Study Area is provided in Niche (2025).

3.1.3 Threatened Fauna

No threatened fauna species were recorded in the supplementary surveys (Niche, 2025). **Figure 3** shows known occurrences of threatened species in the locality.

Fifty-eight threatened fauna species listed on the EPBC Act and/or BC Act have been previously recorded or have potential habitat within a 10 km radius of the Study Area. Of the 58, 28 of these

species were determined to have a moderate or high likelihood of occurrence within the Study Area:

- Frogs: *Heleioporus australiacus* (Giant Burrowing Frog), *Litoria Littlejohni* (Littlejohn's Tree Frog).
- Birds: *Callocephalon fimbriatum* (Gang-gang Cockatoo), *Calyptorhynchus lathamii* (Glossy Black-Cockatoo), *Chthonicola sagittata* (Speckled Warbler), *Circus assimilis* (Spotted Harrier), *Climacteris picumnus victoriae* (Brown Treecreeper (eastern subspecies)), *Daphoenositta chrysoptera* (Varied Sittella), *Glossopsitta pusilla* (Little Lorikeet), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Hieraaetus morphnoides* (Little Eagle), *Lathamus discolor* (Swift Parrot), *Melanodryas cucullata cucullata* (Hooded Robin (south-eastern form)), *Melithreptus gularis* (Black-chinned Honeyeater), *Ninox connivens* (Barking Owl), *Ninox strenua* (Powerful Owl), *Petroica boodang* (Scarlet Robin), *Rostratula australis* (Australian Painted-snipe) and *Stagonopleura guttata* (Diamond Firetail).
- Mammals: *Chalinolobus dwyeri* (Large-eared Pied-bat), *Dasyurus maculatus* (Spotted-tailed Quoll), *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat), *Miniopterus australis* (Little Bent-winged Bat), *Miniopterus orianae oceanensis* (Large Bent-winged Bat), *Myotis macropus* (Southern myotis), *Phascolarctos cinereus* (Koala) and *Pteropus poliocephalus* (Grey-headed Flying-fox).
- Invertebrates: *Meridolum corneovirens* (Cumberland Plain Land Snail).

3.1.4 Areas of Outstanding Biodiversity Value

No Areas of Outstanding Biodiversity Value (AOBV) have been declared for any ecological values within the Study Area. No AOBV will be impacted by the proposal (Niche, 2025).

3.2 Aquatic Biodiversity

3.2.1 Nepean River

The Nepean River is located outside the Study Area and is not expected to experience further impacts related to subsidence. However, as a precautionary measure, the adjacent section from existing aquatic ecology monitoring Site 8 upstream to Site X8 is assessed in Stantec (2025 – see Figure 3-1). The water in this section of the Nepean River is derived from the discharges of the Cataract, Cordeaux, Avon and Nepean Dams and catchment runoff with low flows controlled by Maldon Weir, which is situated approximately 5 km south-west of the proposed longwalls. The lower section includes the 1 m high causeway at Douglas Park. The channel above and below this causeway consists of a continuous pool, approximately 50 m wide and 3.5 m deep, with low flows except during flood events. Overall, aquatic habitat of the sites on the Nepean River are generally

in good condition, although the AUSRIVAS modelling does not fully reflect this observation, indicating impaired habitat and / or water quality.

A full description of the Study Area can be found in Stantec (2025).

The location of relevant aquatic ecology monitoring sites for the Study Area is shown in Figure 4.

3.2.2 Other Creeks and Drainage Lines

Navigation Creek

Approximately 5 km of the third-and-greater order section of Navigation Creek flows through agricultural/pastoral land within the Study Area, with 1.7 km of this creek located directly above Longwalls 712 to 716 and 4.5 km within 400 m. This reach is classified as moderate aquatic habitat (Class 2 i.e. containing some small semi-permanent refuge pools which are unlikely to persist through prolonged drought) (The Ecology Lab 2008). At the time of inspection (which followed recent rainfall) the pools at Site NI were connected by shallow flow, though pool connectivity would not be expected to persist during dry periods (Stantec 2025).

Four unnamed third-order tributaries of Navigation Creek are located within the Study Area with an approximate total cumulative length of 7 km, 3.3 km of which is above the proposed longwalls, and 5.5 km within 400 m of the Study Area. During visits by the Environmental Field Team (EFT) in October 2024 to tributary 1 (NavC16), these watercourses were found to provide minimal to moderate aquatic habitat. This was based on the presence of apparent semi-permanent pools that would likely provide habitat for fish and macroinvertebrates. No large wood debris, rocks or aquatic plants were observed. Aerial imagery indicates that although tributaries 3 to 5 of Navigation Creek flow through comparable areas to other tributaries of Navigation Creek, they would be subject to ongoing degradation due to agricultural and pastoral land use, and would provide minimal aquatic habitat. Tributary 5 (NavC14.5) was visited by EFT in October 2024 and was largely dry except for a few small, disconnected pools.

One unnamed second-order tributary of Navigation Creek (Tributary 2 – NavC15) is located within the Study Area. During visits by EFT in October 2024, this tributary was found to provide minimal aquatic habitat, consisting of disconnected pools.

Foot Onslow Creek

A small section of less than 200 m of Foot Onslow Creek is located in the Study Area. This creek is not located directly above nor within 400 m of Longwalls 712 to 716. The section of the creek provides moderate aquatic habitat and contains a number of relatively large, deep pools that would be expected to persist through prolonged dry periods (The Ecology Lab 2008a).

Apps Gully

Approximately 300 m of the third order Apps Gully (a tributary of Racecourse Creek) is located in the Study Area, with 50 m of its length within 400 m of Longwalls 712 to 716. During visits by Stantec

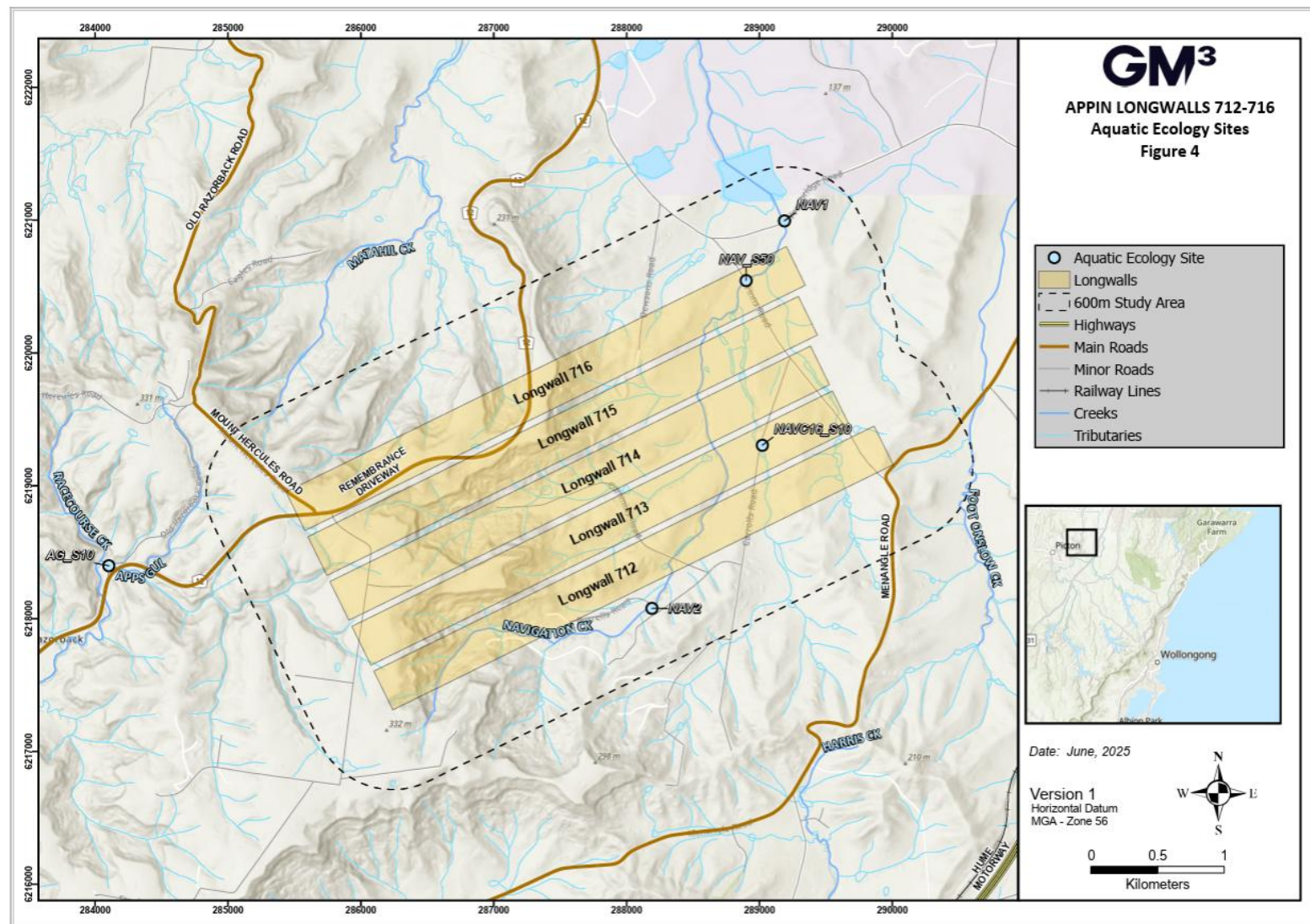
in April 2025 approximately 1.3 km downstream of the Study Area, this watercourse was found to provide moderate aquatic habitat. Aerial imagery indicates Apps Gully and upstream tributaries flow mostly through steep valleys with riparian vegetation surrounded by agricultural / pastoral land use.

Other Tributaries

In addition to Navigation Creek Tributary 2 (NavC16), Stantec (2025) have identified approximately 30 km of several first and second tributaries in the Study Area flow into the Nepean River, with approximately 25 km located within 400 m of the Study Area. Some upstream sections in steeper valleys flow through apparently undisturbed riparian vegetation, though these are located at the extreme upstream extent of their catchments and likely do not provide permanent aquatic habitat. Where these flow through a cleared agricultural land use the watercourses would be highly degraded, ephemeral and provide very limited aquatic habitat.

These first and second order watercourses are considered as Class 4 (unlikely) aquatic habitat.

Figure 4: Aquatic Ecology Monitoring



3.2.3 Aquatic Vegetation

A number of aquatic macrophytes are present within the Nepean River. These were surveyed most recently in December 2023 as part of the ongoing monitoring in AA 7 and 9 (Stantec, 2025) and in December 2024 as part of the ongoing monitoring in AA7 (Stantec, 2025a). They generally grow on the shallower riverbed reaches (confined to a maximum river depth of approximately 3.5 m) where soft sediment is present.

At least nine species of instream aquatic macrophytes have been identified in the Nepean River by Stantec (Figure 4):

- *Potamogeton tricarlinatus* (Floating pondweed);
- *Vallisneria* sp. (Ribbonweed);
- *Hydrilla verticillate* (Hydrilla);
- *Elodea canadensis* (Eelodea);
- *Potamogeton ochreatus* (Blunt pondweed);
- *Potamogeton perfoliatus* (Clasped pondweed);
- *Rorippa nasturtium-aquaticum* (Watercress);
- *Typha* sp. (Cumbungi); and
- *Potamogeton crispus* (Curly Pondweed).

The extent and species composition of instream aquatic macrophytes at individual sites has been variable and appears highly dependent on flow variability, with high flows scouring away river sediments, and thus associated plants, and providing new areas for colonisation following high flows (Cardno, 2019). Notably, high flows appear to be the explanation for the apparent reduction in the extent of ribbonweed observed at Sites 7 and 8 in November 2016 compared with previous surveys. Since this time, including in November 2019, the extent of ribbonweed and tall spikerush has increased as these plants have colonised nearby areas of unvegetated sediment exposed following high flows.

Five species of in-stream aquatic plants (*Elodea*, *Hydrilla*, *Vallisneria Americana*, *Potamogeton sulcatus* and *Triglochin procerum*) were found across the six sites on the Nepean River surveyed by Bioanalysis (2009). The first three have been identified as present at one or more sites on the Nepean River by Cardno, noting that it is possible that *Valisneria* sp. was *V. Americana*. The latter two species identified by Bioanalysis (2009) are additional species. *T. procerum* was identified downstream of Site 8 at NP1_1 and NP1_2 and *P. sulcatus* between X3 and Site 1.

A species of floating pondweed, *Potamogeton* sp., was also observed in Navigation Creek within the current Study Area and in Apps Gully just downstream of the Study Area.

Surveys of aquatic macrophytes by Bioanalysis (2009) identified *P. sulcatus* in Racecourse Creek, but did not identify any native in-stream aquatic plants on Foot Onslow Creek.

3.2.4 Aquatic Macroinvertebrates

Between November 2008 and December 2024, Stantec has undertaken 16 surveys of macroinvertebrates in the Nepean River in relation to AA7 and 9. In total, 100 taxa were identified from 154 samples collected (Stantec, 2025).

During September 2003 to 2024, the number of taxa per sample has ranged from 1 to 34, the OE50 Taxa Score has ranged from 0.06 (Band D – extremely impaired relative to reference condition) to 1.110 (Band A – equivalent to reference condition) and the SIGNAL2 Score ranged from 1.5 (indicative of severe water pollution) to 4.7 (indicative of moderate water pollution). The mean number of taxa per site was relatively comparable among sites, though there was a slight trend for fewer taxa at upstream sites X3 to X8 compared with most sites farther downstream. This likely reflects the variable habitat conditions between these sections of the Nepean River (Stantec, 2025).

The aquatic macroinvertebrate fauna in this section of the Nepean River appears to have experienced some degree of environmental stress prior to, and hence independent of, mining, and continues to do so (Stantec, 2025).

AUSRIVAS surveys undertaken in April 2025 indicated:

- Number of taxa at sites in Navigation Creek ranged from 12 to 20, and was 12 in NAVC16 and 24 in Apps Gully.
- OE50 Taxa Score ranged from 0.46 (Band C) to 0.69 (Band B) in Navigation Creek, was 0.58 (Band B) in NAVC16 and was 0.94 (Band A) in Apps Gully.
- SIGNAL2 Score ranged from 3.0 to 3.5 in Navigation Creek, was 3.0 in NAVC16 and was 3.8 in Apps Gully, with all values indicative of severe water pollution.

These results suggest that these, and likely all watercourses in the Study Area, have historically been and are currently characterised by degradation to aquatic habitat and/or water quality. One possible exception is Apps Gully, where the AUSRIVAS band score suggested no degradation of aquatic habitat and water quality. Notably, however, the site in Apps Gully was located downstream of the Study Area.

3.2.5 Fish

Ten species of fish have been caught using bait traps and backpack electrofishing across Sites 1 to 8 and X1 to X8 on the Nepean River between September 2003 to December 2024.

- Australian bass (*Macquaria novemaculeata*);

- Freshwater catfish (*Tandanus tandanus*);
- Cox's gudgeon (*Gobiomorphus coxii*);
- Flat head gudgeon (*Philypnodon grandiceps*);
- Dwarf flathead gudgeon (*Philypnodon sp.*);
- Empire gudgeon (*Hypseleotris compressa*);
- Australian smelt (*Retropinna semoni*);
- Eastern gambusia (*Gambusia holbrooki*);
- Long-finned eel (*Anguilla reinhardtii*); and
- Carp gudgeon (*Hypseleotris sp.*).

Several species of fish including striped gudgeon, sea mullet, freshwater mullet, bullrout and freshwater herring, which have been recorded further downstream in the section of the Nepean River upstream of Penrith Weir (Baumgartner and Reynoldson, 2007), could potentially colonise the Study Area now that fishways have been installed on the intervening weirs.

Movement of fish into the upstream reaches of the Nepean River is restricted by Maldon Weir. Maldon Weir is the upstream limit of migration for Australian bass and other species that require estuarine areas to spawn (Sammut and Erskine, 1995). Further detail about where each of these fish species has been observed is provided in Stantec (2025).

Backpack electrofishing surveys undertaken by Stantec in April 2025 identified eastern gambusia and yabby in Navigation Creek, NAVC16 and Apps Gully, carp gudgeon in Navigation Creek and NAVC16, freshwater eel in Navigation Creek and yabby in Navigation Creek, NAVC16 and Apps Gully.

3.2.6 Threatened Aquatic Species

In desktop searches four threatened species and invertebrates listed under the FM Act and/or EPBC Act were found to be present in the locality of, or have potential habitat within the Study Area. Table 5 provides a summary of the likelihood of identified threatened species to be present in the Study Area.

Table 5: Likelihood of Occurrence Threatened Aquatic Species in the Study Area (Stantec, 2025)

Species and Listing	Likelihood of Occurrence
Macquarie Perch (endangered under FM Act and EPBC Act)	Not expected to occur in the Study Area due to the limited aquatic habitat provided by ephemeral first, second and third order drainage lines present.

Species and Listing	Likelihood of Occurrence
Adams Emerald Dragonfly (endangered under FM Act)	Not expected to occur in drainage lines within the Study Area. No records within, or adjacent to the Study Area despite extensive sampling, though suitable microhabitat appears to exist adjacent to the Study Area in the Nepean River.
Sydney Hawk Dragonfly (endangered under FM Act)	Not expected to occur in drainage lines in the Study. The only records of this species are from 1979 and 1980 in the Nepean River upstream of the Study Area near Sites X7 and X8 and further upstream near Nepean Dam.
Australian Grayling (protected under FM Act and vulnerable under EPBC Act)	Does not occur in the Study Area. Present in coastal rivers of southern NSW outside of the Study Area.

4. PREDICTED IMPACTS

In accordance with the findings of the Southern Coalfield Inquiry (2008) and Independent Expert Panel for Mining in the Catchment (2019a), subsidence impacts are defined as:

- **Subsidence effects** are defined as the deformation of ground mass such as horizontal and vertical movement, curvature and strains.
- **Subsidence impacts** are the physical changes to the ground that are caused by subsidence effects, such as tensile and sheer cracking and buckling of strata.
- **Environmental consequences** are then identified, for example, as a loss of surface water flows and standing pools.

4.1 Subsidence Effects

Terrestrial ecological features could experience the full range of predicted subsidence movements depending on their location in the Longwalls 712 to 716 Study Area.

4.2 Subsidence Impacts

Predicted subsidence impacts for natural features within the Longwalls 712 to 716 Study Area are outlined in MSEC (2025). A summary of the predictions that could have environmental consequences for terrestrial biodiversity are provided in Table 6.

Table 6: Predicted Impacts to Natural Surface Features as a Result of Subsidence for Longwalls 712 to 716 (MSEC, 2025)

Natural Surface Feature	Predicted Impacts Due to Subsidence
Nepean River	The Nepean River is located more than 2 km from the longwalls. The Nepean River would experience vertical subsidence, upsidence and closure of less than 5 mm. It is considered unlikely, therefore, that the Nepean River would experience adverse physical impacts due to the mining-induced movements from Longwalls 712 to 716. Reactivation of existing gas release zones or new gas release zones could develop due to the mining of the proposed longwalls.
Drainage Lines	There are small reductions in the existing stream grades along Navigation Creek and some of its tributaries upstream of the maingates predicted for Longwalls 712 to 716. There are possible small reversals in stream grade along the flatter sections of the streams or in the locations of the existing farm dams. It is unlikely, therefore, that there would be large-scale adverse changes in the levels of ponding or scouring of the banks along the creeks and tributaries within the Study Area due to the mining-induced tilt. It is possible that localised increased ponding could develop in some isolated locations, where the existing

Natural Surface Feature	Predicted Impacts Due to Subsidence
	grades are small, and upstream of the chain pillars and the edges of the mining area. The potential impacts of increased ponding and scouring of the drainage lines, therefore, are expected to be minor and localised. Impacts resulting from changes in surface water flows due to mining-induced tilt are expected to be small in comparison with those which occur during natural flooding conditions. Fracturing of the uppermost bedrock could occur along watercourses that are located directly above or adjacent to the proposed longwalls. Surface water flow diversions could occur in these watercourses. Fracturing can also occur outside the mining area, with minor and isolated fracturing occurring at distances up to approximately 400 m outside the longwalls. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds. It is unlikely, however, that there would be a net loss of water from the catchment.
Cliffs, Rocky Outcrops and Steep Slopes	Impacts on cliff lines, rock outcrops and other rocky habitats within the Study Area are likely to be minor, as observed in previous mining areas. No large-scale cliff collapses or slope failures are predicted, though tension cracks may appear in steep slopes, which could result in erosion without rehabilitation. It is expected that the rock outcrops located directly above the proposed longwalls would experience fracturing and, where the rock is marginally stable, this could then result in instabilities.

4.3 Environmental Consequences

Table 7 compares the potential consequences as determined in the BSO EA to the residual impact determined by Niche (2025) for the Longwalls 712 to 716 Study Area. Potential impacts as assessed by Niche (2025) are consistent and are generally less than those outlined within the BSO EA.

When compared to the broader BSO EA area there are fewer sensitive vegetation communities in the locality and substantial areas of cleared vegetation. The proposed extraction does not require significant vegetation clearing.

Table 7: Predicted Impacts to Natural Surface Features as a Result of Subsidence for Longwalls 712 to 716 (Niche, 2025)

Potential Impact Assessed	Level of Impact according to FloraSearch (2009), Biosphere (2009) and BSO EA	Level of Impacts Based on Current Survey
Vegetation	Slope and ridge-top vegetation: - Small, isolated impacts to vegetation due to cracking. Riparian vegetation: - Small, localised impacts to vegetation due to ponding, flooding, scouring or gas release. Gently undulating lands - Negligible impacts due to surface cracking.	Vegetation communities which are not dependent on groundwater are unlikely to be impacted by subsidence due to underground mining. None of the PCTs within the study area are formally recognised as Groundwater Dependent Ecosystems (GDEs). Groundwater dependant and riparian vegetation may experience some floristic changes in response to altered groundwater conditions or the release of strata gas, as a result of subsidence, however this has not been observed as a result of previous mining in AA7. Impacts to riparian vegetation associated with the proposal are predicted to be minor in occurrence, being localised if they occurred. Predicted impacts of the proposal on vegetation and TECs are consistent with the predicted impacts from the BSO EA.
Fauna Habitats	Slope and ridge-top habitats: - Potential for small animals to become trapped in soil cracks. Impacts expected to be negligible. - Rare impacts to fauna due to rockfall. Riparian habitats: - Negligible impacts to fauna and fauna habitat. Gently undulating lands: - Minor impacts due to surface cracking. Water habitats: - Impacts to water habitat unlikely to result in impacts to fauna.	Consistent with the predicted impacts from the BSO EA.

Potential Impact Assessed	Level of Impact according to FloraSearch (2009), Biosphere (2009) and BSO EA	Level of Impacts Based on Current Survey
Threatened Flora	No significant impacts on threatened flora species predicted.	Impacts of the BSO Project on threatened flora were previously assessed within the BSO Project EA (BHPBIC 2009). Predicted impacts as a result of the current proposal are likely to be minimal. Therefore, the predicted impacts for the current proposal are consistent with the impact predictions of the BSO EA.
Threatened Fauna	No significant impacts on threatened fauna species predicted.	Impacts of the BSO Project on threatened fauna were previously assessed within the BSO Project EA (BHPBIC 2009). Predicted impacts as a result of the current proposal are likely to be minimal. Therefore, the predicted impacts for the current proposal are consistent with the impact predictions of the BSO EA.
Koala Habitat	As described above for other fauna habitats, the predicted effects of subsidence on Koala habitat are likely to be minimal and are not considered to have any real effect on the species.	Subsidence impacts to the Koala are low as the proposal is unlikely to affect the trees that this species utilises and forages in. Impact not likely to be significant. Predicted impacts for current proposal consistent with predicted impacts in BSO EA. All PCTs identified within the study area, with exception to PCT 3110 – <i>Greater Sydney Enriched Grey Myrtle Dry</i> , can include one or both primary feed trees for Koalas.
Spread of amphibian Chytrid Fungus and Impacts on Frog Species	Collection and handling of frogs or the inadvertent transport of the infected material between frog habitat by persons, vehicles or equipment may promote the spread of the disease.	Not likely to be exacerbated by the current proposal where mitigation and management measures outlined in Section 7 of this BMP are implement
Infection of Native Plants by <i>Phytophthora cinnamomi</i>	Project-related activities have the potential to introduce or spread the infection of native plants by <i>P. cinnamomi</i> .	Not likely to be exacerbated by the current proposal where mitigation and management measures outlined in Section 7 of this BMP are implement.
Weeds	The Project has the potential to increase the spread of weeds though dispersal of seed or soil material containing seed via continued movement of	Not likely to be exacerbated by the current proposal where mitigation and management measures outlined in Section 7 of this BMP are implement.

Potential Impact Assessed	Level of Impact according to FloraSearch (2009), Biosphere (2009) and BSO EA	Level of Impacts Based on Current Survey
	vehicles across the Project area and through rehabilitation or restoration activities.	

4.4 Aquatic Biodiversity

4.4.1 Subsidence Effects

MSEC (2009) undertook an initial assessment of predicted subsidence in the Appin Area 7 Study Area to support the BSO EA. These predictions were updated by MSEC (2025) to account for a revised mine plan for Longwalls 712 to 716. The maximum predicted subsidence, upsidence and closure are outlined in Table 8.

Table 8 Maximum Predicted Subsidence Effects for Creeks and Tributaries located within the Study Area (MSEC 2025)

Name	Maximum predicted total subsidence (mm)	Maximum predicted total tilt (mm/m)	Maximum predicted total hogging curvature (km ⁻¹)	Maximum predicted total sagging curvature (km ⁻¹)
Navigation Creek	1450	5.0	0.07	0.14
Navigation Creek (Tributary NavC14.5)	90	<0.5	<0.01	<0.01
Navigation Creek (Tributary NavC16)	1400	6.5	0.06	0.12
Navigation Creek (Tributary NavC17)	1300	5.0	0.06	0.11
Navigation Creek (Tributary NavC20)	1350	4.5	0.06	0.12
Apps Gully	1100	3.0	0.04	0.07
Foot Onslow Creek	100	1.0	<0.01	<0.01

4.4.2 Subsidence Impacts

Nepean River

The centreline of the Nepean River is located 2.2 km south of the commencing (i.e. western) end of Longwall 712 and 2.5 km east of the finishing (i.e. eastern) end of Longwall 712, at its closest points to the proposed longwalls. No fracturing is predicted to occur in the Nepean River, thus there would be no reductions in the availability and connectivity of aquatic habitat. Longwall extraction is not anticipated to have any significant impacts on surface water quality as a result of mining the proposed longwalls (HGeo, 2025). Mining of previous longwalls within AA7 and 9 has not led to identification of any detectable ferruginous springs in the walls of the Nepean River. It is therefore considered that there is a low likelihood of ferruginous springs induced by the mining of the Longwalls 715 to 716 (HGeo 2025). Significant impacts on aquatic flora and fauna in the Nepean River, including any threatened species, are not expected. There would be no reduction in surface water availability or quality in the Nepean River due to mining. No impacts on aquatic ecology have been noted following previous gas releases in the Nepean River associated with mining in Appin Areas 7 & 9, and it is considered unlikely that significant impacts would occur due to any further gas releases (Stantec, 2025).

Drainage Lines

Localised and minor changes in habitat availability and connectivity may occur along the first, second, third and fourth order tributaries within the Study Area due to tilt, but these effects will be difficult to detect due the high variability in natural flows within these ephemeral watercourses. The impacts resulting from the changes in surface water flows are expected to be small in comparison with those that occur during natural flooding conditions. Consequently, impacts on aquatic habitat and biota due to tilt, if any, are expected to be minor and localised in tributaries located directly above and within 400 m of the proposed longwalls (Stantec 2025).

Fracturing and flow diversions may occur in drainage lines directly above and up to 400 m away from the proposed longwalls. This may result in the draining of pools in these watercourses, particularly during low flows, resulting in a reduction in the availability of aquatic habitat and the connectivity of remaining habitat. This would be expected to result in associated reductions in the population sizes of aquatic biota (Stantec, 2025).

4.4.3 Environmental Consequences

Table 9 compares the potential consequences on aquatic ecology as determined in the BSO EA to the potential consequences determined by Stantec (2025) for the Longwalls 712 to 716 Study Area.

The assessment of the consequences for aquatic ecology of subsidence that occurs during extraction of Longwalls 712 to 716 is concluded to be similar to that based on the BSO EA layout.

Table 9: Comparison of Environmental Consequences from BSO EA and Stantec (2025)

Component of Aquatic Ecology	Impacts Predicted in the BSO EA (Bioanalysis 2009)	Potential Impacts Predicted for Longwalls 712 to 716 (Stantec, 2025)
Nepean River		
Aquatic Habitat	Nepean River – Impacts on flow and pool depth are not expected in the Douglas Park Weir pool.	Same as for BSO EA. It is considered unlikely, that the Nepean River would experience adverse physical impacts due to the mining-induced movements from Longwalls 712 to 716.
	Some fracturing of bed rock is expected, as well as mobilisation of iron and other minerals and transient gas emissions in the weir pool.	Fracturing not expected to occur in the Nepean River. Further gas release zones could develop due to the mining of the proposed longwalls. Any short-term and localised impact on water quality is not expected to significantly affect aquatic biota. Minor localised iron staining may occur but is unlikely to lead to changes in water quality and should not therefore affect the quality of aquatic habitat.
Riparian Vegetation	Changes in the level of water in streams and gas emissions are unlikely to disturb riparian vegetation to the extent that its ecological role would be significantly adversely impacted upon.	Substantial localised gas emissions could result in localised die-back of riparian vegetation. Such impacts are considered unlikely and would be transient. No fracturing is predicted to occur in the Nepean River and no associated impacts on riparian vegetation is expected.
Aquatic macrophytes	Nepean River – limited to no detectable changes in composition or distribution.	Increases in the level of the bank or bed of the Nepean River that could reduce the wetted perimeter and lead to stranding and desiccation of aquatic vegetation along the edge of the river are not expected. Localised gas releases may lead to minor changes in the composition and extent of macrophyte beds, but these are unlikely to be detected because of the natural variability of these beds. Impacts on water quality and surface water availability, and thus associated impacts on aquatic habitat and biota, are not expected.

Component of Aquatic Ecology	Impacts Predicted in the BSO EA (Bioanalysis 2009)	Potential Impacts Predicted for Longwalls 712 to 716 (Stantec, 2025)
Aquatic macroinvertebrates	Potential impacts would be similar in scale to those observed during mining of Appin Area 7 (i.e., none detected).	Minor changes in riparian and aquatic vegetation potentially associated with localised gas releases could lead to the loss of edge habitat and reduction in the abundance of aquatic macroinvertebrates living therein. Losses would be negligible relative to the amount of habitat available within the downstream reach of the river. Impacts on water quality and surface water availability, and thus associated impacts on aquatic habitat and biota, are not expected.
Fish	Potential impacts would be similar in scale to those observed during mining of AA7 (i.e. none detected). Reductions in dissolved oxygen associated with gas emissions are likely to be short-lived and localised and unlikely to have a significant effect, because fish populations are highly mobile.	Same as for BSO EA.
Threatened Species	It is unlikely that a viable population of Macquarie perch is present in the section of the Nepean River adjacent to the Study Area. This is because of a lack of suitable habitat (including natural riffle habitat required for spawning and numerous barriers to fish passage from downstream). Mine subsidence induced impacts resulting from the proposal are not predicted to lead to loss of riffle habitat or large permanent pools within watercourses that provide suitable habitat for Macquarie perch. Changes in water quality are predicted to be localised or transient. It was therefore considered unlikely that the Project would have a significant adverse effect on Macquarie perch. Likewise, impacts to Sydney hawk dragonfly (which was	Same as for BSO EA.

Component of Aquatic Ecology	Impacts Predicted in the BSO EA (Bioanalysis 2009)	Potential Impacts Predicted for Longwalls 712 to 716 (Stantec, 2025)
	not located in the BSO Part 3A Application layout), were also unlikely.	
Drainage Lines		
Aquatic habitat	Potential impacts in Foot Onslow Creek, Navigation Creek, and Apps Gully are expected to be limited to localised areas of iron staining, possibly fracturing and enhanced leakage from farm dams and pools (where present), and possible low flow diversion in areas of rock outcrop or where bedrock is covered by a thin mantle of alluvium. Short term changes in water quality could also occur.	Fracturing could occur and could result in flow diversions and localised reductions in the availability and connectivity of pool habitat. This is unlikely to have a detectable effect on the availability of aquatic habitats beyond the scale of individual pools and watercourses. Impacts on water quality are not expected.
Riparian vegetation	It is considered unlikely that changes in the level of water in streams or the emission of strata gas caused by mine subsidence within this domain would disturb riparian vegetation to the extent that its ecological role would be significantly adversely impacted.	Given the current disturbed nature of riparian vegetation along drainage lines, it is unlikely that any reduction in flow and water availability here would have any significant impact on this vegetation.
Aquatic macrophytes	In Harris Creek, reduced water levels in the downstream reach could lead to exposure and desiccation of macrophytes. These impacts would be short-term and localised and would not persist once water levels are restored.	The extent of native aquatic plants in these tributaries lines appears limited. Some aquatic plants may be lost if fracturing and pool drainage occurs, though this would result in only small decreases in population sizes in the wider catchment.
Aquatic macroinvertebrates	Significant adverse impacts are unlikely given that changes in water quality are expected to be short-lived and localised, and macroinvertebrates should recover quickly once water levels return. Given that changes in water quality were predicted to be localised and transient, macroinvertebrates should recover quickly once water levels return following rain events. It is considered unlikely that populations in	Fracturing and flow diversions could occur and could be associated with reductions in the availability and connectivity of aquatic habitat. An impact on the local population size of these and other native aquatic species could be expected. This could be significant at the scale of individual pools and possibly individual watercourses. However, given the largely disconnected pool habitat provided by these watercourses, the predicted localised reductions in habitat availability and connectivity, and the abundance of such

Component of Aquatic Ecology	Impacts Predicted in the BSO EA (Bioanalysis 2009)	Potential Impacts Predicted for Longwalls 712 to 716 (Stantec, 2025)
	drainage lines would be significantly affected. Moreover, any potential impacts affecting these areas would be hard to discern, should they occur, because of the degraded nature of the existing aquatic habitat in this area.	habitat in the wider Nepean River Catchment, impacts on population size are expected to be negligible at wider scales.
Fish	If fracturing of bedrock leads to loss of habitat, a few species (e.g. eels) may be able to relocate to nearby pools, but others would perish due to desiccation and/or predation. As losses would be restricted to small, localised areas of habitat, this is unlikely to have a significant effect on fish assemblages within the Study Area.	Same as for BSO EA.
Threatened Species	No threatened species identified in drainage lines.	Same as for BSO EA.

5. PERFORMANCE MEASURES AND INDICATORS

The BSO Approval provides subsidence impact performance measures (Condition 1, Schedule 3). Table 10 below details the conditions relevant to biodiversity within the Study Area.

Performance indicators specific to each performance measure have been developed to judge the performance of, and guide the implementation of, the project or any management measures.

In relation to the subsidence impact performance measure for Biodiversity the term 'negligible' is defined within the Project Approval as *"small and unimportant, such as not to be worth considering"*.

Table 10 Subsidence Impact Performance Measures and Indicators (Biodiversity)

Biodiversity	Performance Measure	Performance Indicators
Threatened species, threatened populations or endangered ecological communities	Negligible environmental consequences	The performance measure would be considered to be exceeded if: Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities

Other relevant performance measures from this section of the BSO Approval to the BMP are outlined in Table 11.

Table 11: Subsidence Impact Performance Measures (Other)

Feature	Performance Measure
Nepean River	Negligible environmental consequences including: - negligible diversion of flows or changes in the natural drainage behaviour of pools; - negligible gas releases and iron staining; and - negligible increase in water cloudiness. Note the Nepean River is not within the Study Area and impacts are predicted to be negligible.
Other Watercourses	No greater subsidence impact or environmental consequences than predicted in the EA and PPR.

Cliffs of “special significance” (i.e. cliffs longer than 200 m and/or higher than 40 m; and cliff-like rock faces higher than 5 m that constitute waterfalls)	Negligible impact (that is occasional rock falls displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs) within any longwall mining domain. Note: No Cliffs of Special Significance are present within the Study Area.
Other cliffs flanking the Nepean River	Negligible environmental consequences (that is occasional rock falls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 0.5% of the total face area of such cliffs) within any longwall mining domain.
Other Cliffs	Minor impacts (that is occasional rock falls, displacement or dislodgement of boulders or slabs, or fracturing, that in total do not impact more than 3% of the total face area of such cliffs within any longwall mining domain).

Note. Not all of the above mentioned features are present in the Longwall 712 to 716 Study Area as the subsidence impact performance measures in Schedule 3 relate to the entire BSO Area

Other performance indicators relevant to the BMP include those applicable to the performance measures specified in Table 11 are detailed in the Longwalls 712 to 716 Water Management Plan.

In order to mitigate the potential subsidence impacts and environmental consequences from the mining of Longwalls 712 to 716, monitoring and recording will be undertaken prior to mining, throughout the extraction and at the completion of subsidence (refer Section 6).

Where subsidence impacts are recorded, consideration would be given to implementing appropriate management, remediation and/or mitigation measures in consultation with relevant landowners, CPHR, DPI Fisheries and other relevant stakeholders (refer Section 7).

If the subsidence impact performance measures are exceeded as outlined in Table 12, ICHPL will notify CPHR and other stakeholders and implement the Contingency Plan (Section 8).

6. MONITORING AND REPORTING

6.1 Monitoring Program

Subsidence parameters (i.e. subsidence, tilt, tensile strain, compressive strain, valley closure and closure strain) will be measured in accordance with the Longwalls 712 to 716 Subsidence Monitoring Program provided in Appendix B of the Extraction Plan.

The monitoring program outlined below will be implemented to monitor the impacts of subsidence effects to biodiversity within the Longwalls 712 to 716 Study Area. As subsidence effects are predicted to be small in magnitude, the monitoring program outlined below reflects the magnitude of these expected impacts.

6.1.1 Aquatic Biodiversity

Monitoring for aquatic biodiversity would address biota and measure relevant water quality variables at appropriate spatial and temporal scales. This will enable changes to water quality, aquatic habitats and biota resulting from mining related subsidence to be distinguished from natural variability and other catchment influences.

Within the Longwall 712 to 716 Study Area, monitoring at five aquatic ecology sites will be undertaken (Figure 4).

Sampling will be conducted twice in spring for two years prior to the commencement of mining in order to establish a baseline condition and once every two years during and after mining to detect any changes to the aquatic environment and its biota that could be attributed to mining activities. Monitoring at each site would employ a range of techniques including:

- Water quality sampling
- In-situ water quality
- Aquatic macrophyte observations (where it is appropriate noting that the ephemeral tributaries of Navigation Creek are not likely to aquatic macrophytes).
- AUSRIVAS sampling
- Fish sampling (where it is appropriate noting that the ephemeral tributaries of Navigation Creek are not likely to support fish).

Detailed recommendations for monitoring including methods and data analysis are provided by Stantec (2025).

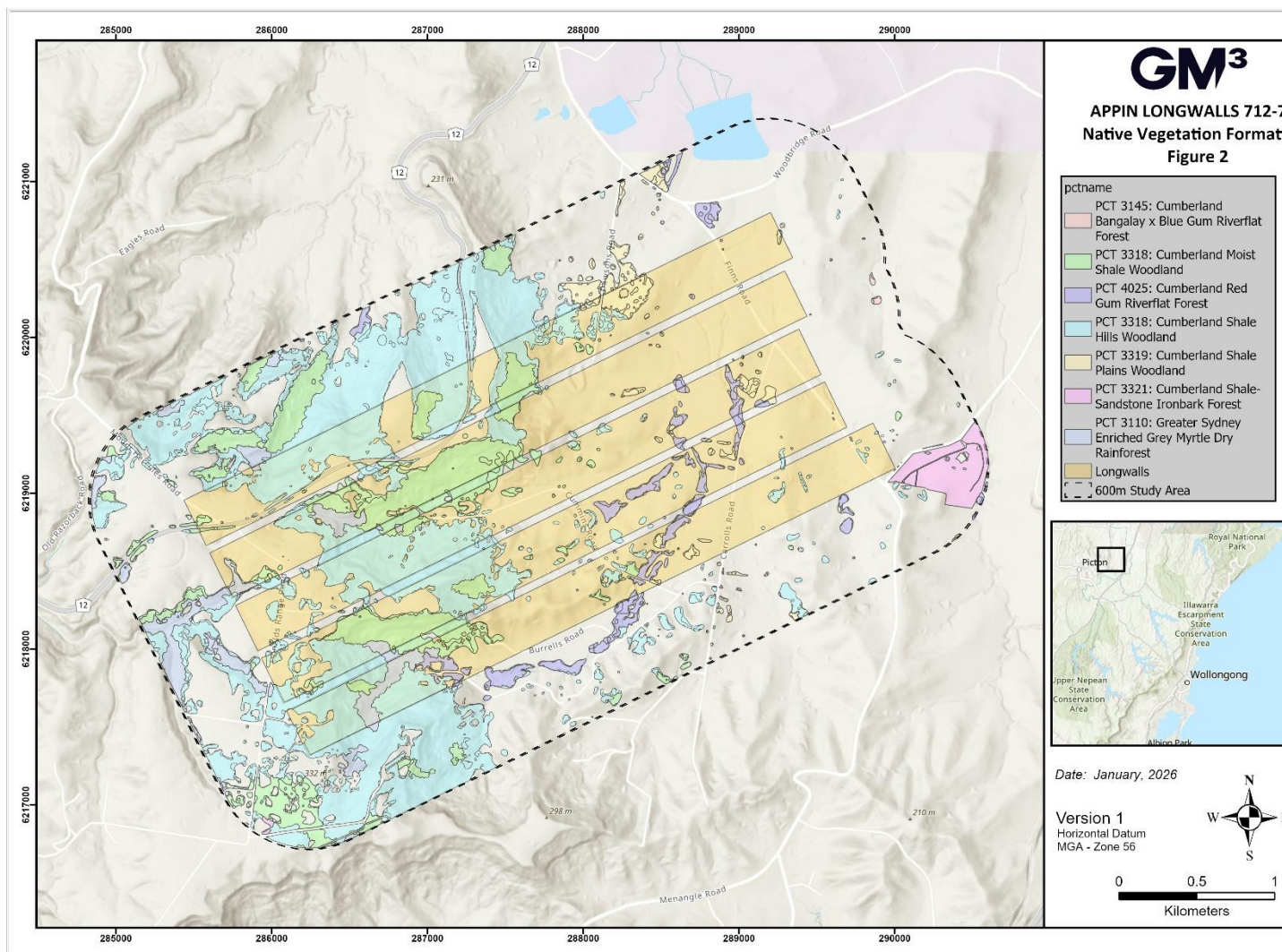
Additional aquatic ecology studies would be triggered by events such as significant changes in water quality and availability of aquatic habitats. Trigger values for aquatic ecology monitoring parameters are outlined in Table 12.

6.1.2 *Terrestrial Biodiversity*

The monitoring program for mining related subsidence effects on terrestrial biodiversity reflects the predicted small magnitude of subsidence effects on biodiversity values for the Longwalls 712 to 716 Study Area.

Monitoring will focus on detecting changes to vegetation communities and fauna habitats present within the Longwalls 712 to 716 Study Area and will have coverage across the Study Area.

Groundwater dependant and riparian vegetation may experience some floristic changes in response to changed groundwater conditions, as a result of subsidence. Subsidence effects are more likely to result in impacts to natural features through loss of surface water flows and the impacts to groundwater dependant ecological features (PAC, 2010). Groundwater dependant vegetation communities present within the Study Area, as shown in Figure 2 - Vegetation Communities



and Niche 2025 (Figure 5), include PCT 4025 (Cumberland Red Gum Riverflat). Other vegetation communities are less likely to be impacted as a result of subsidence effects, hence less monitoring of these communities will be undertaken.

Visual inspections of vegetation communities within the Longwall 712 to 716 Study Area will be undertaken as part of routine landscape and water monitoring programs. A targeted inspection by a qualified ecologist will follow should changes to vegetation health be observed.

Inspections of vegetation condition will assess the following:

- Vegetation health and appearance; and
- Visible impacts such as canopy thinning, thinning of shrub layer, loss of ground cover, dead branches present.

All areas of impact or any subsidence effects will be mapped and documented using digital photography. Where an impact is detected a qualified ecologist will be engaged to document the following:

- The total area of impact mapped using GPS and aerial photo interpretation;
- The Foliage Percentage Cover; and
- Modified Braun-Blanquet cover abundance scores for each species.

This information will be used to objectively assess the extent and degree of impact. Assessment of similar vegetation communities or fauna habitat within the broader locality will be undertaken to determine if the detected changes are within normal variation or represent a possible impact of mining. Additional studies (e.g. gas release measurements) will be undertaken in response to an observed mining impact to understand the mechanism involved and consider any Corrective Management Actions (CMAs) that may be required.

Impact assessment reports will be prepared and provided to relevant Government Agencies.

The reports will:

- Detail any impact detected;
- Provide a proposed assessment methodology for further study; and
- BCS will be consulted in relation to assessment methodology.

ICHPL will implement remediation measures (Section 7.1) where significant impacts to vegetation communities or fauna habitat are caused by subsidence effects.

6.2 Reporting

Results from the monitoring program will be reported annually in the Annual Review. This report will:

- Detail the outcomes of monitoring undertaken;
- Provide results of visual inspections;
- Determine whether performance indicators have been exceeded; and
- Make recommendations in relation to any CMAs required.

Monitoring results will be reviewed monthly by the ICHPL Subsidence Management Committee. However, if the findings of monitoring are deemed to warrant an immediate response, the Principal Approvals will initiate the requirements of the Trigger Action Response Plan (TARP) (Table 12).

Monitoring results will be made publicly available in accordance with BSO Approval Condition 8 & 11, Schedule 6 and will also be included in the Annual Review in accordance with Condition 4, Schedule 6.

7. MANAGEMENT AND MITIGATION MEASURES

7.1 Terrestrial Biodiversity

7.1.1 *Mitigation Strategies*

Where ICHPL staff and contractors are required to access surface areas as a part of monitoring programs, implement CMAs or undertake other activities, the following mitigation measures will be applied:

- Mitigation measures within Sections 5.8.3 and 5.9.3 of the BSO EA;
- Implementation of monitoring program (Section 6.1);
- Implementation of offset measures (Sections 7.3 and 8);
- Prepare and implement TARPs (Section 7.3);
- Vegetation clearance mitigation measures (if applicable);
- Implementation of weed control measures;
- Implementation of measures for the management of Chytrid/Phytophthora e.g. restricting vehicle movements and access, limiting soil disturbance, encouraging natural regeneration, hygiene of staff and equipment;
- Manage fire (if applicable);
- Manage dust (if applicable);
- Minimise fauna traps e.g. mitigate cracking where access is available;
- Implement speed limits on fire roads and tracks;
- Manage noise (if applicable);
- Manage artificial lighting (if applicable);
- No introduced fauna e.g. no pets;
- Report pest species and include pest awareness in induction/awareness sessions;
- Any remediation works will take appropriate measures to minimise other impacts;
- Vehicular access will be restricted to recognised tracks and disturbed areas where possible to avoid and minimise impacts to native vegetation and fauna habitat;
- Should access to areas of native vegetation be required, access on foot will be preferred to vehicular access;

- If vegetation clearing is required a suitably qualified ecologist will be engaged to determine the vegetation/fauna habitat characteristics of the area to determine the potential impacts and recommended measures to reduce these impacts.

7.1.2 Management Measures

As detailed in Section 6.1.2, where significant impacts are observed and are a result of subsidence effects, ICHPL will implement a remediation program where access to the site is available.

Initially management measures will be targeted at reducing the subsidence impacts (if possible). If this is not possible CMAs, such as assisted regeneration will be implemented. These actions will be implemented to address any ecological impacts.

These management measures are aimed at ensuring long term viability of impacted biodiversity values through assisted regeneration and replanting, as well as measures to continue to address subsidence effects that are causing impacts.

Assisted natural regeneration will include weed management measures, as well as fencing off affected areas to prevent grazing (where agreed with the landowner and the relevant statutory authority). Where natural assisted regeneration is not meeting expected outcomes, replanting of ground cover, shrub and tree species will be implemented. All replanting will be undertaken using the relevant PCT benchmark conditions as outlined in the 'Guideline Rehabilitation objectives and rehabilitation completion criteria', with planting undertaken with local provenance species where available. Where natural assisted regeneration is not successful, re-vegetation activities will target 80% success rate, with dead plants replaced where reasonably feasible and where agreed with the landowner and the relevant statutory authority.

7.2 Aquatic Biodiversity

7.2.1 Mitigation Strategies

The potential impacts of Longwalls 712 to 716 on aquatic habitats and biota in the Study Area will be minimised by:

- Adopting a mine layout that does not involve mining under the Nepean River, noting that the Study Area is more than 2km from the River.
- Identifying triggers that would prompt surveys to assess any impacts on aquatic habitats and their biota identified during and after extraction of the longwalls within the Study Area.
- Identifying physical and water quality impacts that occur during the extraction of Longwalls 712 to 716 within the Study Area through ongoing monitoring and timely implementation of appropriate CMAs.

7.2.2 Management Measures

Standard management measures will be implemented for negligible impacts to aquatic biodiversity where those impacts occur as a result of mining. Standard management measures include photographic records, continuation of the approved monitoring program and reporting.

Specific management measures for aquatic biodiversity will be employed where more than negligible impacts resulting from subsidence occur. Management measures include implementation of monitoring and reporting as well as the involvement of relevant stakeholders, agencies and specialists to investigate and report on the changes that are identified and any specific mitigation measures required.

Water quality samples and targeted fish and aquatic vertebrate sampling would be undertaken once an impact is confirmed. Additional monitoring would be undertaken with specialists providing updates on the investigation process and the relevant stakeholders and agencies would be provided with investigation results. In the event that the impacts of mine subsidence on aquatic habitats are greater than predicted, the following mitigation measures would also be considered, in consultation with key stakeholders:

- Should impacts on aquatic biodiversity occur which are considered to be outside of the performance measures of the BSO Approval, ICHPL would review future longwalls. The review would consider measures including decreases in longwall width and length.
- Implementing stream remediation measures, such as backfilling or grouting in areas where fracturing of controlling rock bars and/or stream bed leads to diversion of stream flow and drainage of pools.
- Implementing appropriate control measures, such as installation of sediment fences down slope of areas where subsidence has led to erosion, and stabilisation of areas prone to erosion and soil slumping using rock, brush matting or vegetation, to limit the potential for deposition of eroded sediment into watercourses.

If these management measures prove ineffectual, appropriate offset or compensatory measures would be implemented.

7.3 Trigger Action Response Plan

The AA7 Biodiversity TARP is shown in Table 12.

Table 12: Appin Area 7 Longwalls 712 to 716 BMP Trigger Action Response Plan

Performance Measure	Potential Impacts	Monitoring sites	Parameters	Monitoring Frequency	Reporting Trigger	Trigger Response
AQUATIC ECOLOGY						
Threatened species, threatened populations or endangered ecological communities: Negligible environmental consequences to aquatic ecology in watercourses within the Study Area.	Localised and minor changes in aquatic habitat availability and connectivity Fracturing and flow diversions could occur in watercourses	Impact Sites: Nav2, NavC16_s10, Nav_S50, Nav1 Control Sites AG_S10 and/or site located on Mount Hunter Rivulet, Wattle Creek and Bringelly Creek to the north of the Study Area	▪ Aquatic habitat. ▪ In situ water quality. ▪ Aquatic macrophytes. ▪ Aquatic macroinvertebrates. ▪ Fish	Annually during extraction Twice following the completion of mining	Level 1* • Reduction in aquatic habitat resulting from the mining over 1 season	• Continue monitoring program • Submit an Impact Report to CPHR, DPHI, DPI Fisheries and other relevant resource managers • Report in End of Panel Report • Summarise actions and monitoring in Annual Review
					Level 2* • Reduction in aquatic habitat resulting from the mining over 2 seasons	• Actions as stated for Level 1 • Report trigger to key stakeholders • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts.</i>
					Level 3* • Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons	• Actions as stated for Level 2 • Notify CPHR, DPHI, DPI Fisheries, relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback) This may include: – Grouting of fractures which result in flow diversion – Completion of works following approvals • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders <i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant</i>

Performance Measure	Potential Impacts	Monitoring sites	Parameters	Monitoring Frequency	Reporting Trigger	Trigger Response
						<i>consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i>
					Performance Indicator Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological community.	• Actions stated for Level 3 • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
TERRESTRIAL BIODIVERSITY						
Threatened species, threatened populations or endangered ecological communities: Negligible environmental consequences to terrestrial ecology within the Study Area.	Localised vegetation dieback	Visual inspections as part of landscape and water monitoring programs in active mining areas	Observational and fixed photo point monitoring	Ongoing during extraction as per Land Management Plan – targeted ecological assessment based on identified impacts	Level 1* • Impacts detectable via observational monitoring (e.g. canopy thinning, thinning of shrub layer, minor loss of ground cover) to a single vegetation strata • Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will mitigate without CMA	• Continue monitoring program • Submit an Impact Report to CPHR, DPHI and other relevant stakeholders • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Slope instability impacts to vegetation	Rock fall impact to threatened species habitat	Habitat monitoring along watercourses	EoP Reporting	Level 2* • Impacts detectable via observational monitoring (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata • Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will not mitigate without CMA	<i>Actions as stated for Level 1</i> • Report triggers to key stakeholders • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i>
					Level 3* • Impacts (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple	<i>Actions stated for Level 2</i> • Notify CPHR, DPHI and relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include:

Performance Measure	Potential Impacts	Monitoring sites	Parameters	Monitoring Frequency	Reporting Trigger	Trigger Response
					areas) to multiple vegetation strata caused by subsidence effects - Subsidence impacts (such as surface cracking, rock falls) resulting in large areas of disturbance that will not mitigate without CMA - Negligible environmental consequences to threatened species, populations or EEC Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat	- Erosion preventions works - Establishment of vegetation - Completion of works following approvals, including monitoring and reporting on success - Review the TARP and Management Plan in consultation with key stakeholders <i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i>
					Performance Indicator Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological community	<i>Actions stated for Level 3</i> - Investigate reasons for the exceedance - Update future predictions based on the outcomes of the investigation - Provide environmental offset if CMAs are unsuccessful

* These may be revised in consultation with DPHI and other key stakeholders following analysis of natural variability within the pre-mining baseline data.

Monitoring subject to access agreement from landowners.

Note: The NSW Development Coordination Authority (DCA) was established on 1 July 2026 and centralises several NSW Agencies in responses to development applications and post-approval matters. Where agencies that are included within DCA have been listed as stakeholders (or are required to be notified under a TARP trigger response) notifications and impact reports will be provided to the DCA.

8. CONTINGENCY RESPONSE PLAN

In the event that performance measures detailed in Section 5 of this BMP are exceeded, or are likely to be exceeded, ICHPL will implement a contingency plan to manage any unpredicted impacts and their consequences.

This would generally involve:

- Capture photographic record.
- Notify relevant stakeholders soon as practicable.
- Notify relevant agencies and specialists soon as practicable.
- Offer site visits with stakeholders.
- Contract specialists to investigate and report on changes identified.
- Provide incident report to relevant agencies.
- Establish weekly monitoring frequency where appropriate until stabilised.
- Updates from specialists on investigation progress.
- Inform relevant agencies and stakeholders of results of investigation.
- Develop site CMA in consultation with key stakeholders if required, (pending stakeholder availability) and seek approvals.
- Implement CMA as agreed with stakeholders following approvals.
- Conduct initial follow up monitoring and reporting of CMA completion.
- Review Management Plan.
- Report in regular reporting and Annual Review.

ICHPL will consult with appropriate specialists and relevant agencies in order to devise an appropriate response in respect to any identified exceedance.

The development and implementation of contingency measures will be specifically designed to address the specific circumstances of the exceedance and assessment of environmental consequences.

If the contingency measures implemented by ICHPL fail to remediate the impact or the Secretary determines that it is not reasonable or feasible to remediate the impact, ICHPL will provide a suitable offset to compensate for the impact to the satisfaction of the Secretary in accordance with the BSO Approval Condition 2, Schedule 3.

9. COMPLAINTS AND COMPLIANCE MANAGEMENT

9.1 Incidents

An incident is defined in the BSO Approval as “An occurrence or set of circumstances that causes, or threatens to cause, material harm to the environment, and as a consequence of that environmental harm, may cause harm to the safety of human beings, and which may or may not be or cause a non-compliance”.

The reporting of incidents will be conducted in accordance with Condition 7, Schedule 6 of the BSO Approval. ICHPL will notify the Secretary of the DPHI via the NSW Planning Portal and any other relevant agencies of any incident associated with the BSO within 24 hours after ICHPL becomes aware of the incident. Within seven days of the date of the incident, ICHPL will provide the Secretary of the DPHI and relevant agencies with a detailed report on the incident.

An Incident Report will be prepared in accordance with Appendix 7 (3) of the BSO Approval and will:

- identify how the incident was detected;
- identify when ICHPL became aware of the incident;
- identify any actual or potential non-compliance with conditions of consent;
- details on the nature of the incident (including survey results, photographs and date of the incident);
- results of investigation(s) to identify/evaluate the contributing factors to and the cause of the incident;
- proposed course of action (including proposed timeline for implementation of corrective and preventative actions to address the incident and prevent recurrence) and development of contingency measures;
- details of any communication with other stakeholders regarding the incident; and
- relevant ICHPL contact details to obtain further information on the incident.

9.2 Complaints and Dispute Resolution

ICHPL has a readily accessible contact point through a 24-hour toll-free Community Call Line (1800 102 210) and email address (community@gm3.au). The number is displayed on the GM³ website, prominently on ICHPL Projects and Mine sites in a position visible by the public as well as on publications, letters and other correspondence provided to the local community. The call line is for all complaints and general enquiries regarding environmental or community issues associated with ICHPL operations.

Community complaints and enquiries may also be received in person by any employee of ICHPL, with details to be immediately shared with the Community Team for investigation. All complaints received in relation to Dendrobium Mine will be managed in accordance with the Handling Community Complaints, Enquiries and Disputes Procedure.

Upon receipt of a community complaint, preliminary investigations will commence as soon as practicable to determine the likely cause of the complaint. An initial response will be provided to the complainant within 24 hours of the complaint being made, with a follow up response being provided as soon as practicable once a more detailed investigation is complete.

A summary of all complaints received during the reporting year will be provided as part of the Annual Review. A log of complaints is also maintained on the GM³ website.

9.3 Non-Compliance, Corrective Action and Preventative Action

Non-compliances will be notified and reported in accordance with Condition 7A of Schedule 6 of the BSO Approval. ICHPL will notify the DPHI in writing via the NSW Planning Portal and will include the following information:

- the development including the development application number and name;
- the condition of consent that the development is non-compliant with and why it does not comply;
- the reasons for the non-compliance (if known);
- what actions have been undertaken or will be undertaken to address the non-compliance.

The BSO Approval states that “a non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

10. PLAN ADMINISTRATION

This BMP will be administered in accordance with the requirements of the Appin Mine Environmental Management Strategy (EMS) and the BSO Approval Conditions. A summary of the administrative requirements is provided below.

10.1 Roles and Responsibilities

Statutory obligations applicable to this Plan are identified and managed via an online compliance management system (TICKIT).

The overall responsibility for the implementation of this Plan resides with the Manager Approvals who is the Plan's authorising officer.

Parties responsible for environmental management in AA7 and the implementation of the Plan include:

Director Sustainability and Government

- Ensure that the requisite personnel and equipment are provided to enable this Plan to be implemented effectively.
- Authorise the Plan and any amendments thereto.

Principal Approvals

- Document any changes to the Plan, recognising the potential for those changes to affect other aspects of the Plan.
- Provide regular updates to ICHPL on the results of the Plan.
- Arrange information forums for key stakeholders as required.
- Prepare any report in accordance with the Plan. Maintain records required by the Plan.
- Organise and participate in assessment meetings called to review mining impacts.
- Within 24 hours, respond to any queries or complaints made by members of the public in relation to aspects of this Plan.
- Organise audits and reviews of the Plan.
- Address any identified non-conformances, assess improvement ideas submitted and implement if considered appropriate.
- Arrange for the implementation of any agreed actions, responses or remedial measures.
- Check surveys required by this Plan are conducted and record details of instances where circumstances prevent these from taking place.

Coordinator Environment

- Instruct suitable person(s) in the required standards for inspections, recording and reporting and be satisfied that these standards are maintained.
- Investigate significant subsidence impacts.
- Identify and report any non-conformances with the Plan.
- Participate in any other assessment meetings called to review subsidence impacts in the area affected by mining.

Survey Coordinator

- Collate survey data and present in an acceptable form for review at assessment meetings.
- Bring to the attention of the Principal Approvals any findings indicating an immediate response may be warranted.
- Bring to the attention of the Principal Approvals any non-conformances identified with the Plan provisions or ideas aimed at improving the Plan.

Technical Experts

- Conduct the roles assigned to them in a competent and timely manner to the satisfaction of the Principal Approvals and formally provide expert opinion as requested.

Person(s) Performing Inspections

- Formally bring to the attention of the Coordinator Environment any nonconformances identified with the Plan, or ideas aimed at improving the Plan.
- Conduct inspections in a safe manner.

10.2 Resources Required

The Manager Approvals provides resources sufficient to support this Plan.

Equipment may be needed for this Plan. Where this equipment is of a specialised nature, it will be provided by the supplier of the relevant service. All equipment is to be appropriately maintained, calibrated and serviced as required in operation manuals.

It is the responsibility of the Manager Approvals to ensure that personnel and equipment are provided as required to allow the provisions of this Plan to be implemented.

10.3 Training

All staff and contractors working on ICHPL sites are required to complete the ICHPL training program which includes:

- An initial site induction (including all relevant aspects of heritage, environment, safety and community).
- Safe Work Methods Statements and Job Safety Analyses, Toolbox Talks and Pre-shift communications.
- On-going job specific training and re-training (where required).

All training records are maintained by the ICHPL Training Department.

It is the responsibility of the Manager Approvals to ensure that all persons and organisations having responsibilities under this Plan are trained and understand their responsibilities.

The person(s) performing regular inspections will be under the supervision of the Coordinator Environment and be trained in observation and reporting. The Coordinator Environment will be satisfied that the person(s) performing the inspections are capable of meeting and maintaining this standard.

10.4 Review and Update

In accordance with Condition 5 of Schedule 6 of the BSO Approval, the BMP will be reviewed, and if necessary revised, within three months, of:

- the submission of an Annual Review;
- the submission of an incident report;
- the submission of an Independent Environmental Audit (IEA) report; or
- any modification to the conditions of the BSO Approval (unless the conditions require otherwise).

If significant deficiencies in this BMP are identified in the interim period, the Plan will be modified as required. This process has been designed to ensure that documentation continues to meet current requirements, including changes in technology and operational practice, and expectations of stakeholders.

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12. APPENDICES

Appendix A – Stantec, 2025. Appin Longwalls 712 to 716 Extraction Plan – Aquatic Ecology Assessment

Appin Longwalls 712 to 716 Extraction Plan – Aquatic Ecology Assessment

Prepared for:
ICHPL

22 September 2025

Project/File:
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Appin Longwalls 712 to 716 Extraction Plan – Aquatic Ecology Assessment

Revision	Description	Author	Date	Quality Check	Date	Independent Review	Date
A	Draft	DP	27-04-25	WM, GS	05-05-25	CB, BB, LZ (ICHPL)	11-07-25
0	Final	DP	22-09-25	DP	22-09-25		



Appin Longwalls 712 to 716 Extraction Plan – Aquatic Ecology Assessment

The conclusions in the Report titled Appin Longwalls 712 to 716 Extraction Plan - Aquatic Ecology Assessment are Stantec's professional opinion, as of the time of the Report, and concerning the scope described in the Report. The opinions in the document are based on conditions and information existing at the time the scope of work was conducted and do not take into account any subsequent changes. The Report relates solely to the specific project for which Stantec was retained and the stated purpose for which the Report was prepared. The Report is not to be used or relied on for any variation or extension of the project, or for any other project or purpose, and any unauthorized use or reliance is at the recipient's own risk.

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Executive Summary

Introduction

Illawarra Coal Holdings Pty Ltd (ICHPL) plans to extract coal from Longwalls 712 to 716 in Appin Area 7 (the Project). These longwalls are located at least 2.3 kilometres (km) northwest of the Nepean River near Appin. This Aquatic Ecology Assessment (AEA) has been prepared to support the Extraction Plan (EP) for these longwalls and outlines the monitoring and management activities required to assess and mitigate potential impacts due to mining. Previously, impacts on aquatic flora and fauna due to extraction of coal from Appin Area 7 and 9 were assessed as part of the wider Bulli Seam Operations (BSO) Environmental Assessment (EA). The proposed longwalls considered in this assessment represent an update to the longwall layout.

The AEA focuses on sections of first, second and third order drainage lines located directly above and within 600 metres (m) (the Study Area) of the longwalls. Potential impacts on associated aquatic flora and fauna may arise following water diversion associated with subsidence and fracturing of bedrock, and consequent loss of aquatic habitat, in watercourses. The aquatic habitat and biota in the Nepean River adjacent to but outside of the Study Area is also considered to aid in the compilation of existing information, albeit mining impacts are very unlikely to occur in the Nepean River. The AEA includes:

- A review and synthesis of existing information on the aquatic flora and fauna in the Nepean River and in drainage lines within the Study Area. While the Nepean River is located outside the Study Area, it was included in the assessment because it supports significant aquatic habitat. The review included the findings of the most recent surveys at sites on the Nepean River in December 2024 as part of the ongoing aquatic ecology monitoring for Appin Area 7.
- Assessment of the potential impacts on aquatic flora and fauna (including threatened species) arising directly and indirectly from the proposed mining. This included examination of whether the predicted impacts on aquatic habitats and biota differ from the Conditions of the BSO Project Approval.
- Recommendations on impact mitigation measures and monitoring for inclusion within the EP.

Existing Environment

The Nepean River supports significant and permanent aquatic habitat including extensive beds of submerged macrophytes in the shallower river edges, and large wood debris and boulders along the channel edge. Riparian vegetation is relatively undisturbed and provides a source of substantial in-stream woody debris, an important habitat for many species of aquatic fauna, including a number of species of native fish and aquatic macroinvertebrates. It is classified as Type 1 – Highly Sensitive Key Fish Habitat (KFH) (Type 1 – KFH). Aquatic habitat provided by first, second, third and fourth order tributaries within the Study Area (including Navigation Creek and small sections of Foot Onslow Creek and Apps Gully) generally consists of a series of disconnected pools with connecting flow for short periods during and following rainfall. These watercourses have been, and continue to be subject to disturbance due to historic land clearance and current agricultural land use. This has resulted in fragmented riparian vegetation, elevated sediment input and impaired water quality. They provide aquatic habitat of relatively limited value, though do support native aquatic plants, macroinvertebrates



and fish. Third and fourth order sections of these drainage lines provide Type 1 – KFH to Type 2 – Moderately Sensitive KFH, while first and second order sections are not KFH. The threatened Macquarie perch (*Macquaria australasica*) occurs in the Nepean River upstream of the Study Area, though the presence of Maldon Weir appears to prevent access to the section adjacent to the Study Area and it is considered unlikely to occur in this section. The only records of the threatened Sydney Hawk dragonfly are in the Nepean River approximately 5 km upstream of the Study Area. These and other threatened species would be highly unlikely to occur in tributaries within the Study Area.

Impact Assessment

The Nepean River would experience vertical subsidence, upsidence and closure of less than 5 mm from Longwalls 712 to 716 (MSEC, 2025) and it is considered unlikely it would be subject to adverse physical impacts due to extraction of these longwalls. Thus, significant impacts on aquatic flora and fauna in the Nepean River, including any threatened species, are not expected. There would be no reduction in surface water availability or quality in the Nepean River due to mining. No impacts on aquatic ecology have been noted following previous gas releases in the Nepean River associated with mining in Appin Areas 7 & 9, and it is considered unlikely that significant impacts would occur due to any further gas releases.

Fracturing and flow diversions may occur in drainage lines directly above and up to 400 m away from the proposed longwalls. In total, approximately 10 km of third-and-greater order drainage line habitat is located directly above and within 400 m of the proposed longwalls. A total of approximately 25 km of first and second order watercourses is located directly above and within 400 m of the proposed longwalls. Based on observations during extraction of previous Appin Area 7 and 9 longwalls, however, the likelihood of associated flow diversions or pool drainage is low. In the unlikely event flow diversions did occur, this may result in the draining of pools in these watercourses, particularly during low flows, resulting in a reduction in the availability of aquatic habitat and the connectivity of remaining habitat. This would be expected to result in a decrease in population size of associated native aquatic biota, including aquatic plants, macroinvertebrates and fish. While such impacts would be significant at the scale of individual pools and drainage lines, they would be relatively minor at the wider scale of the Nepean River catchment.

Recommendations and Management

Potential impacts on aquatic habitat and biota within the Study Area would be managed by:

- Impact minimisation, which includes the significant distance of the longwalls from the Nepean River, along with identification of triggers that would prompt surveys to assess any impacts on aquatic habitats and their biota identified during and after extraction of the longwalls.
- Monitoring of aquatic habitat and biota during and after mining to determine the nature and extent of any subsidence-induced impacts on aquatic ecology, and responses of aquatic ecosystems to any remediation or management works implemented.
- Undertaking additional aquatic ecology studies in response to specific impacts on water quality and availability of aquatic habitats within the watercourses.
- Implementation of contingent measures such as review of mine layout and appropriate offset distances from major watercourses such as the Nepean River, watercourse remediation measures for tributaries above the mining area, appropriate control measures to limit deposition



of any eroded sediment into the watercourses, and appropriate offset and compensatory measures.



1 Introduction

1.1 Background

Illawarra Coal Holdings Pty Ltd (ICHPL), formerly BHP Billiton Illawarra Coal (BHPBIC) and South32 – Illawarra Metallurgical Coal (IMC), owns and operates the Appin Mine, which extracts Bulli Seam coal of the Southern Coalfield of NSW. Approved Longwalls 701 to 710B in Appin Area 7 were extracted between October 2007 and June 2025, and extraction of Longwall 711 is now underway. Under Condition 5 of Schedule 3 of the BSO Project Approval MP08_0150, ICHPL is required to submit an Extraction Plan (EP) for approval of the Planning Secretary. The EP (equivalent to Subsidence Management Plans – SMPs) for Longwalls 712 to 716 is to be submitted and approved prior to commencement of mining. EPs and SMPs satisfy legislative conditions and outline the monitoring and management activities required to assess and mitigate potential impacts due to mining. The overall objective of the EP is to protect important watercourses, other natural and built features from impacts associated with mine-induced subsidence. It contains environmental monitoring and management plans aimed at minimising any impacts on natural (e.g., groundwater quality, terrestrial ecology, aquatic ecology) and man-made (cultural heritage, infrastructure) features of the environment due to subsidence and include development of a Biodiversity Management Plan (BMP).

Stantec (formerly Cardno and The Ecology Lab) was engaged by ICHPL to undertake the Aquatic Ecology Assessment (AEA) to support the EP application for Longwalls 712 to 716.

Previously, SMPs for Longwalls 705 to 710 (Cardno Forbes Rigby 2008) were approved in February 2008 (Longwalls 705 and 706) and September 2012 (Longwalls 707 to 710). The EP for Appin Area 9 Longwalls 901 to 904 (BHPBIC 2013), supported by the AEA (Cardno Ecology Lab 2011a), was approved in September 2014 and the EP (IMC 2022) for Longwalls 709 to 711 and 905, supported by the AEA (Cardno 2021), was approved July 2022.

1.2 Scope of Works

The scope of works for the AEA includes:

- Desktop review and compilation of information on existing aquatic habitat, vegetation and macroinvertebrates, fish, and any listed threatened species and populations, in the third-or-greater Strahler stream order (order) section of the Nepean River and its tributaries adjacent to the longwalls. This information was obtained primarily from previous investigations that have been underway for several years as part of existing mining operations in Appin Areas 7 & 9.
- Assessment of the potential impacts of the Project on aquatic ecology, including threatened species and any cumulative impacts, in the Nepean River and its tributaries that may be subjected to physical and water quality impacts associated with potential mining subsidence. This included examination of whether the predicted impacts on aquatic habitats and biota differ from the conditions in the those presented within the Conditions of the BSO Project Approval (**Section 2.1**).
- Provide recommendations on measures to avoid and mitigate potential impacts on aquatic ecology, and the form and content of the requisite aquatic ecology monitoring plan for these longwalls. This would be implemented to determine the nature and extent of any subsidence-induced impacts on aquatic ecology and assess the response of aquatic ecology to any subsequent remediation and management works.

1.3 Summary of Previous Studies

Stantec has produced a number of reports on the aquatic habitat and biota associated with the Nepean River and nearby watercourses. These have incorporated reviews of existing literature, the results of baseline surveys, threatened species searches, predictions of mine-subsidence impacts on aquatic ecology, and results of during- and post-mining monitoring. In this section, a brief timeline of these studies is presented.

The initial aquatic ecology investigation in Appin Area 7 in September 2003 included a review of existing literature on aquatic ecology relevant to Appin Area 7 Longwalls 701 to 704, a summary of field investigations describing the ecological conditions of the relevant watercourses, an assessment of the likely impacts on aquatic habitats and biota based on predictions of subsidence / upsidence and recommendations for additional work (The Ecology Lab 2004). Following a substantial change in the mine layout, ICHPL commissioned a further field study (September 2005) for inclusion in the SMP that addressed the effects of mine subsidence on aquatic ecology in the area that could potentially be affected by the mining of Longwalls 701 to 704 (The Ecology Lab 2006). The April 2008 field study provided further data to support the assessment of potential effects of mine subsidence on aquatic habitats and biota resulting from the proposed mining of Longwalls 705 to 710 (The Ecology Lab 2008a). This assessment was included in the SMP for Longwalls 705 to 710 submitted to the Department of Primary Industries Mineral Resources (Cardno Forbes Rigby 2008) and also supported the EP (IMC 2022) and AEA (Cardno 2021) for Longwalls 709 to 711 and 905.

Additional monitoring in accordance with the recommendations made in the SMPs for Longwalls 701 to 704 and 705 to 711 was undertaken in November 2008 (The Ecology Lab 2008b), December 2010 (Cardno Ecology Lab 2011b), December 2011 (Cardno Ecology Lab 2012a), December 2012 (Cardno Ecology Lab 2013), December 2013 (Cardno Ecology Lab 2014), December 2014 and January 2015 (hereafter referred to as December 2014) (Cardno Ecology Lab 2015), November 2015 (Cardno 2016), November 2016 (Cardno 2017), November 2017 (Cardno 2018), November 2018 (Cardno 2019), November 2019 (Cardno 2020), December 2020 (Cardno 2021b), December 2021 (Cardno 2022), December 2022 (Stantec 2023), December 2023 (Stantec 2024) and December 2024 (Stantec, in prep). AEAs were prepared by Cardno Ecology Lab following extraction of Longwalls 701–704 to support the End of Panel reports for these longwalls (The Ecology Lab 2008b and Cardno Ecology Lab 2009, 2011c and 2012b).

The AEA for Appin Longwalls 901 to 904 was undertaken in May 2012 (Cardno Ecology Lab 2012c). This assessment formed part of the Biodiversity Management Plan for the EP (BHPBIC 2014). It included a review and synthesis of existing information on the aquatic habitats and biota that may be affected by extraction of these longwalls and identified potential impacts to aquatic habitats and biota due to the predicted physical and water quality impacts. It also recommended actions to minimise such impacts, including the implementation of ongoing monitoring of aquatic habitats and biota. The first baseline survey for Appin Area 9 was undertaken in December 2014 and November 2015 (Cardno Ecology Lab 2015), with during-mining monitoring undertaken in November 2017 (Cardno 2018), November 2019 (Cardno 2020), December 2021 (Cardno 2022) and December 2023 (Stantec 2024).

The Environmental Assessment (EA) (BHPBIC 2009) for the BSO was also supported by the associated AEA (BioAnalysis 2009) that included survey of aquatic habitat and biota in the Nepean River.

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Information on aquatic habitat, water quality, aquatic macroinvertebrates and fish in the Study Area available from these previous studies is reviewed in **Sections 3.2 to 3.7**. Details of the methods used in these studies and the GPS coordinates of monitoring sites are provided in **Appendix A**.

Information on aquatic habitat present in third order drainage lines that traverse the Study Area has been compiled based on the results of fields surveys undertaken in 2008 (The Ecology Lab 2008a) and 2009 (Bioanalysis 2009), and from visits undertaken by the ICHPL Environmental Field Team (EFT) in 2020 and 2024. Information in Bioanalysis (2009) relevant to the current assessment includes descriptions of aquatic habitat of named third order drainage lines (Navigation Creek and Foot Onslow Creek) and the results of autumn 2008 surveys of aquatic plants, macroinvertebrates and fish at Sites FC_1 and FC_2 on Foot Onslow Creek and Sites NP1_1, NP1_2, NP2_1, NP2_2, NP3_1 and NP3_2 in the Nepean River.

2 Relevant Legislation, Policies, Guidelines and Conditions

2.1 BSO Project Approval

The conditions specified in the BSO Project Approval (including Modifications 1 [April 2015] and 2 [October 2016]) (NSW DPIE 2016) that are relevant to aquatic ecology include:

- Subsidence Impact Performance Measures for Natural Features (**Table 2-1**).
- Preparation of an EP incorporating a Biodiversity Management Plan that provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on aquatic flora and fauna, particularly threatened species, populations and their habitats; endangered ecological communities; and water dependent ecosystems.
- Additional targeted surveys for threatened species, sufficient to identify any actions required to protect significant populations from potential impacts.

The term negligible, used in **Table 2-1**, is defined in the BSO Project Approval as small and unimportant, such as to be not worth considering.

Table 2-1 Subsidence Impact Performance Measures Pertinent to Aquatic Ecology in the current Study Area.

Natural Feature	Performance Measure
Nepean River	Negligible environmental consequences (that is, negligible diversion of flows, negligible change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases).
Other watercourses	No greater subsidence impact or environmental consequences than predicted in the EA.
Threatened species, threatened populations, or endangered ecological communities	Negligible environmental consequences.

2.2 Fisheries Management Act 1994

The Fisheries Management Act 1994 (FM Act) contains provisions for the conservation of fish stocks, Key Fish Habitat (KFH), biodiversity, and threatened species, populations and ecological communities. The FM Act regulates the conservation of fish, marine vegetation and some aquatic macroinvertebrates, along with the development and sharing of the fishery resources of NSW for present and future generations. The FM Act lists threatened species, populations and ecological communities under Schedules 4, 4A and 5. Schedule 6 lists key threatening processes (KTPs) for species, populations, ecological communities and declared critical habitat in NSW waters, which are listed in a register kept by the Minister of Primary Industries. Impacts on these species, populations, communities, processes and habitats due to the Project need to be considered. Assessment guidelines to determine whether a significant impact is expected are detailed in Section 220ZZ and 220ZZA of the FM Act. The guidelines specify the important factors that must be taken into consideration when assessing potential impacts on threatened species, populations and/or ecological communities. The factors requiring consideration are:

- How is the Project likely to affect the lifecycle of a threatened species and/or population?
- How is the Project likely to affect the extent and composition of a threatened ecological community?

- How is the Project likely to affect the habitat of a threatened species, population or ecological community?
- Will the Project affect any critical habitat?
- Is the Project consistent with the objectives or actions of a recovery plan or threat abatement plan?
- Is the Project part of a KTP or is it likely to exacerbate a KTP?

The potential for adverse effects on the lifecycle of threatened fish species depends on whether the works are likely to cause loss or degradation of habitat, reduction in water quality, limit their foraging activities and/or disrupt their reproduction and recruitment.

Another objective of the FM Act is to conserve KFH. These are defined as aquatic habitats that are important to the sustainability of recreational and commercial fishing industries, the maintenance of fish populations generally, and the survival and recovery of threatened aquatic species. In freshwater systems, most permanent and semi-permanent rivers, creeks, lakes, lagoons, billabongs, weir impoundments and impoundments to a level up to the top of the bank are considered KFH. Small headwater creeks and gullies that flow for a short period after rain and farm dams on such systems are excluded, as are artificial water bodies except for those that support populations of threatened fish or invertebrates. At a broad scale, KFH relevant to the Project includes the following:

- Permanently flowing rivers and creeks including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified.
- Intermittently flowing rivers and creeks that retain water in a series of disconnected pools after flow ceases including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified.
- Any waterbody if it is known to support or could be confidently expected (based on predictive modelling) to support threatened species, threatened populations or threatened communities listed under the provisions of FM Act.

2.3 NSW DPIRD (Fisheries) Policy and Guidelines for Fish Habitat Conservation and Management

The NSW Department of Primary Industries and Regional Development (NSW DPIRD), formerly the Department of Primary Industries (DPI), Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013) (NSW DPI 2013a) replaces the Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (NSW DPI 1999) and the former Fisheries NSW Policy and Guidelines for Fish Friendly Waterway Crossings (Fairfull and Witheridge 2003). These updated policies and guidelines are applicable to all planning and development proposals and various activities that affect freshwater, estuarine and marine ecosystems. The aims of the updated policies and guidelines are to maintain and enhance fish habitat for the benefit of native fish species, including threatened species, in marine, estuarine and freshwater environments. The updated document assists developers and their consultants, and government and non-government organisations to ensure their actions comply with legislation, policies and guidelines that relate to fish habitat conservation and management. It is also intended to inform land use and natural resource management planning, development planning and assessment processes, and to improve awareness and understanding of the importance of fish habitats and how impacts can be mitigated, managed or offset. The policies and guidelines outlined in this document are considered when NSW DPIRD

assesses proposals for developments and other activities that affect fish habitats. The document contains:

- Background information on aquatic habitats and fisheries resources of NSW.
- An outline of the legislative requirements relevant to planning and development that may affect fisheries or aquatic habitats in NSW.
- General policies and classification schemes for the protection and management of fish habitats and an outline of the information that NSW DPIRD requires to be included in development proposals that affect fish habitat.
- Specific policies and guidelines aimed at maintaining and enhancing the free passage of fish through instream structures and barriers.
- Specific policies and guidelines for foreshore works and waterfront developments.
- Specific policies and guidelines for the management of other activities that affect waterways.

NSW DPIRD considers the 'sensitivity' of any KFH that would be affected by the Proposal (NSW DPI 2013a). The term 'sensitivity' refers to the importance of the habitat to the survival of fish and its ability to withstand disturbance. In freshwater ecosystems, instream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 m in length, native aquatic plants, and areas known or expected to contain threatened and protected species are considered highly sensitive KFH. Other freshwater habitats plus weir pools and dams across natural waterways are considered to be moderately sensitive KFH. Ephemeral aquatic habitat that does not support native aquatic or wetland vegetation is considered to be of minimal sensitivity. It is important to note that aquatic habitats within first and second order gaining streams, sections of stream that have been concrete-lined or piped (excluding waterway crossings) and artificial ponds are not regarded as KFH unless they support a listed threatened species, population or ecological community, or 'critical habitat'. NSW DPIRD may in addition assess development proposals in relation to waterway class (i.e., their ability to provide habitat that is suitable for fish), which in turn determines the appropriate type of any waterway crossings.

2.4 Key Threatening Processes

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. KTPs are listed under the FM Act, *Biodiversity Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are eight listed KTPs under the FM Act, 38 listed under the BC Act and 21 listed under the EPBC Act. Broadly, the KTPs include threats to threatened species, population and/or ecological communities as well as cause species, population or ecological communities to become threatened.

One KTP listed under the BC Act is directly applicable to the Project: *Alteration of habitat following subsidence due to longwall mining*.

In the final determination for this KTP, the NSW Scientific Committee found that:

- Mining subsidence following longwall mining is frequently associated with cracking of valley floors and creek lines, with subsequent effects on surface and groundwater hydrology.
- Subsidence-induced cracks occurring beneath a stream or other surface water body may result in the loss of water to near-surface groundwater flows. If the water body is located in an area where the coal seam is less than approximately 100 to 120 m below the surface, longwall mining can

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cause the water body to lose flow permanently. If the coal seam is deeper than approximately 150 m, the water loss may be temporary unless the area is affected by severe geological disturbances such as strong faulting.

- In the majority of cases, surface waters lost to the sub-surface re-emerge downstream. The ability of the water body to recover is dependent on the width of the crack, the surface gradient, the substrate composition and the presence of organic matter. An already-reduced flow rate due to drought conditions or an upstream dam or weir will increase the impact of water loss through cracking.
- Subsidence can cause decreased stability of slopes and escarpments, contamination of groundwater by acid drainage, increased sedimentation, bank instability and loss, creation or alteration of riffle and pool sequences, changes to flood behaviour, increased rates of erosion with associated turbidity impacts, and deterioration of water quality due to a reduction in dissolved oxygen (DO) and to increased salinity, iron oxides, manganese, and electrical conductivity (EC).
- Loss of native plants and animals may occur directly via iron toxicity, or indirectly via smothering. Long-term studies in the United States indicate that reductions in diversity and abundance of aquatic invertebrates occur in streams in the vicinity of longwall mining and these effects may still be evident 12 years after mining.
- In the Southern Coalfield, substantial surface cracking has occurred in watercourses within the Upper Nepean, Avon, Cordeaux, Cataract, Bargo, Georges and Woronora catchments, including Flying Fox Creek, Wongawilli Creek, Native Dog Creek and Waratah Rivulet. The usual sequence of events has been subsidence-induced cracking within the streambed, followed by significant dewatering of permanent pools and in some cases complete absence of surface flow.
- Subsidence associated with longwall mining has contributed to adverse effects on upland swamps. The conversion of perched water table flows into subsurface flows through voids as a result of mining-induced subsidence may significantly affect the water balance of upland swamps. The timeframe of these changes is likely to be long-term. While subsidence may be detected and monitored within months of a mining operation, displacement of susceptible species by those suited to altered conditions is likely to extend over years to decades as the vegetation equilibrates to the new hydrological regime.

The Department of Environment and Conservation, now the Conservation Programs, Heritage, and Regulation (CPHR) group within the Department of Climate Change, Energy, the Environment and Water (DCCEEW), has identified several priority actions to promote the abatement of this KTP, including:

- Examining the effects of subsidence from longwall mining on priority ecosystems including streams, wetlands, and threatened species, populations and ecological communities.
- Preparing guidelines outlining key factors that should be considered when assessing impacts of new longwall mines on biodiversity.
- Developing recommendations for monitoring impacts of new longwall mines on biodiversity and mitigation methods.
- Ensuring rigorous assessment of new mines continues through existing approval processes including the preparation of SMPs.

Consideration of the effect of exacerbation of any KTP on a listed threatened species, population or ecological community must be taken into consideration during any assessment.

2.5 Biodiversity Conservation Act (2016)

The *Biodiversity Conservation Act 2016* (BC Act) contains provisions for the conservation of some aquatic species and communities except for those listed under the FM Act (i.e., fish, crayfish and all other aquatic animals, but not freshwater vegetation). Listings under the BC Act are considered in detail by in the terrestrial ecology specialist study (NEH 2025). Regardless, listings and records of aquatic plants were reviewed in this assessment.

3 Existing Environment

3.1 Study Area and Surveys

The Study Area for the AEA is the surface environment directly above and within 600 m of the footprint of Longwalls 712 to 716 (**Figure 3-1** and **Figure 3-2**). **Figure 3-1** and **Figure 3-2** also include the 400 m boundary. In the Southern Coalfield, subsidence-induced fracturing has been observed up to 400 m from the longwall goaf. Therefore the 400 m boundary has been used as a reference to make predictions about the extent of impacts to watercourses in MSEC (2025) and in this AEA.

The Nepean River is located outside this area and is not expected to experience impacts related to subsidence. However, as a precautionary measure, the adjacent section from existing Site 8 upstream to Site X8 (**Figure 3-1**) and associated surveys of aquatic habitat, macrophytes, macroinvertebrates and fish have been included in this assessment. Sites 1 to 8, X1 and X2 have been sampled between nine (Sites 3, 4, X1 and X2) and 20 (Sites 1, 2, 5, 6, 7 and 8) occasions from September 2003 (TEL 2004) to December 2024 (Stantec, in prep) for the ongoing Appin Area 7 monitoring program. Monitoring at Sites 3, 4, X1 and X2 ceased after December 2014 following the completion of extraction of Longwalls 701 to 704 (Cardno Ecology Lab 2015). Sites X3 to X8 have been surveyed on six occasions between December 2014 and December 2023 for the ongoing Appin Area 9 monitoring program. The water in the relevant section of the Nepean River is derived from the licensed discharges of the Cataract, Cordeaux, Avon and Nepean Dams, and flow is controlled by Maldon Weir, which is situated approximately 5 km south-west of the proposed longwalls. Surveys of the Nepean River were also undertaken in 2008 to support the BSO AEA (Bioanalysis 2009). These included surveys of aquatic habitat, plants, macroinvertebrates and fish in the Nepean River at NP1 approximately 400 m downstream of Maldon Weir, NP2 just upstream of the confluence with Allens Creek (located outside the Study Area) and NP3 at Menangle Weir.

The Study Area is traversed by several tributaries of the Nepean River, including Navigation Creek and Foot Onslow Creek (**Figure 3-2**). The third-and-greater order watercourses within the Study Area are Navigation Creek, four tributaries of Navigation Creek (NavC16, NavC20, NavC17 and NavC14.5), Apps Gully (a tributary of Racecourse Creek) and Foot Onslow Creek (at the extreme eastern extent of the Study Area). Several unnamed first and second order tributaries also flow through the Study Area, including NavC15 (a second order tributary of Navigation Creek).

The condition of aquatic habitat present in NavC16 (Site AE03 and AE04), NavC15 (Site AE05) and Foot Onslow Creek (Site AE06) was assessed previously in September 2003 for the initial Appin Longwalls 701 to 715 AEA (TEL 2004). Aquatic habitat in Navigation Creek (Sites WPT64, WPT65 / N1, WPT67 and WPT68), NavC16 (WPT70 / AE03 and WPT69), NavC15 (WPT71 / AE05) and Foot Onslow Creek (Sites F1, F2, WPT72, WPT73 and WPT75) was assessed in April 2008 as part of the Appin Longwalls 705 to 71 AEA (TEL 2008a).

TEL (2008a) also undertook fish and macroinvertebrate surveys in Navigation Creek (Site N1) and Foot Onslow Creek (Sites F1 and F2). Monitoring of macroinvertebrates was subsequently undertaken at F1 and F2 in November 2008 (TEL 2009) and at N1, F1 and F2 in December 2010 (CEL 2011b) but ceased after this survey as these creeks were considered to provide very limited aquatic habitat (Cardno Ecology Lab 2013, 2014). Surveys of aquatic habitat, plants and macroinvertebrates were undertaken in Racecourse Creek (RC) and Foot Onslow Creek (FC) in 2008 by Bioanalysis (2009).

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In October 2024, EFT inspected Navigation Creek (Sites NAV1/EFT8, EFT9, EFT30, and NAV2) and its third order tributaries NavC16 (EFT11), NavC15 (EFT10) and NavC14.5 (EFT15 and EFT16) from road crossings and other areas of public access.

On 9 April 2025, Stantec visited Sites NAV1, NAV2 and NAV_S50/EFT9 on Navigation Creek, Site NAVC16_S10/EFT11 on Navigation Creek Tributary C16, and Site AG_S10 on Apps Gully to survey aquatic habitat, aquatic macroinvertebrates and fish using the methods described in **Appendix A**.

The review of existing information in **Sections 3.2 to 3.7** is based on the information collected from these previous studies and sites visited, examination of current aerial imagery, and inspections (primarily from roads) of watercourses by EFT. It is noted that access to Navigation Creek and other tributaries within the Study Area was restricted due to the area being privately owned by multiple landowners. Thus, sites were primarily established at public road crossings, where safe to access and at a few locations where landowner access could be arranged.

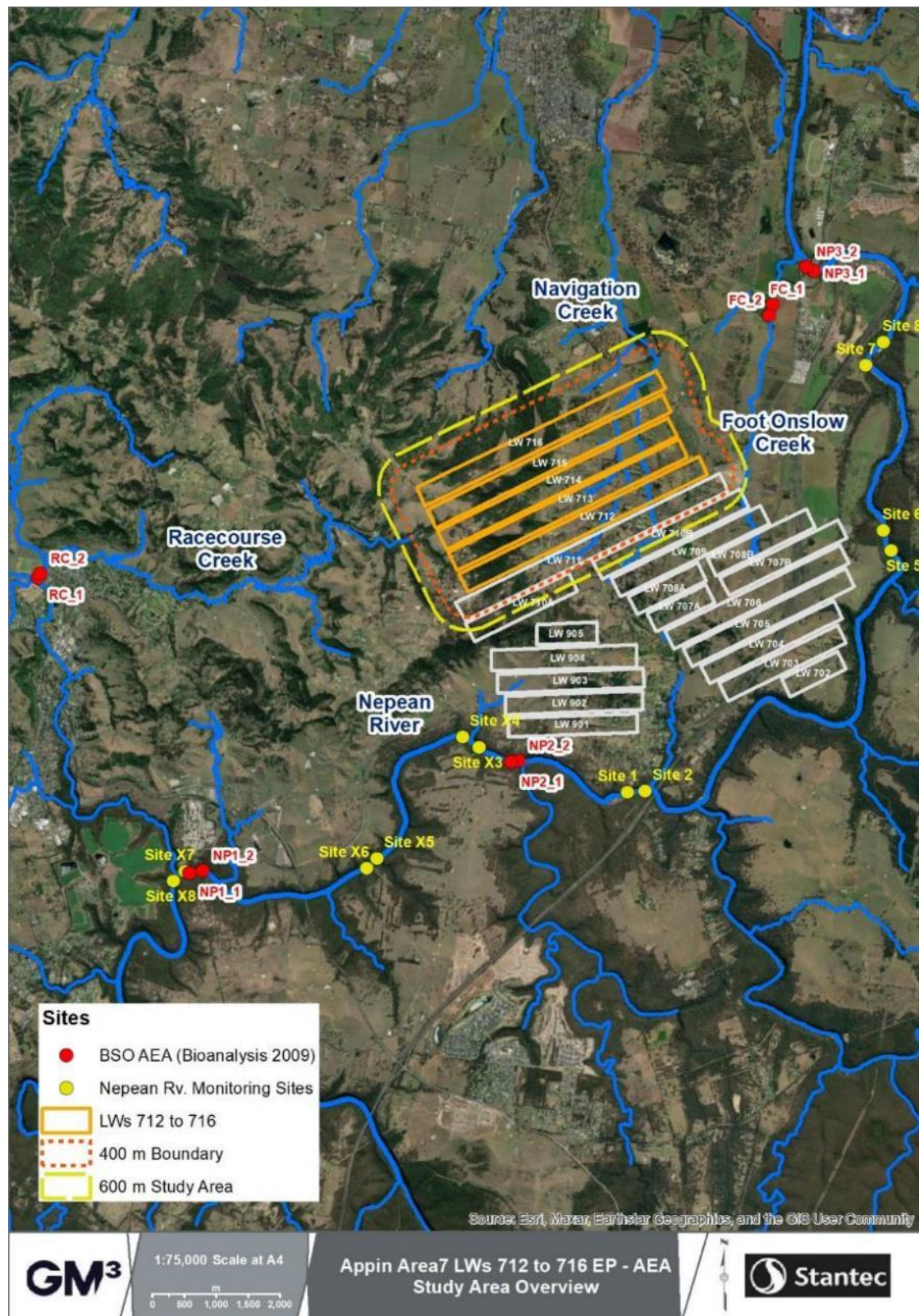


Figure 3-1 Overview of longwall layouts, watercourses and aquatic ecology sites within and adjacent to the Longwalls 712 to 716 and Study Area (600 m boundary). The 400 m boundary is presented to provide context for the subsidence predictions (Fracturing has been observed up to approximately 400 m outside of previously extracted longwalls in the Southern Coalfield (MSEC 2025)). Only third-order and greater watercourses displayed.

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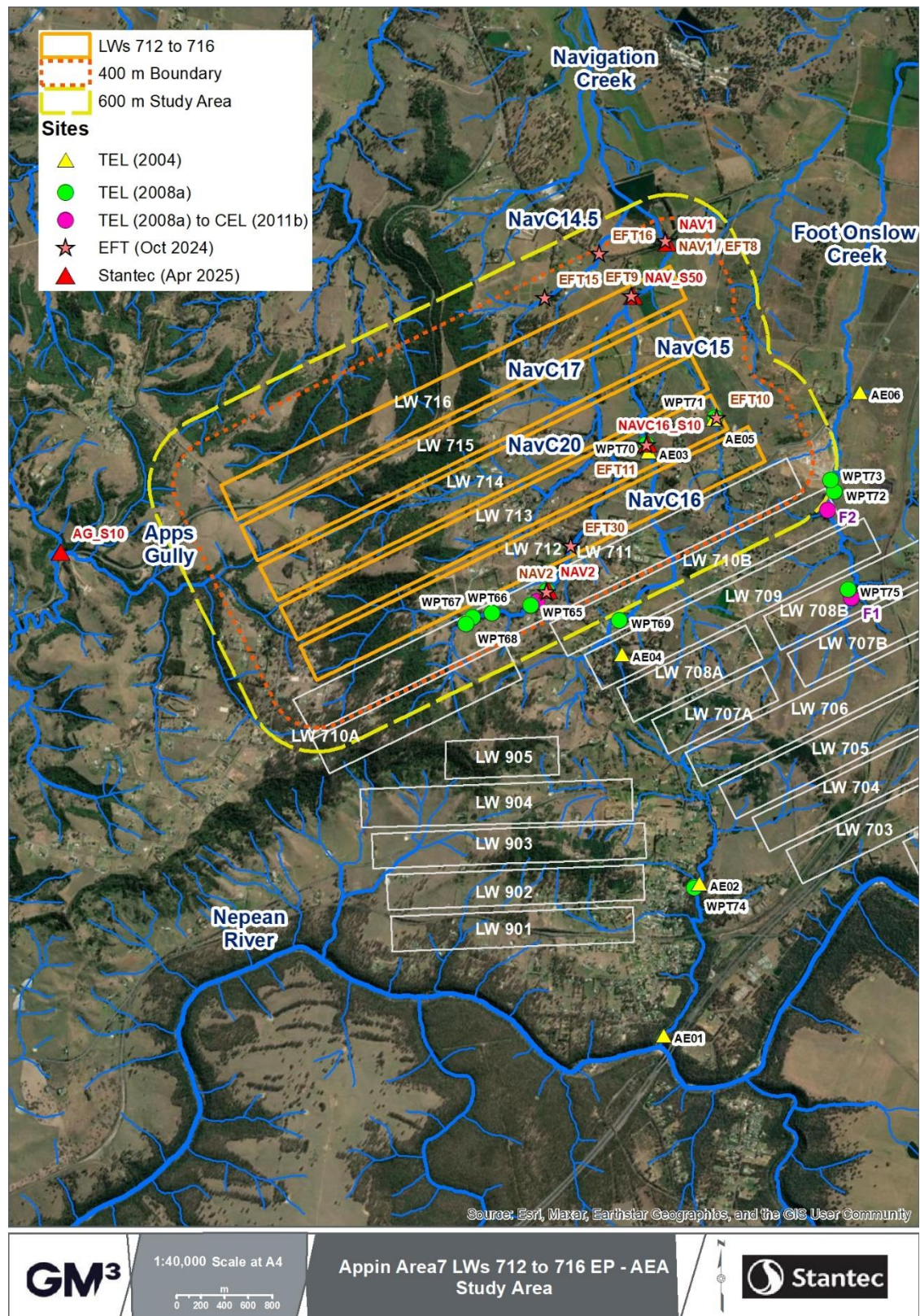


Figure 3-2 Longwall layouts, watercourses and aquatic ecology sites within and adjacent to the Longwalls 712 to 716 and Study Area (600 m boundary). The 400 m boundary is presented to provide context for the subsidence predictions (Fracturing has been observed up to approximately 400 m outside of previously extracted longwalls in the Southern Coalfield (MSEC 2025)).

3.2 Aquatic Habitat

3.2.1 Nepean River

The Nepean River between Site 8 (downstream) and Site X8 (upstream) can be divided into two relatively distinct sections. A flooded lower section (**Plate 1a** and **b**) from around 1 km upstream of Site 1 to Site 8 in which surface water level is controlled by Douglas Park Weir, and an upper section (**Plate 1c** and **d**) upstream of that point to Site X8 in which surface flow is controlled by boulder fields and small riffle sections.

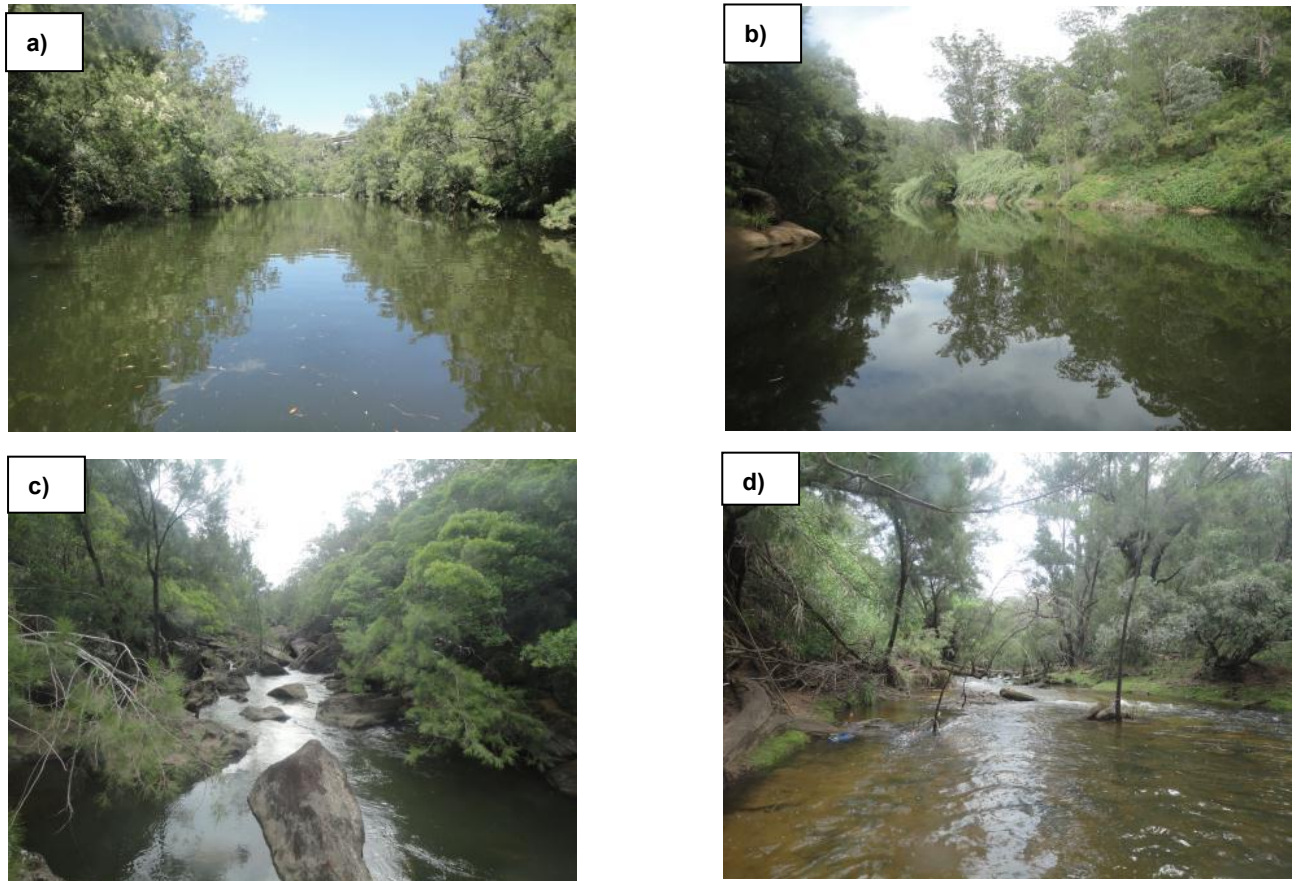


Figure 3-3 a) and b) wide channel and relatively deep and slow flowing water typical of Sites 1 to 8, X1 and X2, and c) and d) narrower and shallower channel typical of Sites X3 to X8 on the Nepean River.

The lower section includes the 1 m high causeway at Douglas Park. The channel above and below this causeway consists of a continuous pool, approximately 50 m wide and 3.5 m deep, with no observable flow except during flood events. The riverbanks support a mixture of native and exotic trees and shrubs, including Casuarina, Eucalyptus and Lantana. There are extensive beds of submerged macrophytes in the shallower river edges and large wood debris and boulders along the channel edge. The riverbanks generally support a combination of native and exotic trees, shrubs and grasses. Aquatic habitats include sandbars, overhanging banks, snags and some boulders. In the upper section, aquatic habitat comprises shallow pools interspersed by riffles over gravel and boulders. The riparian zone in the section upstream of the boulder field is continuous and dominated by native species. The substratum includes bedrock, boulders, gravel and sand.

Overall, aquatic habitat at these sites on the Nepean River are generally in good condition, although the AUSRIVAS modelling does not fully reflect this observation, indicating impaired habitat and/or

water quality (**Section 3.6**). The relatively undisturbed riparian strip present would not be expected to result in any impaired aquatic habitat in this section of river and would help stabilise riverbanks and prevent erosion and sediment mobilisation. Furthermore, riparian vegetation is a source of in-stream woody debris, which provides important habitat for many species of aquatic fauna, including fish. It is also an important source of allochthonous material such as insects and leaves. The relatively dense patches of macrophytes observed at most sites would also fulfil many important ecological roles, including the provision of refuge and nursery habitat for aquatic fauna, serving as a source of food for macroinvertebrates and fish, and assisting in nutrient cycling. There are no barriers to fish passage within the Nepean River adjacent to the Study Area (a fishway is present at the Douglas Park Causeway); however, both Menangle Weirs would create significant barriers to upstream fish movement. There does not appear to be any livestock access to these sections of the Nepean River. While there is no public access via the adjacent land, recreational fishers, canoeists and other members of the public do access this area by boat from either Douglas Park Weir or Menangle Weir.

3.2.2 Tributaries

Several named third-or-greater order tributaries of the Nepean River and/or their upstream tributaries are located in the Study Area. These are described individually in **Sections 3.2.2.1 to 3.2.2.4**.

3.2.2.1 Navigation Creek

Main Channel

Approximately 5 km of the third-and-greater order section of Navigation Creek flows through the Study Area, with 1.7 km of this located directly above Longwalls 712 to 716 and 4.5 km within 400 m. This reach runs through agricultural / pastoral land use and so has been and continues to be subjected to degradation associated with clearing of riparian vegetation, sediment mobilisation and sedimentation. It was classified as Class 2 (moderate) aquatic habitat – (i.e., *containing some small semi-permanent refuge pools which are unlikely to persist through prolonged drought*) (The Ecology Lab 2008a) (**Appendix A**). At the time of the 2008 inspection (which followed recent rainfall) the pools at Site N1 (**Figure 3-4a**) were connective by shallow flow, though pool connectivity would not be expected to persist during drier periods. Riparian vegetation was generally sparse with some patches of mature eucalypt and melaleuca trees. Exotic shrubs and grasses were common along the banks. Vegetation noted within the channel and associated with farm dams included *Typha sp.*, *Ludwigia sp.*, *Ottelia sp.*, *Cyperus sp.* and *Juncus sp.* Only *Ottelia sp.* would be considered an in-stream aquatic macrophyte. The substratum of the watercourse was dominated by soft silt and clay sediments, with some sections of shale bedrock, gravel and sand bars. Sections of the channel banks were eroded from cattle access (The Ecology Lab 2008a, Bioanalysis 2009).

In October 2024 Navigation Creek at EFT9, EFT30 and NAV1 also consisted of a series of disconnected pool habitat (**Figure 3-4b-g**). During surveys at NAV1, NAV2 and NAV_S50 in Navigation Creek undertaken by Stantec on 9 April 2025, watercourse habitat at these sites (**Figure 3-5a-c**) provided moderate aquatic habitat. This was based on the presence of apparent semi-permanent pools that would likely provide habitat for fish and macroinvertebrates. There was a relatively complete riparian strip along the banks at each site. The instream aquatic macrophyte *Potamogeton sp.* was observed at NAV_S50, though no large wood debris or rocks were observed. The culvert at NAV_S50 at the downstream extent of the Study Area would be a barrier to fish passage during low conditions.

Tributaries of Navigation Creek

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Four third-order tributaries of Navigation Creek are located within the Study Area (NavC16, NavC20, NavC17 and NavC14.5), with an approximate total cumulative length of 7 km within in the Study Area, 3.3 km of which is above the longwalls, and 5.5 km within 400 m. These watercourses provide minimal (i.e., watercourses that contain some small semi-permanent refuge pools that are unlikely to persist through prolonged drought) to moderate (watercourses that contain some larger permanent and semi-permanent refuge pools that would persist through prolonged drought but become greatly reduced in extent) aquatic habitat (The Ecology Lab 2008a). In 2004 and 2008, NavC16 (Tributary 1 in TEL 2004, 2008a) consisted of disconnected pools formed where road culverts have had a dam effect, and farm dams along or adjacent to the channel (The Ecology Lab 2004; 2008a) (**Figure 3-6a-c**).

During surveys at EFY11 / NAVC16_S10 in NAVC16 (NavC16) undertaken by EFT in October 2024 and Stantec on 9 April 2025, those watercourses were found to provide minimal to moderate aquatic habitat (**Figure 3-6d-f**). This was based on the presence of apparent semi-permanent pools that would likely provide habitat for fish and macroinvertebrates. There was a relatively complete riparian strip along the banks at each site. No large wood debris, rocks or aquatic plants were observed. The culvert at NAVC16_S10 near the downstream extent of the Study Area would be a barrier to fish passage during low conditions.

NavC20, NavC17 and NavC14.5 were not visited by The Ecology Lab (2004, 2008a). However, examination of aerial imagery indicates that although they flow through comparable areas to other tributaries of Navigation Creek, they would be subject to ongoing degradation due to agricultural and pastoral land use and would provide minimal aquatic habitat. NavC14.5 was visited by EFT in October 2024 (Sites EFT15 and EFT16) (**Figure 3-7a-d**) and was largely dry except for a few small, disconnected pools.

NavC15 (Tributary 2) is one of the several second order tributaries and is located within the Study Area east of the main channel of Navigation Creek and west of Foot Onslow Creek. It was visited by EFT in October 2024 (**Figure 3-8a-c**) and found to provide minimal aquatic habitat, consisting of disconnected pools.



Figure 3-4 a) Site N1 / WPT65 on Navigation Creek (The Ecology Lab 2008a) and b) to g) Sites EFT9, EFT30 and NAV1 on Navigation Creek visited by EFT in October 2024

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Figure 3-5 Navigation Creek at a) Site NAV1, b) Site NAV2 and c) Site NAV_S50 on Navigation Creek surveyed by Stantec April 2025.

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Figure 3-6 NavC16 at a) and b) Carols Road / Hawkey Road intersection, c) at Carols Road Crossing, d) and e) at EFT11, and f) at EFT11 / NAVC16_S10

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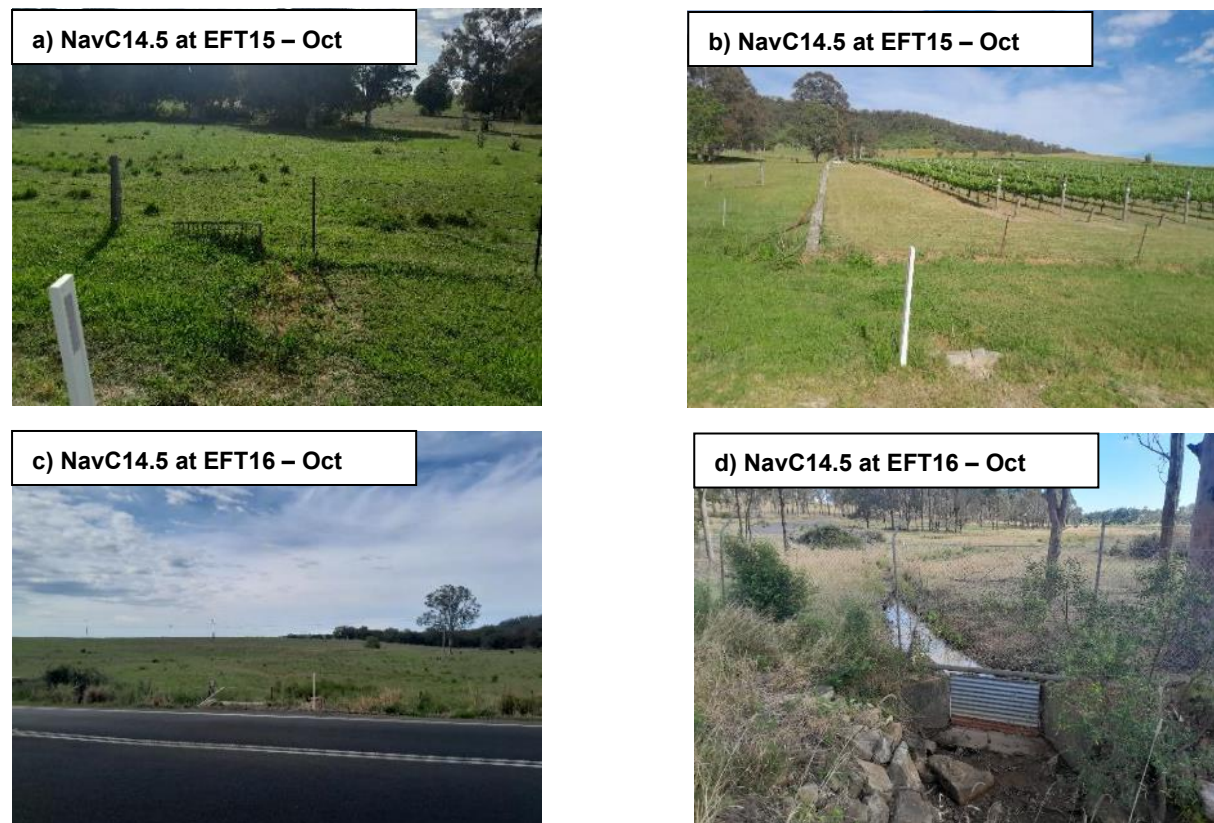


Figure 3-7 NavC14.5 at a) and b) EFT15 and c) and d) at EFT16.

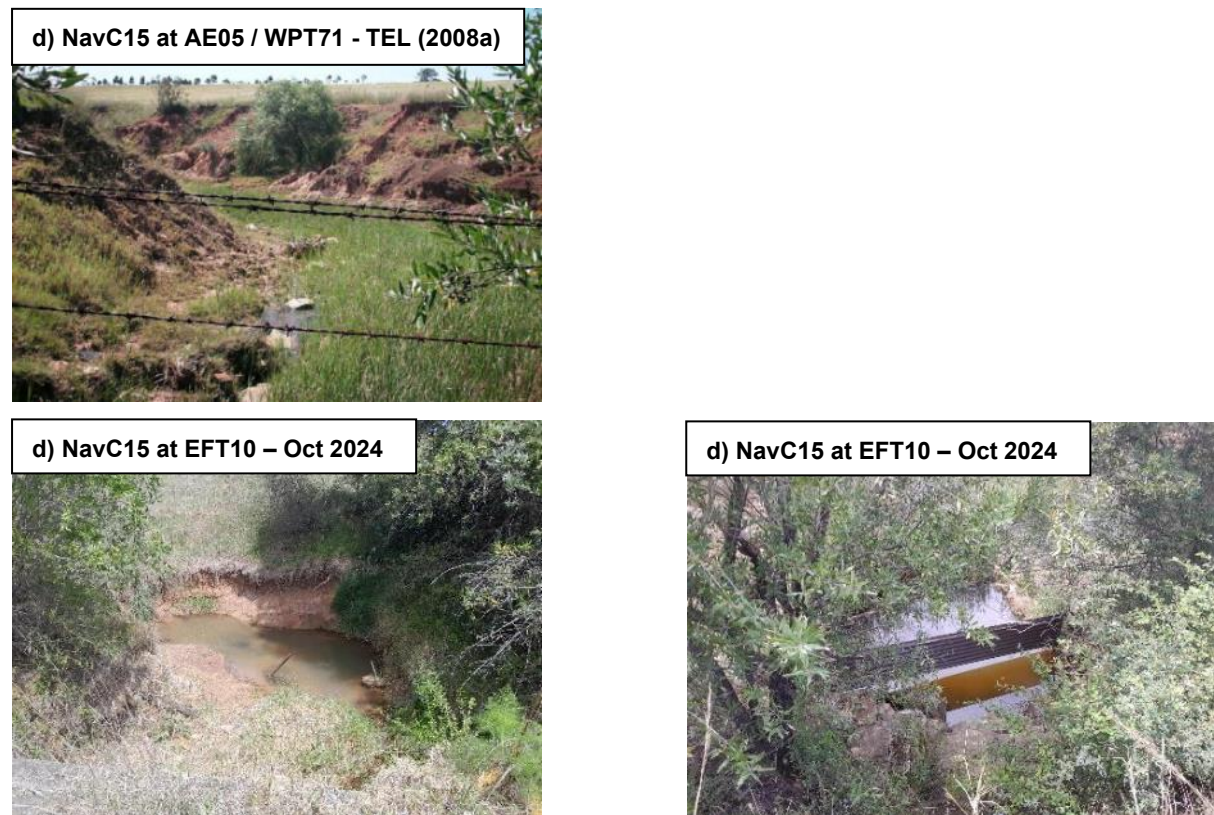


Figure 3-8 NavC15 at a) Finns Road Crossing and b) and c) at EFT10.

3.2.2.2 Foot Onslow Creek

A small section (< 200 m) of Foot Onslow Creek is located in the Study Area. The section of creek at nearby Sites AE06, F1 and F2 (**Figure 3-9a-c**) provides moderate aquatic habitat and contains a number of relatively large, deep pools that would be expected to persist through prolonged dry periods (The Ecology Lab 2008a). At the time of the April 2008 inspection, there was no flow connectivity and standing pools were separated by sections of dry creek bed. Riparian vegetation was sparse and consisted of some native eucalypt, tea tree and melaleuca trees. There were also numerous exotic tree, shrub and grass species amongst the riparian vegetation. No instream aquatic macrophytes were present in the reach of the watercourse inspected. The substratum of the watercourse was primarily soft silt and clay, with some sand and gravel bars. The banks of the watercourse were heavily eroded likely due to removal of riparian vegetation and extensive stock access (The Ecology Lab 2004). The water was generally very turbid, with some surface scum present. Further downstream at FC-1 and FC-2, the creek continued through areas of agriculture land use, and banks of the creek channel were heavily eroded, most likely associated with access by stock. The channel was overgrown by grasses and the emergent macrophyte, *Typha orientalis* (Bioanalysis 2009).

a) Foot Onslow Creek at AE06 - TEL (2004)



b) Foot Onslow Creek at F1 – TEL (2008a)



c) Foot Onslow Creek at F2 – TEL (2008a)



Figure 3-9 Foot Onslow Creek at a) AE06 at Menangle Road, at b) F1, and c) F2.

3.2.2.3 Apps Gully

Approximately 300 m of the third order Apps Gully (a tributary of Racecourse Creek) is located in the Study Area, with 50 m within 400 m of Longwalls 712 to 716. Albeit located approximately 1.3 km downstream of the Study Area, Site AG_SC10 was surveyed by Stantec 9 April 2025 (**Figure 3-10a-b**). Apps Gully at AG_SC10 provided moderate aquatic habitat. *Potamogeton* sp. was present although large rocks and wood debris were not observed. The culvert at the road crossing would be a barrier to fish passage during low flow conditions.

Aerial imagery indicates Apps Gully and upstream tributaries flow mostly through steep valleys with riparian vegetation surrounded by agricultural / pasture land use.

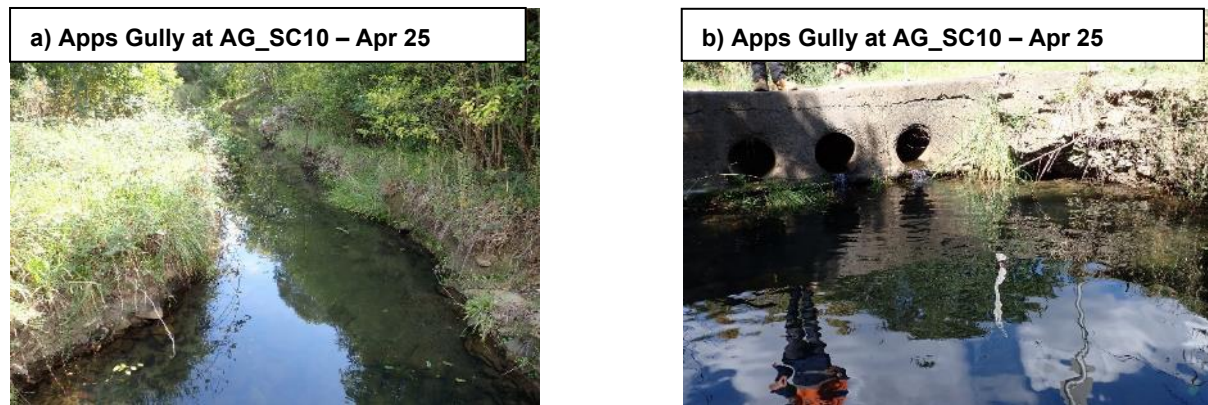


Figure 3-10 a) and b) Apps Gully at Site AG_SC10 in April 2025.

Although located several kms downstream of the Study Area, Sites RC-1 and RC-2 in Racecourse Creek were surveyed by Bioanalysis (2009) (**Figure 3-1**). The channel of Racecourse Creek at Sites RC-1 and RC-2 comprised a series of small pools and short runs (Bioanalysis 2009). The substratum was predominantly silt and clay. A few patches of in-stream macrophytes were present in pools in the lower reaches (i.e., near Picton). The banks of the channel were heavily eroded, probably associated with removal of riparian vegetation and access by cattle.

3.2.2.4 Other Tributaries

In addition to NavC15, approximately 30 km of several first and second tributaries in the Study Area flow into the Nepean River, with approximately 25 km located within 400 m. Some upstream sections in steeper valleys flow through apparently undisturbed riparian vegetation, though these are located at the extreme upstream extent of their catchments and likely do not provide permanent aquatic habitat. Where these flow through a cleared agricultural land use the watercourses would be highly degraded, ephemeral and provide very limited aquatic habitat.

These first and second order watercourses are considered as Class 4 (unlikely) aquatic habitat (i.e., *Ephemeral drainage lines that only contain flow during and immediately after significant rainfall. Permanent or semi-permanent pools that could provide refuge for aquatic biota during prolonged dry weather are absent*) (The Ecology Lab 2008a) (**Appendix A**).

3.3 Key Fish Habitat

The broad-scale KFH spatial data available on the NSW DPIRD website indicates that the Nepean River is KFH (NSW DPIRD 2025). The third order sections of Navigation Creek and the third order tributaries of Navigation Creek, Foot Onslow Creek and Apps Gully are also identified as KFH.

The lower, fourth order section of Navigation Creek and third order section of Apps Gully within the Study Area were classified as providing Type 1 – Highly Sensitive KFH (**Figure 3-11**). This was due to the presence of native aquatic plants (*Potamogeton* sp.) at Site NAV_S50 on Navigation Creek and Site AG_SC10 on Apps Gully. Aquatic plants were, however, absent from Sites farther upstream on Navigation Creek and this section was classified as providing Type 2 – Moderately Sensitive KFH.

The classification of the entire fourth order section of Navigation Creek as Type 1 – Highly Sensitive KFH has been applied as a precautionary measure in the absence of direct survey data from this

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section of creek. This section of Navigation Creek also has been, and continues to be degraded due to past and current land use practices. Aerial images indicate absence of significant riparian vegetation and several potential barriers to fish passage such as farm dams. Fish passage into Navigation Creek within the Study Area is also hindered by the culvert present at NAV_S50. It is possible that this section of creek would be found not to support Type 1 – Highly Sensitive KFH if survey access was possible.

Other third order watercourses within the Study Area (tributaries of Navigation Creek, Foot Onslow Creek) were classified as providing Type 2 – Moderately Sensitive KFH. These watercourses are also degraded due to past and current land use practices, and large rocks, wood debris and aquatic plants have not been identified within the channels.

The first and second tributaries in the Study Area do not provide KFH.

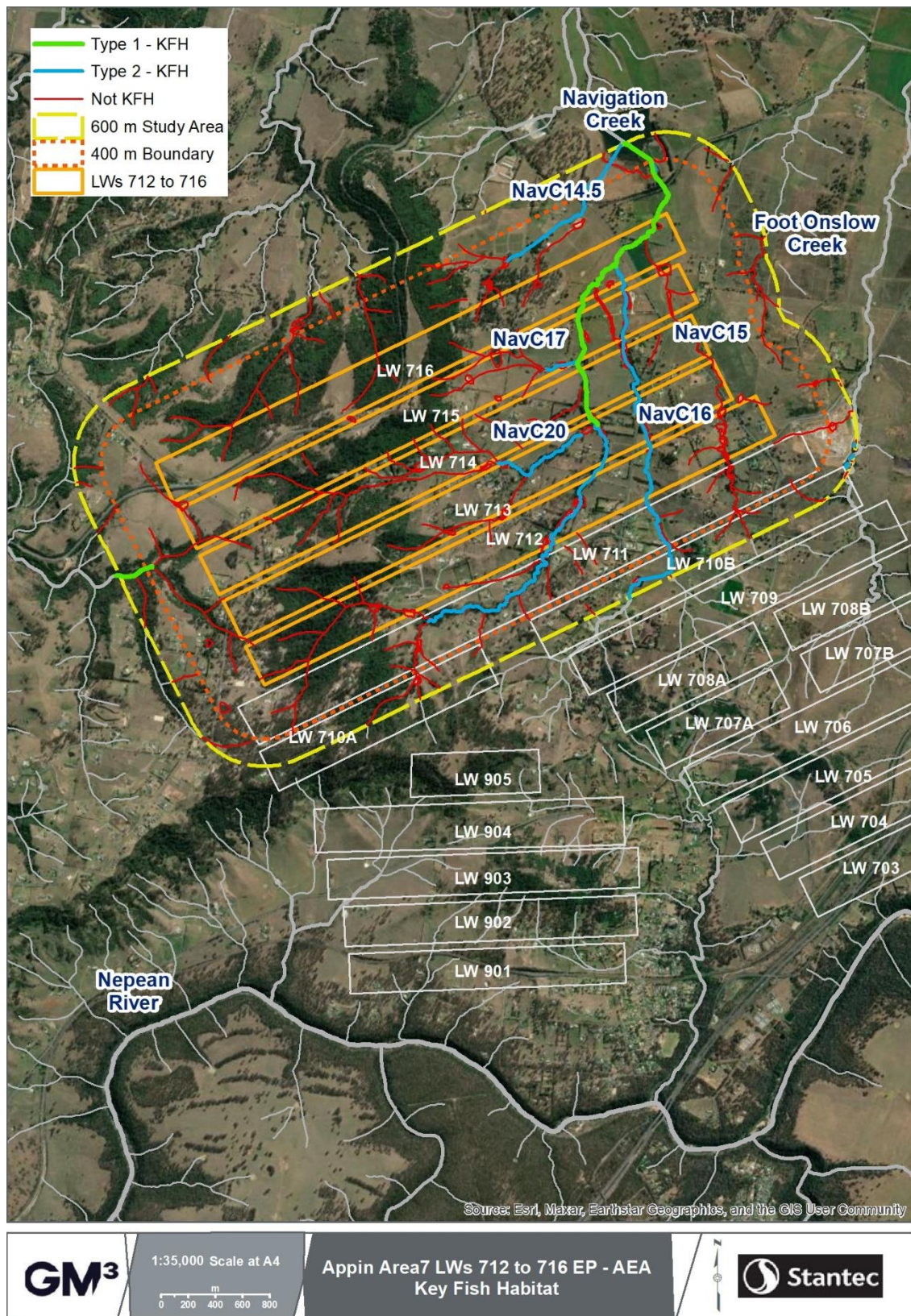


Figure 3-11 Key fish habitat in watercourses within the Study Area. It is noted that the entire fourth order section of Navigation Creek has been classified as Type 1 KFH as a precautionary measure in the absence of survey data from this entire section. This creek is highly degraded and provides habitat of limited of value for fish (see text).

Overall, this watercourse provides relatively limited aquatic habitat for native fish due to its degraded condition from land clearance and cattle access. The aquatic habitat present consists primarily of a series of disconnected pools, except during and following rainfall. First and second order tributaries, including the first and second order drainage lines within the Study Area, are not KFH (NSW DPI 2013a). Although located outside the Study Area, the Nepean River provides Type 1 – Highly sensitive KFH, and contains substantial areas of aquatic plants, large rocks and large wood debris.

3.4 Water Quality

Water input to Nepean River is contributed from a number of environmental and industrial sources, including rainfall within catchment areas, licensed discharges from collieries, sewage treatment plants, agricultural and industrial sites, and stormwater runoff from urban areas. Consequently, its chemistry is highly variable (Geoterra 2005). The surface water quality indicators measured by Stantec have been largely within, or very slightly outside, guidelines for the protection of aquatic ecosystems (Stantec 2023). Deeper samples taken near the riverbed have shown that DO at the riverbed to be below the lower DTV on occasions. Turbidity was also often below the lower DTV, but values marginally outside of DTVs are unlikely to be cause for concern for aquatic ecology. The low levels of DO recorded previously are indicative of stratification of the water column, with hypoxic water at the bottom and oxygenated water at the surface. Stratification can occur naturally in summer due to limited vertical mixing between the warm upper water layer and colder, denser layer(s) below. It can also occur due to inflow of saline water. Stratification could lead to impacts on aquatic systems, particularly if the water column mixes dramatically, possibly in a flood event. It can be deleterious to biota due to anoxia, or toxicity from contaminants liberated from bottom sediments during periods of reduced pH. Gas releases could also result in reductions in DO due to microbial consumption of dissolved methane (Ecoengineers 2009).

There is some evidence of more variable water quality in tributaries of the Nepean River. EC on Foot Onslow Creek ranged from between 1,781 $\mu\text{S}/\text{cm}$ and 2,446 $\mu\text{S}/\text{cm}$ in April 2008 (The Ecology Lab 2008a) to between 188 $\mu\text{S}/\text{cm}$ and 192 in March 2008 (Bioanalysis 2009), with measures in April 2008 above the upper ANZECC (2000) Default Trigger Value (DTV). During April 2008, turbidity ranged from 7.8 to 60.2 NTU and from 8.0 to 25.9 in March 2008. DO ranged between 74.3% and 84.7% in April 2008 and between 71% and 100% in March 2008. pH has ranged between 8.3 in April 2008 and 5.5 in March 2008. EC (1,946 $\mu\text{S}/\text{cm}$) and turbidity (21 NTU) were also elevated in Navigation Creek in April 2008 and DO (58% saturation) was below the lower DTV (The Ecology Lab 2008a).

In-situ water quality data (**Appendix B**) collected by Stantec in Navigation Creek, NAVC16 and Apps Gully in April 2025 indicated:

- EC between 733 $\mu\text{S}/\text{cm}$ and 2,732 $\mu\text{S}/\text{cm}$ in Navigation Creek, at 243 $\mu\text{S}/\text{cm}$ in NAVC16, and at 618 $\mu\text{S}/\text{cm}$ in Apps Gully, and above the upper DTV at NAV1.
- pH between 8.1 and 8.4, and above the upper DTV at each site.
- DO between 38.4% and 60.6% saturation and below the lower DTV in Navigation Creek and NAVC16, and at 88.5% saturation and within DTVs in Apps Gully.
- Turbidity between 2.3 NTU and 19.8 NTU on Navigation Creek, at 42.9 NTU on NAVC16 and at 0.6 NTU in Apps Gully. It was below the lower DTV at Apps Gully and at one Site on Navigation Creek (NAV_S50) and above the upper DTV on NAVC16.

These water quality data are comparable to those measured previously in watercourses within the Study Area.

3.5 Macrophytes

A number of aquatic macrophytes are present at Sites 1 to 8 and X2 to X8 on the Nepean River. These were surveyed most recently in December 2023 as part of the ongoing monitoring in Appin Areas 7 and 9 (Stantec 2025) and in December 2024 as part of the ongoing monitoring in Appin Area 7 (Stantec, in prep). They generally grow on the shallower riverbed reaches (confined to a maximum river depth of about 3.5 m) where soft sediment is present.

At least nine species of instream aquatic macrophytes have been identified in the Nepean River by Stantec:

- Floating pondweed (*Potamogeton tricarinatus*).
- Ribbonweed (*Vallisneria* sp.) (**Plate 4a and b**).
- Hydrilla (*Hydrilla verticillata*).
- Elodea (*Elodea canadensis*) (**Plate 4c and d**).
- Clasped pondweed (*Potamogeton perfoliatus*).
- Curly pondweed (*Potamogeton crispus*).
- Blunt pondweed (*Potamogeton ochreatus*).
- Cumbungi (*Typha* sp.).
- Watercress (*Rorippa* sp.).

A further nine species of emergent or bankside aquatic associated plants have also been identified (Stantec 2025b):

- Tall spikerush (*Eleocharis sphacelata*) (**Plate 4c and d**).
- Alligator weed (*Alternanthera philoxeroides*).
- Rushes (*Juncus* sp. and *Juncus usitatus*).
- River clubrush (*Schoenoplectus validus*).
- Slender knotweed (*Persecaria decipens*).
- Floating Primrose (*Ludwigia peploides*).
- Giant reed (*Arundo donax*).
- Spiny-headed mat-rush (*Lomandra longifolia*).
- Annual water pepper (*Persicaria hydropiper* c.f.).

The extent and species composition of instream aquatic macrophytes at individual sites has been variable and appears highly dependent on flow variability, with high flows scouring away river sediments, and thus associated plants, and providing new areas for colonisation following high flows (Cardno 2019). Notably, high flows appear to be the explanation for the apparent reduction in the extent of ribbonweed observed at Sites 7 and 8 in November 2016 compared with previous surveys. Since this time, including in November 2019, the extent of ribbonweed and tall spikerush has increased as these plants have colonised nearby areas of unvegetated sediment exposed following high flows.

Five species of in-stream aquatic plants (*Elodea*, *Hydrilla*, *Vallisneria Americana*, *Potamogeton sulcatus* and *Triglochin procerum*) were found across the six sites on the Nepean River surveyed by

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Bioanalysis (2009). The first three have been identified as present at one or more sites on the Nepean River by Cardno, noting that it is possible that *Valisneria* sp. was *V. Americana*. The latter two species identified by Bioanalysis (2009) are additional species. *T. procerum* was identified downstream of Site 8 at NP1_1 and NP1_2 and *P. sulcatus* between X3 and Site 1.

A species of floating pondweed, *Potamogeton* sp., was also observed in Navigation Creek within the current Study Area and in Apps Gully just downstream of the Study Area (**Section 3.2**).

Surveys of aquatic macrophytes by Bioanalysis (2009) identified *P. sulcatus* in Racecourse Creek, but did not identify any native in-stream aquatic plants on Foot Onslow Creek.



Figure 3-12 Beds of ribbonweed (*Vallisneria* sp.) at a) Site 8 and b) Site 7, c) and d) hydrilla / elodea at Sites 7 and 8 and e) and f) ribbonweed and tall spikerush (*Eleocharis sphacelata*) at Sites 1 and 2.

3.6 Macroinvertebrates

Between November 2008 and December 2024, Stantec has undertaken 16 surveys of macroinvertebrates in the Nepean River in relation to Appin Areas 7 and/or 9, with a total of 154 AUSRIVAS edge samples collected across Sites 1 to 8 and X1 to X8 (though the individual sites sampled on each occasion varied with the staging of longwall extraction) (**Appendix C**).

In total, 100 taxa were identified from the 154 samples collected. The most common taxa (occurring in $\geq 90\%$ samples) were Hydracarina (water mites), Corixidae (water boatmen), Chironominae (non-biting midge) and Leptoceridae (caddisfly). Leptoceridae and Hydracarina are somewhat pollution sensitive (IGNAL2 grade 6), while Corixidae and Chironominae are pollution tolerant (IGNAL2 grade 2 or 3). Of the 87 taxa assigned a SIGNAL2 grade, 68 were very to moderately pollution tolerant (i.e., SIGNAL2 grade 1 to 5). Fifteen pollution sensitive taxa (IGNAL2 grade 7 and above) were also recorded. These included Telephlebiidae and Corduliidae (families of dragonfly), Leptophlebiidae (a family of mayfly), Galamoceratidae (a family of caddisfly), Gripopterygiidae (a family of stonefly) and Elmidae (riffle beetles). Telephlebiidae, Leptophlebiidae, Galamoceratidae and Elmidae occurred in over a third of all samples collected, whilst Corduliidae, Synlestidae and Gripopterygiidae occurred in one sample only.

For sampling undertaken on the Nepean River between September 2003 to December 2024, the number of taxa per sample has ranged from 1 to 34 (**Appendix B**), the OE50 Taxa Score has ranged from 0.06 (Band D – extremely impaired relative to reference condition) to 1.11 (Band A – equivalent to reference condition) and the SIGNAL2 Score has ranged from 1.5 (indicative of severe water pollution) to 4.7 (indicative of moderate water pollution). The mean number of taxa per site was relatively comparable among sites, though there was a slight trend for fewer taxa at upstream sites X3 to X8 compared with most sites farther downstream (**Figure 3-13**). This likely reflects the variable habitat conditions between these sections of the Nepean River. There was also relatively little difference in mean OE50 Taxa Scores (**Figure 3-14**) and SIGNAL2 Scores (**Figure 3-15**) among sites on the Nepean River.

The aquatic macroinvertebrate fauna in this section of the Nepean River appears to have experienced some degree of environmental stress prior to, and hence independent of, mining, and continues to do so. This is evident throughout the 2003 to 2024 monitoring period, with AUSRIVAS Band Scores generally being indicative of impaired macroinvertebrate assemblages (i.e., AUSRIVAS Band B) and SIGNAL2 Indices indicative of moderate to severe water pollution. There is no evidence that any impaired aquatic habitat or water quality is due to any previous mining-related disturbance in the Nepean River. Despite this, several pollution sensitive taxa have been identified, and, on occasion, AUSRIVAS Bands were equivalent to the AUSRIVAS reference condition (i.e., AUSRIVAS Band A) and hence have been, at times, indicative of undisturbed macroinvertebrate assemblages. Due to the relatively undisturbed condition of the riparian vegetation, it is probable that poor water quality, such as low DO, and alteration to the natural flow regime of the river, may explain the somewhat depauperate condition of the macroinvertebrate fauna in this section of the river. It is possible, if not likely, that macroinvertebrate assemblages in the deeper hypoxic sections of the river are depauperate also.

Site N1 on Navigation Creek was surveyed using AUSRIVAS in April 2008 (The Ecology Lab 2008a) and December 2010 (Cardno Ecology Lab 2011b), while Sites F1 and F2 on Foot Onslow Creek were surveyed using AUSRIVAS in April 2008 (The Ecology Lab 2008a), November 2008 (The Ecology Lab 2008b) and December 2010 (Cardno Ecology Lab 2011b). The numbers of taxa (24 to 26 at

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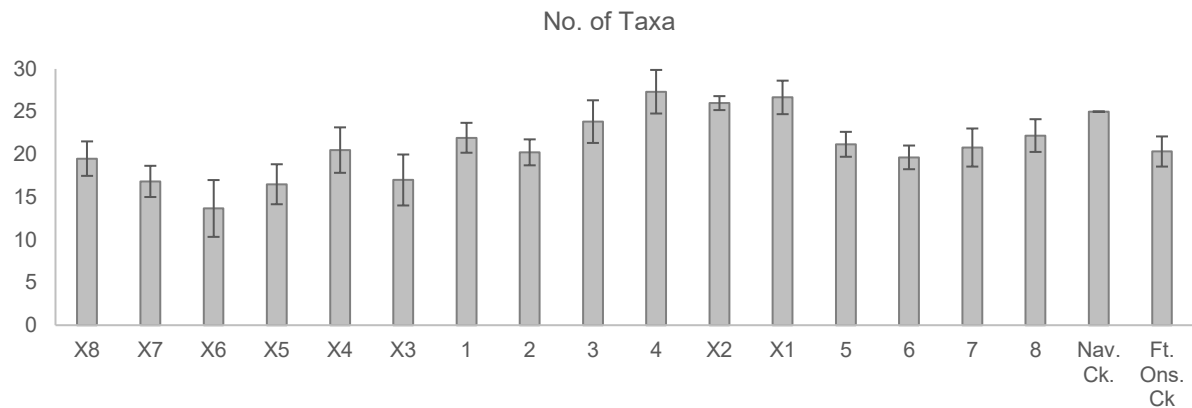


Figure 3-13 Mean (averaged across all surveys from September 2003 to December 2024 - **Appendix B**) number of taxa at each site on the Nepean River arranged from X8 upstream to Site 8 downstream and on N1 on Navigation Creek (Nav. Ck.) and F1 and F2 on Foot Onslow Creek (F1 and F2).



Figure 3-14 Mean (averaged across all surveys from September 2003 to December 2024 - **Appendix B**) OE50 Taxa Score at each site on the Nepean River arranged from X8 upstream to Site 8 downstream and on N1 on Navigation Creek (Nav. Ck.) and F1 and F2 on Foot Onslow Creek (F1 and F2).

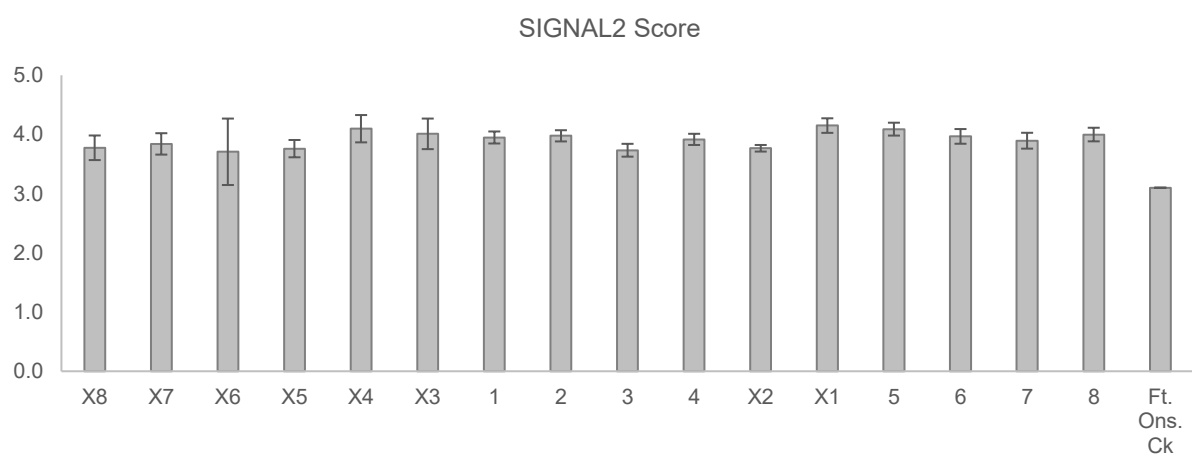


Figure 3-15 Mean (averaged across all surveys from September 2003 to December 2024 - **Appendix B**) SIGNAL2 Score at each site on the Nepean River arranged from X8 upstream to Site 8 downstream and on N1 on Navigation Creek (Nav. Ck.) and F1 and F2 on Foot Onslow Creek (F1 and F2).

Navigation Creek and 15 to 23 on Foot Onslow Creek) and SIGNAL2 Scores (3.1 on Navigation Creek and 2.9 to 4.1 on Foot Onslow Creek) were largely comparable to those on the Nepean River, with SIGNAL2 Scores indicating severe to moderate water pollution. The OE50 Taxa Scores at N1 ranged between 0.65 (significantly impaired) and 0.87 (equivalent to reference condition), indicating sometimes significant impairment of the macroinvertebrate assemblage. OE50 Taxa Scores on Foot Onslow Creek ranged from 0.66 (significantly impaired) to 1.20 (more diverse than reference condition), with the latter score greater than any recorded for the Nepean River.

AUSRIVAS surveys undertaken by Bioanalysis (2009) at the six sites on the Nepean River indicated OE50 Taxa Scores of 0.22 (Band C) to 0.76 (Band B). The OE50 Taxa Scores at the two sites on Foot Onslow Creek were 0.20 (Band C) and 0.51 (Band C), and on Racecourse Creek were 0.62 (Band C) and 0.67 (Band C). These are comparable to scores recorded by Stantec in the Nepean River, Navigation Creek and Foot Onslow Creek.

AUSRIVAS surveys undertaken in April 2025 indicated:

- Number of taxa at sites in Navigation Creek ranged from 12 to 20, and was 12 in NAVC16 and 24 in Apps Gully.
- OE50 Taxa Score ranged from 0.46 (Band C) to 0.69 (Band B) in Navigation Creek, was 0.58 (Band B) in NAVC16 and was 0.94 (Band A) in Apps Gully.
- SIGNAL2 Score ranged from 3.0 to 3.5 in Navigation Creek, was 3.0 in NAVC16 and was 3.8 in Apps Gully, with all values indicative of severe water pollution.

These results suggest that these and likely all watercourses in the Study Area have historically been, and are currently characterised by degradation to aquatic habitat and/or water quality. One possible exception is Apps Gully, where the AUSRIVAS band score suggested no degradation of aquatic habitat and water quality. Notably, however, the site in Apps Gully was located downstream of the Study Area. The full results of the April 2025 AUSRIVAS surveys are provided in **Appendix D**.

3.7 Fish

The regulated flows from the three dams in the upper reaches of the Nepean River system and the 13 weirs that have been constructed along the main channel of the river are likely to have had a major impact on the fish fauna (Baumgartner and Reynoldson 2007). These weirs are substantial barriers to the passage of fish and have probably resulted in fragmentation of populations, reduced opportunities for genetic exchange and prevented the larvae of species that migrate to the estuary/sea to spawn from making recolonising migrations (Gehrke *et al.* 2000). The recent installation of vertical slot fishways at the barriers along the river from Penrith Weir up to Douglas Park weir will enable some species to increase their upstream distribution (Rourke and Baumgartner 2011).

The current Study Area is situated adjacent to the 20 km section of the Nepean River from Menangle Weir, upstream to Douglas Park Weir and Maldon Weir, and is therefore likely to show an increase in fish diversity now that species in a large section of the downstream reach of the river are able to move upstream via the fishways. Douglas Park weir would be submerged during some high flow conditions. The movement of fish further upstream in the Nepean River is restricted by the 15 m high x 40 m wide fixed-crest weir at Maldon, which restricts fish passage during all flow conditions due to excessive head loss and by Pheasants Nest Weir (Mallen-Cooper and Smith 2005; NSW DPI 2006a). Maldon Weir is the upstream limit of migration for Australian bass and other species that require estuarine areas to spawn (Sammut and Erskine 1995).

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Ten species of fish have been caught using bait traps and backpack electrofishing across Sites 1 to 8 and X1 to X8 on the Nepean River (**Table 3-1**). Ornamental carp (*Cyprinus carpio*) have also been observed in the Nepean River but not caught via sampling.

Table 3-1 Fish species caught by bait trapping and / backpack electrofishing in the Nepean River during the aquatic ecology monitoring undertaken for the Appin Area 7 and 9 Longwalls from September 2003 to December 2024. Yellow shading indicates where species was caught only in upstream reaches of Nepean River at Sites X3 to X8. Grey shading indicates non-native species.

Scientific Name	Common Name	Sep 03	Apr 08	Nov 08	Dec 10	Dec 11	Dec 12	Dec 13	Dec 14	Nov 15	Nov 16	Nov 17	Nov 18	Nov 19	Dec 20	Dec 21	Dec 22	Dec 23	Dec 24
<i>Philypnodon grandiceps</i>	Flathead gudgeon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
<i>Hypseleotris</i> sp.	Carp gudgeon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
<i>Philypnodon macrostomus</i>	Dwarf flathead gudgeon	X		X	X	X	X	X				X		X	X	X		X	
<i>Gambusia holbrooki</i>	Eastern gambusia		X		X			X	X			X	X	X	X	X	X	X	X
<i>Retropinna semoni</i>	Australian smelt		X		X	X	X	X	X	X		X							X
<i>Tandanus tandanus</i>	Freshwater catfish					X	X											X	
<i>Hypseleotris compressa</i>	Empire gudgeon			X															
<i>Gobiomorphus coxii</i>	Cox's gudgeon														X				
<i>Macquaria novemaculeata</i>	Australian bass								X										
<i>Anguilla reinhardtii</i>	Longfinned eel								X	X		X							

Most recently in 2024, three species were identified, native carp gudgeon (*Hypseleotris* sp.), Australian smelt (*Retropinna semoni*) and non-native eastern gambusia (*Gambusia holbrooki*). The species composition of fish recorded in 2024 was comparable to those recorded in previous years.

Australian bass (*Macquaria novemaculeata*), which was recorded at Site X8 in 2014 (Cardno Ecology Lab 2015), has not been caught since. Though it is noted that accumulations of debris following the high flows that occurred prior to the 2017 survey have limited access to where Australian bass were caught previously, just downstream of Maldon Weir. Fewer Cox's gudgeons were recorded in 2017 than in 2014, but this was apparent across all sites. Australian smelt (*Retropinna semoni*) were previously recorded in most surveys done to 2017, while longfinned eel (*Anguilla reinhardtii*) were caught only in 2014, 2015 and 2017. They tended to be caught in relatively low abundance and at a few sites, and there is no suggestion their occurrence or abundance has been affected by mining. No fish have been caught in any of the bait traps deployed at Appin Area 9 Sites X3 to X8 during any survey. Freshwater prawns (Genus: *Macrobrachium*) also occur in this section of the Nepean River (Cardno Ecology Lab 2011).

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Fish surveys were also undertaken in April 2008 at N1 on Navigation Creek (and two of its tributaries including Tributary 1) and in Foot Onslow Creek by The Ecology Lab (2008a). No fish were caught using backpack electrofishing in Navigation Creek or its tributaries, though several hundred eastern gambusia were caught in AUSRIVAS dip nets. Eastern gambusia are likely to be widespread through tributaries in the Study Area.

Bioanalysis (2009) recorded eight species of fish (Longfinned eel, striped gudgeon – *Gobiomorphus australis*, eastern gambusia, Australian smelt, flathead gudgeon, Australian bass, dwarf flathead gudgeon and freshwater catfish), across the 6 sites on the Nepean River using backpack electrofishing, and two species (Australian smelt and flathead gudgeon) using bait traps. All of these, except striped gudgeon (one individual which was caught at NP1_1), have been caught on the Nepean River by Cardno previously. Striped gudgeon, eastern gambusia and ornamental carp were caught in Racecourse Creek.

The surveys undertaken by Stantec adjacent to Appin Areas 7 & 9 were based on a combination of backpack electrofishing, baited traps and dip netting and were consequently limited to relatively shallow (< 1 m in depth) areas. Goldfish (*Carrasius auratus*) and ornamental carp, as well as Cox's gudgeon, longfinned eel, freshwater eel, flathead gudgeon, firetail gudgeon and Australian bass, were recorded during a boat-based electrofishing survey of the sections of the river upstream of the Douglas Park and Menangle weirs (Baumgartner and Reynoldson 2007). Several species of fish including striped gudgeon, sea mullet (*Mugil cephalus*), freshwater mullet (*Myxus petardi*), bullrout (*Notesthes robusta*) and freshwater herring (*Potamalosa richmondia*), which have been recorded further downstream in the section of the Nepean River upstream of Penrith Weir (Baumgartner and Reynoldson (2007), could potentially colonise the Study Area now that fishways have been installed on the intervening weirs. There is evidence that some species have already increased their distribution in the Nepean River (Rourke and Baumgartner 2011).

Backpack electrofishing surveys undertaken by Stantec in April 2025 identified eastern gambusia and yabby in Navigation Creek, NAVC16 and Apps Gully, carp gudgeon in Navigation Creek and NAVC16, freshwater eel in Navigation Creek and yabby in Navigation Creek, NAVC16 and Apps Gully (**Table 3-2**).

Table 3-2 Fish species caught by backpack electrofishing by Stantec in watercourses within and adjacent to the Study Area in April 2025. Grey shading indicates non-native species.

Common Name	Scientific Name	Navigation Creek NAV1	Navigation Creek NAV2	Navigation Creek NAV_S50	NAVC16 NAVC16_S1	Apps Gully AG_S10
Eastern Gambusia	<i>Gambusia holbrooki</i>	4		100	2	50
Carp gudgeon	<i>Hypseleotris</i> sp.	9			4	
Freshwater eel	<i>Anguilla</i> sp.	1				
Yabby	<i>Cherax destructor</i>	2			10	2

3.8 Listed Threatened Species, Populations and Ecological Communities

3.8.1 Information Sources

A search for information on records and distributions of threatened (or endangered) species, populations and ecological communities listed under the FM Act, EPBC Act and BC Act in the Nepean

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River catchment within the Study Area was undertaken to update searches completed for previous assessments for Appin Areas 7 & 9 (The Ecology Lab 2008a; Cardno Ecology Lab 2011). The search used the following resources:

- The DCCEE Protected Matters Search Tool (PMST) (DCCEE 2024) for Matters of National Environmental Significance (MNES) listed under schedules of the EPBC Act that occurred within a 10 km radius from the centre of the Study Area.
- The DPE managed BioNet searched for records of BC Act listed flora and fauna within the Sydney – Cataract sub-region held in the Atlas of NSW Wildlife. The Atlas of Living Australia (ALA 2025) was also searched for records of species of fish (including invertebrates and vertebrates) listed under the FM Act occurring in the catchments of Lake Cordeaux and Wongawilli Creek.
- Species distribution maps contained in the NSW DPI Fish Communities and Threatened Species Distributions of NSW (NSW DPI 2016a) for the occurrence of threatened species listed under the FM Act in the upper catchments of Cordeaux River and Avon River.

The desktop search indicated several species that occur, or have potential to occur, in the Study Area. Amphibians, aquatic mammals and reptiles are being considered by other specialists and were excluded from the search. None of the aquatic plants listed under the BC Act were identified in the Nepean Catchment. Species of threatened fish and invertebrates listed under the FM Act and/or EPBC Act with records in the Study Area or surrounding catchments are identified in **Sections 3.8.2 to 3.8.7**.

3.8.2 Macquarie Perch

Macquarie perch (*Macquaria australasica*) is listed as endangered under the EPBC Act and the FM Act. The PMST indicated this species or its habitat may occur in the search area. Records from the Australian Museum indicate that Macquarie perch were present in the upper Nepean River between 1894 and 1905. Recent records indicate that Macquarie perch occurs in the Nepean River upstream and downstream of Pheasant's Nest Weir (Baumgartner and Reynoldson 2007), including a 2005 record from the Cordeaux River at the confluence with the Nepean River. This structure was previously believed to block the downstream passage of this species (Gehrke *et al.* 1996). The presence of this weir and another significant barrier to fish passage further downstream at Maldon Weir, and absence of any recent records from the downstream reaches of the Nepean River and its tributaries as far as Glenbrook Creek near Glenbrook (in 2012) (ALA 2025), suggests that it is unlikely that the Nepean River adjacent to the Study Area supports a population of Macquarie perch. This section of the Nepean River from around Site 5 upstream to Buxton (upstream of X8) is mapped as providing suitable habitat for Macquarie perch (NSW DPI 2016a). There are no records of Macquarie perch from tributaries within the Study Area, nor would this species be expected to occur here due to the unsuitable and degraded habitat provided by these tributaries.

Macquarie perch prefer clear water and deep, rocky holes with extensive cover in the form of aquatic vegetation, large boulders, debris and overhanging banks (NSW DPI 2016b). They spawn in spring or summer and lay their eggs over stones and gravel in shallow, fast-flowing upland streams or flowing parts of rivers. Macquarie perch is an active predator of macroinvertebrates. While other large-bodied percichthyids are generally higher-order ambush predators that may have limited range, the Macquarie perch tends to have a relatively larger linear (along shore) diel range (Ebner *et al.* 2010). A study in a Canberra reservoir found that Macquarie perch have a mean linear diel range of 516 m ($\pm$ 89 S.E.), which suggests that discontinuous and small pools would not provide suitable habitat for this species (Ebner *et al.* 2010).

The National Recovery Plan for Macquarie perch (DEE 2018) contains background information on the biology, ecology, distribution and populations, decline and threats and recovery objectives and strategies and associated actions for this species. Identified threats include:

- Habitat degradation.
- Alien (non-native) fish.
- Barriers to fish movement.
- Altered flow and thermal regimes.
- Disease.
- Illegal / incidental capture.
- Chemical water pollution.
- Climate change.

Recovery Strategies include the following:

- Conserve existing Macquarie perch populations.
- Protect and restore Macquarie perch habitat.
- Investigate threats to Macquarie perch populations and habitats.
- Establish additional Macquarie perch populations.
- Improve understanding of the biology and ecology of the Macquarie perch and its distribution and abundance.
- Increase participation by community groups in Macquarie perch conservation.

Actions directly applicable to the Project include the provision of advice on the distribution of Macquarie perch to determining authorities to ensure appropriate consideration during development assessment processes, and the undertaking of targeted surveys to determine the current distribution and abundance of Macquarie perch.

3.8.3 Australian Grayling

Australian grayling is listed as a vulnerable species under the EPBC Act and is a protected species under the FM Act. The PMST indicated this species or its habitat may occur in the search area. It occurs in coastal streams and rivers on the eastern and southern flanks of the Great Dividing Range from Sydney southwards to the Otway Ranges in Victoria, and Tasmania (NSW DPI 2006). Australian grayling has been recorded in the Grose River, but there are no records of this species from the upper Nepean Catchment. They have also been recorded in estuarine areas. The life cycle of Australian grayling is dependent upon migration to and from the sea (McDowall 1996). Spawning occurs in late summer or autumn and larvae are swept downstream to the sea (NSW DPI 2006b). Juvenile fish return to freshwater when they are about six months old and remain in rivers and streams for the rest of their life. Australian Grayling has undergone a considerable decline in its distribution and abundance and, although it was historically present in the Hawkesbury-Nepean, it is now restricted to the coastal rivers of southern NSW (Morris *et al.* 2001; NSW DPI 2016a). The decline of this species has been attributed to dams, weirs and culverts preventing it from migrating to and from the sea and completing its life cycle. As Australian grayling is highly unlikely to occur within the Study Area, further consideration of this species is not considered necessary.

3.8.4 Murray Cod

Murray cod is listed as vulnerable under the EPBC Act. It was formerly widespread and abundant in the lower and mid-altitude reaches of the Murray-Darling Basin. It now has a patchy distribution and abundance across its historic range (MDBA 2011a). There are records of this species upstream of the Study Area in Cataract Creek (2010) and Cataract River (2019) (ALA 2025). It is found in diverse habitats including flowing and standing waters of small, clear, rocky streams on the inland slopes and uplands of the Great Dividing Range, and large, turbid, meandering slow-flowing rivers, creeks, anabranches, and lakes and larger billabongs of the inland plains of the Murray Darling Basin (National Murray Cod Recovery Team 2010). Murray cod are usually found in association with large rocks, large snags and smaller structural woody habitat, undercut banks and over-hanging vegetation, but also frequent the main river channel and larger tributaries and anabranches. Commercial fisheries data indicate that natural populations declined in the 1920s and then again dramatically in the 1950s. Murray cod form breeding pairs prior to spawning and a spawning site or nest is selected, usually a sunken log in lowland rivers, or a submerged rock in upland streams. Murray cod have been recorded excavating and laying eggs in depressions in clay banks as well.

Both hatchery-bred and wild-caught individuals have been translocated and stocked within and outside the natural distribution range. It has been selectively stocked in river systems in NSW, Victoria and Western Australia, but has generally failed to establish itself in those areas.

Threats to Murray cod include habitat removal, modification and degradation, barriers to movement, altered river flow regimes and reduced water quality.

3.8.5 Trout Cod

Trout cod, listed as endangered under the FM Act and the EPBC Act, is usually associated with deeper pools and instream cover such as logs and boulders. Trout cod was described originally from the Macquarie River, but there are now only three self-sustaining populations of Trout cod remaining in the wild (MDBA 2011b). The largest is in the Murray River between Yarrawonga and Barmah (approximately 200 km of river). The other populations are small, translocated populations present in Lake Cataract (upstream of the Study Area, and in about 15 km of the upper reaches of Sevens Creek near Euroa in Vic. There are records of this species from the 1980s in the Georges River and Lake Cataract (ALA 2025). This species has been reintroduced to several rivers in the Murray-Darling Basin as part of a long-term stocking program that began in the late 1980s. Unfortunately, these reintroductions have not resulted in the establishment of viable populations (MDBA 2011a). The Nepean River and its tributaries have not been mapped as providing suitable habitat (NSW DPI 2016a) and it is very unlikely to occur here.

3.8.6 Sydney Hawk Dragonfly

The Sydney hawk dragonfly (*Austrocordulia leonardi*) is listed as endangered under the FM Act and EPBC Act. The PMST indicated this species or its habitat may occur in the search area. It is extremely rare, having been collected in small numbers at only a few locations in a small area to the south of Sydney, between Audley and Picton (NSW FSC 2004). The species is also known from the Hawkesbury-Nepean, Georges River and Port Hacking drainages. It was discovered in 1968 from Woronora River and Kangaroo Creek, south of Sydney, and has subsequently been found in the Nepean River at Maldon Bridge (seven records from 1979 to 1980 in the vicinity of Sites X7 and X8) near Picton and further upstream near Lake Nepean (one record from 1979) (ALA 2025). It has been recorded from the Nepean River at Maldon Bridge near Wilton in the 1990s and from both the Maldon

Bridge site and another site 23 km downstream near Menangle Weir subsequent to this (FSC 2020). Extensive sampling has failed to discover further specimens in other areas suggesting that it has a highly restricted distribution within the catchment of the Nepean River (NSW DPI 2007). This species has not been found in AUSRIVAS samples collected by Cardno from any sites on the Nepean River nor was it caught by Bioanalysis (2009). Suitable habitat for this species is predicted to occur in the Nepean River and Stonequarry Creek adjacent to the Study Area, but not in tributaries within the Study Area (NSW DPI 2016a).

Most of the lifecycle of this species is spent as an aquatic larva, with adults living for only a few weeks. The larvae appear to have specific habitat requirements, being found under rocks in deep, cool, shady pools (NSW DPI 2007), and including slow-flowing water in rocky rivers with steep sides that provide shady resting areas. Relative environmental stability appears to be an important habitat feature, with rapid variation in water level and flow rate likely to have a negative effect on the suitability of habitat for larvae. It would therefore be considered unlikely to occur in the degraded and ephemeral tributaries within the Study Area.

No Recovery and Threat Abatement Plans exist for this species. Several conservation and recovery actions for Sydney hawk dragonfly are included in NSW DPI (2007):

- Allocate and manage environmental water through water sharing planning processes, to lessen the impacts of altered flows.
- Prevent sedimentation and poor water quality by using conservation farming and grazing practices, conserve and restore riparian (riverbank) vegetation and use effective erosion and sediment control measures.
- Rehabilitate degraded habitats. Protect riparian vegetation and encourage the use of effective sediment control measures in catchments where the dragonfly may occur.
- Protect the few remaining sites with the potential to support the species, and address key threats such as habitat degradation and water quality decline.
- Conduct further research into the species' biology, ecology and distribution.
- Implement the Protected, Threatened and Pest Species Sighting Program and report any sightings to NSW DPIRD.

FSC (2020) includes several management and research actions that will benefit the conservation of the species:

- Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on Sydney hawk dragonfly habitats and water quality.
- Undertake work to identify, restore and protect known and potential Sydney hawk dragonfly habitats and address key threats such as habitat degradation and water quality declines from expanding development.
- Undertake priority rehabilitation, restoration and enhancement work at key sites known to support Sydney hawk dragonfly (noting that weir removal as part of broader riverine habitat rehabilitation works may be detrimental to the species).
- Protect the few remaining sites with the potential to support the species, and address key threats such as habitat degradation and water quality decline.
- Conduct further research into the biology, ecology and distribution of the species.
- eDNA may offer the most cost-effective means of establishing the distribution of the species. This would require a trial to demonstrate effectiveness of eDNA and subsequent widespread survey within streams within suitable riverine pools.

3.8.7 Adam's Emerald Dragonfly

Adam's emerald dragonfly (*Archaeophya Adam'si*) is listed as endangered under the FM Act. It is extremely rare, having been collected only in small numbers at a few locations in the greater Sydney region (NSW DPI 2013b). Specimens have been collected at five localities: Somersby Falls and Floods Creek in Brisbane Waters National Park near Gosford; Berowra Creek near Berowra and Hornsby; Bedford Creek in the Lower Blue Mountains; and Hungry Way Creek in Wollemi National Park. There are no records for this species within the Study Area or the Cordeaux and Lake Avon catchments (ALA 2025). There are no records of Adam's emerald dragonfly occurring south of Sydney, despite active collecting in the Hawkesbury-Nepean River catchment (NSW FSC 2008). This species was not collected by Stantec nor was it caught by Bioanalysis (2009), but aquatic habitat that appears suitable for this species does occur in the upper section of the Nepean River from around X8 to X3, but not in tributaries within the Study Area. The larvae of Adam's emerald dragonfly have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms (NSW DPI 2013b). The larvae live for approximately seven years before metamorphosing into adults that probably live for only a few months. They are thought to have a low natural rate of recruitment and limited dispersal abilities.

No Recovery and Threat Abatement Plans exist for this species. Conservation and recovery actions (NSW DPI 2007) for Adam's emerald dragonfly include the following:

- Rehabilitate degraded habitats. Protect riparian vegetation and encourage the use of effective erosion and sediment control measures in catchments where the dragonfly may occur.
- Protect the few remaining sites that still support the species, and address key threats such as habitat degradation and water quality decline from expanding development.
- Conduct further research into the biology and distribution of the species.
- Report any sightings to NSW DPIRD.

3.8.8 Likelihood of Occurrence

Table 3-3 summarised the likelihood of occurrence of Listed Threatened Species in the Study Area. Although there are records of Macquarie perch, trout cod, Murray cod and Sydney hawk dragonfly in the Nepean River adjacent to the Study Area or in upstream connected waterbodies, there are none from tributaries within the Study Area. This is not unexpected given the unsuitable habitat provided by these drainage lines. There are no records of Adam's emerald dragonfly within or adjacent to the Study Area and Australian grayling occurs only in coastal rivers of southern NSW outside of the Study Area. As such, and given no significant physical or water quality impacts from mining are expected in the Nepean River, formal Assessments of Significance were not considered necessary for any of these species.

3.8.9 Critical Habitat

The Study Area does not contain any critical habitats listed under the FM Act, BC Act or EPBC Act.

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Table 3-3 Likelihood of Occurrence of FM Act and/or EPBC Act Listed Threatened Aquatic Species in the Study Area.

Species and Listing	Likelihood of Occurrence
Macquarie perch (endangered under FM Act and EPBC Act)	Not expected to occur in the Study Area due to the limited aquatic habitat provided by largely degraded ephemeral first, second and third order drainage lines present here. Occurs in the Nepean River upstream of Maldon Weir with recent records upstream and downstream of Pheasants Nest Weir (approximately 10 km upstream). Considered unlikely to occur in the Nepean River downstream of Maldon Weir and adjacent to the Study Area, though suitable habitat is mapped as occurring downstream of Maldon Weir to Site 5 (NSW DPI 2016a).
Australian grayling (endangered under FM Act and vulnerable under EPBC Act)	Does not occur in tributaries the Study Area. Present in coastal rivers of southern NSW outside of the Study Area.
Murray cod	Does not occur in tributaries the Study Area. The nearest records of this species are upstream of the Study Area in Cataract Creek and Cataract River.
Trout cod	Does not occur in the Study Area. There are records of this species from the 1980s in the Georges River and Lake Cataract.
Adam's emerald dragonfly (endangered under FM Act)	Not expected to occur in tributaries within the Study Area. No records within, or adjacent to the Study Area despite extensive sampling, though suitable microhabitat appears to exist adjacent to the Study Area in the Nepean River.
Sydney hawk dragonfly (endangered under FM Act and EPBC Act)	Not expected to occur in tributaries within the Study Area. The only records of this species are from the Nepean River upstream of the Study Area near Sites X7 and X8 and further upstream near Nepean Dam. Not caught in the AUSRIVAS samples collected from X7 and X8 (or from any other site on the Nepean River) by Cardno or from nearby by Bioanalysis (2009).

3.9 Observed Mining Impacts

There has been limited evidence of subsidence related physical and water quality impacts in the Nepean River due to extraction of Appin Area 7 Longwalls 701 to 704 and 705 to 709, commencement of extraction of Longwall 710 and Appin Area 9 Longwalls 901 to 905. Surface monitoring undertaken during and following the extraction of Longwalls 701 to 704 identified several gas releases in the Nepean River adjacent to Sites 3 and 4 (impact sites for Longwalls 701 to 704) and X1 and X2 (impact sites for Longwalls 702 to 704). In total, approximately 50 gas release zones have been observed by IMCEFT during extraction in Appin Areas 7 and 9. No fracturing, changes in water levels and flow or changes in water quality were observed in the Nepean River following extraction of these longwalls. Some minor iron staining following gas releases associated with Longwall 701 was observed (BHPBIC 2008a and b).

There was no evidence that gas releases and iron staining, or any other potential mining impact, has had any adverse effects on aquatic habitat and biota (Stantec 2025a, b). The changes in a biotic index of aquatic habitat and/or quality (OE50 Taxa Score) at one of the monitoring sites in 2011 more likely represented natural variation, rather than any potential impact due to mining (Cardno Ecology Lab 2012a). While marked changes in the distribution, extent and composition of macrophyte beds have been observed after the commencement of extraction, similar changes were apparent before extraction (Cardno Ecology Lab 2011a). Changes in macrophytes were attributed to localised differences in the depth of the water column, aspect of the site relative to the sun, suitability of the substratum for attachment, shading effects from vegetation on the banks, water flow, water transparency and availability of nutrients, rather than any effect due to mining.

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Similarly, several gas releases were identified in the Nepean River during extraction of Longwalls 705 to 708A, though no fracturing, changes in water levels and flow or changes in water quality were observed during or following extraction (Cardno 2020 and references therein). No fracturing, ponding, flooding or desiccation was observed in the monitored tributaries of the Nepean River. No loss or diversions of flow or impacts on water quality were observed in the Nepean River during extraction of these longwalls.

No changes in aquatic ecology indicators that could be associated with extraction of Longwalls 705, 706, 707A, 707B, 708 and 709 were identified (Cardno 2020; Stantec 2024, 2025a). In November 2016, high flows that occurred in the river since the previous survey in 2015 appeared to have a substantial effect on the extent of aquatic macrophytes (Cardno 2017). Despite this, the species composition of macrophytes has been relatively consistent and the number and type of species identified in November 2016 were very similar to those identified previously. There were also no observed impacts on indicators of aquatic ecology (number of taxa and biotic indices derived from macroinvertebrate sampling, fish and macrophytes) monitored in November 2017 to December 2024 that could be attributed to extraction of these longwalls (Cardno 2018a, 2019 and 2020, Stantec 2025a, 2025b).

In Appin Area 9, approximately 30 gas release zones were identified in an approximate 2 km section of the Nepean River located just downstream of Impact Sites X3 and X4. No fracturing was observed in the Nepean River during extraction of Longwall 901, though the flooded valley and sediment profile limits observations of some sections of the riverbed. There was also no observed ponding, flooding, changes in stream alignment or any surface water flow diversions. Monthly monitoring by ICHPL indicated a decline in pool water levels at site NR0 (on the Nepean River just west of Longwall 901 and adjacent to aquatic ecology monitoring sites X3 and X4) relative to baseline levels; however, due to the limited water level data the cause for these changes was uncertain (Hgeo 2018). Changes in EC at some monitoring sites were identified; however, these were upstream of Longwall 901 and therefore not attributed to mining (Hgeo 2018).

Assessment of changes in water levels and water quality undertaken by Hgeo (2019) for Longwall 902 indicated a 0.43 m decrease in water level at Site NR0 (adjacent to aquatic ecology monitoring Site X3) below the baseline level that occurred throughout the reporting period of Longwalls 901 and 902. An increase in EC (greater than two standard deviations for two consecutive months) was observed at Sites NR0 and SW3 (also known as NR1) (adjacent to Site X3), and NR2 (adjacent to Sites 1 and 2). A decrease in pH (between one and two standard deviations for two consecutive months) occurred at Sites NR0 and NR1 during the reporting period. Water quality triggers associated with these changes occurred between May 2018 and March 2019. However, these changes appeared to be short-term and surface water quality in the Nepean River has since returned to baseline levels. Similar changes were also observed at upstream reference sites during this period. Changes in DO or the concentration of iron were not observed. A change in concentration of magnesium was identified; however, it was not attributed to mining (Hgeo 2019). There was a single water quality trigger at site NR1 during extraction of Longwall 903. Similar changes were observed at the control site upstream on the Nepean River. There was no indication of any associated impacts on aquatic ecology during the November 2017 to December 2023 surveys undertaken as part of the monitoring for Appin Area 9 Longwalls (Cardno 2018; 2020; Stantec 2025a).

Longwall 708 was the first longwall to be extracted beneath the third order section of Foot Onslow Creek during April 2019 to January 2022, followed by extraction of Longwall 709 during February 2022 to October 2023, and commencement of extraction of Longwall 710 in November 2023. No physical impacts on Foot Onslow Creek have been identified associated with extraction of these longwalls. Previous physical impacts on tributaries of the Nepean River due to longwall extraction

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have included gas releases in Ousedale Creek during extraction of Longwall 708 and in Elladale Creek and Ousedale Creek during extraction of Longwall 709. No fracturing or flow diversions have been observed in tributaries directly above Longwalls 701 to 710A and 901 to 905 (MSEC 2025).

4 Impact Assessment

4.1 Subsidence Predictions

The extraction of coal from the proposed longwalls may result in vertical and horizontal movements of the rock and soil mass above the extracted coal seam. These ground movements, referred to as subsidence, may affect natural features on and below the land surface (MSEC 2025). Subsidence that occurs under watercourses may cause fracturing of the streambed and banks, movements of joint and bedding planes in the streambed, and uplift and buckling of strata in the streambed. These physical impacts can cause diversions of surface and sub-surface flows, drainage of pools and increases in groundwater inflows. These changes, in turn, may have adverse effects on aquatic flora and fauna in the watercourses by facilitating loss of aquatic habitat, desiccation of fringing vegetation, reductions in longitudinal connectivity and deterioration of water quality. Ground movements can also lead to tilting of streambeds that can, in turn, lead to erosion of the streambed and banks, increased instream sediment load, and changes in flow rates and migration of stream channels. Subsidence may also allow the release of gas from sub-surface strata that could reduce water quality and, in some cases, lead to dieback of riparian vegetation. Mining does not occur beneath the Nepean River, thus, fracturing and flow diversions are not expected.

The subsidence-related physical impacts predicted to occur in watercourses in the Study Area and in the Nepean River by MSEC (2025) are summarised as follows:

- The Nepean River is located a minimum distance of 2.2 km from the longwalls. The predicted subsidence effects are less than 5 mm vertical subsidence, less than 5 mm upsidence and less than 5 mm closure. It is unlikely that the Nepean River would experience adverse physical impacts due to the mining-induced movements associated with Longwalls 712 to 716. Reactivation of existing gas release zones or new gas release zones could develop in the Nepean River due to the mining of the proposed longwalls.
- Maximum predicted subsidence for Navigation Creek, Navigation Creek Tributaries NavC14.5, NavC16, NavC17, NavC20, Apps Gully and Foot Onslow Creek ranges from 50 mm to 1,450 mm. The predicted mining-induced tilts are generally less than the average existing gradients of the creeks (1 in 200 to 1 in 3). It is unlikely, therefore, that there would be large-scale adverse changes in the levels of ponding or scouring of the banks along the creeks and tributaries within the Study Area due to the mining-induced tilt. It is possible that localised increases in ponding could develop in some isolated locations, such as where the existing grades are small, and upstream of the chain pillars and the edges of the mining area.
- Fracturing is expected to occur where the creeks and tributaries are located directly above the mining area. Impacts can also occur outside the mining area, with minor and isolated fracturing occurring at distances up to approximately 400 m outside the longwalls, as previously observed at Appin Mine and elsewhere in the Southern Coalfield.
- Surface water flow diversions could occur along the creeks and tributaries that are located directly above the mining area. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds. Most sections of the creeks and tributaries within the Study Area are ephemeral and, therefore, surface water flows only occur during and for short periods after rain events.

4.2 Impacts on Aquatic Habitat and Biota

4.2.1 Nepean River

No fracturing is predicted to occur in the Nepean River, thus there would be no reductions in the availability and connectivity of aquatic habitat. Longwall extraction is not anticipated to have any significant impacts on surface water quality as a result of mining the proposed longwalls (Hgeo 2025).

Previous mining experience within the area indicates a low likelihood ferruginous springs. In the unlikely event ferruginous springs were to occur the effects are anticipated to be localised and minor (Hgeo 2025).

Reactivation of previous gas release zones or development of new gas release zones may occur due to longwall extraction though any associated impacts on water quality would be negligible (Hgeo 2025).. No impacts on aquatic biota have been observed in the Nepean River associated with gas releases observed during extraction of previous Appin Area 7 and 9 longwalls (Stantec 2025a and references therein). Similarly, no impacts on aquatic habitat and biota have been observed associated with the relatively minor changes in water levels and water quality that occurred during extraction of Appin Area 9 Longwalls 901 and 905 (**Section 3.9**).

Longwall extraction is expected to result in negligible groundwater drawdown in alluvial aquifers and there would be negligible flow loss from tributaries and the Nepean River (Hgeo 2025).

Overall, based on predictions of subsidence, changes to water quality and observations from previous aquatic ecology monitoring in the Nepean River, impacts on aquatic habitat and biota are not expected to occur in the Nepean River due to extraction of Longwalls 712 to 716.

4.2.2 Tributaries

Localised and minor changes in habitat availability and connectivity may occur along the first, second, third and fourth order tributaries within the Study Area due to tilt, but these effects will be difficult to detect due the high variability in natural flows within these ephemeral watercourses. The impacts resulting from the changes in surface water flows are expected to be small in comparison with those that occur during natural flooding conditions. Consequently, impacts on aquatic habitat and biota due to tilt, if any, are expected to be minor and localised in tributaries located directly above and within 400 m of the proposed longwalls.

Fracturing and flow diversions could occur in watercourses directly above and up to 400 m away from the proposed longwalls. In total, approximately 5 km of third-and-greater order drainage line habitat is located directly above the longwalls and 10 km is located within 400 m. A total of approximately 25 km of first and second order watercourses is located directly above or within 400 m of the proposed longwalls. This may result in the draining of pools in these watercourses, particularly during low flows, resulting in a reduction in the availability of aquatic habitat and the connectivity of remaining habitat. This would be expected to result in associated decreases in the population sizes of aquatic biota.

Foot Onslow Creek is not located within 400 m of the longwalls and direct physical impacts associated with extraction of Longwalls 712 and 716 would not be expected to occur. Indirect impacts on aquatic habitat and biota in Foot Onslow Creek due to loss surface flow associated with potential fracturing and flow diversions in the few upstream first and second order tributaries within the Study Area are expected to be negligible. Similarly, only a very small third-order section of Apps Gully is located within the far western extent the 400 m boundary, and it would be relatively unlikely that direct

physical impacts due to longwall extraction in this section would occur. Potential indirect impacts on aquatic habitat and biota in Apps Gully due to fracturing and flow diversion in upstream first and second order would also be unlikely.

The aquatic biota within these watercourses consists of a mixture of native flora (e.g., *Ottelia sp.*, a floating aquatic macrophyte), a number of aquatic macroinvertebrates, and native (e.g., carp gudgeon and freshwater eels) and non-native (e.g., eastern gambusia) fish species. Overall, aquatic habitat within these watercourses is degraded due to historic vegetation clearing and current land use practices. It is noted, however, that these watercourses provide habitat for some native, albeit relatively widespread and common species of fish such as longfinned eels and species of gudgeons such as flathead gudgeon and carp gudgeon. Impacts on the local population size of these and other native aquatic species attributable to direct physical impacts in watercourses from mining could be expected, and could be significant at the scale of individual pools and possibly individual watercourses. However, given the natural ephemeral nature of these watercourses and pools (albeit water would provide some refuge for several weeks and potential months depending on weather conditions), the predicted localised reductions in habitat availability and connectivity, and the abundance of such habitat in the Nepean River Catchment, impacts on population size are expected to be small at wider scales.

Further, no fracturing and flow diversions in tributaries overlying Longwalls extracted from Appin Areas 7 and 9 have been observed during monitoring undertaken by ICHPL (MSEC 2025). It is possible that the relatively deep soil profile that overlies the sandstone rock (compared with the shallow soil profile and often exposed sandstone outcrops in the Dendrobium Mine Area) obscures any fractures and limits any associated flow diversions. Given these observations, it is possible that flow diversions resulting in reductions in the availability of aquatic habitat may not occur during extraction of Longwalls 712 to 716.

Longwall extraction is not anticipated to have any significant impacts on surface water quality as a result of mining the proposed longwalls (Hgeo 2025). Longwall extraction is not predicted to result in groundwater drawdown in alluvial aquifers (Hgeo 2025) and no loss of water in tributaries is expected due to any groundwater drawdown.

Given the current disturbed nature of riparian vegetation along tributaries, it is unlikely that any reduction in flow and water availability here would have any significant impact on this vegetation.

Although impacts at the scale of individual pools and tributaries could be significant, considering the scale of the Nepean River catchment and the abundance of comparable first, second, third and fourth order watercourse habitat in the local area, such impacts represent a minor impact on aquatic habitat and biota at the broader scales. The aquatic habitat provided by these watercourses is also relatively degraded due to historic land clearing and agricultural land-use. These watercourses consist of disconnected pools the majority of the time during natural conditions. Thus, there would be no substantial change to the nature of these watercourses (i.e., they are largely disconnected pools prior to and irrespective of any potential mining-related physical impacts).

4.2.3 Key Fish Habitat

Impacts on KFH would also be relatively minor. Although the lower section of Navigation Creek was identified as providing Type 1 – Highly Sensitive KFH, this was based on the identification of native aquatic plants. These plants would provide microhabitat, including cover from prey/predators and potentially a substratum for laying eggs. Other aspects of the creek, such as the generally poor quality of riparian habitat (though some is present in places), generally disconnected and ephemeral pool

habitat, silty substratum and likely generally poor water quality, would limit the value of this habitat for native fish. Thus, the potential reduction in availability and connectivity of this habitat due to fracturing and flow diversions is not expected to result in significant impacts on any native fish here and the wider catchment. Some Type 2 – Moderately Sensitive KFH in other third order drainage lines (Navigation Creek and its third order tributaries NavC16 and NavC20 to NavC14.5, Foot Onslow Creek and Apps Gully) may be lost, though again this habitat is likely to be of limited value to native fish. No impacts on Type 1 – Highly Sensitive KFH provided by the Nepean River are expected. A small section (few hundred metres) of the upper part of Apps Gully was also identified as providing Type 1 – Highly Sensitive KFH. However, this section of creek is located at the extreme western extent of the Study Area, so potential fracturing, flow diversions and loss of aquatic habitat would be relatively limited in this location.

4.2.4 Threatened Species

The potential for adverse effects on the lifecycle of threatened species depends on whether the works are likely to cause loss or degradation of habitat, reduction in water quality, limitations to their foraging activities, and/or disruption of their reproduction and recruitment. Given that there are no records of threatened species within tributaries in the Study Area, and that these watercourses do not provide suitable habitat for these species, these species are unlikely to occur here and so impacts associated with potential habitat loss or further degradation due to extraction of Longwalls 712 to 716 would not be expected occur.

4.3 Comparison with BSO Assessment

Table 4-1 compares the impacts on aquatic habitat and biota predicted using the original Part 3A Application layout (Bioanalysis 2009) with those predicted based on the current layout of Longwalls 712 to 716. Overall, the current predictions indicate impacts to aquatic habitat and biota would be comparable to or of lesser magnitude and/or extent than those predicted by Bioanalysis (2009). Impacts on aquatic habitat, riparian vegetation, macrophytes, macroinvertebrates and fish in the Nepean River are generally less likely to occur and are less severe than predicted previously. This is due to the absence of adverse physical impacts predicted to occur here due to extraction of Longwalls 712 to 716. Impacts on threatened species (i.e., determined as unlikely) are comparable, primarily because Macquarie perch and Sydney hawk dragonfly do not appear to be located within the Study Area. Predictions for tributaries are comparable, with the potential for fracturing, flow diversions and localised impacts on aquatic biota expected to occur in the BSO AEA and in the current assessment.

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Table 4-1 Potential impacts on aquatic habitat and biota described in the BSO AEA (Bioanalysis 2009) and predicted as a result of the current Extraction Plan layout for Longwalls 712 to 716.

Component of Aquatic Ecology	Impacts Predicted in the AEA prepared for the BSO EA	Potential Impacts Predicted for Longwalls 712 to 716
Nepean River		
Aquatic habitat	Nepean River – Impacts on flow and pool depth are not expected in the Douglas Park Weir pool.	Same as for BSO EA. It is considered unlikely that the Nepean River would experience adverse physical impacts due to mining-induced movements from Longwall 712 to 716.
	Some fracturing of bed rock is expected, as well as mobilisation of iron and other minerals, and transient gas emissions in the weir pool.	Fracturing not expected to occur in the Nepean River. Further gas release zones could develop due to the mining of the proposed longwalls. Any short-term and localised impact on water quality is not expected to significantly affect aquatic biota. Minor localised iron staining may occur but is unlikely to lead to changes in water quality and should not therefore affect the quality of aquatic habitat.
Riparian vegetation	Changes in the level of water in streams and gas emissions are unlikely to disturb riparian vegetation to the extent that its ecological role would be significantly adversely impacted upon.	Substantial localised gas emissions could result in localised die-back of riparian vegetation. Such impacts are considered unlikely and would be transient. No fracturing is predicted to occur in the Nepean River and no associated impacts on riparian vegetation is expected.
Aquatic macrophytes	Nepean River – limited to no detectable changes in composition or distribution.	Increases in the level of the bank or bed of the Nepean River that could reduce the wetted perimeter and lead to stranding and desiccation of aquatic vegetation along the edge of the river are not expected. Localised gas releases may lead to minor changes in the composition and extent of macrophyte beds, but these are unlikely to be detected because of the natural variability of these beds. Impacts on water quality and surface water availability, and thus associated impacts on aquatic habitat and biota, are not expected.
Aquatic macroinvertebrates	Potential impacts would be similar in scale to those observed during mining of Appin Area 7 (i.e., none detected).	Minor changes in riparian and aquatic vegetation potentially associated with localised gas releases could lead to the loss of edge habitat and reduction in the abundance of aquatic macroinvertebrates living therein. Losses would be negligible relative to the amount of habitat available within the downstream reach of the river. Impacts on water quality and surface water availability, and thus associated impacts on aquatic habitat and biota, are not expected.
Fish	Potential impacts would be similar in scale to those observed during mining of Appin Area 7 (i.e., none detected). Reductions in dissolved oxygen associated with gas emissions are likely to be short-lived and localised and unlikely to have a significant effect, because fish populations are highly mobile.	Same as for BSO EA.

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Component of Aquatic Ecology	Impacts Predicted in the AEA prepared for the BSO EA	Potential Impacts Predicted for Longwalls 712 to 716
Threatened Species	It is unlikely that a viable population of Macquarie perch is present in the section of the Nepean River adjacent to the Study Area. This is because of a lack of suitable habitat (including natural riffle habitat required for spawning and numerous barriers to fish passage from downstream. Mine-subsidence-induced impacts resulting from the Project are not predicted to lead to loss of riffle habitat or large permanent pools within watercourses that provide suitable habitat for Macquarie perch. Changes in water quality are predicted to be localised and transient. It was therefore considered unlikely that the Project would have a significant adverse effect on Macquarie perch. Likewise, impacts on Sydney hawk dragonfly (which was not located in the BSO Part 3A Application layout), were also considered unlikely.	Same as for BSO EA.
Drainage Lines (Tributaries)		
Aquatic habitat	Potential impacts in Foot Onslow Creek, Navigation Creek, and Racecourse Creek are expected to be limited to localised areas of iron staining, possibly fracturing and enhanced leakage from farm dams and pools (where present), and possible low flow diversion in areas of rock outcrop or where bedrock is covered by a thin mantle of alluvium. Short term changes in water quality could also occur.	Fracturing could occur and could result in flow diversions and localised reductions in the availability and connectivity of pool habitat. This is unlikely to have a detectable effect on the availability of aquatic habitats beyond the scale of individual pools and watercourses. Impacts on water quality are not expected.
Riparian vegetation	It is considered unlikely that changes in the level of water in streams or the emission of strata gas caused by mine subsidence within this domain would disturb riparian vegetation to the extent that its ecological role would be significantly adversely impacted.	Given the current disturbed nature of riparian vegetation along drainage lines, it is unlikely that any reduction in flow and water availability here would have any significant impact on this vegetation.
Aquatic macrophytes	Reduced water levels could lead to exposure and desiccation of macrophytes. These impacts would be short-term and localised and would not persist once water levels are restored.	The extent of native aquatic plants in these tributaries lines appears limited. Some aquatic plants may be lost if fracturing and pool drainage occurs, though this would result in only small decreases in population sizes in the wider catchment.
Aquatic macroinvertebrates	Significant adverse impacts are unlikely given that changes in water quality are expected to be short-lived and localised, and macroinvertebrates should recover quickly once water levels return. Given that changes in water quality were predicted to be localised and transient, macroinvertebrates should recover quickly once water levels return following rain events. It is considered unlikely that populations in drainage lines would be significantly affected. Moreover, any potential impacts affecting these areas would be hard to discern, should they occur, because of the degraded nature of the existing aquatic habitat in this area.	Fracturing and flow diversions could occur and could be associated with reductions in the availability and connectivity of aquatic habitat. An impact on the local population size of these and other native aquatic species could be expected. This could be significant at the scale of individual pools and possibly individual watercourses. However, given the largely disconnected pool habitat provided by these watercourses, the predicted localised reductions in habitat availability and connectivity, and the abundance of such habitat in the wider Nepean River Catchment, impacts on population size are expected to be negligible at wider scales.
Fish	If fracturing of bedrock leads to loss of habitat, a few species (e.g., eels) may be able to relocate to nearby pools, but others would perish due to desiccation and/or predation. As losses would be restricted to small, localised areas of habitat, this is unlikely to have a significant effect on fish assemblages within the Study Area.	Same as for BSO EA.
Threatened Species	No threatened species identified in drainage lines.	Same as for BSO EA.

5 Recommendations

Four approaches would be used to manage potential impacts on aquatic ecology within the Study Area from Longwalls 712 to 716.

- Impact minimisation.
- Aquatic ecology monitoring.
- Additional aquatic ecology studies that would be triggered by specific impacts on physical and water quality characteristics of the watercourses.
- Contingent measures should impacts exceed predictions.

5.1 Impact Minimisation

The potential impacts from the extraction of Longwalls 712 to 716 on aquatic habitats and biota in the Nepean River will be minimised as the mining is 2.2 km from the river. Temporary erosion and sediment control measures such as sediment fences, sandbag weirs, temporary drains and temporary silt traps should be installed prior to any minor surface works (e.g., works associated with subsidence monitoring, mitigation and rehabilitation) in the vicinity of watercourses and swamps to prevent the input of sediment into watercourses and perched aquifer systems during rainfall events.

5.2 Monitoring

5.2.1 Background

An aquatic ecology monitoring program would be implemented to:

- Determine the nature and extent of any subsidence-induced impacts on aquatic ecology due to extraction of Longwalls 712 to 716, and
- Assess the response of aquatic ecosystems to any stream remediation and management works implemented.

Potential longwall mining induced subsidence may cause a disturbance to water flow, levels and/or water quality in nearby watercourses. Any changes in water flow, levels and/or water quality in watercourses that can be attributed to mining would constitute physical and/or water quality impact(s) on the watercourses due to the Project. Changes in physical and/or water quality attributes of watercourses, whether attributable to mining or not, may cause a disturbance to aquatic ecology. Any changes to aquatic ecology indicators (such as number of taxa and biotic indices derived from macroinvertebrate sampling, fish and macrophytes) detected in those watercourses that can be attributed to change in physical and/or water quality attributes would constitute impact(s) on aquatic ecology, whether changes are attributable to mining or not. If changes to aquatic ecology indicators in watercourses are detected and can be attributed to the physical and/or water quality impact(s), this would constitute impact(s) on aquatic ecology attributable to the Longwall extraction.

In order to better understand and adequately assess the potential effects of subsidence on aquatic substrata and water quality, along with consequent changes in aquatic habitat and biota in affected watercourses, a baseline condition is established two years prior to mining, in accordance with the recommendations in the 'Southern Coalfields Strategic Review' (NSW DoP 2008). Aquatic biota would be monitored and relevant water quality variables measured at appropriate spatial and

temporal scales, so that any changes in aquatic habitats and biota resulting directly or indirectly from extraction of longwalls and any remediation works can be distinguished from natural variability.

The Independent Expert Panel for Mining in the Catchment was established in late February 2018 to provide informed expert advice to the (then) NSW Department of Planning and Environment, now Department of Planning, Housing and Infrastructure (DPHI), on the impact of mining activities in the Greater Sydney Water Catchment Special Areas, with a focus on risks to the quantity of water and swamps. Part 1 (IEPMC 2019a) reviewed specific mining activities at the Metropolitan and Dendrobium coal mines, while Part 2 (IEMPC 2019b) focused on the impacts of mining on water quantity and swamps, including cumulative impacts, and includes review and update of relevant findings of the strategic review (NSW DoP 2008). Recommendations specific to monitoring of aquatic ecology were not included, though several recommendations relevant to monitoring of groundwater and surface water and the development of associated TARPs will assist in the future assessment and identification of causes of any impacts on aquatic ecology.

Previously, monitoring plans designed to assess the potential impacts of mine subsidence on aquatic habitat and biota within watercourses of Appin Area 7 Longwalls 701 to 711 and Appin Area 9 Longwalls 901 to 905 were outlined in The Ecology Lab (2008a) and Cardno Ecology Lab (2011a). The objective of these monitoring plans was to measure changes in the aquatic habitats and biota that may arise during or following the extraction of Appin Area 7 and 9 longwalls or as a result of any remediation works undertaken. These monitoring plans focussed on the Nepean River, which is directly adjacent to Longwalls 701 to 711 and 901 to 905. Monitoring undertaken through 2024 has not identified any significant impact to aquatic habitat, macrophytes, macroinvertebrates and fish on the Nepean River associated with extraction of Appin Area 7 and 9 Longwalls (Cardno Ecology Lab 2025, Stantec 2025b). Assuming the absence of impacts to aquatic ecology identified following completion of planned after-extraction monitoring for Longwall 711, and given the Nepean River is located farther from Longwalls 712 to 716 and would experience very minor subsidence associated with these longwalls, monitoring of aquatic ecology in the Nepean River associated with Longwalls 712 to 716 would not be considered unnecessary or recommended (Stantec 2025b).

The monitoring plan proposed for Longwalls 712 to 716 would focus on the third and greater order sections of Navigation Creek and its tributaries within the Study Area. Navigation Creek and its tributaries provide the majority of watercourse habitat within the Study Area and are also expected to experience direct impacts due to mining. The small third order sections of Apps Gully and Foot Onslow Creek within the Study Area are not expected to experience significant direct or indirect impacts and ongoing monitoring of these watercourses is not considered necessary.

5.2.2 Sites and Timing

Two types of monitoring sites have been incorporated the plan: 'Impact' sites that may be subject to mine subsidence impacts during and after longwall extraction, and 'Control' sites that will provide a measure of the background environmental variability within the catchments as distinct from any mine subsidence impacts. Provisionally, two Impact sites would be established on Navigation Creek within the 400 m boundary and two Impact sites would be established on Navigation Creek downstream of the 400 m boundary (total of 4 sites in Navigation Creek). The objective would be to quantify any impacts on aquatic habitat and biota in Navigation Creek within the 400 m boundary (where they may be expected to occur) and identify any potential impacts downstream of the 400 m boundary (where impacts are not expected to occur). Two Control sites would also be established in each of two Control watercourses that would not be subject to impacts associated with Longwalls 712 to 716 (total of 4 control sites). If possible, these watercourses would include any tributaries of Navigation Creek

that provide comparable aquatic habitat that would be unaffected by mining. Data from these sites will be used to help confirm and validate the impact predictions made in the aquatic ecology impact assessment and other specialist studies for Longwalls 712 to 716.

The exact location of sites on Navigation Creek, the location of Control watercourses and the sites on the Control watercourses, will be confirmed prior to collection of the first round of monitoring data . The location of each of these sites will also depend on the availability of ongoing access. Potential Control watercourses should consider tributaries of the Nepean River and Navigation Creek flowing through similar areas of land usage as those associated with Navigation Creek, but would be unaffected by mining. Potential Control watercourses may also include Mount Hunter Rivulet, Wattle Creek and Bringelly Creek to the north. These creeks should be visited, inspected and their suitability confirmed at the commencement of the monitoring program.

It is recommended that baseline surveys at Impact and Control sites ideally be undertaken twice over a 24-month period prior to the commencement of mining (i.e., once in 2025 and once in 2026) to provide a measure of background temporal variability and provide confidence regarding detection of potential changes occurring several years into the future. If mining of Longwalls 712 to 716 would commence prior to spring 2026, then it is recommended that monitoring be undertaken twice in spring 2025 to provide a measure of temporal variability. In this case, monitoring would be undertaken in twice during spring 2025 to align with the AUSRIVAS spring sampling window (15 September to 15 December).

During-extraction monitoring would be undertaken annually to determine the extent and nature of any impacts. Post-extraction monitoring would be undertaken twice following the completion of mining. It is recommended that monitoring specific to Longwalls 712 to 716 be undertaken in spring to align with the timing of previous surveys undertaken in the Nepean River from 2008 to 2024.

5.2.3 Indicators and Methods

The following indicators of aquatic ecology would be monitored at each site:

- Aquatic habitat.
- In situ water quality.
- Aquatic macrophytes.
- Aquatic macroinvertebrates.
- Fish.

Ideally, each site would be 100 m long. However, the final length of each site would depend on access and availability of aquatic habitat at each site.

5.2.3.1 Aquatic Habitat

Ongoing monitoring of physical attributes (such as flow and depth of water in pools) of the Nepean River and larger drainage lines would be undertaken by EFT. These data would be examined alongside aquatic ecology data as part of the aquatic ecology reporting. These observations may also trigger additional surveys of aquatic ecology (**Section 5.3**).

5.2.3.2 Water Quality

At each site, two replicate measurements of DO, EC, ORP, pH, temperature and turbidity of the water would be taken from just below the surface of the water. The measurements taken would be used to

help interpret differences in biotic assemblages. The EC, DO, pH and turbidity measures would also be compared with the ANZECC (2000) default trigger values (DVTs) for slightly disturbed upland rivers in south-east Australia. Specific guidelines are not available for temperature and ORP measures.

A more comprehensive assessment of changes in surface water quality at selected sites would be undertaken by EFT and other specialist consultants.

5.2.3.3 Aquatic Macrophytes

A species inventory of macrophytes would be compiled and observations of any signs of desiccation, die back or other features of the macrophytes that could be indicative of potential mining-related impacts would be recorded at each site. The areal coverage of aquatic macrophytes within each site would also be quantified.

5.2.3.4 Aquatic Macroinvertebrates

The AUSRIVAS protocol for NSW streams (Turak *et al.* 2004) would be used to monitor aquatic macroinvertebrates. At each site, samples of aquatic macroinvertebrates associated with the pool edge habitat would be collected by using dip nets (250 µm mesh) to agitate and scoop up material from vegetated areas of the creek bank. Samples would be collected over a period of 3 to 5 minutes from a 10 m length of habitat along the river, in accordance with the AUSRIVAS Rapid Assessment Method (RAM) (Turak *et al.* 2004). If the required habitat was discontinuous, patches of habitats with a total length of 10 m would be sampled. Each RAM sample would be rinsed from the net onto a white sorting tray from which animals are picked using forceps and pipettes. Each tray would be picked for a minimum period of forty minutes, after which they would be picked at 10-minute intervals for either a total of one hour or until no new specimens are found. These samples would be preserved in alcohol and transported to the laboratory for identification. Three replicate RAM samples would be collected from each site.

In accordance with the AUSRIVAS protocol, RAM samples would be sorted under a binocular microscope (at 40 X magnification), with macroinvertebrates identified to family level and counted up to a maximum count of ten animals for any one taxon (Turak *et al.* 2004). A randomly chosen 10% of the RAM sample identifications would be checked by a second experienced scientist to validate macroinvertebrate identifications.

Data would be analysed using the spring AUSRIVAS predictive models for the edge habitat (Coysh *et al.* 2000). The AUSRIVAS methodology and predictive model requires that sampling be done in autumn (15 March to 15 June) and/or spring (15 September to 15 December).

AUSRIVAS models generate the following indices:

- **OE50 Taxa Score** – The ratio of the number of macroinvertebrate families with a greater than 50% predicted probability of occurrence that were actually observed (i.e., collected) at a site to the number of macroinvertebrate families with a greater than 50% probability of occurrence expected (based on prescribed reference watercourses selected by the AUSRIVAS). OE50 taxa values range from 0 to 1 and provide a measure of the impairment of macroinvertebrate assemblages at each site, with values close to 0 indicating an impoverished assemblage and values close to 1 indicating that the condition of the sampled assemblage is similar to the condition of assemblages in the reference watercourses.

- Overall Bands – These indicate the level of impairment of the assemblage and are derived from OE50 Taxa Scores. These bands are graded as follows:
 - Band X = Richer invertebrate assemblage than reference condition.
 - Band A = Equivalent to reference condition.
 - Band B = Sites below reference condition (i.e., significantly impaired).
 - Band C = Sites well below reference condition (i.e., severely impaired).
 - Band D = Impoverished.

The revised SIGNAL2 biotic index (Stream Invertebrate Grade Number Average Level) developed by Chessman (2003) would also be used to determine the environmental quality of sites on the basis of the presence or absence of families of macroinvertebrates. This method assigns grade numbers between 1 (highly tolerant of pollution) and 10 (highly sensitive to pollution) to each macroinvertebrate family or taxa found, based largely on their responses to chemical pollutants. For a given sample, the sum of all grade numbers is then divided by the total number of families recorded to calculate the SIGNAL2 index for that sample. The SIGNAL2 index therefore uses the average sensitivity of macroinvertebrate families to present a snapshot of biotic integrity at a site. SIGNAL2 values greater than 6, between 5 and 6, between 4 and 5, and less than 4 indicate that the habitat is healthy, or mildly, moderately or severely polluted/degraded, respectively.

5.2.3.5 Fish

Fish would be sampled using backpack electrofishing. Backpack electrofishing is a non-destructive technique that is restricted to depths of less than approximately 1 m (hip height) and water bodies with low to moderate salinity. The operator of the electrofisher would stun fish by discharging electric pulses into the water enabling them to be captured by an assistant equipped with a dip net. Electrofishing would be conducted in riffles, shallow pools and beneath overhanging banks and vegetation along standardised lengths of creek or for a set time interval (e.g., 8 replicates of 150 minutes).

5.2.3.6 Threatened Species

Inspection of AUSRIVAS samples would be undertaken for the two threatened aquatic macroinvertebrate species (Adam's emerald dragonfly and Sydney hawk dragonfly) identified in this assessment. Although Adam's emerald dragonfly does not appear to occur in the local area, suitable habitat may exist in the Study Area. All the dragonfly larvae collected would be identified to family level. Any individuals of the genera *Austrocorduliidae* and *Gomphomacromiidae* found would be identified to species level, if possible. If there is any uncertainty as to their identification, specimens will be referred for further taxonomic assessment. The presence of either one or both of these threatened species would trigger further investigations into the species and its habitats in relation to potential subsidence impacts. Albeit unlikely, any Macquarie perch caught during surveys would also be reported.

5.2.3.7 Statistical Analysis

The aim of the statistical analyses would be to identify any temporal changes in the selected indicators of aquatic ecology at the Impact sites that are in a different direction, or of a different magnitude, to temporal trends at the Control sites. Statistically significant differences provide evidence that an impact may have occurred. Evidence would be assessed by examining data from

before commencement of longwall extraction with those collected after commencement of mining activities.

Spatial and temporal changes in AUSRIVAS indices and macroinvertebrate assemblage presence / absence data would be examined using permutational analysis of variance (PERMANOVA) for analysis of univariate data. Spatial differences and temporal changes, and their interaction, in macroinvertebrate assemblages sampled using artificial collectors would be examined via multivariate PERMANOVA. Patterns in the multivariate data would also be examined using the unconstrained ordination technique Principal Coordinates Analysis (PCO). This will provide a graphical representation of assemblages based on their similarity within and among places or times sampled. In these plots, samples having similar sets of organisms are grouped closer together than ones containing more disparate sets of organisms.

5.3 Additional Aquatic Ecology Studies

The aquatic ecology monitoring program outlined in **Section 5.2** has been designed to detect and determine the extent and nature of impacts on aquatic habitat and biota resulting from physical impacts on the Nepean River and its tributaries associated with mining-induced subsidence. It incorporates monitoring events throughout the duration of mining regardless of observed physical and chemical impacts within watercourses. Physical-chemical impacts detected within watercourses by routine surface monitoring by EFT that may require further investigation into potential impacts on the aquatic ecology include:

- Reductions in flow in watercourses that exceed predictions; and
- Greater than minor change in water chemistry (particularly pH, dissolved oxygen, turbidity, or metal concentration) in the Nepean River and tributaries.

Other observations made during routine surface monitoring that may require further investigation of the aquatic ecology would include:

- Fish/crayfish kills; and
- Die-off of macrophyte beds (where present).

Trigger values for aquatic ecology monitoring parameters are contained in the Appin Area 7 Longwalls 707 to 710 Environmental Management Plan (South32 2015) and the Biodiversity Management Plan for Appin Area 9 Longwalls 901 to 904 (BHPBIC 2014). These are based on the duration of reductions in aquatic habitat that may occur in watercourses due to mining impacts.

5.4 Contingent Measures

In the event that impacts on aquatic habitats and biota in the Nepean River due to the extraction of Longwalls 712 to 716 are greater than predicted, the following contingent measures are recommended:

- Implementation of watercourse remediation measures, such as backfilling or grouting, in areas where fracturing of controlling rock bars and/or the creek bed leads to diversion of creek flow and drainage of pools.
- Implementation of appropriate control measures, such as installation of sediment fences down-slope of areas where subsidence has led to erosion, and stabilisation of areas prone to erosion

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and soil slumping using rock, brush matting or vegetation, to limit the potential for deposition of eroded sediment into the watercourses.

If these management strategies prove ineffectual, appropriate offset and compensatory measures would be implemented.

6 Conclusion

The layout design for Longwalls 712 to 716 includes a setback of at least 2.2 km from the Nepean River. As a result, it is unlikely the Nepean River would experience adverse physical impacts due to the mining-induced movements. Significant impacts on aquatic habitat and biota including threatened aquatic species, are, thus, not expected.

Although fracturing and flow diversions could occur in tributaries of the Nepean River directly above and within 400 m of the proposed longwalls, the aquatic habitat provided by these tributaries is relatively limited as it is characterised by pre-existing and ongoing impacts associated with historic land clearing and agricultural land-use. Nevertheless, these tributaries do provide habitat for native aquatic biota including fish, aquatic plants and macroinvertebrates. In the unlikely event that flow diversion or pool drainage did occur, impacts on aquatic biota at the local scale (e.g., individual pools and tributaries) would be significant. However, due to the abundance of this habitat throughout the Nepean River catchment, impacts on aquatic biota at this wider scale would be minor. No significant impacts on the threatened Macquarie perch, Sydney hawk dragonfly or Adam's emerald dragonfly are expected, as these species are unlikely to occur in tributaries traversing the Study Area that would be most susceptible to physical or water quality impacts associated with mining-related subsidence. It is noted also that no fracturing or flow diversions have previously been observed during extraction of earlier Appin Area 7 and 9 longwalls.

Monitoring associated with Longwalls 712 to 716 will focus on Navigation Creek, the catchment of which comprises the majority of watercourse habitat overlaying these longwalls and where fracturing and flow diversions have the greatest potential to occur. The monitoring program will also consider the results of monitoring of physical and water quality impacts undertaken by the EFT. The detection of physical impacts, such as rockbar fractures resulting in water loss in a pool within the Nepean River, or more than minor changes in water chemistry, would trigger investigations into potential impacts on aquatic ecology. Observations of fish/crayfish kills or die-off of any macrophyte beds would also trigger further monitoring to determine the nature and extent of secondary impacts on aquatic ecology. The level of impact would determine the type of response. The implementation of reactive management measures would reduce impacts on aquatic ecology.

Overall, potential impacts on aquatic habitat and biota associated with extraction of Longwalls 712 to 716 are comparable to, or less severe than those predicted to occur in the BSO EA. Potential impacts are expected to result in negligible consequences to aquatic habitat and biota outside the Study Area and at the scale of the Nepean River catchment, and negligible consequences to threatened aquatic species. The results of the monitoring program will be used to confirm and validate the predictions made in this aquatic ecology impact assessment.

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Appendix A Survey Methodology

Site Coordinates

Table A-i. Site Coordinates

Site	Easting	Northing
Site 1 upstream extent	288463	6214100
Site 1 downstream extent	288780	6214152
Site 2 downstream extent	289008	6214219
Site 2 upstream extent	288851	6214182
Site 3 downstream extent (sampling ceased)	291889	6215263
Site 3 upstream extent (sampling ceased)	291644	6215370
Site 4 upstream extent (sampling ceased)	292071	6215217
Site 4 downstream extent (sampling ceased)	292281	6215350
Site 5 downstream extent	292791	6218045
Site 5 upstream extent	293002	6217805
Site 6 downstream extent	292647	6218567
Site 6 upstream extent	292785	6218240
Site 7 upstream extent	292582	6220829
Site 7 downstream extent	292581	6221116
Site 8 upstream extent	292815	6221295
Site 8 downstream extent	292963	6221582
Site X1 upstream extent (sampling ceased)	292378	6216501
Site X1 downstream extent (sampling)	292348	6216638
Site X2 upstream extent (sampling ceased)	292356	6216590
Site X2 downstream extent (sampling)	292379	6216875
Site X3 centre	286453	6214934
Site X4 centre	286194	6215120
Site X5 centre	284800	6213117
Site X6 centre	284680	6213032
Site X7 centre	281754	6212912
Site X8 centre	281655	6212798

Aquatic Habitat and Vegetation

The Ecology Lab (2008a) mapped four habitat types (adapted from Fairfull and Witheridge 2003) within The Nepean River and its drainage lines:

- Unlikely habitat: Ephemeral drainage lines that only contain flow during and immediately after significant rainfall. Permanent or semi-permanent pools that could provide refuge for aquatic biota during prolonged dry weather are absent.
- Minimal habitat: Watercourses that contain some small semi-permanent refuge pools that are unlikely to persist through prolonged drought. Flow connectivity would only occur during and following significant rainfall. These pools may provide habitat for some aquatic species including aquatic macroinvertebrates and freshwater crayfish.
- Moderate habitat: Watercourses that contain some larger permanent and semi-permanent refuge pools that would persist through prolonged drought but become greatly reduced in extent. These watercourses should support a relatively diverse array of aquatic biota including some fish, freshwater crayfish and aquatic macroinvertebrates. There may also be some aquatic plant species present.



- Significant habitat: Watercourses that contain numerous large, permanent pools and generally have flow connectivity except during prolonged drought. They provide extensive and diverse aquatic habitat for aquatic flora and fauna.

Key Fish Habitat

The occurrence of sensitive fish habitat in the Study Area was assessed using the criteria in NSW DPI (2013a) relevant to freshwater habitat (**Table A-ii**).

Mapping was done initially as a desktop exercise with the aid of existing information from previous surveys including information on habitat types (Fairfull and Witheridge 2003). Findings were used to inform the detailed KFH mapping using the updated classifications in NSW DPI (2013a). Where sections of drainage lines could not be accessed, KFH type was inferred based on the findings from other drainage lines in the Study Area.

Table A-ii. Classification of KFH according to sensitivity (NSW DPI 2013a).

Classification	Habitat Type
Type 1 – Highly sensitive KFH	Instream gravel beds, rocks greater than five hundred millimetres in two dimensions, snags (wood debris) greater than three hundred millimetres in diameter or three metres in length, native aquatic plants, and areas known or expected to contain threatened and protected species
Type 2 – Moderately sensitive KFH:	Freshwater habitats other than those defined in Type 1
Type 3 – Minimally sensitive KFH	Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation
Not considered KFH	First and second order streams on gaining streams (i.e., those where streams are coming together and becoming progressively larger), based on the Strahler method of stream ordering.

In-situ Water Quality

At each site, two replicate measurements of DO, EC, oxidation-reduction potential (ORP), pH, temperature and turbidity of the water were taken from just below the surface of the water using a YSI multiprobe. The measurements taken are used to assist in interpretation of the results of biotic sampling. The EC, DO, pH and turbidity measures were also compared with the ANZECC (2000) DTVs for slightly disturbed upland rivers in south-east Australia. Specific guidelines are not available for temperature and ORP measures.

AUSRIVAS Macroinvertebrates

Field and Laboratory Methods

At each site, samples of aquatic macroinvertebrates associated with the pool edge habitat were collected by using dip nets (250 µm mesh) to agitate and scoop up material from vegetated areas of the riverbank. Samples were collected over a period of 3 to 5 minutes from a 10 m length of habitat along the river, in accordance with the AUSRIVAS Rapid Assessment Method (RAM) (Turak et al. 2004). If the required habitat was discontinuous, patches of habitats with a total length of 10 m were sampled. Each RAM sample was rinsed from the net onto a white sorting tray from which animals were picked using forceps and pipettes. Each tray was picked for a minimum period of forty minutes, after which they were picked at ten-minute intervals for either a total of one hour or until no new specimens were found. Samples were preserved in alcohol and transported to the laboratory for



identification, and subsequent derivation of biotic indices and assessment of habitat and water quality using the AUSRIVAS modelling software.

AUSRIVAS samples were sorted under a binocular microscope (at 40 X magnification) and identified to family level, with the exception of Oligochaeta and Polychaeta (to class), Ostracoda (to subclass), Nematoda and Nemertea (to phylum), Acarina (to order) and Chironomidae (to subfamily). Individuals of each family were counted up to a maximum of ten, in accordance with the latest AUSRIVAS protocol (Turak et al. 2004). There is a possibility, albeit unlikely, that two threatened aquatic macroinvertebrate species (Adam's emerald dragonfly and Sydney hawk dragonfly) occur in the Study Area. Therefore, if any individuals of the family Austrocorduliidae and Gomphomacromiidae were found these would have been identified to species level.

AUSRIVAS Model

The AUSRIVAS protocol uses an internet-based software package to determine the environmental condition of a waterway based on predictive models of the distribution of aquatic macroinvertebrates at reference sites (Coysh et al. 2000). The ecological health of the creek is assessed by comparing the macroinvertebrate assemblages collected in the field (i.e., 'observed') with macroinvertebrate assemblages expected to occur in reference waterways with similar environmental characteristics. The data from this study were analysed using the NSW models for pool edge habitat sampled in spring. The AUSRIVAS predictive model generates the following indices:

- **OE50 Taxa Score** – The ratio of the number of macroinvertebrate families with a greater than 50% predicted probability of occurrence that were actually observed (i.e., collected) at a site to the number of macroinvertebrate families with a greater than 50% probability of occurrence expected (based on prescribed reference watercourses selected by the AUSRIVAS). OE50 Taxa Scores provide a measure of the impairment of macroinvertebrate assemblages at each site, with values close to 0 indicating an impoverished assemblage and values close to 1 indicating that the condition of the sampled assemblage is similar to the condition of assemblages in the reference watercourses.
- **Overall Bands** indicate the level of impairment of the assemblage and are derived from OE50 Taxa Scores. These bands are graded as described in **Table A-iii**.

Table A-iii. AUSRIVAS Bands and corresponding OE50 Taxa Scores for AUSRIVAS edge habitat sampled in spring.

Band	Description	Spring OE50 Score
X	Richer invertebrate assemblage than reference condition	>1.16
A	Equivalent to reference condition	0.84 to 1.16
B	Sites below reference condition (i.e., significantly impaired)	0.52 to 0.83
C	Sites well below reference condition (i.e., severely impaired)	0.20 to 0.51
D	Impoverished (i.e., extremely impaired)	≤0.19

The revised SIGNAL2 biotic index (Stream Invertebrate Grade Number Average Level) developed by Chessman (2003) would also be used to determine the environmental quality of sites on the basis of the presence or absence of families of macroinvertebrates. This method assigns grade numbers between 1 (highly tolerant of pollution) and 10 (highly sensitive to pollution) to each macroinvertebrate family or taxa found, based largely on their responses to chemical pollutants. For a given sample, the sum of all grade numbers is then divided by the total number of families recorded to calculate the SIGNAL2 index for that sample. The SIGNAL2 index therefore uses the average sensitivity of



macroinvertebrate families to present a snapshot of biotic integrity at a site. SIGNAL2 values are as follows:

- SIGNAL > 6 = Healthy habitat
- SIGNAL 5 – 6 = Mild pollution
- SIGNAL 4 – 5 = Moderate pollution
- SIGNAL < 4 = Severe pollution.

Fish

Fish were sampled using a backpack electrofisher (model LR-24 Smith-Root) and baited traps. At each site, five baited traps were set for approximately one hour in a variety of habitats, such as amongst aquatic plants and snags, in deep holes and over bare substratum. Bait traps were approximately 30 cm x 30 cm x 40 cm with 0.3 cm aperture mesh and a 3 cm opening. The backpack electrofisher was operated around the edge of pools and in riffles (if present) at Sites 1, 2 and X3 to X8 (i.e., where water depth was suitable for sampling), with four two-minute shots being performed at each site. Fish stunned by the current were collected in a scoop net, identified and measured. All captured fish were be handled with care to minimise stress and were released as soon as possible.



Appendix B Water Data April 2025

Measure	DTV	Navigation Creek	Navigation Creek	Navigation Creek	NAVC16	Apps Gully
		NAV1	NAVS1/NAV2	NAV_S50	NAVC16_S10	AG_S10
Temperature (°C)		16.7	17.4	18.5	16.6	17.4
Conductivity (µS/cm)	125-2,200	2,732	733	1,979	241	618
pH	6.5-8.0	8.1	8.1	8.4	8.1	8.2
ORP (mV)		96	163	146	195	155
DO (% saturation)	85-110	54.5	38.4	55.6	60.6	88.5
Turbidity (NTU)	6-25	19.8	6.7	2.3	42.9	0.6

Grey shading indicates measures outside of ANZECC (2000) default trigger values (DTVs)



Appendix C AUSRIVAS Indices 2003 to 2024

Date	X8	X7	X6	X5	X4	X3	1	2	3	4	X2	X1	5	6	7	8	Nav.	F1	F2
No. of Taxa																			
Sep-03							13	14	15	16			13	14					
Apr-08																	26	23	21
Nov-08							32	30	32	32	27	31	25	27	33	30		17	15
Dec-10							30	27	25	31	27	23	25	15	27	30	24	21	17
Dec-11							28	24	19	30	27	24	28	21					
Dec-12							28	24	28	31	26	26	20	21	25	26			
Dec-13							19	22			27	22	25	22	22	20			
Dec-14	23	23	15	19	25	17	22	20	24	24	22	34	27	26	23	21			
Nov-15	18	16	18	19	22	19	20	29					27	23	28	29			
Nov-16							22	22					25	23	17	24			
Nov-17	23	19	14	18	13	21	27	16					19	15	25	15			
Nov-18							25	14					16	23	19	26			
Nov-19	23	13	20	18	26	24	22	15					15	16	19	17			
Dec-20							25.0	19					25	25	25	27			
Dec-21	14	14	14	18	22	14	14	21					22	22	20	24			
Dec-22							12	15.0					16	13	10	10			
Dec-23	16	16	1	7	15	7	16	17					17	13	8	17			
Dec-24							18	15					15	15	11	17			
OE50 Taxa Score																			
Sep-03							0.52	0.58	0.64	0.58			0.52	0.58					
Apr-08																	0.65	1.07	1.2
Nov-08							1.05	0.87	0.99	0.93	0.81	0.81	0.64	0.76	0.81	0.99		0.73	0.6
Dec-10							0.93	0.99	0.82	0.76	0.81	0.76	0.81	0.47	0.81	0.76	0.87	0.58	0.8
Dec-11							0.99	0.76	0.7	0.99	0.76	0.64	0.82	0.52					
Dec-12							1.11	0.7	0.93	1.05	0.7	0.87	0.64	0.58	0.76	0.7			
Dec-13							0.76	0.82			0.93	0.88	0.87	0.7	0.82	0.76			
Dec-14	0.94	0.98	0.82	0.87	0.87	0.83	0.81	0.58	0.87	0.76	0.82	0.99	0.87	0.87	0.7	0.64			
Nov-15	0.69	0.86	0.7	0.83	0.57	0.87	0.7	0.99					0.82	0.81	0.76	0.81			
Nov-16							0.7	0.7					0.87	0.7	0.7	0.81			
Nov-17	0.82	0.64	0.52	0.58	0.53	0.76	0.64	0.58					0.7	0.52	0.76	0.58			
Nov-18							0.87	0.47					0.52	0.81	0.64	0.76			
Nov-19	0.88	0.59	0.7	0.64	0.82	0.7	0.81	0.47					0.47	0.64	0.64	0.81			
Dec-20							0.9	0.76					0.87	0.93	0.99	0.87			
Dec-21	0.53	0.59	0.64	0.7	0.88	0.7	0.52	0.64					0.87	0.87	0.76	0.87			
Dec-22							0.35	0.4					0.58	0.41	0.35	0.35			
Dec-23	0.47	0.58	0.06	0.29	0.58	0.23	0.7	0.7					0.64	0.47	0.47	0.58			
Dec-24							0.64	0.64					0.52	0.47	0.35	0.7			
SIGNAL2 Score																			
Sep-03							3.7	3.9	3.6	4			3.8	3.5					
Apr-08																	4.1	4.1	
Nov-08							3.9	3.7	3.3	4	3.7	4.2	3.7	3.4	3.8	3.6		3.4	3.4
Dec-10							3.8	3.8	3.8	3.5	3.8	4.1	3.9	3.2	3.2	3.3	3.1	2.9	3.2
Dec-11							3.8	3.8	3.7	3.9	4	3.7	3.6	4.1					
Dec-12							4.1	4.1	4	3.9	3.6	4	4.3	4.5	3.3	3.7			
Dec-13							3.6	4.6			3.8	4.6	4.3	3.9	4.2	3.8			
Dec-14	4.1	3.6	4.1	4.1	4.5	4.1	3.9	3.9	4	4.2	3.7	4.3	4.3	3.7	3.7	4.1			
Nov-15	3	3.6	3.8	3.4	4.5	4.1	4.3	4.1					4	4.2	4.2	4			
Nov-16							4.1	4.6					4.5	4.1	4	4.2			
Nov-17	3.8	3.9	4.7	3.8	3.7	4.1	4.2	3.8					4.5	4.3	3.9	4.6			
Nov-18							4	3.6					4.2	4.4	4.5	3.5			
Nov-19	4	4.5	4	4.1	4	4.3	3.7	3.7					3.5	4	3.9	4.4			
Dec-20							4.0	4.2					4.0	4.4	4.0	4.2			
Dec-21	3.7	3.9	4.1	3.6	4.5	4.5	5.0	4.3					4.2	3.9	3.7	4.3			
Dec-22							3.8	3.4					4.2	4.5	4.6	4.1			
Dec-23	4.1	3.5	1.5	3.6	3.4	3.0	3.4	4.1					4.9	4.1	3.3	4.3			
Dec-24							3.8	4.1					3.7	3.2	4.1	3.9			



Appendix D Raw AUSRIVAS Macroinvertebrate Data 2025

Taxon	Navigation Creek NAV1	Navigation Creek NAVS1/NAV2	Navigation Creek NAV_S50	NAVC16 NAVC16_S10	Apps Gully AG_S10
Temnocephalidae		1			
Corbiculidae / Sphaeriidae					1
Lymnaeidae		1			
Physidae	1	1	3		1
Oligochaeta			2		
Cladocera	1	1		10	
Copepoda	1	10	1	10	4
Ostracoda	1	10	1	10	
Ceinidae					10
Atyidae	10	10	1	1	10
Parastacidae				2	
Araneae					2
Hydracarina	1	4		1	2
Entomobryidae	1	4			2
Baetidae		6		1	8
Leptophlebiidae					3
Coenagrionidae		1			3
Isostictidae	1				
Synlestidae			1		
Aeshnidae					4
Hemicorduliidae / Corduliidae	2		3		3
Libellulidae			1		
Veliidae	2	1		3	10
Gerridae					1
Corixidae	1	10		5	4
Notonectidae		10		1	6
Dytiscidae	4	9	10	8	10
Gyrinidae			1		
Hydrophilidae	2				
Scirtidae	2				
Dixidae					3
Culicidae				4	2
Chironominae	2	6	5		8
Tanypodinae		2	1		10
Ceratopogonidae		1			
Tipulidae					1
Stratiomyidae		3			
Ecnomidae		1			
Leptoceridae					2

Note: a maximum of 10 individuals counted per sample.





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Appendix B – Niche Environment and Heritage, 2025. *Appin – Longwalls 712 to 716
Biodiversity Impact Assessment*



Appin - Longwalls 712- 716

Biodiversity Impact Assessment

Prepared for GM3 | 29 August 2025



Document control

Project number	Client	Project manager	LGA
8975	GM3	Stephen Bloomfield	Wollondilly

Version	Author	Review	Status	Comments	Date
D1	Itzel Gonzalez Carna Feldtmann	Stephen Bloomfield	Draft 01		28 July 2025
D2		Bruce Blunden (GM3)	Final		29 August 2025

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Executive Summary

Project outline

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by GM³ to prepare a Biodiversity Impact Assessment (BIA) to inform the Biodiversity Management Plan (BMP) component of the Appin Longwalls 712-716 Extraction Plan (the Study Area), in accordance with Schedule 3, Condition 5 of the Bulli Seam Operations Project Approval (08_0150) and the NSW Department of Planning and Environment's Extraction Plan Guideline (2022).

The BIA involved flora and fauna surveys within the Study Area and focused on landscape features and associated biodiversity which may be sensitive to the impacts of subsidence from longwall extraction. The Study Area was defined by the limit of subsidence associated with proposed Longwalls 712-716.

Literature review

The findings from the Mining Subsidence Engineering Consultants (MSEC) (2025) report form the basis to which the impact assessments for threatened flora, fauna and ecological communities have been assessed in this report.

A significant body of work relating to previous approvals and monitoring for underground mining within the Study Area and surrounds was reviewed as part of this report:

- Illawarra Coal Bulli Seam Operations Project Terrestrial Flora Assessment (FloraSearch 2009)
- Illawarra Coal Bulli Seam Operations Project – Appendix F – Terrestrial Fauna Assessment (Biosphere Environmental Consultants 2009)
- Appin Area 9 Longwalls 901 to 904 Biodiversity Impact Assessment (Biosis 2012)
- Appin Colliery Area 7 Longwalls 705-710 Impacts of Subsidence on Terrestrial Flora and Fauna (Biosis Research 2008)
- Appin - Longwalls 709 to, 711 and 905 Biodiversity Impact Assessment (Niche 2021)
- Appin Longwalls 712-716 Subsidence Predictions and Impact Assessments (MSEC 2025).

Summary of methods

The literature review was supplemented with field survey concentrating on landscape features and associated biodiversity which may be sensitive to impacts of subsidence from longwall extraction, such as watercourses and rocky areas. Survey was conducted in February, March and June 2025.

Survey activities involved validation of vegetation mapping and habitat assessment. A likelihood of occurrence and impact analysis was conducted for threatened species after considering the literature review and survey results.

Summary of MSEC (2025) conclusions

Natural areas and features sensitive to subsidence within the Study Area include watercourses, cliffs, rock outcrops and steep slopes. Significant conclusions from the MSEC (2025) report, relevant to this BIA include the following:

- It is unlikely that the Nepean River would experience adverse physical impacts due to the mining-induced movements from Longwall 712-716.



- It is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the banks along the creeks and tributaries within the Study Area due to the mining-induced tilt. The potential impacts of increased ponding and scouring of the drainage lines are expected to be minor and localised. Impacts resulting from changes in surface water flows due to mining-induced tilt are expected to be small in comparison with those which occur during natural flooding conditions.
- Fracturing could develop along the creeks and tributaries due to the mining of the proposed Longwall 712-716. Fracturing will predominately occur where the creeks and tributaries are located directly above the mining area. Impacts can also occur outside the mining area, with minor and isolated fracturing occurring at distances up to approximately 400 metres (m) outside the longwalls.
- The mining-induced compression due to valley closure effects can also result in dilation and the development of bed separation in the topmost bedrock, as it is less confined. Compression can also result in buckling of the topmost bedrock resulting in heaving in the overlying surface soils.
- Surface water flow diversions could occur along the creeks and tributaries that are located directly above the mining area. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds. Most sections of the creeks and tributaries within the Study Area are ephemeral and, therefore, surface water flows only occur during, and for short periods after, rain events.
- Previously mined beneath creeks in Appin Areas 7 and 9 have not reported fracturing which resulted in surface water flow diversions, except West Cliff Area 5 (Longwall 29 to Longwall 37), which observed fracturing in the bed of Mallaty Creek and loss of water holding capacity in one pool.
- It is estimated that between 3 % and 5 % of the total length, or between 1 % and 3 % of the total face area of the cliffs that are located directly above the proposed longwalls would experience adverse impacts. Cliffs that are not above the proposed longwalls are not predicted to experience adverse impacts. However, it is possible that isolated rock falls could occur at these cliffs, representing less than 1 % of the total length or total face area.
- Rock outcrops are expected to experience the full range of predicted subsidence movements. It is likely that fracturing would occur where rock outcrops are located directly above the proposed longwalls, and where the rock is marginally stable; this could then result in instabilities.
- As the slopes along the Razorback Range are steep, exhibit natural soil erosion and are predicted to experience the full range of predicted subsidence movements, it is likely that the extraction of the proposed longwalls would result in large surface cracks near the tops and along the sides of these slopes. If tension cracks were to develop, as the result of the extraction of the proposed longwalls, it is possible that soil erosion could occur if these cracks were left untreated.
- While in most cases, impacts on steep slopes are likely to consist of surface cracks, there remains a low probability of large-scale downslope movements. Experience indicates that the probability of mining induced large-scale slippages is extremely low due to the significant depth of cover within the Study Area.
- The groundwater bores could experience adverse impacts due to the extraction of the proposed Longwalls 712-716, particularly the bores located directly above the proposed mining area. Impacts could include lowering of the piezometric surface, blockage of the bores due to differential horizontal displacements at different horizons within the strata and changes to groundwater quality.

Summary of results and impact assessment

Groundwater dependant and riparian vegetation may experience some floristic changes in response to changed groundwater conditions, as a result of subsidence. Two Plant Community Types (PCT) that meet the definition of the Threatened Ecological Community (TEC) under the NSW *Biodiversity Conservation Act 2016* (BC Act) and



Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), display structural and floristic variation within their composite community in response to more frequent contact with shallow groundwater:

- PCT 4025: *Cumberland Red Gum Riverflat Forest*
 - River-flat Eucalypt Forest on the Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (listed as Endangered under the BC Act)
 - River-flat Eucalypt Forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as Critically Endangered under the EPBC Act)
- PCT 3145: *Cumberland Bangalay x Blue Gum Riverflat Forest*
 - River-flat Eucalypt Forest on the Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (listed as Endangered under the BC Act)
 - River-flat Eucalypt Forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as Critically Endangered under the EPBC Act).

Habitats such as pools are likely to experience some level of subsidence impacts (comprising both direct and indirect impacts). Subsidence impacts to features such as cliffs, overhangs and rocky outcrops have the potential to occur but are likely to have limited impacts on threatened biodiversity within the Study Area due to the small area of predicted impacts.

One threatened flora species was known to occur in the Study Area, White-flowered Wax Plant (*Cynanchum elegans*). Impacts for this species are likely to be minimal, given its occurrence within a vegetation type that is less reliant on groundwater and surface water flows and hence less likely to be impacted by subsidence.

One threatened fauna species, Southern Myotis (*Myotis macropus*) was considered potentially impacted by the proposal. Although due to the minor subsidence predictions in cliffs, impacts are unlikely to be significant to the habitat for the population or individuals within the Study Area.

Impacts of the proposed mine expansion on threatened biodiversity were previously assessed within the Bulli Seam Operations Project Environment Impact Assessment (BHPBIC 2009). Predicted impacts as a result of the current proposal are likely to be minimal. Therefore, the predicted impacts for the current proposal are consistent with the impact predictions of the Bulli Seam Operations Project Environment Impact Assessment.

Ongoing monitoring requirements for biodiversity are provided within the recommendations section of the report. Recommendations are focussed on frog and habitat monitoring along watercourses in conjunction with end of panel reports or established aquatic monitoring programs for measuring physical impacts of subsidence.



Glossary and list of abbreviations

Term or abbreviation	Definition
AOBV	Areas of Outstanding Biodiversity Value
AoS	Assessment of Significance
asl	Above sea level
BC Act	NSW Biodiversity Conservation Act 2016
BHPBIC	BHP Billiton Illawarra Coal
BIA	Biodiversity Impact Assessment
BMP	Biodiversity Management Plan
BSO	Bulli Seam Operations
CPHR	Conservation Programs, Regulation and Heritage
Cth	Commonwealth
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPE	Department of Planning and Environment (formerly Department of Planning, Industry and Environment)
DPHI	Department of Planning, Housing and Infrastructure
DPI	NSW Department of Planning and Industry
EA	Environmental Assessment
EEC	Endangered Ecological Communities
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
GDE	Groundwater Dependent Ecosystems
ha	Hectares
ICHPL	Illawarra Coal Holdings Pty Ltd
IMC	Formerly BHP Billiton Illawarra Coal
IMPP	Integrated Mine Planning Process
km	Kilometre(s)
KTP	Key threatening processes
LGA	Local Government Area
m	Metre(s)



Term or abbreviation	Definition
MSEC	Mining Subsidence Engineering Consultants
Niche	Niche Environment and Heritage Pty Ltd
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
RAHA	Rapid Aquatic Habitat Assessment
RDP	Rapid Data Point
SVTM	NSW State Vegetation Type Map
TARP	Trigger Action Response Plan
TEC	Threatened Ecological Communities
TSC Act	NSW Threatened Species Conservation Act 1995, repealed and replaced by the BC Act



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1. Introduction

1.1 Background and need for the project

Illawarra Coal Holdings Pty Ltd (ICHPL), a wholly owned subsidiary of GM³, owns and operates the Appin Colliery. The Appin Colliery is located in the Southern Coalfield of New South Wales (NSW), approximately 25 kilometres (km) west of Wollongong, in the Wollondilly Local Government Area (LGA) (Annex 1) (Figure 1). The Appin Colliery uses longwall mining techniques to extract premium quality, hard coking coal (used for steel production) and some energy coal from the Bulli Seam, conducted via underground methods.

In 2009, BHP Billiton Illawarra Coal (BHPBIC) now known as ICHPL, sought approval under Part 3A (now repealed) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) to expand its underground coal mining operations at Appin Colliery to extract coal in Areas 5, 7, 8, and 9. Collectively this area is known as the Bulli Seam Operations (BSO) Project. On 22nd December 2011 the Planning Assessment Commission (under delegation of the Minister for Planning) approved the BSO Project enabling to continue mining operations for a further 30 years. In September 2014, ICHPL sought and gained approval for the Longwalls 901-904 Extraction Plan in Appin Area 9 (IMC 2014) and in April 2020 an extension for the Longwalls 707 to 710 Subsidence Management Plan was approved by the Department of Planning, Housing and Infrastructure (DPHI) (formerly Department of Planning and Environment [DPE]).

An assessment of the impacts of subsidence on terrestrial ecological values, in accordance with the EP&A Act and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was completed for the BSO Project Part 3A Environmental Assessment (EA) (BHPBIC 2009) and subsequent longwall layouts (IMC 2014 and IMC 2015).

Niche Environment and Heritage Pty Ltd (Niche) has been commissioned by GM³ to prepare a Biodiversity Impact Assessment (BIA) to inform the Biodiversity Management Plan (BMP) component of GM³'s Extraction Plan for Longwalls 712, 713, 714, 715, 716. The earlier assessments were based on different longwall layouts than those proposed for Longwalls 712-716. Accordingly, this BIA updates and refines predicted ecological impacts using revised subsidence modelling and current site conditions.

In 2025, updated subsidence predictions specific to Longwalls 712-716 were provided in the MSEC Report (MSEC 2025), which forms a key input into this BIA.

An assessment of the impacts of subsidence on terrestrial ecological values, in accordance with the EP&A Act and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was completed for the BSO Project Part 3A Environmental Assessment (EA) (BHPBIC 2009) and subsequent longwall layouts (IMC 2014 and IMC 2015). The earlier assessments were based on different longwall layouts than those proposed for Longwalls 712-716. Accordingly, this BIA updates and refines predicted ecological impacts using revised subsidence modelling and current site conditions.

1.2 Statutory and other approvals

The statutory obligations with regard to Appin Areas 7 and 9 are contained in:

- The Conditions of Project Approval for the BSO Project (08_0150)
- Relevant biodiversity legislation, including:
 - NSW Biodiversity Conservation Act 2016 (BC Act)



- EPBC Act.

This BIA satisfies Condition 5(i), Schedule 3 of the BSO Approval (08_0150) which states:

- *Each extraction plan must:*
 - i. *include a Biodiversity Management Plan, which has been prepared in consultation with [Office of Environment and Heritage] OEH and [Department of Primary Industry] DPI (Fisheries), which provides for the management of the potential impacts and/or environmental consequences of the proposed second workings on aquatic and terrestrial flora and fauna, with a specific focus on threatened species, populations and their habitats; endangered ecological communities; and water dependent ecosystems, including (for Appin Areas 7, 8 and 9):*
- Additional targeted surveys for threatened species, sufficient to identify any actions required to protect significant populations from potential impacts.

This BIA will be used to assist ICHPL with the development of a BMP for the proposed Longwalls.

1.3 Timeline and project justification

Mine layouts for Appin Area 7 have been developed using ICHPL's Integrated Mine Planning Process (IMPP). This process considers mining and surface impacts when designing mine layouts. ICHPL has assessed mining layout options for the Appin Mining lease against the following criteria:

- Extent, duration and nature of any community, social and environmental impacts;
- Coal customer requirements
- Roadway development and longwall continuity
- Mine services such as ventilation
- Recovery of the resources for the business and the State
- Gas drainage, geological and geotechnical issues.

Several layout alternatives were assessed by ICHPL using a multi-disciplinary team including environment, community, mining and exploration expertise. These included variations in the number of longwalls and orientations, lengths, and setbacks of the longwalls from key surface features. These options were reviewed, analysed and modified until an optimised longwall layout for Longwalls 712-716 in Appin Area 7 was achieved (Figure 2).

There are a number of surface and subsurface constraints within the vicinity of the Study Area including major surface water features such as the Nepean River, and a number of geological constraints such as dykes and faults. The process of developing the layout for Longwall 712-716 was informed by updated subsidence predictions from the MSEC (2025), which allowed potential subsidence effects on sensitive surface features to be modelled in detail and minimised to the extent practicable. The process adopted in designing the mine layout incorporated the hierarchy of avoid/minimise/mitigate as requested by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) and its incorporated Conservation Programs, Regulation and Heritage division (CPHR).

1.4 Objectives

The objectives of this BIA include:

- Outline the biodiversity values present with the Study Area using data collected during the BSO Project Part 3A Environmental Assessment (EA), as well as supplementary data collected by Niche.



- Consideration of the existing consent for BSO Project (Appin and West Cliff Collieries) and Biodiversity Management Plans (BMPs) of previously approved adjacent longwalls near the Study Area.
- Identify potential impacts to these biodiversity values resulting from subsidence predictions contained in MSEC Report No. MSEC1459 Rev. A (2025)
- Determine if the predicted impacts to biodiversity values differ from those contained within the BSO EIS (BHPBIC 2009).
- Provide recommendations to avoid, minimise and mitigate impacts to identified biodiversity values.
- Report on residual impacts to biodiversity values and ensure they are consistent with the Conditions of the BSO Project Approval (08_0150).

1.5 Approach

The approach to this assessment has been informed by previous ecological survey work and impact assessment for the Study Area and surrounding areas, recent field survey efforts, current knowledge of subsidence impacts on the landscape, legislative guidelines and agency consultation.

While biodiversity impact assessments for the Appin Area 7 Study Area have already been undertaken (Section 32.2), this updated assessment is required to ensure that the findings of the previous reports remain valid in light of the revised mine layout, considering the following:

- Amendments to relevant legislation and listing schedules, which may affect the conservation status of species or communities.
- Updated subsidence predictions specific to Longwalls 712-716 (MSEC 2025), and improved understanding of actual subsidence effects informed by the results of monitoring programs undertaken.

Previous ecological assessments for the Bulli Seam Operations Plan (BSOP) and associated longwalls in the Appin Area 9 and 7 (Biosis Research 2008, FloraSearch 2009, Biosphere Environmental Consultants 2009 and Biosis 2012) covered the majority of the current Study Area. However, some data gaps identified during this review have been addressed through targeted habitat assessments and updated evaluation of ecological values, with a focus on those sensitive to subsidence and upsidence related impacts, as outlined in MSEC (2025) and Section 2.2.

1.6 Study Area

Five longwalls; Longwall 712, Longwall 713, Longwall 714, Longwall 715 and Longwall 716, (hereafter referred to as 'the proposal') are proposed for extraction within the Study Area. The extent of the Study Area (Figure 2) aligns with the area defined in MSEC (2025) as potentially impacted by the proposal and incorporates:

- The 35° angle of draw line from the extent of the proposed Longwalls 712-716
- The predicted limit of vertical subsidence, defined by the additional 20 millimetre (mm) subsidence contour resulting from the extraction of Longwalls 712-716
- The natural features located within 600 m of the proposed mining area, in accordance with Condition 5(i), Schedule 3 of the BSO Approval (08_0150)
 - Primarily watercourses and associated ecosystems, cliffs, rock outcrops and steep slopes.

The Study Area (Figure 2) constitutes approximately 1,659 hectares (ha) and comprises a mosaic of land uses including undisturbed bushland, pastureland paddocks and urban development. The primary drainage feature is Navigation Creek (Figure 3, an ephemeral watercourse with associated minor tributaries that traverse the



Douglas Park township and form part of the Hawkesbury-Nepean Catchment. Importantly, no declared drinking water catchments or Special Areas occur within the Study Area boundary (Figure 1).

1.7 Consultation

Consultation with the proponent was undertaken during a project risk briefing held on 12 June 2025, attended by Stephen Bloomfield, where key biodiversity risks associated with the proposed extraction of Longwalls 712-716 were discussed. This consultation focused on clarifying the ecological values within the Study Area, reviewing updated subsidence predictions, and identifying priority areas for impact avoidance or mitigation. Outcomes from this meeting have directly informed the finalisation of the Biodiversity Impact Assessment (BIA), ensuring alignment between predicted impacts, client expectations, and regulatory requirements. Further engagement with regulatory agencies will be undertaken as part of the development of the Biodiversity Management Plan (BMP).



2. Subsidence predictions for natural features

2.1 Natural features of the Study Area

2.1.1 Rivers, creeks and drainage lines

There are no rivers within the Study Area. The nearest river is the Nepean River, located approximately 2.2 km south of the commencing (i.e. western) end of Longwall 712 and 2.5 km east of the finishing (i.e. eastern) end of Longwall 712 at its closest points (MSEC 2025). The third order creeks occur as a shallow incision into the surface soils, which have been derived from Wianamatta Group, with some sandstone outcropping (MSEC 2025). First and second order creeks and tributaries have more substantial incisions into the surface soils, with exposed sandstone in the bases and rock outcropping in the valley sides (MSEC 2025). Pools have naturally developed along the lengths of these creeks within the surface soils and rock platforms (MSEC 2025). In some locations farm dams have been established (MSEC 2025).

Table 1: Creeks of third and fourth order within the Study Area based on the 600 m boundary (MSEC 2025)

Name		Location	Total length above mining area (Longwall 712-716) (km)	Total length within the Study Area (km)
Navigation Creek (third and fourth order)		Directly above Longwall 711 - 716	3.1 (third order) 1.4 (fourth order)	3.0 (third order) 2.1 (fourth order)
Tributaries to Navigation Creek (third order)	NavC14.5	Outside the mining area, 200 m north of Longwall 716	-	1.3
	NavC16	Directly above Longwall 710B - 716	1.9	3.7
	NavC17	Directly above Longwall 715	0.27	0.27
	NavC20	Directly above Longwall 713 - 714	1.1	1.1
Apps Gully (third order)		Outside the mining area, 250 m west of Longwall 715	-	0.39
Foot Onslow Creek (third order)		560 m south-east of Longwall 712	-	0.29
Total			7.7	12.1

2.1.2 Swamp, wetlands or water related ecosystems

No swamps or wetlands have been identified within the Study Area. However, water-related ecosystems are present along the major streams (MSEC 2025).



While none of the Plant Community Types (PCTs) within the Study Area are formally recognised as Groundwater Dependent Ecosystems (GDEs), some riverflat vegetation communities, such as PCT 3145: *Cumberland Bangalay x Blue Gum Riverflat Forest* and PCT 4025: *Cumberland Red Gum Riverflat Forest*, may access shallow subsurface moisture or experience periodic inundation. However, these communities are primarily influenced by surface water dynamics rather than reliant on groundwater. Additionally, PCT 3110: *Greater Sydney Enriched Grey Myrtle Dry Rainforest* and PCT 3318: *Cumberland Moist Shale Woodland* may be sensitive to long-term reductions in subsurface moisture, particularly where they occur in enriched alluvial settings within the Study Area.

2.1.3 Cliffs

Cliffs are defined as 'a continuous rock face', including overhangs, having a minimum length of 20 m, a minimum height of 10 m and a minimum slope of 2:1 ($>63.4^\circ$)" (MSEC 2025).

A total of eleven cliffs have been identified within the Study Area, nine of which occur directly above proposed longwalls (Longwalls 714-716) and the other two occurring above Longwall 710A and 275 m north of Longwall 716 (MSEC 2025). These features are primarily located in the western portion of the Study Area, near Razorback Range. The total mapped length of cliffs and minor cliffs above the mining area is approximately 440 m, with individual cliff heights ranging from 5 to 20 m, consistent with definitions used for cliff and escarpment stability monitoring in the Southern Coalfield (MSEC 2025).

2.1.4 Rock outcrops

Rock outcrops are defined as exposed rock faces with heights of less than 10 m or slopes of less than 2:1 (MSEC 2025). Within the Study Area, rock outcrops are primarily located along the Razorback Range, as well as within the incised creek lines and tributaries (MSEC 2025).

2.1.5 Steep slopes

A steep slope is defined as "an area of land having a gradient between 1 in 3 (33 % or 18.3°) and 2 in 1 (200 % or 63.4°)" (MSEC 2025).

Within the Study Area, steep slopes have been identified along the Razorback Range above the western ends of the proposed longwalls (MSEC 2025). There are also more isolated steep slopes above the eastern ends of the proposed longwalls associated with small ridgelines and the banks of the streams (MSEC 2025).

2.2 Subsidence predictions for natural features

Subsidence predictions for the proposed Longwalls 712 to 716 within Appin Area 7 have been investigated and reported by MSEC (2025). The report examines predicted subsidence-related impacts to a range of natural features that are potentially sensitive to ground movement, including:

- Major creeks and associated drainage lines, particularly third order watercourses
- Cliffs and minor rock outcrops
- Steep slopes along ridgelines and incised valleys.

These natural features may support important habitat for threatened species or correspond to listed Threatened Ecological Communities (TECs) and, therefore, form a key focus of this assessment. A summary of the predicted impacts on these features, including maximum predicted vertical subsidence, tilts, and strains, is provided in Table 2, based on modelling and analysis documented in MSEC (2025).



Table 2: Predicated subsidence impacts to natural features and potential biodiversity impacts for Longwalls 712-716 (MSEC 2025)

Feature	Description of natural feature	Predicted subsidence or surface water impact (MSEC 2025)	Previously observed impacts in other areas (MSEC 2025)
Rivers	There are no rivers within the Study Area. The nearest river is the Nepean River, located approximately 2.2 km south of the commencing (i.e. western) end of Longwall 712 and 2.5 km east of the finishing (i.e. eastern) end of Longwall 712 at its closest points (MSEC 2025).	The predicted subsidence effects for the Nepean River, due to the mining of Longwall 712 – 716, are less than 5 mm vertical subsidence, less than 5 mm upsidence and less than 5 mm closure. While the river could experience very low levels of vertical subsidence or valley-related effects, it is not predicted to experience measurable tilts, curvatures or strains. It is unlikely that the Nepean River would experience adverse physical impacts due to the mining-induced movements from Longwall 712-716.	Gas release zones have previously been observed along the Nepean River during the extraction of longwalls in Appin Areas 7 and 9. Further gas release zones could develop as a result of mining the proposed Longwalls 712 to 716.
Creeks and tributaries	The creeks that have third order reaches are Navigation Creek, four tributaries to Navigation Creek (NavC14.5, NavC16, NavC17 and NavC20), Apps Gully and Foot Onslow Creek. There is also a fourth order section of Navigation Creek located within 600 m of the proposed longwalls (MSEC 2025).	It is unlikely that large-scale adverse changes in the levels of ponding or scouring of the banks along creeks and tributaries within the Study Area would occur as a result of mining-induced tilt. It is possible that localised increased ponding could develop in some isolated locations, where the existing grades are small and upstream of the chain pillars and the edges of the mining area. The potential impacts of increased ponding and scouring of the drainage lines, therefore, are expected to be minor and localised. Impacts resulting from changes in surface water flows due to mining-induced tilt are expected to be small in comparison with those which occur during natural flooding conditions. Fracturing could develop along the creeks and tributaries due to the mining of the proposed longwalls. Fracturing will predominately occur where the creeks and tributaries are located directly above the mining area. Impacts can also occur outside the mining area, with minor and isolated fracturing occurring at distances up to approximately 400 m outside the longwalls. The mining-induced compression due to valley closure effects can also result in dilation and the development of bed separation in the topmost bedrock, as it is less confined. This additional dilation	Creeks and tributaries have been mined directly beneath by previously completed longwalls in Appin Areas 7 and 9. These activities have not resulted in observed fracturing resulting in surface water flow diversions. However, based on experience in the Southern Coalfield, it remains likely that some fracturing will occur along the streams within the Study Area, particularly those located directly above or adjacent to the proposed longwalls. Such fracturing may reduce the water-holding capacity of existing standing pools.



Feature	Description of natural feature	Predicted subsidence or surface water impact (MSEC 2025)	Previously observed impacts in other areas (MSEC 2025)
		due to valley closure is expected to develop predominately within the top 10 m to 20 m of the bedrock. Compression can also result in buckling of the topmost bedrock resulting in heaving in the overlying surface soils. Surface water flow diversions could occur along the creeks and tributaries that are located directly above the mining area. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds. The creeks and tributaries are ephemeral and, therefore, surface water flows only occur during and for short periods after rain events.	
Cliffs	Eleven cliffs have been identified in the western part of the Study Area along Razorback Range, nine of which occur directly above proposed longwalls and the other two occurring above Longwall 710A and 275 m north of Longwall 716 (MSEC 2025).	Based on the experience of mining beneath cliffs it is estimated that between 3 % and 5 % of the total length, or between 1 % and 3 % of the total face area of the cliffs that are located directly above the proposed longwalls would experience adverse impacts. The two cliffs (Refs. RR-CL5 and RR-CL8) and eight of the minor cliffs (Refs. MCL01 to MCL07 and MCL09) are located above the mining area (MSEC 2025). The total length of these cliffs is 440 m and the total face is area is approximately 4550 m². Cliff RR - CL5 is located directly above the existing Longwall 710A, the predicted subsidence effects for this cliff are predominantly due to this existing longwall rather than the proposed longwalls. Cliff RR-CL8 is located above Longwall 714 and, therefore, the predicted subsidence effects are due to the proposed longwall. Minor cliff MCL08 is located 275 m north of the proposed LW716. At this distance, adverse impacts are not anticipated at this minor cliff due to the proposed mining. Minor cliff MCL07 is located adjacent to the eastern side of Remembrance Drive along the Razorback Range and is directly above the proposed LW716. The	Where cliffs were directly mined under for other longwalls, minor cracking and rockfalls were observed.



Feature	Description of natural feature	Predicted subsidence or surface water impact (MSEC 2025)	Previously observed impacts in other areas (MSEC 2025)
		potential for impacts on this minor cliff is considered low (MSEC 2025).	
Rock outcrops	There are rock outcrops located across the Study Area, primarily along the Razorback Range and the incised creeks and tributaries (MSEC 2025).	Rock outcrops within the Study Area are expected to experience the full range of predicted subsidence movements, including vertical subsidence, tilt, and strain. Fracturing is likely to occur where these features are located directly above the proposed longwalls. Where rock outcrops are marginally stable, this fracturing could result in localised instabilities or slumping. However, significant impacts are not anticipated beyond areas directly above or immediately adjacent to the longwalls.	Minor cracking recorded elsewhere under similar strain levels. Previous experience of mining beneath rock outcrops at the Mine indicates that the proportion of rock outcrops that experience adverse impacts is small, typically affecting less than 3 % of the total surface area of such features. This aligns with observations across the Southern Coalfield, where most rock outcrops remain stable despite subsidence-related ground movements.
Steep slopes	The steep slopes within the Study Area have been identified primarily along the Razorback Range above the western end of the proposed longwalls (MSEC 2025). There are also more isolated steep slopes above the eastern ends of the proposed longwalls associated with small ridgelines and the banks of the streams (MSEC 2025).	Mining-induced tilts are unlikely to result in adverse impacts on the stability of steep slopes. Steep slopes are more likely to be affected by mining-induced curvatures and strains, which may result in increased horizontal movements downslope. These movements can lead to the formation of tension cracks near the tops and along the flanks of the slopes, and compression ridges towards the base. The steep slopes along the Razorback Range are expected to experience the full range of predicted subsidence effects, and due to their inclination and existing signs of natural erosion, the extraction of the proposed longwalls may lead to the development of prominent surface cracking. If such cracks are left untreated, they could accelerate soil erosion processes. While these impacts are generally limited to surface cracking, the risk of large-scale downslope failures remains very low, as the substantial depth of cover across the Study Area reduces the likelihood of significant slippage.	In past areas, minor instability observed only where steep slopes intersected fault zones or loose colluvium, given the extensive mining beneath steep slopes in the Southern Coalfield, including areas along the Cataract, Nepean, Bargo and Georges Rivers. No large-scale slope failures have been recorded along these features, even where longwalls have been mined directly beneath them. However, tension cracking has been observed at the tops and along the sides of steep slopes, primarily due to increased horizontal movements downslope associated with subsidence. In areas with depths of cover greater than 400 m, such as within the current Study Area, these downslope movement cracks typically range from 25 mm to 50 mm in width. In some cases, particularly at the tops of very steep slopes or near prominent rock outcrops, larger cracks have developed with widths commonly between 100 mm and 150 mm or more.



3. Previous surveys

Previous desktop and field assessment work has been conducted within Appin Areas 7 and 9 just south of the Study Area for previous longwall mining approvals and to satisfy approval conditions in regard to monitoring. Relevant documentation was reviewed as part of this BIA with the results of select key relevant assessments summarised in this report (see sections 3.1 to 3.5). Threatened species previously recorded in those assessments have generally been supplied to CPHR (and its predecessors) for inclusion in the BioNet Atlas of NSW Wildlife threatened species database which has been consulted for this assessment.

Relevant assessments conducted within Appin Areas 7 and 9 include:

- Illawarra Coal Bulli Seam Operations Project Terrestrial Flora Assessment (FloraSearch 2009).
- Illawarra Coal Bulli Seam Operations Project – Appendix F - Terrestrial Fauna Assessment (Biosphere Environmental Consultants 2009).
- Appin Area 9 Longwalls 901 to 904 Biodiversity Impact Assessment (Biosis 2012).
- Appin Colliery Area 7 Longwalls 705-710 Impacts of Subsidence on Terrestrial Flora and Fauna (Biosis Research 2008).
- Appin – Longwalls 709 to, 711 and 905 Biodiversity Impact Assessment (Niche 2021).

3.1 Illawarra Coal Bulli Seam Operations Project – Appendix E - Terrestrial Flora Assessment (FloraSearch 2009)

FloraSearch (2009) prepared a terrestrial flora and vegetation impact assessment for potential subsidence and surface impacts predicted for the BSO Project. Six TECs were recorded within the Study Area:

- O'Hares Creek Shale Forest, Shale/sandstone Transition Forest – listed as Endangered under the BC Act
- Shale Sandstone Transition Forest – listed as Critically Endangered under the EPBC Act
- Cumberland Plain Woodland – listed as Endangered under the BC Act
- River-flat Eucalypt Forest on Coastal Floodplains – listed as Critically Endangered under the EPBC Act
- Moist Shale Woodland in the Sydney Basin Bioregion – listed as Endangered under the BC Act
- Western Sydney Dry Rainforest in the Sydney Basin Bioregion – listed as Endangered under the BC Act.

These communities were listed as Endangered Ecological Communities (EECs) under the NSW *Threatened Species Conservation Act 1995* (TSC Act) (now repealed by the BC Act) and/or the EPBC Act at the time of the report (2009). The assessment concluded that the proposal was unlikely to have a significant impact on any of these TECs. The impacts of surface cracking as the result of systematic subsidence movements was expected to be isolated and of a minor nature due to the relatively low magnitudes of the predicted strains and the relatively high depths of cover for all TECs.

Threatened species recorded by FloraSearch (2009) that are relevant to the Study Area are:

- *Epacris purpurascens* var. *purpurascens*
- Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*)
- Bargo Geebung (*Persoonia bargoensis*).



With minor impacts to specific locations of threatened plants, mitigated through various avoidance measures, the BSO Project was considered unlikely to have a significant impact on any threatened flora species, populations, ecological communities, or their habitats.

3.2 Illawarra Coal Bulli Seam Operations Project – Appendix F - Terrestrial Fauna Assessment (Biosphere Environmental Consultants 2009)

Biosphere Environmental Consultants (2009) prepared a terrestrial fauna impact assessment for potential subsidence and surface impacts predicted for the BSO Project. Threatened species recorded by Biosphere Environmental Consultants (2009) that are relevant to the Study Area are:

- Giant Burrowing Frog (*Heleioporus australiacus*);
- Red-crowned Toadlet (*Pseudophryne australis*);
- Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis gularis*);
- Powerful Owl (*Ninox strenua*);
- Spotted-tailed Quoll (*Dasyurus maculatus*);
- Koala (*Phascolarctos cinereus*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Southern Myotis (*Myotis macropus*)
- Eastern Bent-wing Bat (*Miniopterus orianae oceanensis*).

Of the threatened fauna recorded by Biosphere Environmental Consultants (2009), Powerful Owl, Southern Myotis and Grey-headed Flying-Fox were recorded in close proximity to the Study Area for the current assessment. Potential adverse impacts of the Project on terrestrial fauna and their habitats were assessed and those relating to subsidence include:

- Surface cracking, changes in pool levels, flooding or scouring, changes in stream alignments, changes in the availability of water due to cracking of rock strata in watercourses, changes in water quality, strata gas emissions and rock falls as a result of mine subsidence.

No significant impacts on threatened fauna species were predicted (Biosphere Environmental Consultants 2009). The following conclusions were made by Biosphere Environmental Consultants (2009) in relation to subsidence impacts of the BSO Project:

- Along Navigation Creek, there may be isolated instances of iron staining and spikes in water quality parameters such as iron, transient strata gas emission and induced leakage in pools and farm dams.
- Highly unlikely that there would be any observable effects on stream flow or water levels in the Nepean River within this domain (Appin Area 7).

3.3 Appin Area 9 Longwalls 901 to 904 Biodiversity Impact Assessment (Biosis Research 2012)

A BIA was prepared by Biosis Research (2012) to inform the BMP component of the Appin Area 9, Longwalls 901 to 904, Extraction Plan. Threatened species recorded by Biosis Research (2012) that are relevant to the Study Area are:



- TECs:
 - Shale Sandstone Transition Forest
 - Cumberland Plain Woodland (Shale Hills and Shale Plains Woodland)
 - Moist Shale Woodland
 - Western Sydney Dry Rainforest.
- Fauna:
 - Cumberland Plain Land Snail (*Meridolum corneovirens*)
 - Brown Treecreeper (south-eastern) (*Climacteris picumnus victoriae*)
 - Koala.

Potential impacts as assessed by Biosis Research (2012) were found to be largely consistent with those outlined within the BSO EA.

3.4 Appin Colliery Area 7 - Longwalls 705-710 Impacts of Subsidence on Terrestrial Flora and Fauna (Biosis Research 2008)

Biosis Research (2008) prepared a terrestrial flora and fauna impact assessment for potential subsidence impacts predicted for the proposed longwall mining in Appin Area 7, specifically Longwalls 705-710. TECs and threatened species recorded by Biosis Research (2008) that are relevant to the Study Area are:

- TECs:
 - Cumberland Plain Woodland
 - Shale Sandstone Transition Forest
 - River-flat Eucalypt Forest
 - Moist Shale Woodland.
- Threatened species:
 - Camden White Gum (*Eucalyptus benthamii*)
 - Matted Bush-pea (*Pultenaea pedunculata*)
 - Brown Pomaderris (*Pomaderris brunnea*)
 - Sydney Plains Greenhood (*Pterostylis saxicola*)
 - Giant Burrowing Frog
 - Red-crowned Toadlet
 - Southern Myotis.

The assessment concluded that the proposal was unlikely to have a significant impact on any of the above listed TECs or threatened species.

As possible impacts from subsidence were likely to be restricted to changes in surface flow and water quality in the Nepean River and its tributaries, only animal species which rely on these natural features for their survival were considered in the detailed impact assessment. Southern Myotis forages along the creek lines and pools although the minor changes were not considered to significantly impact the species. There were predicted possibilities of minor rockfalls, surface cracking and erosion events although these impacts are likely to be minor and temporary in nature and are unlikely to alter the flora species composition or distribution of PCTs in the Study Area.



3.5 Appin - Longwalls 709 to, 711 and 905 Biodiversity Impact Assessment (Niche 2021)

Niche was commissioned by GM³ to prepare a BIA to inform the BMP component of the Appin Area 9 and Appin Area 7, Longwalls 905, 709, 710A, 710B and 711 Extraction Plan, as required by the Condition of Project Approval.

TECs recorded by Niche (2021) that are relevant to the Study Area were:

- Cumberland Plain Woodland
- River-flat Eucalypt Forest.

One threatened flora species was known to occur in the Study Area, Spiked Rice-flower (*Pimelea spicata*). Impacts for this species were considered minimal, given its occurrence within drier PCTs that are less reliant on groundwater and surface water flows and hence less likely to be impacted by subsidence.

One threatened fauna species, Southern Myotis, was considered potentially impacted by the proposal. Although, due to the minor subsidence predictions in cliffs, impacts were unlikely to be significant to the habitat for the population or individuals within the Study Area.



4. Methods

4.1 Previous survey effort

Previous assessments to support the BSO Approval, including terrestrial flora and fauna assessments (Flora Search 2009; Biosphere Environmental Consultants 2009), involved 42 days of surveys across Woronora plateau, Nepean River and Razorback Range, comprising 71 quadrat samples, 92 spot samples and 56 random meander searches across vegetated areas. Additional terrestrial assessments for Appin Areas 7 and 9 (Biosis Research 2008; Biosis Research 2012; Niche 2021) were undertaken on several occasions between 9 September 2003 and 26 February 2004, with an additional three days in February 2006 (Biosis Research 2008), four days in July 2010 (Biosis Research 2012) and one day in August 2020 (Niche 2021).

The previous survey effort encompasses a significant portion of the current Study Area. Accordingly, Niche will utilise these existing data sources and focus additional survey efforts on areas that have not been previously investigated.

4.2 Survey timing

Surveys were conducted throughout the Study Area on:

- 4 February 2025 by Itzel Gonzalez and Alan Davies
- 13 March 2025 by Itzel Gonzalez and David Wilkinson
- 19 June 2025 by Itzel Gonzalez and Emma Laurence-Whalley.

The current scope involved flora and fauna habitat surveys within the Study Area, focusing on landscape features and associated biodiversity that may be sensitive to the impacts of subsidence from longwall extraction, such as TECs, waterways and rocky areas. Survey effort was concentrated in parts of the study area that had not been subject to previous coverage or where past effort was limited (Figure 4). The level of survey was commensurate with the potential for impact and as such no targeted surveys for threatened flora or fauna were completed.

4.3 Preliminary assessment

A review of the following information was initially undertaken to develop a list of threatened flora and fauna species with potential to occur within the Study Area:

- NSW DCCEEW BioNet Atlas (NSW DCCEEW 2025a)
- Commonwealth DCCEEW EPBC Act Protected Matters Search Tool (PMST) (Cth DCCEEW 2025)
- The NSW State Vegetation Type Map (SVTM) (NSW DCCEEW 2024a)
- The NSW Hydrography watercourse mapping (NSW DCCEEW 2024b).

4.4 Flora and vegetation assessment

Prior to the field surveys, the Study Area was stratified using aerial photography interpretation (API), former Niche PCT mapping (Niche 2021) and vegetation mapping for the locality (NSW SVTM [NSW DCCEEW 2024a]).



Following a review of the existing mapping, field surveys were conducted to ground-truth existing vegetation mapping.

Vegetation communities were categorised into PCTs using data collected via Rapid Data Point (RDPs), as detailed below. A total of 59 RDPs were collected containing points in which the most dominant species and their percent cover were recorded for each stratum. Data collected at each of these points included:

- Dominant species present within all strata levels
- Total projective foliage cover and height at all strata levels
- Photographic evidence.

Flora surveys focused on vegetation validation of SVTM of TECs and opportunistic threatened plant searches. Species composition and characteristic were then compared with PCT descriptions (NSW DCCEEW 2025b).

4.5 Fauna habitat assessment

Aquatic habitat within the Study Area was determined using the NSW Hydrography watercourse mapping (NSW DCCEEW 2024b). Prior to the field surveys, the Study Area was stratified using API, former Niche mapping (Niche 2021), and existing NSW Hydrography (NSW DCCEEW 2024b). Following a review of the existing mapping, field surveys were conducted to ground-truth existing aquatic habitat mapping.

The ground-truthing assessment was conducted to determine potential aquatic habitat for threatened frogs likely to occur within the Study Area. The survey involved walking accessible riparian zones and watercourses, with fauna surveys limited to searches for habitat and indirect signs of presence. In addition to incidental observations, a Rapid Aquatic Habitat Assessment was undertaken, which included evaluating habitat characteristics and parameters such as:

- Physical aspects such as climate (desktop), geology, soils, slope, elevation, drainage and aspect
- Identification and mapping of ground refugia that could potentially support threatened frogs
- Structural habitat including the identification and recording of indirect signs of fauna presence
- Key stream features such as a channel morphology, flow characteristics, substrate composition, in-stream vegetation, and the presence of pools, riffles, and snags.

4.6 Limitations

Surveys were conducted during February, March and June 2025, focusing on biodiversity that could potentially be impacted by subsidence, such as frog habitat and riparian zones sensitive to water loss. Due to the location of the proposed longwalls, access to some private properties was not secured during the current assessment. As such, this constrained the habitat surveys and reduced the capacity to survey the entire Study Area. In some cases, vegetation was viewed using public vantage points to confirm communities with previously mapped areas. The likelihood of threatened species occurring was inferred based on the availability and quality of suitable habitat within the Study Area. Discussions of ecological values for land not ground-truthed, including vegetation mapping and suitable habitat are based on previously published work and interpretation of recent aerial photography.



4.7 Likelihood of occurrence

A list of threatened flora and fauna within the locality (10 km radius) was derived from the BioNet Atlas (DCCEEW 2025a). This list was analysed to determine species that may potentially be impacted by the proposed activity (Annex 2).

The likelihood of species occurring within the Study Area was evaluated on a species-by-species basis to determine potential impacts and the necessary level of assessment. Five categories for 'likelihood of occurrence' were attributed to species after considering criteria such as known records, presence or absence of important habitat features in the Study Area and applying professional judgement (Table 3).

Additionally, a PMST search (Cth DCCEEW 2025) was conducted in conjunction with the BioNet Atlas and is attached in Annex 3. It should be noted that the PMST search did not provide any additional species that would be likely to occur within the Study Area.

Table 3: Likelihood of occurrence criteria

Likelihood rating	Threatened flora criteria	Threatened and migratory fauna criteria
Known	The species was observed within the Study Area.	The species was observed within the Study Area.
High	It is likely that a species inhabits or utilises habitat within the Study Area.	It is likely that a species inhabits or utilises habitat within the Study Area.
Moderate	Potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the Study Area.	Potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be wholly dependent on the habitat present within the Study Area.
Low	It is unlikely that the species inhabits the Study Area.	It is unlikely that the species inhabits the Study Area. If present at the site, the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its on-going local existence.
None	The habitat within the Study Area is unsuitable for the species.	The habitat within the Study Area is unsuitable for the species.



5. Results

5.1 Preliminary assessment

Data from the BioNet Atlas (NSW DCCEEW 2025a), which holds records from a number of custodians, was collected on 10 January 2025 via a database search [for the location North: -34.02 West: 150.54 East: 150.84 South: -34.27] returned a total of 10,212 records of 107 species within a 10 km radius of the Study Area.

5.2 Flora and native vegetation

5.2.1 Existing Vegetation Mapping

Existing vegetation mapping (NSW DCCEEW 2024a) indicates seven PCTs occurring within the Study Area:

- PCT 3110: *Greater Sydney Enriched Grey Myrtle Dry Rainforest*
- PCT 3145: *Cumberland Bangalay x Blue Gum Riverflat Forest*
- PCT 3318: *Cumberland Moist Shale Woodland*
- PCT 3319: *Cumberland Shale Hills Woodland*
- PCT 3320: *Cumberland Shale Plains Woodland*
- PCT 3321: *Cumberland Shale-Sandstone Ironbark Forest*
- PCT 4025: *Cumberland Red Gum Riverflat Forest.*

As part of this survey, vegetation mapping was reviewed and updated to align with the current PCT classification system (updated 2022) as previous assessments referenced decommissioned PCTs. Table 4 provides a summary of the updated PCTs identified within the Study Area, including their transfer from legacy classifications to the current classification (as per SVTM) (NSW DCCEEW 2024a).

Table 4: PCTs for the Study Area based on 2022 SVTM

PCT	Parent PCT (Niche 2021)	Associated TEC (BC Act)	Associated TEC (EPBC Act)	Area in Study Area (ha)	Area directly mined beneath (ha)
PCT 3110: <i>Greater Sydney Enriched Grey Myrtle Dry Rainforest</i>	PCT 877: <i>Grey Myrtle dry rainforest of the Sydney Basin Bioregion and South East Corner Bioregion</i>	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (Endangered); and Western Sydney Dry Rainforest and Moist Woodland on Shale (Endangered)	Western Sydney Dry Rainforest and Moist Woodland on Shale (Critically Endangered)	35.02	12.71



PCT	Parent PCT (Niche 2021)	Associated TEC (BC Act)	Associated TEC (EPBC Act)	Area in Study Area (ha)	Area directly mined beneath (ha)
PCT 3145: <i>Cumberland Bangalay x Blue Gum Riverflat Forest</i>	N/A	Elderslie Banksia Scrub Forested (Critically Endangered); and River-Flat Eucalypt Forest on the Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Endangered)	Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion (Critically Endangered); and River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria (Critically Endangered)	0.40	0
PCT 3318: <i>Cumberland Moist Shale Woodland</i>	PCT 830: <i>Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion</i>	Moist Shale Woodland in the Sydney Basin Bioregion (Endangered)	Western Sydney Dry Rainforest and Moist Woodland on Shale (Critically Endangered)	122.28	64.32
PCT 3319: <i>Cumberland Shale Hills Woodland</i>	PCT 830: <i>Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion</i> ; and PCT850: <i>Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion</i>	Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)	370.96	137.99
PCT 3320: <i>Cumberland Shale Plains Woodland</i>	PCT 835: <i>Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion</i> ; and PCT850: <i>Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion</i> ; and PCT849: <i>Grey Box - Forest Red Gum</i>	Cumberland Plain Woodland in the Sydney Basin Bioregion (Critically Endangered); and Shale Gravel Transition Forest in the Sydney Basin Bioregion (Endangered)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Critically Endangered)	39.70	10.83



PCT	Parent PCT (Niche 2021)	Associated TEC (BC Act)	Associated TEC (EPBC Act)	Area in Study Area (ha)	Area directly mined beneath (ha)
	<i>grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion</i>				
PCT 3321: Cumberland Shale-Sandstone Ironbark Forest	PCT 1395: <i>Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion</i>	Shale Sandstone Transition Forest in the Sydney Basin Bioregion (Critically Endangered)	Shale Sandstone Transition Forest of the Sydney Basin Bioregion (Critically Endangered)	0.38	0
PCT 4025: Cumberland Red Gum Riverflat	PCT 835: <i>Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion</i>	River-Flat Eucalypt Forest on the Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Endangered)	River-flat eucalypt forest on coastal floodplains of southern NSW and eastern Victoria (Critically Endangered)	31.03	15.41
Total:				599.77	241.27

5.2.2 Plant Community Types (PCTs)

All PCT descriptions detailed in Table 5 are derived from the BioNet Vegetation Classification (NSW DCCEEW 2025b).

Table 5: PCTs and vegetation description

PCT	Description
PCT 3110: Greater Sydney Enriched Grey Myrtle Dry Rainforest	A mid-high to very tall, mid-dense to dense rainforest, sometimes with eucalypt emergent, or rarely a very tall to extremely tall sclerophyll open forest with a dense rainforest sub-canopy or mid-stratum. This PCT occurs most extensively in the Sydney Basin hinterland, in ranges and hills between the Hunter valley near Singleton and the Ettrema catchment west of Nowra. The canopy almost always includes <i>Backhousia myrtifolia</i> , which usually dominates with the highest cover. Other species that rarely occur, either as emergent or in the canopy, include <i>Eucalyptus tereticornis</i> , <i>Angophora floribunda</i> and <i>Corymbia maculata</i> . <i>Notelaea longifolia</i> is very frequently present in the canopy or understorey however usually not abundant. Other species of small trees or shrubs which occur in the mid-stratum, or sometimes in the canopy, commonly include <i>Breynia oblongifolia</i> , and occasionally <i>Melicytus dentatus</i> , <i>Alectryon subcinereus</i> , <i>Bursaria spinosa</i> , <i>Clerodendrum tomentosum</i> and <i>Pittosporum undulatum</i> . The vines <i>Geitonoplesium cymosum</i> and <i>Pandorea pandorana</i> are almost always present, usually with a low cover. The very sparse to mid-dense ground layer is comprised of ferns, forbs and grasses. Species almost always include <i>Pellaea falcata</i> , very frequently <i>Adiantum aethiopicum</i> , <i>Asplenium flabellifolium</i> and <i>Microlaena stipoides</i> , commonly with <i>Plectranthus parviflorus</i> , <i>Dichondra repens</i> , <i>Oplismenus</i>



PCT	Description
	<i>imbecillis</i> and the epiphytic fern <i>Pyrrosia rupestris</i> . This PCT occurs mainly in mild, relatively dry locations receiving 720-900 mm mean annual rainfall, at mid-elevations of 140-510 m above sea level (asl). It occurs mainly on sandstone lithology, occasionally on shale or ignimbrite, along creeks, in gullies or on steep rocky slopes, where there is a degree of protection from fire. It partly overlaps in range and environment with PCT 3151, which also has a dense canopy or sub-canopy of <i>Backhousia myrtifolia</i> , however tends to occur in cooler sites than that PCT. These two PCTs are floristically related, however PCT 3110 has a higher frequency of vines <i>Geitonoplesium cymosum</i> and <i>Pandorea pandorana</i> . PCT 3110 grades into grassy forest PCTs on surrounding slopes which are more exposed or subject to more frequent fire. For example, in the Burragarang area it may grade into PCT 3482 or PCT 3484.
PCT 3145: Cumberland Bangalay x Blue Gum Riverflat Forest	A very tall sclerophyll open forest with a scattered mesic mid-stratum and a grassy ground cover that occurs along the sandy riverbanks of the Nepean and Georges rivers in south western Sydney. The canopy very frequently includes either <i>Eucalyptus botryoides</i> or the hybrid <i>Eucalyptus botryoides - saligna</i> , with a mix of other eucalypts none of which are common. These may include <i>Eucalyptus elata</i> , <i>Eucalyptus benthamii</i> , <i>Angophora subvelutina</i> or <i>Eucalyptus amplifolia</i> . An open layer of small trees almost always includes one or more <i>Acacia</i> species, of which <i>Acacia binervia</i> is most frequent and abundant. On the banks of the Georges River the small tree layer may include dense stands of the exotic <i>Ligustrum sinense</i> and as a result, smaller shrubs may have a reduced cover and diversity. Nevertheless, <i>Phyllanthus gunnii</i> , <i>Melicytus dentatus</i> and <i>Phebalium squamulosum</i> are commonly present. The mid-dense ground layer is typically comprised of a hardy fern, grasses and forbs, almost always including <i>Microlaena stipoides</i> and very frequently <i>Pteridium esculentum</i> , <i>Austrostipa ramosissima</i> and <i>Oplismenus aemulus</i> . Common ground covers include <i>Microlaena stipoides</i> , <i>Aristida vagans</i> , <i>Dianella caerulea</i> , <i>Vernonia cinerea</i> , <i>Pomax umbellata</i> and <i>Lobelia purpurascens</i> . This PCT is situated on elevated alluvial systems that have a greater proportion of sandy material in the soil than the true broad silt-rich floodplains of the Nepean and Georges rivers. It typically occurs at elevations of below 70 metres asl in a warm, moist climate, with localised higher elevation found in a perched creek flat on an aeolian sand terrace at Spring Farm near Elderslie. It is related to PCT 4025, a river flat forest found on the Cumberland Plain and nearby on the Georges River, however PCT 4025 has fewer mesic small trees and shrubs a consistently higher cover of <i>Eucalyptus tereticornis</i> or <i>Eucalyptus amplifolia</i> and a diverse grass and herb ground cover that reflect the richer clay soils. This PCT is only defined from ten primary plots, many of which include a high proportion of exotic species, and the assemblage and environment of any new plots should be carefully evaluated before they are assigned to it.
PCT 3318: Cumberland Moist Shale Woodland	A tall to very tall sclerophyll woodland to open forest with a mid-stratum of soft-leaved species and ground cover featuring ferns and vines on protected aspects on steeper shale hills and rises of the southern half of the Cumberland Plain, in the Sydney Basin. The canopy very frequently includes <i>Eucalyptus tereticornis</i> occasionally with <i>Eucalyptus moluccana</i> which is prominent in localised areas. <i>Corymbia maculata</i> is rare overall however can be prominent on the sheltered slopes around Cecil Hills and Orangeville. It differs from the grassy woodlands found in western Sydney by the prevalence of waxy-leaved shrubs and small trees in the mid-stratum and a ground cover of soft-leaved forbs, fleshy vines, ferns and grasses. The shrub to small tree layer almost always includes one or more <i>Acacia</i> species, of which <i>Acacia implexa</i> is the most frequent and abundant. <i>Bursaria spinosa</i> and <i>Breynia oblongifolia</i> are also very frequent and <i>Clerodendrum tomentosum</i> and the scrambler <i>Rubus parvifolius</i> are common. The mid-dense ground layer is comprised of ferns, vines, grasses, forbs, twiners and low-growing shrubs. It almost always includes <i>Cayratia clematidea</i> and very frequently <i>Adiantum aethiopicum</i> , <i>Desmodium varians</i> , <i>Dichondra repens</i> , <i>Pandorea pandorana</i> subsp. <i>pandorana</i> , <i>Geitonoplesium cymosum</i> , <i>Microlaena stipoides</i> , <i>Pellaea falcata</i> , <i>Oplismenus imbecillis</i> and <i>Eustrephus latifolius</i> . Much of the habitat of this PCT has been cleared, with remaining stands commonly invaded by weeds including dense thickets of <i>Olea europaea</i> subsp. <i>cuspidata</i> . Weed invasion impacts on native species diversity and possibly helps explain the relative low frequency of canopy species of this PCT compared to other PCTs on the Cumberland Plain shales. This PCT typically occurs in a warm, moist climate on mid to lower slopes below 290 metres asl near Cecil Hills, Orangeville and on the Razorback Range. There is some floristic overlap of this PCT with nearby dry rainforests on more sheltered sites, which share species such as <i>Clerodendrum tomentosum</i> and <i>Cayratia clematidea</i> . On more exposed aspects, this PCT grades into PCT 3319 which includes similar canopy species however lacks the sheltered shrubs, ferns and vines that are present in this PCT.



PCT	Description
PCT 3319: <i>Cumberland Shale Hills Woodland</i>	A tall to very tall sclerophyll woodland to open forest with a mid-stratum of soft-leaved shrubs and small trees with a grassy ground cover that is extensive on rises and upper slopes of hills south from Cecil Hills, in the south-western part of the Cumberland Plain to the west of Sydney. It is most extensive in Campbelltown, Camden and Wollondilly local government areas. The canopy commonly includes <i>Eucalyptus moluccana</i> and <i>Eucalyptus tereticornis</i> , with a sparse shrub to small tree layer which very frequently includes <i>Bursaria spinosa</i> and at least one species of <i>Acacia</i> , of which <i>Acacia implexa</i> is most frequent. The presence of <i>Acacia implexa</i> helps distinguish this PCT from PCT 3320, which has a similar assemblage and structure. The mid-dense ground layer typically includes forbs, grasses and twiners. <i>Dichondra repens</i> is almost always present and <i>Microlaena stipoides</i> , <i>Desmodium varians</i> , <i>Brunoniella australis</i> and <i>Aristida ramosa</i> are very frequent. This PCT typically occurs in a warm, moist climate between 90-300 metres asl. It has been heavily cleared and now occurs in small remnants with varying levels of disturbance within a rural landscape. The canopy in these remnants often comprises immature cohorts of trees that have regenerated after thinning or clearing. The distribution of this PCT overlaps with PCT 3320 between Cecil Hills and the Nepean River, in which area of overlap PCT 3319 typically occurs on higher elevation hills and ridges. This PCT grades into PCT 3318 on lower protected slopes in the more dissected hills around Cecil Hills and the Razorback Range, and into PCT 3321 near the interface with the sandstone plateaus on the edge of the Cumberland Plain. PCT 3318 includes shrubs, ferns and vines typical of sheltered habitats that are rare in this PCT. Ironbark eucalypts are very frequent and <i>Eucalyptus punctata</i> is common in the canopy of PCT 3321, and <i>Eucalyptus moluccana</i> and <i>Eucalyptus tereticornis</i> are both rare.
PCT 3320: <i>Cumberland Shale Plains Woodland</i>	A tall sclerophyll open forest or woodland with a sparse mid-stratum of soft-leaved shrubs and small trees with a grassy ground cover on the undulating Wianamatta Group shale plains of western Sydney. The canopy very frequently includes <i>Eucalyptus tereticornis</i> and <i>Eucalyptus moluccana</i> , with ironbarks (<i>Eucalyptus crebra</i> and <i>Eucalyptus fibrosa</i>) occasionally present and sometimes prominent in localised areas. The sparse shrub to small tree layer very frequently includes <i>Bursaria spinosa</i> and one or more species of <i>Acacia</i> , of which <i>Acacia parramattensis</i> , <i>Acacia decurrens</i> and <i>Acacia falcata</i> are the most frequent and abundant. Presence of these <i>Acacia</i> species helps to distinguish this PCT from the related PCT 3319 on rises of the southern Cumberland Plain which typically includes <i>Acacia implexa</i> . The mid-dense ground layer typically includes grasses, forbs, twiners and hardy small ferns. <i>Microlaena stipoides</i> is almost always present and <i>Themeda triandra</i> , <i>Dichondra repens</i> , <i>Brunoniella australis</i> , <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> , <i>Desmodium varians</i> , <i>Aristida vagans</i> and <i>Glycine tabacina</i> are very frequent. This is the most widespread PCT on the Cumberland Plain, occupying much of the plain between Bankstown and the Hawkesbury and Nepean rivers. It typically occurs in a warm, moist climate below 120 metres asl however can occur up to 200 metres asl on the undulating terrain between Douglas Park and Campbelltown to the east of the Nepean River. A northern outlier occurs near Maroota on a small remnant on a narrow shale ridge. While widespread on the main part of the plain, this PCT primarily occurs in small, often disturbed patches within a rural or urban matrix. In the hilly country to the west of the Nepean River, this PCT is replaced by PCT 3319. On thinner shales above sandstone around the periphery of the Cumberland Plain, it grades into PCT 3321. Ironbarks are very frequent and <i>Eucalyptus punctata</i> is common in the canopy of PCT 3321, and <i>Eucalyptus moluccana</i> and <i>Eucalyptus tereticornis</i> are both rare.
PCT 3321: <i>Cumberland Shale-Sandstone Ironbark Forest</i>	A tall sclerophyll open forest with a mid-stratum of dry and soft-leaved shrubs or small trees and a ground cover of grasses and graminoids found on the fringes of the Cumberland Plain in the Sydney Basin. It is one of a suite of forests that are associated with the subtle intergrade between clay-rich shale soil and the coarse sandy substrates of the sandstone plateau. The canopy almost always includes ironbark eucalypts (<i>Eucalyptus crebra</i> , <i>Eucalyptus fibrosa</i>) and commonly <i>Eucalyptus punctata</i> and stringybark eucalypts (<i>Eucalyptus globoidea</i> or <i>Eucalyptus eugenioides</i>). A sparse small tree layer almost always includes one or more <i>Acacia</i> species, of which <i>Acacia parramattensis</i> and <i>Acacia decurrens</i> are the most frequent and abundant, commonly with <i>Allocasuarina littoralis</i> or <i>Allocasuarina torulosa</i> . The shrub layer includes a mix of species that typically occur on sandstone soils and shale substrates. The sandstone shrubs very frequently include <i>Persoonia linearis</i> and shale species commonly include <i>Bursaria spinosa</i> and <i>Leucopogon juniperinus</i> . The mid-dense ground layer typically consists of graminoids, forbs and hardy ferns, and very frequently includes <i>Microlaena stipoides</i> , <i>Lobelia purpurascens</i> , <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> , <i>Entolasia stricta</i> , <i>Aristida vagans</i> , <i>Lepidosperma laterale</i> , <i>Themeda triandra</i> and <i>Lomandra multiflora</i> subsp. <i>multiflora</i> . This PCT occurs in a warm, moist climate on the western edge of the Woronora Plateau, on the rim of the Nepean and Georges rivers, along the



PCT	Description
	edge of the Lapstone Monocline and in Hawkesbury and The Hills local government areas. It is floristically related to PCT 3448 which differs in that <i>Eucalyptus fibrosa</i> and <i>melaleucas</i> (<i>Melaleuca decora</i> or <i>Melaleuca nodosa</i>) are almost always present, and it is primarily found on Tertiary alluvium or shale-gravel soils. There is much gradation between these PCTs, especially in the northern Holsworthy. On soil where shale has a lesser influence on the vegetation composition, this PCT grades into either PCT 3616 or 3619, in which ironbarks, <i>Bursaria spinosa</i> and soft ground covers such as <i>Lobelia purpurascens</i> , <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> and <i>Dichondra repens</i> are less frequent than in this PCT. Trees, shrubs and hardier groundcovers that are more frequent in PCT 3616 include <i>Eucalyptus punctata</i> , <i>Corymbia gummifera</i> , <i>Leptospermum trinervium</i> and <i>Acacia linifolia</i> , <i>Lomandra obliqua</i> and <i>Cyathochaeta diandra</i> . <i>Corymbia gummifera</i> is very frequent in PCT 3619 which also includes sandstone heath species and hardier groundcovers such as <i>Banksia spinulosa</i> , <i>Persoonia levis</i> , <i>Lambertia formosa</i> , <i>Lomandra obliqua</i> and <i>Cyathochaeta diandra</i> . With a greater shale influence, this PCT grades into PCT 3320 which includes <i>Eucalyptus tereticornis</i> and <i>Eucalyptus moluccana</i> in its canopy.
PCT 4025: <i>Cumberland Red Gum Riverflat</i>	A tall to extremely tall sclerophyll open forest with a mid-stratum of soft-leaved shrubs and small trees and dense, grassy ground layer situated on the alluvial flats alongside streams that drain the Cumberland Plain or more rarely the broad alluvial flats of the Hawkesbury and Nepean River systems to the west of Sydney. The canopy almost always includes red gums (<i>Eucalyptus tereticornis</i> , <i>Eucalyptus amplifolia</i>), occasionally associated with an apple (<i>Angophora floribunda</i> , <i>Angophora subvelutina</i>), which may be locally prominent. A sparse mid-stratum almost always includes <i>Bursaria spinosa</i> and one or more <i>Acacia</i> species, of which <i>Acacia parramattensis</i> is the most frequent and abundant. The ground layer is typically characterised by a dense cover of grasses along with soft-leaved forbs and ferns. A high cover of <i>Microlaena stipoides</i> is almost always present with more scattered <i>Dichondra repens</i> , <i>Oplismenus aemulus</i> and <i>Solanum prinophyllum</i> being very frequent. The largest remaining areas are situated along the smaller streams and, while widespread, this PCT primarily occurs in small, often disturbed patches and is threatened by ongoing weed invasion following flood events. It typically occurs in a warm, moist climate at low elevation with a mean of 60 metres asl, however may occur up to 320 metres in southern parts of the Cumberland Plain. Where saline soils occur on the floodplain, this PCT grades into PCT 4023 which includes <i>Casuarina glauca</i> in its canopy. Where the floodplain narrows in valleys with sandstone escarpments upslope, it grades into PCT 4058 which includes a wider range of shrubs and scramblers including <i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i> , <i>Breynia oblongifolia</i> and <i>Rubus parvifolius</i> . As elevation or distance from the margin of the floodplain increases, this PCT grades into grassy woodlands of the Cumberland Plain (PCT 3320) in which <i>Eucalyptus moluccana</i> is common.

5.3 Threatened ecological communities

The following TECs are associated with the PCTs mapped within the Study Area. These associations are based on legislative listings under the BC Act and EPBC Act. A summary of these associations is provided in Table 4.

PCT 3110: *Greater Sydney Enriched Grey Myrtle Dry Rainforest*:

- Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (listed as Endangered under the BC Act)
- Western Sydney Dry Rainforest and Moist Woodland on Shale (listed as Endangered under the BC Act)
- Western Sydney Dry Rainforest and Moist Woodland on Shale (listed as Critically Endangered under the EPBC Act).

PCT 3145: *Cumberland Bangalay x Blue Gum Riverflat Forest*:

- Elderslie Banksia Scrub Forested (listed as Critically Endangered under the BC Act)
- Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion (listed as Critically Endangered under the EPBC Act)
- River-Flat Eucalypt Forest on the Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (listed as Endangered under the BC Act)



- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as Critically Endangered under the EPBC Act).

PCT 3318: *Cumberland Moist Shale Woodland*:

- Equivalent: Moist Shale Woodland in the Sydney Basin Bioregion (listed as Endangered under the BC Act)
- Western Sydney Dry Rainforest and Moist Woodland on Shale (listed as Critically Endangered under the EPBC Act).

PCT 3319: *Cumberland Shale Hills Woodland*:

- Cumberland Plain Woodland in the Sydney Basin Bioregion (listed as Critically Endangered under the BC Act)
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (listed as Critically Endangered under the EPBC Act).

PCT 3320: *Cumberland Shale Plains Woodland*:

- Cumberland Plain Woodland in the Sydney Basin Bioregion (listed as Critically Endangered under the BC Act)
- Shale Gravel Transition Forest in the Sydney Basin Bioregion (listed as Endangered under the BC Act)
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (listed as Critically Endangered under the EPBC Act).

PCT 3321: *Cumberland Shale-Sandstone Ironbark Forest*:

- Shale Sandstone Transition Forest in the Sydney Basin Bioregion (listed as Critically Endangered under the BC Act)
- Shale Sandstone Transition Forest of the Sydney Basin Bioregion (listed as Critically Endangered under the EPBC Act).

PCT 4025: *Cumberland Red Gum Riverflat Forest*:

- Elderslie Banksia Scrub Forested (listed as Critically Endangered under the BC Act)
- Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion (listed as Critically Endangered under the EPBC Act)
- River-Flat Eucalypt Forest on the Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (listed as Endangered under the BC Act)
- River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (listed as Critically Endangered under the EPBC Act).

5.4 Threatened flora

A total of 33 threatened plant species listed on the EPBC Act and/or BC Act have been previously recorded or have potential habitat within a 10 km radius of the Study Area (Annex 3 and Figure 6). Of the 33 threatened species obtained in the database searches, nine species (White-flowered Wax Plant [*Cynanchum elegans*], Camden White Gum, *Epacris purpurascens* var. *purpurascens*, Small-flower Grevillea, Bargo Geebung, Matted Bush-pea, Brown Pomaderris, Spiked Rice-flower, Sydney Plains Greenhood) were known to occur or considered to have a Moderate to High likelihood of occurrence in the Study Area. White-flowered Wax Plant has been previously recorded within the Study Area along Remembrance Driveway and in the north-west corner of the site. No other threatened flora has been recorded within the Study Area (NSW DCCEW 2025a); noting that targeted



surveys were not undertaken as part of this assessment. Potential impacts to threatened flora are discussed in Section 6.2.

5.5 Threatened fauna

A total of 58 threatened fauna species listed on the EPBC Act and or BC Act have been previously recorded or have potential habitat within a 10 km radius of the Study Area (Annex 2 and Figure 7). Of the 58 threatened species obtained in the database searches, 28 of these species were determined to have a moderate or high likelihood of occurrence within the Study Area:

- Frogs: Giant Burrowing Frog, Red-crowned Toadlet.
- Birds: Dusky Woodswallow (*Artamus cyanopterus cyanopterus*), Gang-gang Cockatoo, Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*), Speckled Warbler (*Chthonicola sagittata*), Spotted Harrier (*Circus assimilis*), Brown Treecreeper (*eastern subspecies*), Varied Sittella (*Daphoenositta chrysoptera*), Little Lorikeet (*Glossopsitta pusilla*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Little Eagle (*Hieraaetus morphnoides*), Swift Parrot (*Lathamus discolor*), Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*), Black-chinned Honeyeater, Barking Owl (*Ninox connivens*), Powerful Owl, Scarlet Robin (*Petroica boodang*) and Diamond Firetail (*Stagonopleura guttata*).
- Mammals: Large-eared Pied-bat (*Chalinolobus dwyeri*), Spotted-tailed Quoll, Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*), Little Bent-winged Bat (*Miniopterus australis*), Eastern Bent-winged Bat, Southern Myotis, Koala and Grey-headed Flying-fox.
- Invertebrates: Cumberland Plain Land Snail.
- No threatened fauna was recorded within the Study Area; however targeted surveys were not undertaken as part of this assessment. Potential impacts to threatened fauna are discussed in Section 6.4.

5.6 Fauna habitat

Fauna habitat within the Study Area considered sensitive to subsidence impacts is described below.

5.6.1 Creeks and drainage lines

Navigation Creek remains the principal watercourse traversing the Study Area, with several unnamed first- and second-order tributaries feeding into it. In addition to Navigation Creek, Apps Gully and Foot Onslow Creek are watercourses directly overlying Longwalls 712–716 (MSEC 2025). These watercourses, along with their tributaries, form part of the Hawkesbury-Nepean Catchment, exhibiting a mixture of ephemeral and semi-permanent flow regimes.

All drainage lines within the Study Area are currently in poor to moderate condition; a result of historical land use pressures, including grazing, vegetation clearing, and weed invasion. Nevertheless, these systems retain important ecological values, including emergent riparian vegetation, riffle-pool sequences, gravel and sandy substrates, exposed sandstone platforms, and woody debris, all of which provide habitat for native fauna.

According to MSEC (2025), the total length of third-order or greater streams directly overlying the proposed longwalls is approximately 4.9 km, with an additional 10 km of such watercourses located within the broader Study Area. These stream segments have been mapped and assessed as part of the subsidence modelling and are expected to experience minor to moderate subsidence effects, including fracturing, localised surface water redirection, and reduced pool retention capacity in some sections.



These aquatic and riparian habitats are ecologically significant, particularly for amphibians and reptiles, including several threatened frog species. Surface water features such as rock pools, riffle zones, gravel beds, large woody debris, and aquatic vegetation support essential life cycle functions like breeding, foraging, and sheltering. The suitability of habitat varies depending on stream size, gradient, and hydrological permanence. Ephemeral channels often support terrestrial breeders and burrowing species, while semi-permanent or perennial reaches may support aquatic larval stages.

5.6.2 Sandstone outcrops, overhangs and caves

Sandstone outcrops, overhangs and caves within the Study Area are typically important habitat features, particularly to reptile and microbat species. Threatened fauna, such as the Broad-headed Snake (*Hoplocephalus bungaroides*) may utilise the sandstone outcrop features. Caves and overhangs may also provide habitat for microbats, including threatened species: Eastern Bent-wing Bat, Little Bent-wing Bat and Southern Myotis.

According to MSEC (2025), eleven cliffs have been identified within the Study Area, primarily located along the Razorback Range where cliffs have formed in the sandstone members of the Wianamatta Group. Nine of these are directly above Longwalls 714-716 and consequently have the potential for minor fracturing and direct impacts (MSEC 2025).

While these geological features can support roosting habitat, cave development in the Study Area is limited. As such, roosting opportunities for cave-dependent bat species are expected to be highly localised and restricted to small fissures or overhangs, and no large breeding colonies of such species are anticipated within the Study Area.

5.7 Key threatening processes

The 39 Key Threatening Processes (KTPs) that are listed on the BC and/or EPBC Acts and are applicable to terrestrial environments are shown in Table 6. Of these, two KTPs that would potentially be exacerbated by the Proposal:

- Alteration of habitat following subsidence due to longwall mining
- Alteration of the natural flow regimes of rivers, stream, floodplains and wetlands.

Table 6: Key threatening processes

Key Threatening Process		BC Act	EPBC Act equivalent	Exacerbated due to Project
1.	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners, <i>Manorina melanoccephala</i>	√	√	No
2.	Alteration of habitat following subsidence due to longwall mining	√	x	Yes – see below
3.	Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands	√	x	Yes – see below
4.	Anthropogenic Climate Change	√	√	Negligible
5.	Bushrock removal	√	x	No
6.	Clearing of native vegetation	√	√	No



Key Threatening Process		BC Act	EPBC Act equivalent	Exacerbated due to Project
7.	Competition and grazing by the feral European rabbit, <i>Oryctolagus cuniculus</i>	√	√	No
8.	Competition and habitat degradation by feral goats, <i>Capra hircus</i> Linnaeus 1758	√	√	No
9.	Competition from feral honeybees, <i>Apis mellifera</i>	√	√	No
10.	Death or injury to marine species following capture in shark control programs on ocean beaches (as described in the final determination of the Scientific Committee to list the key threatening process)	√	x	No
11.	Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments (as described in the final determination of the Scientific Committee to list the key threatening process)	√	√	No
12.	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	√	x	No
13.	Habitat degradation and loss by Feral Horses (brumbies, wild horses), <i>Equus caballus</i> Linnaeus 1758	√	x	No
14.	Herbivory and environmental degradation caused by feral deer	√	x	No
15.	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	√	√	No
16.	Importation of Red Imported Fire Ants <i>Solenopsis invicta</i> Buren 1972	√	√	No
17.	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	√	√	No
18.	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	√	√	No
19.	Infection of native plants by <i>Phytophthora cinnamomi</i>	√	√	No
20.	Introduction and establishment of Exotic Rust Fungi of the order Puccinales pathogenic on plants of the family Myrtaceae	√	x	No
21.	Introduction of the Large Earth Bumblebee <i>Bombus terrestris</i> (L.)	√	x	No
22.	Invasion and establishment of exotic vines and scramblers	√	x	No



Key Threatening Process		BC Act	EPBC Act equivalent	Exacerbated due to Project
23.	Invasion and establishment of Scotch Broom (<i>Cytisus scoparius</i>)	√	x	No
24.	Invasion and establishment of the Cane Toad (<i>Bufo marinus</i>)	√	√	No
25.	Invasion, establishment and spread of Lantana (<i>Lantana camara</i> L. sens. lat)	√	x	No
26.	Invasion of native plant communities by African Olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	√	x	No
27.	Invasion of native plant communities by <i>Chrysanthemoides monilifera</i>	√	x	No
28.	Invasion of native plant communities by exotic perennial grasses	√	(only N. Aust)	No
29.	Invasion of the Yellow Crazy Ant, <i>Anoplolepis gracilipes</i> (Fr. Smith) into NSW	√	(only Christmas Island)	No
30.	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	√	√	No
31.	Loss of hollow-bearing trees	√	x	No
32.	Loss or degradation (or both) of sites used for hill-topping by butterflies	√	x	No
33.	Predation and hybridisation by Feral Dogs, <i>Canis lupus familiaris</i>	√	√	No
34.	Predation by <i>Gambusia holbrooki</i> Girard, 1859 (Plague Minnow or Mosquito Fish) (as described in the final determination of the Scientific Committee to list the threatening process)	√	x	No
35.	Predation by the European Red Fox <i>Vulpes vulpes</i> (Linnaeus, 1758)	√	√	No
36.	Predation by the Feral Cat <i>Felis catus</i> (Linnaeus, 1758)	√	√	No
37.	Predation by the Ship Rat <i>Rattus rattus</i> on Lord Howe Island	√	√	No
38.	Predation, habitat degradation, competition and disease transmission by Feral Pigs, <i>Sus scrofa</i> Linnaeus 1758	√	√	No
39.	Removal of dead wood and dead trees	√	x	No



5.7.1 Alteration of habitat following subsidence due to longwall mining

Alteration of habitat following subsidence due to longwall mining is listed as a KTP under Schedule 4 of the BC Act. Alteration of habitat following subsidence due to longwall mining remains listed as a KTP under Schedule 4 of the BC Act. This KTP is directly relevant to the Project. As confirmed by MSEC (2025), longwall mining can result in subsidence that leads to changes in surface hydrology, fracturing of rock beds, and loss of surface water retention in pools and creeks—all of which can significantly alter habitats. Species and ecological communities reliant on aquatic and semi-aquatic habitats are particularly vulnerable to these changes.

The NSW Scientific Committee (2005) Final Determination identifies a number of threatened species and ecological communities that may be adversely impacted by subsidence-induced habitat alteration. Of relevance to this assessment are several threatened fauna species including Southern Myotis, Red-crowned Toadlet and Grey-headed Flying Fox. No flora species are specifically listed in the determination as relevant to this assessment.

These potential impacts highlight the importance of careful consideration of hydrological and habitat changes associated with subsidence in biodiversity impact assessments, especially within sensitive environments such as ephemeral creeks, hanging swamps, and rocky escarpments. Refer to Table 2 for detailed subsidence predictions and associated surface water and habitat implications for Longwalls 712-716.

5.7.2 Alteration of the natural flow regimes of rivers, stream, floodplains and wetlands

Alteration of the natural flow regimes of rivers, streams, floodplains and wetlands is listed as a KTP under Schedule 4 of the BC Act. This KTP is directly relevant to the Project, as subsidence resulting from longwall mining can lead to measurable changes in flow regimes across affected landscapes.

Subsidence can alter natural hydrology by reducing or increasing surface flows, changing the frequency, duration, timing, and magnitude of flow events, and modifying both surface and subsurface water levels. These alterations can also disrupt the seasonality and predictability of flow regimes and affect the rate at which water levels rise or fall. According to MSEC (2025), such changes are most likely to occur along creeks and drainage lines situated directly above or adjacent to the proposed longwalls (712-716), where fracturing and valley-related effects may locally affect stream baseflows, standing pools, or connectivity between surface and groundwater systems.

These impacts may in turn affect the condition of aquatic and riparian ecosystems and contribute to broader ecological degradation across the Study Area if not carefully monitored and mitigated.

5.8 Areas of Outstanding Biodiversity Value (AOBV)

No Areas of Outstanding Biodiversity Value (AOBV) have been declared for any ecological values within the Study Area. No AOBV will be impacted by the proposal.



6. Impact assessment

6.1 Potential impacts to vegetation

Vegetation communities in the Study Area that are not reliant on groundwater, such as much of the PCT 3319: *Cumberland Shale Hills Woodland* and PCT 3321: *Cumberland Shale-Sandstone Ironbark Forest*, are considered unlikely to be significantly affected by subsidence resulting from the proposed longwall mining activities. However, areas mapped as GDEs – including parts of PCT 4025: *Cumberland Red Gum Riverflat Forest* and PCT 3145: *Cumberland Bangalay x Blue Gum Riverflat Forest*, overlap with the predicted subsidence footprint and may be more susceptible to impacts from subsidence-related hydrological change.

Mapped GDEs include zones of high, moderate, and low groundwater dependence (from the national assessment), with notable areas of high potential GDEs intersecting the western and central portions of the Study Area, directly above or adjacent to the proposed longwalls. These ecosystems may experience changes in floristic composition due to altered groundwater availability, strata gas emissions, or surface cracking. However, subsidence modelling from MSEC (2025) predicts limited vertical movement and minimal hydrological disruption, suggesting that widespread or severe impacts are unlikely.

Historical observations from the Southern Coalfield indicate that subsidence-related impacts to riparian and GDE vegetation are typically minor and highly localised. For this proposal, predicted impacts remain within the range assessed under the original BSO Environmental Assessment (BHPBIC 2009). Nonetheless, the spatial overlap between high-value GDEs and the subsidence zone reinforces the need for targeted monitoring and management, as will be detailed in the Biodiversity Management Plan.

6.2 Potential impacts to threatened flora

Nine threatened flora species have been assessed as previously recorded or having a moderate to high likelihood of occurrence within the Study Area (Annex 2). However, only a subset of these species are associated with habitat types potentially susceptible to subsidence-related impacts such as cracking, changes in drainage, or gas emissions (Table 7).

One threatened plant species, White-flowered Wax Plant, has been previously recorded within the Study Area; along the eastern portion of Remembrance Driveway and the north-west corner of the site. This on Razorback Range and associated with PCT 3310: *Greater Sydney Enriched Grey Myrtle Dry Rainforest* (Figure 6). MSEC (2025) identifies Razorback Range as an area subject to greater subsidence tilt and curvature, which increases the likelihood of surface cracking and potential indirect effects on shallow-rooted vegetation. Therefore, there is the potential for White-flowered Wax Plant to be impacted by mine subsidence due to its potential likely presence on steep rocky slopes and shallow soils.

Other threatened flora species such as Small-flower Grevillea, *Epacris purpurascens* var. *purpurascens*, and Camden White Gum have not been confirmed in the Study Area but are considered to have suitable habitat, particularly in association with creek lines and shale-sandstone transition soils. Modelled subsidence is not predicted to result in large-scale hydrological changes, and, as such, any impacts to the habitat of these species is considered to be negligible (HGEO 2025).

Overall, the predicted impacts on threatened flora from the current proposal remain consistent with the BSO Environmental Assessment (BHPBIC 2009), with risk levels generally assessed as negligible to low (Table 7). The integration of updated site-specific subsidence modelling (MSEC 2025) improves confidence in this assessment.



However, given the confirmed presence of habitat within the Study Area, a precautionary monitoring and management approach will be recommended within the Biodiversity Management Plan to ensure early detection of impacts.

Table 7: Threatened flora with potential to be impacted within the Study Area

Species	Potentially habitat in Study Area	Level of impact according to FloraSearch (2009)	Level of impact according to Biosis (2012)	Level of impact according to Biosis (2008)	Level of impact based on current survey
White-flowered Wax Plant	Previously recorded in Razorback Range. Potential habitat associated with PCT 3110: <i>Greater Sydney Enriched Grey Myrtle Dry Rainforest</i>	Habitat may potentially be subject to mine subsidence-related rock falls and land slips. However, the likelihood of rock falls and land slips are reduced due to the high depths of cover above the Bulli Seam in the Razorback Ranges. Significant impact unlikely.	As for BSO EA. Negligible residual risk.	Not considered due to absence of suitable habitat.	Habitat may be impacted by subsidence, but only minimal impacts likely. Predicted impacts for current proposal consistent with predicted impacts in BSO EA.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	Previously recorded adjacent to Study Area. Open woodland, damp gullies, riparian on shale/sandstone transition soils.	Habitat could potentially be affected by mechanisms of subsidence. The magnitude of the predicted subsidence effects is considered too small to significantly influence the hydrological processes in shale/sandstone transition soils. Therefore, it is unlikely there would be any biologically significant effect on the habitats of threatened shale/sandstone transition species due to soil moisture change. Significant impact unlikely.	As for BSO EA. Negligible residual risk.	Habitat not likely to be impacted by subsidence.	Habitat may be impacted by subsidence, but only minimal impacts likely. Predicted impacts for current proposal consistent with predicted impacts in BSO EA.
Camden White Gum	Not previously recorded in Study Area. Potential habitat along larger stretches of Navigation Creek.	Not considered.	Not considered.	Habitat could potentially be affected by mechanisms of subsidence. Unlikely to be significantly impacted.	Habitat may be impacted by subsidence, but only minimal impacts likely. Predicted impacts for current proposal consistent with predicted impacts in BSO EA.
Small-flower Grevillea	Not previously recorded in Study Area.	Habitat could potentially be affected by mechanisms of subsidence. The magnitude of the predicted subsidence effects is considered too small	As for BSO EA.	Habitat not likely to be impacted by subsidence.	Potential habitat occurs within the drier soils of shale/sandstone communities,



Species	Potentially habitat in Study Area	Level of impact according to FloraSearch (2009)	Level of impact according to Biosis (2012)	Level of impact according to Biosis (2008)	Level of impact based on current survey
	Open woodland on shale/sandstone transition soils.	to significantly influence the hydrological processes in shale/sandstone transition soils. Therefore, it is unlikely there would be any biologically significant effect on the habitats of threatened shale/sandstone transition species due to soil moisture change. Significant impact unlikely.	Negligible residual risk.		hence less likely to be impacted by potential hydrological changes due to subsidence. Habitat not likely to be impacted by subsidence. Predicted impacts as a result of current proposal consistent with predicted impacts in BSO EA.
Bargo Geebung	Not previously recorded in Study Area. Open woodland on shale/sandstone transition soils.	Habitat could potentially be affected by mechanisms of subsidence. The magnitude of the predicted subsidence effects is considered too small to significantly influence the hydrological processes in shale/sandstone transition soils. Therefore, it is unlikely there would be any biologically significant effect on the habitats of threatened shale/sandstone transition species due to soil moisture change. Significant impact unlikely.	As for BSO EA. Negligible residual risk.	Habitat not likely to be impacted by subsidence.	Potential habitat occurs within the drier soils of shale/sandstone communities, hence less likely to be impacted by potential hydrological changes due to subsidence. Habitat not likely to be impacted by subsidence. Predicted impacts as a result of current proposal consistent with predicted impacts in BSO EA.
Spiked Rice-flower	Previously recorded adjacent to Study Area. Potential habitat within Cumberland Plain Woodland.	Habitat could potentially be affected by mechanisms of subsidence. The magnitude of the predicted subsidence effects is considered too small to significantly influence the hydrological processes in shale/sandstone transition soils. Therefore, it is unlikely there would be any biologically significant effect on the habitats of threatened shale/sandstone transition species due to soil moisture change.	Not considered.	Habitat not likely to be impacted by subsidence.	Species and its potential habitat occur within the drier soils of Cumberland Plain Woodland communities, hence less likely to be impacted by potential hydrological changes due to subsidence. Habitat not likely to be impacted by subsidence. Predicted impacts



Species	Potentially habitat in Study Area	Level of impact according to FloraSearch (2009)	Level of impact according to Biosis (2012)	Level of impact according to Biosis (2008)	Level of impact based on current survey
		Significant impact unlikely.			as a result of current proposal consistent with predicted impacts in BSO EA.
Brown Pomaderris	Not previously recorded in Study Area. Potential habitat along larger stretches of Navigation Creek	Habitat, occurring along the Nepean River, could potentially be affected by subsidence related movements. Deep, loose alluvial soils of active floodplains are mainly wet during flood events and rainfall, and the soil moisture regime is unlikely to be significantly impacted. Due to the design criteria applied to the Nepean River (i.e. avoid significant cracking of rock bars that could result in surface flow diversion and draining of pools) it is highly unlikely the river would be significantly impacted by bedrock tilting, stream realignment or loss of flow to dilated bedrock strata. The alluvial floodplain habitats of Pomaderris brunnea are unlikely to be modified physically or hydrologically by mining related subsidence. However, there is expected to be strata gas emissions from the bedrock in some locations, which may temporarily affect a population of Pomaderris brunnea. However, it is expected that regeneration would occur and that local populations would not be placed at risk of extinction. Significant impact unlikely.	As for BSO EA. Negligible residual risk.	Habitat could potentially be affected by mechanisms of subsidence. Unlikely to be significantly impacted.	Habitat may be impacted by subsidence, but only minimal impacts likely. Predicted impacts for current proposal consistent with predicted impacts in BSO EA.
Sydney Plains Greenhood	Not previously recorded in Study Area. Potential habitat along larger stretches of Navigation Creek	Habitat could potentially be affected by mechanisms of subsidence. Subsidence may affect the species through rock falls, with potential for the collapse of a sandstone shelf to eliminate a local population of the species, which characteristically occurs in small, isolated groups on suitable shelves. However, rock	As for BSO EA. Negligible residual risk.	Habitat could potentially be affected by mechanisms of subsidence. Unlikely to be significantly impacted.	Habitat may be impacted by subsidence, but only minimal impacts likely. Predicted impacts for current proposal consistent with



Species	Potentially habitat in Study Area	Level of impact according to FloraSearch (2009)	Level of impact according to Biosis (2012)	Level of impact according to Biosis (2008)	Level of impact based on current survey
		Falls are usually small, sporadic and isolated in the landscape with higher intensity events being relatively rare. Large cliff instabilities are not expected. Subsidence cracking of cliff top rock shelves may result in loss of water via cracks and accelerated drying out of moss and lichen beds to the detriment of the species, however the species is adapted to moisture stress. The likelihood of cracks on cliff tops coinciding with rock shelves suitable for the species is low, as is the probability that significant additional moisture stress would result. Therefore, it is considered unlikely that cliff top cracking would significantly affect species. Significant impact unlikely.			predicted impacts in BSO EA.
Matted Bush-pea	Not previously recorded in Study Area. Open woodland on shale/sandstone transition soils.	Habitat could potentially be affected by mechanisms of subsidence. The magnitude of the predicted subsidence effects is considered too small to significantly influence the hydrological processes in shale/sandstone transition soils. Therefore, it is unlikely there would be any biologically significant effect on the habitats of threatened shale/sandstone transition species due to soil moisture change. Significant impact unlikely.	As for BSO EA. Negligible residual risk.	Habitat not likely to be impacted by subsidence.	Habitat may be impacted by subsidence, but only minimal impacts likely. Predicted impacts for current proposal consistent with predicted impacts in BSO EA.

6.3 Potential impacts to fauna

Subsidence may directly affect known and potential habitat for threatened fauna through impacts on watercourses, riparian vegetation, cliffs, rock outcrops, overhangs, and crevices. These features provide important habitat for species such as microbats, reptiles and amphibians. Woodland and forest habitats, which



comprise a significant proportion of the Study Area – particularly PCT 3318: *Cumberland Moist Shale Woodland*, PCT 3319: *Cumberland Shale Hills Woodland*, and PCT 3321: *Cumberland Shale-Sandstone Ironbark Forest* - are not typically groundwater dependent and are therefore unlikely to experience significant structural change as a result of subsidence. Key microhabitat features such as tree hollows, exfoliating bark, and understorey complexity are not expected to be materially affected by predicted ground movements.

The proposed longwall layouts are set back from the major watercourse near the Study Area including Nepean River, and as such, subsidence impacts within these areas would be limited (MSEC 2025). Watercourses that are directly mined beneath are likely to have minor bedrock fracturing with associated impacts such as diversion of surface water flows and draining of pooled water (MSEC 2025). During the mining of previous longwalls within Appin Area 7 and 9 ephemeral creeks with comparable predicted subsidence movements to those of third order creeks within the Project Area showed no reported observed fracturing that has resulted in surface water flow diversion (MSEC 2025). The assessment by MSEC (2025) found that although fracturing along streams may occur it is unlikely that there would be a significant loss of surface water yield from the catchment.

The iron and manganese precipitates form an organic flocculant which decomposes and decreases dissolved oxygen, which may impact aquatic fauna and insects, although is highly unlikely to be increased by the Project due to potential minor bedrock cracking. Both such impacts (hydrological and water quality) may extend some distance downstream from the zone of fracturing, with the severity of impacts reducing with distance from the zone of fracturing as a result of dilution, particularly in partially ground-water fed systems.

According to MSEC (2025), a total of 4.9 km of third-order or greater streams are located directly above the proposed Longwalls 712-716. The 4.9 km of mapped watercourses within the Study Area are potentially susceptible to subsidence impacts (both direct and indirect); however impacts are likely to be confined to features such as standing pools, which make up a small but important proportion of the overall watercourse. In regard to terrestrial fauna, such impacts are of relevance to frog species including the threatened species, Giant Burrowing Frog and the Red-crowned Toadlet, which are discussed in detail in Section 6.4.

Cliff and escarpment habitats, particularly along Razorback Range, are also predicted to experience minor and localised impacts. MSEC (2025) identifies two major cliffs (RR-CL5 and RR-CL8) and nine minor cliff lines (MCL01 to MCL09) within the Study Area, with a total cliff length of approximately 440 m. While some surface cracking or local rock instability may occur—especially in marginally stable formations—no large-scale collapses or slope failures are expected. Historically, only a small percentage (<3 %) of rocky habitat in the Southern Coalfield has shown adverse effects due to mining-induced subsidence (MSEC 2035). Consequently, the risk to cliff-associated fauna such as roosting bats, reptiles, and invertebrates is considered low, and no cliff-dependent species of conservation concern are known to be confined to these features in the Study Area.

In summary, while portions of sensitive habitat types, including riparian zones, shallow aquatic pools, and cliff features, do overlap with areas of predicted subsidence, the overall scale and severity of impacts are expected to be limited. This is consistent with previous mining experience in similar geological settings.

6.4 Potential impacts to threatened fauna

A total of 58 threatened fauna species listed under the EPBC Act and/or BC Act were considered during the likelihood of occurrence assessment (Annex 2). Of these, 28 species were assessed as having a moderate or high likelihood of occurrence within the Study Area. These include threatened frogs, woodland birds, arboreal and microbat species, and the Cumberland Plain Land Snail.

Based on the subsidence predictions provided in MSEC (2025), impacts from the proposed Longwalls 712-716 are expected to be negligible for the majority of these species, with potential effects limited to minor surface



cracking, localised habitat disturbance, or shallow pool desiccation. Table 8 provides an assessment of potential impacts to each species, drawing on updated subsidence modelling and previous impact evaluations.

As part of the BSO Environmental Assessment (BHPBIC 2009), significance assessments were conducted under the TSC Act (now repealed by the BC Act) for nine threatened fauna species considered most likely to be impacted. These species have been re-evaluated in the context of the current proposal, with updated findings presented in Table 8. In all cases, the predicted impacts remain consistent with those previously assessed in the BSO Environmental Assessment (BHPBIC 2009), with no new or increased risk identified for these species as a result of the proposed mining activities.

One species of note is the Southern Myotis, a foraging bat associated with open water habitats. While potential risks include injury from localised rock collapse or reduced foraging success due to drying of aquatic microhabitats, HGEO (2025) predicts that these impacts are expected to be minor and localised. Therefore, are unlikely to result in significant harm to local populations.

Table 8: Threatened fauna with potential to be impacted within the Study Area

Species	Potentially habitat in Study Area	Level of impact according to Biosphere (2009)	Level of impact according to Biosis (2008; 2012)	Level of impact according to this survey
Amphibians				
Giant Burrowing Frog	There are no recent records although there is potential habitat within the ephemeral creeks downstream of Nepean River.	Assessment of Significance (AoS) undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk.	The Study Area provides marginal habitat; however, the impacts to potential habitat would be insignificant.
Red-crowned Toadlet	There are no recent records although there is potential habitat within the ephemeral creeks downstream of Nepean River.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk.	The Study Area provides marginal habitat; however, the impacts to potential habitat would be insignificant.
Birds				
Dusky Woodswallow	There a several records across the Study Area, towards the more vegetated bushland areas.	Recorded but not assessed as species was not listed as threatened at the time of the study. Species listed as Vulnerable in 2016 (NSW Scientific Committee 2016).	Recorded not assessed as species was not listed as threatened at the time of the study. Species listed as Vulnerable in 2016 (NSW Scientific Committee 2016).	The Study Area has a large amount of grassland habitat adjacent to open woodlands; however, the impacts to potential habitat would be insignificant.
Gang-gang Cockatoo	There are no recent records although there is potential habitat	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	The Study Area has potential nesting and roosting habitat in tree hollows; however, the impacts to potential habitat would be insignificant.



Species	Potentially habitat in Study Area	Level of impact according to Biosphere (2009)	Level of impact according to Biosis (2008; 2012)	Level of impact according to this survey
	within the Study Area.			
Glossy-Black Cockatoo	There are no recent records although there is potential habitat within the Study Area.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	The Study Area has potential nesting and roosting habitat in tree hollows; however, the impacts to potential habitat would be insignificant.
Speckled Warbler	There a several records across the Study Area, towards the more vegetated bushland areas.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	The Study Area has potential nesting and roosting habitat in tree hollows; however, the impacts to potential habitat would be insignificant.
Spotted Harrier	There a several records across the Study Area, towards the more vegetated bushland areas.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	The Study Area has a large amount of grassland habitat adjacent to open woodlands; however, the impacts to potential habitat would be insignificant.
Brown Treecreeper (eastern subspecies)	There a several records across the Study Area, towards the more vegetated bushland areas.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	The Study Area has potential open woodland and forest habitats; however, the impacts to potential habitat would be insignificant.
Varied Sittella	There a several records across the Study Area, towards the more vegetated bushland areas.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	The Study Area has potential open woodland and forest habitats; however, the impacts to potential habitat would be insignificant.
Little Lorikeet	There a several records across the Study Area, towards the more vegetated bushland areas.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	The Study Area has potential nesting and roosting habitat in tree hollows; however, the impacts to potential habitat would be insignificant.
White-bellied Sea-eagle	There a several records across the Study Area, towards the more vegetated bushland areas.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk.	The Study Area has a large amount of grassland habitat adjacent to open woodlands; however, the impacts to potential habitat would be insignificant.
Little Eagle	There a several records across the Study Area, towards the more	No AoS undertaken as impact to species habitat was	As for BSO EA. Negligible residual risk.	The Study Area has a large amount of grassland habitat adjacent to open woodlands;



Species	Potentially habitat in Study Area	Level of impact according to Biosphere (2009)	Level of impact according to Biosis (2008; 2012)	Level of impact according to this survey
	vegetated bushland areas.	considered highly unlikely.		however, the impacts to potential habitat would be insignificant.
Swift Parrot	There are no recent records although there is potential habitat within the Study Area.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk.	The Study Area has potential nesting and roosting habitat in tree hollows; however, the impacts to potential habitat would be insignificant.
Hooded Robin	There a several records across the Study Area, towards the more vegetated bushland areas.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk.	The Study Area has potential open woodland and forest habitats; however, the impacts to potential habitat would be insignificant.
Black-chinned Honeyeater	There a several records across the Study Area, towards the more vegetated bushland areas.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk.	The Study Area has potential open woodland and forest habitats; however, the impacts to potential habitat would be insignificant.
Barking Owl	There are no recent records although there is potential habitat within the Study Area.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk.	The Study Area has potential nesting and roosting habitat in tree hollows; however, the impacts to potential habitat would be insignificant.
Powerful Owl	There are no recent records although there is potential habitat within the Study Area.	AoS undertaken. No significant impacts on the species	As for BSO EA. Negligible residual risk	The Study Area has potential nesting and roosting habitat in tree hollows, the impacts to potential habitat would be insignificant.
Scarlet Robin	There a several records across the Study Area, towards the more vegetated bushland areas.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	The Study Area has potential open woodland and forest habitats, the impacts to potential habitat would be insignificant.
Diamond Firetail	There a several records across the Study Area, towards the more vegetated bushland areas.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	The Study Area has potential riparian or artificial aquatic habitats, the impacts to potential habitat would be insignificant across the Study Area.
Invertebrates				
Cumberland Plain Land Snail	There a several records across the Study Area,	No AoS undertaken as impact to species habitat was	As for BSO EA.	The Study Area provides marginal open woodland habitat,



Species	Potentially habitat in Study Area	Level of impact according to Biosphere (2009)	Level of impact according to Biosis (2008; 2012)	Level of impact according to this survey
	towards the more vegetated bushland areas in the west.	considered highly unlikely.	Negligible residual risk	the impacts to potential habitat would be insignificant.
Mammals				
Large-eared Pied-bat	There a several records across the Study Area, towards the more vegetated bushland areas in the west.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	Potential impacts include death or injury as result of rock fall or collapse and impacts on prey availability due to drying of pools. The likelihood of this happening is highly improbable.
Spotted-tailed Quoll	There are no recent records although there is potential habitat within the Study Area.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	The Study Area has potential open and/or shrubby woodland and forest habitats, the impacts to potential habitat would be insignificant.
Eastern Coastal Free-tailed Bat	There a several records across the Study Area, towards the more vegetated bushland areas in the west.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	Potential impacts include death or injury as result of rock fall or collapse and impacts on prey availability due to drying of pools. The likelihood of this happening is highly improbable.
Little Bent-winged Bat	There a several records across the Study Area, towards the more vegetated bushland areas in the west.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	Potential impacts include death or injury as result of rock fall or collapse and impacts on prey availability due to drying of pools. The likelihood of this happening is highly improbable.
Large Bent-winged Bat	There a several records across the Study Area, towards the more vegetated bushland areas in the west.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	The Study Area provides cliffs and overhangs; there are no known roosts in the Study Area and the impacts to potential habitat would be insignificant.
Southern Myotis	There is one recent record to the south of the Study Area along an ephemeral creek, a first order stream from the Nepean River.	AoS undertaken. No significant impact on the species.	As for BSO EA. Negligible residual risk	Potential impacts include death or injury as result of rock fall or collapse and impacts on prey availability due to drying of pools. The likelihood of this happening is highly improbable.
Koala	There are recent records along the	No AoS undertaken as impact to species	As for BSO EA.	Subsidence impacts to the Koala are low as the proposal is unlikely



Species	Potentially habitat in Study Area	Level of impact according to Biosphere (2009)	Level of impact according to Biosis (2008; 2012)	Level of impact according to this survey
	Nepean and within suburban areas near the Study Area.	habitat was considered highly unlikely.	Negligible residual risk	to affect the trees that this species utilises and forages in.
Grey Headed Flying Fox	There is a large camp to the south-east of the Study Area along the Nepean River (Biosis 2008), and various ATLAS records across the current Study Area.	No AoS undertaken as impact to species habitat was considered highly unlikely.	As for BSO EA. Negligible residual risk	Subsidence impacts to the Grey Headed Flying Fox are low as the proposal is not directly above or within the campsite and unlikely to affect the trees that this species roosts in.



7. Monitoring and recommendations

7.1 Existing monitoring and requirements

Findings from subsidence monitoring across features such as creeks, cliffs, rock outcrops, and steep slopes are documented in End of Panel Reports, which provide detailed analysis of ground movement and environmental response. For Appin Areas 7 and 9, terrestrial ecology monitoring has primarily consisted of observational and fixed photo-point monitoring, with targeted assessments conducted in response to identified impacts such as vegetation dieback or slope instability.

7.2 Recommendations for future monitoring

Consistent with previous assessments, observational monitoring of vegetation communities within the Study Area will continue to be undertaken as part of routine landscape and subsidence monitoring programs. This includes visual assessments, fixed photo-point comparisons, and documentation of any signs of stress, dieback, or surface cracking. Where vegetation health appears compromised, targeted inspections by a qualified ecologist will be triggered to assess the nature, extent, and possible cause of the impact.

Habitat monitoring along watercourses will be conducted in conjunction with End of Panel reporting and established aquatic ecology programs, focusing on parameters such as pool integrity, flow diversion, and bank stability. Monitoring will include repeat site visits before and after mining to detect physical changes related to subsidence, particularly in areas of known or potential frog habitat.



8. Conclusion

Impacts on features from subsidence resulting from longwall mining within the Appin Area are largely predictable given a particular longwall mine layout. This is evidenced through identification of reasonably consistent patterns during monitoring of subsidence impacts.

MSEC (2025) have determined it is unlikely that the Nepean River would experience adverse physical impacts due to the mining-induced movements from Longwalls 712-716. Further, MSEC (2025) determine that it is unlikely there would be large-scale adverse changes in the levels of ponding or scouring of the banks along the creeks and tributaries within the Study Area due to the mining-induced tilt. While in most cases, impacts to steep slopes are likely to consist of surface cracks, there remains a low probability of large-scale downslope movements. Experience indicates that the probability of mining induced large-scale slippages is extremely low due to the significant depth of cover within the Study Area.

Surface water flow diversions could occur along the creeks and tributaries that are located directly above the mining area. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds. The creeks and tributaries are ephemeral and, therefore, surface water flows only occur during and for short periods after rain events.

In addition, habitats such as pools, along a combined length of 4.9 km of watercourses within the 35° angle of draw Study Area, are likely to experience subsidence impacts (comprising both direct and indirect impacts). Subsidence impacts to features such as cliffs, overhangs and rocky outcrops have the potential to occur but are likely to have negligible impacts on threatened biodiversity within the Study Area due to the small area of predicted impacts.

Impacts of the BSO Project on threatened biodiversity were previously assessed within the BSO Project EA (BHPBIC 2009). Predicted impacts as a result of the current proposal are likely to be minimal. Therefore, the predicted impacts for the current proposal are consistent with the impact predictions of the BSO EA.

Ongoing monitoring requirements for biodiversity are provided within the recommendations section of the report. Recommendations are focussed on habitat monitoring along watercourses in conjunction with End of Panel Reports or established aquatic monitoring programs for measuring physical impacts of subsidence.



9. References

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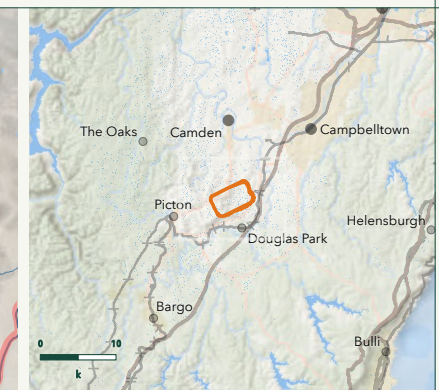
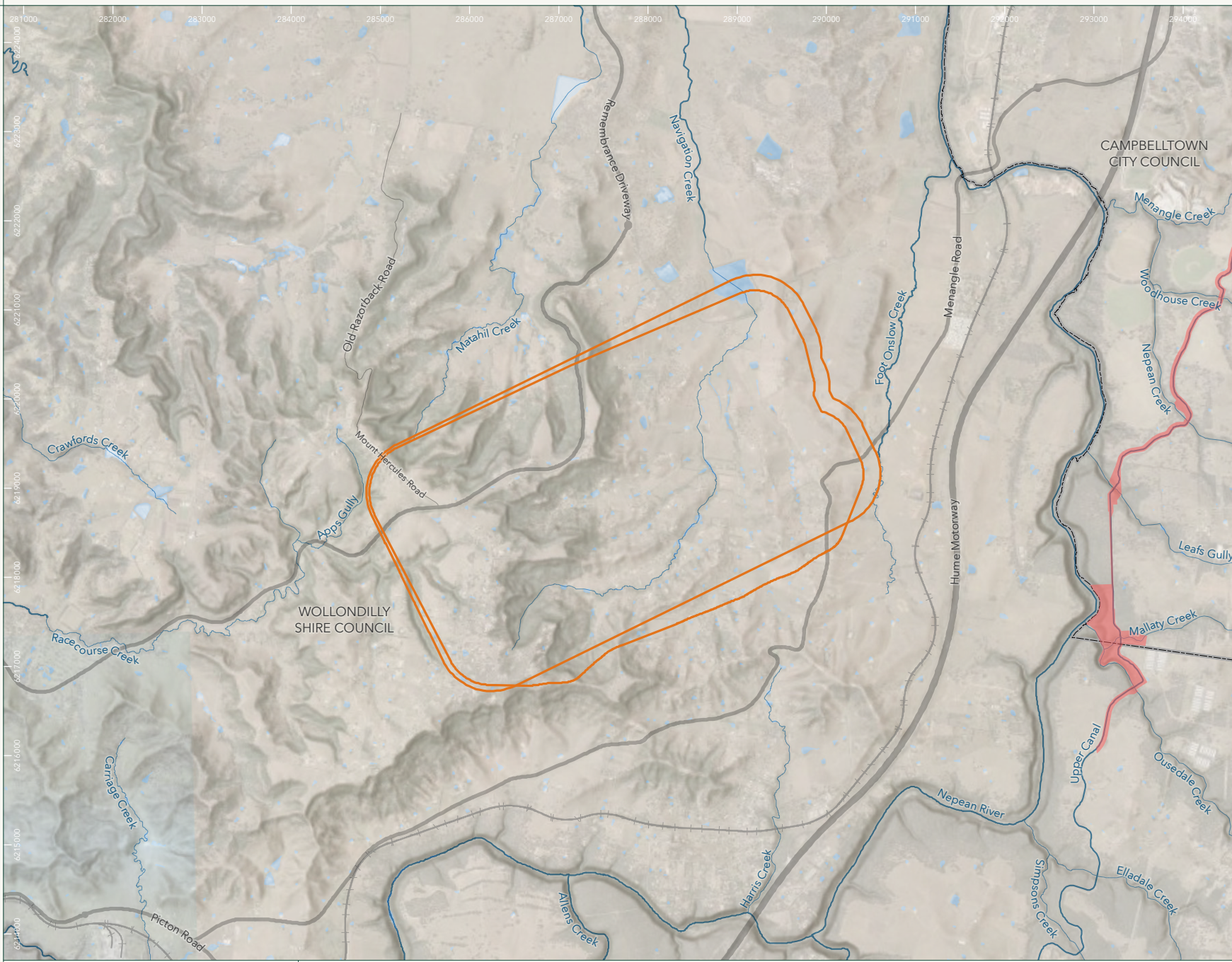


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Figures

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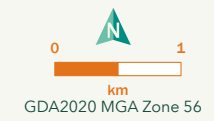


- Study area
- Special and controlled areas
 - Schedule 1 Controlled Area
- Transport
 - Major road
 - Minor road
 - Rail
- Hydrography
 - Perennial Stream
 - Non Perennial Stream
 - Waterbody
- Administrative and Property Boundaries
 - Local Government Area



Figure 1
Location Map
Appin Long Walls 712-716 BIA

Niche PM: Itzel Gonzalez
Niche Proj. #: 8975
Client: GM3



Local Government Area: / Suburb: / Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS/ Transparency Mask: / Road: / Rail: / Study area: / World_Ocean_Base: NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue/ Watercourse: / NPWS Reserve: / PlacePoint: / State Forest: / Waterbody: / public/NSW_Imagery: © Department of Customer Service 2020/ Sydney Drinking Water Catchment Boundary: WaterNSW/ Hillshade: Esri, CGIAR | Watercourses, Waterbodies, Road and Rail alignments, Protected areas of NSW © Spatial Services 2021. | Niche uses GDA2020 as standard for all project-related data. In order to ensure that data from numerous sources and coordinate systems is aligned, on-the-fly transformation to GDA2020 MGA Zone 56 is used in the map above. For ease of reference, the grid tick marks and labels shown around the border of the map are presented in GDA2020 MGA Zone 56.

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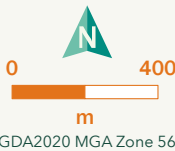


- Study area**
- 600m boundary
 - 35 degree angle of draw
 - Longwall
 - Mine layout
- Transport**
- Major road
 - Minor road
 - Rail
- Hydrography**
- Perennial Stream
 - Non Perennial Stream
 - Waterbody
- Administrative and Property Boundaries**
- Local Government Area



Figure 2
Study Area
Appin Long Walls 712-716 BIA

Niche PM: Itzel Gonzalez
Niche Proj. #: 8975
Client: GM3



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Study area

- 600m boundary
- 35 degree angle of draw
- Longwall
- Mine layout

Transport

- Major road
- Minor road
- Rail

Hydrography

Strahler stream order

- 1
- 2
- 3
- 4

- Waterbody

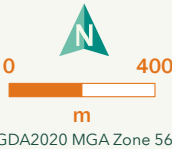
Administrative and Property Boundaries

- Local Government Area

Figure 3
Watercourses
Appin Long Walls 712-716 BIA



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Niche Proj. #: 8975
Client: GM3



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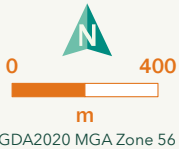


- Study area**
- 600m boundary
 - 35 degree angle of draw
 - Longwall
 - Mine layout
 - Floristics RDP
 - Aquatic assessment
 - Survey tracks
- Transport**
- Major road
 - Minor road
 - Rail
- Hydrography**
- Strahler stream order
- 1
 - 2
 - 3
 - 4
- Waterbody
- Administrative and Property Boundaries**
- Local Government Area

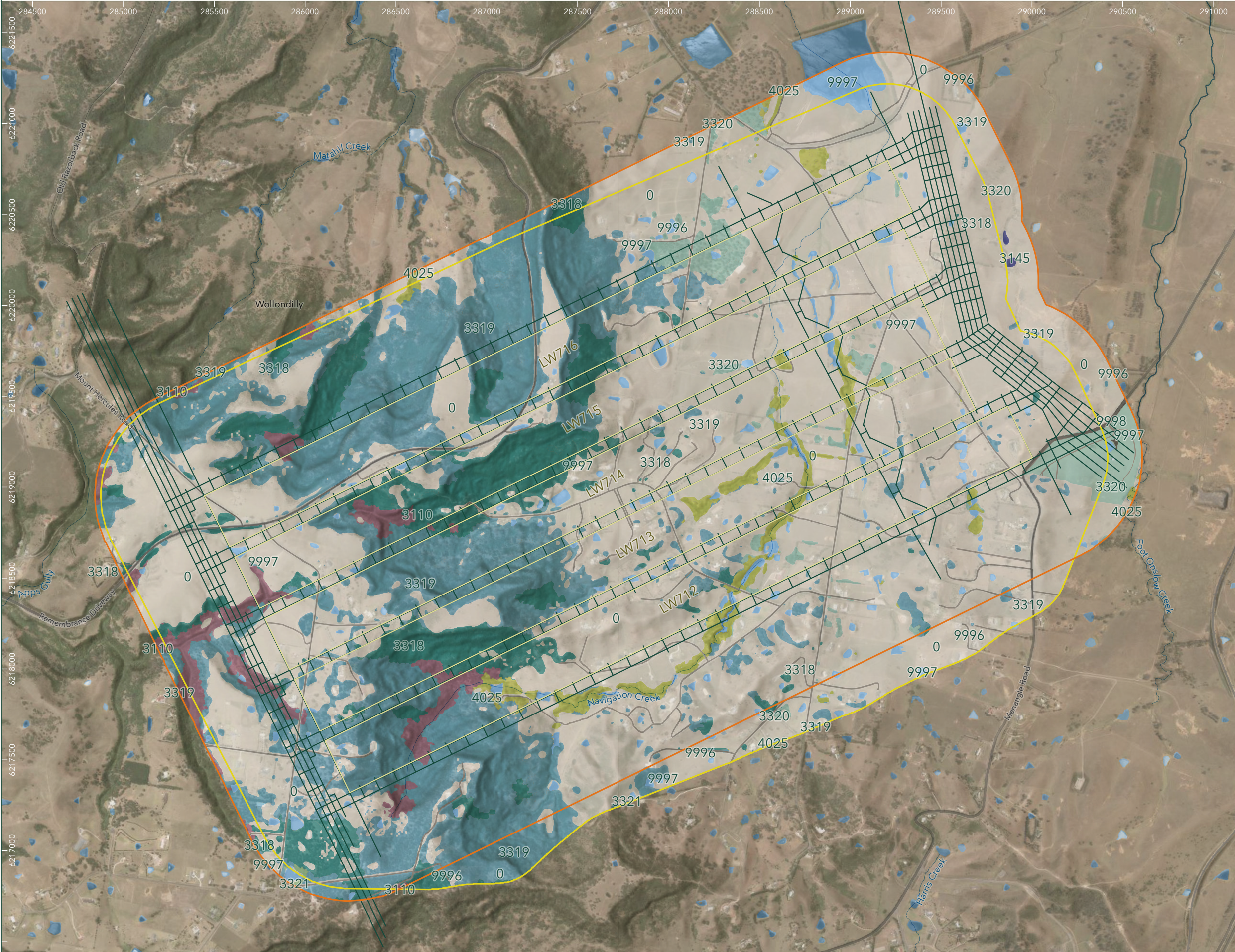
Figure 4
Survey effort
Appin Long Walls 712-716 BIA



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Niche Proj. #: 8975
Client: GM3



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Study area

- 600m boundary
- 35 degree angle of draw
- Longwall
- Mine layout

Transport

- Major road
- Minor road
- Rail

Hydrography

- Perennial Stream
- Non Perennial Stream
- Waterbody

Administrative and Property Boundaries

- Local Government Area

Preliminary vegetation

- 0: Not Native
- 3110: Greater Sydney
- Enriched Grey Myrtle Dry Rainforest
- 3145: Cumberland Bangalay x Blue Gum Riverflat Forest
- 3318: Cumberland Moist Shale Woodland
- 3319: Cumberland Shale Hills Woodland
- 3320: Cumberland Shale Plains Woodland
- 3321: Cumberland Shale-Sandstone Ironbark Forest
- 4025: Cumberland Red Gum Riverflat Forest
- 9996: Not Native (Road)
- 9997: Not Native (Waterbody)
- 9998: Not Native (Planted Exotic Vegetation)

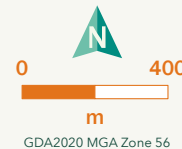


Figure 5

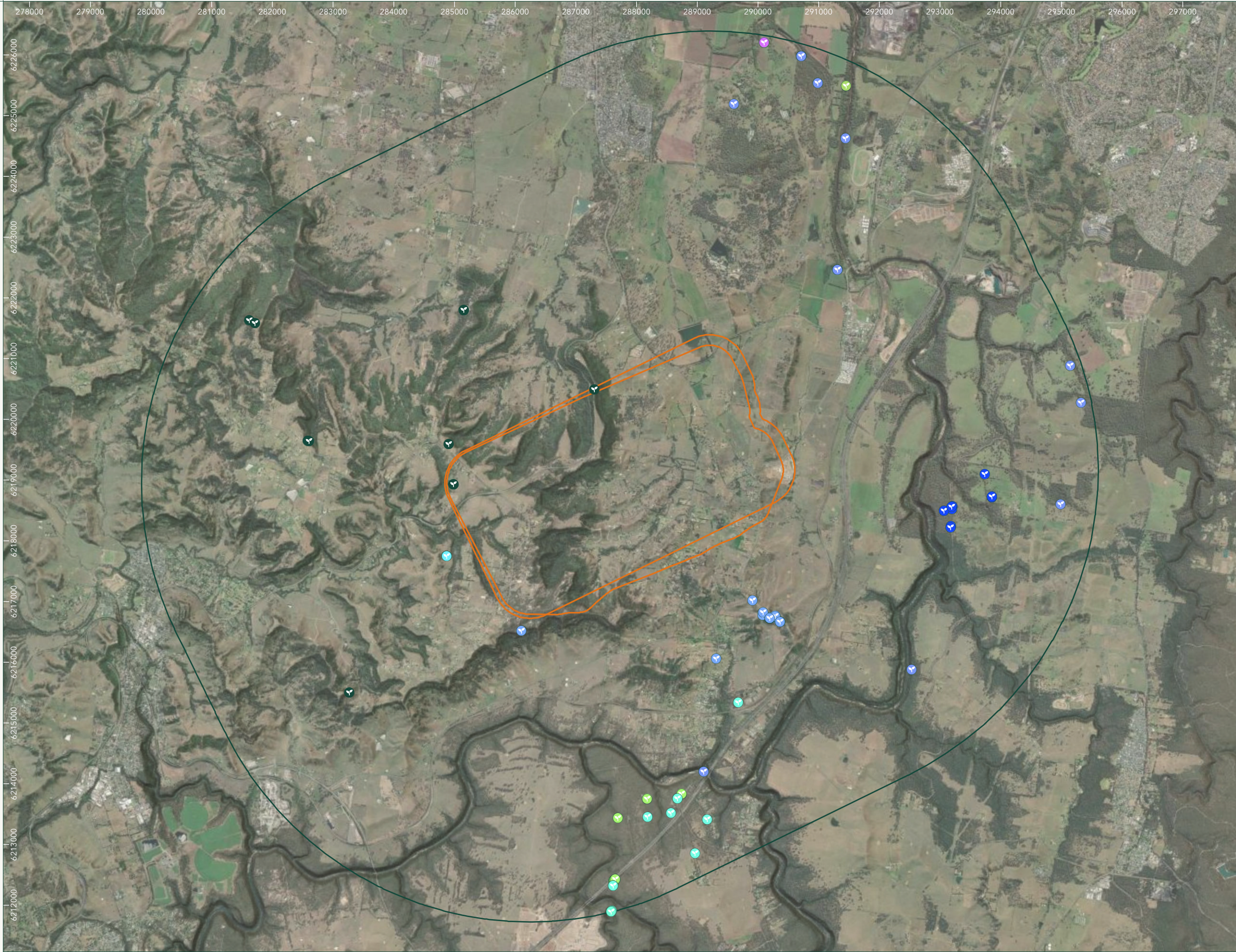
Vegetation

Appin Long Walls 712-716 BIA

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- Study area
- 5km buffer
- BioNet Threatened Flora
 - Acacia bynoeana
 - Cynanchum elegans
 - Epacris purpurascens var. purpurascens
 - Eucalyptus benthamii
 - Grevillea parviflora subsp. parviflora
 - Melaleuca deanei
 - Persoonia bargoensis
 - Persoonia nutans
 - Pimelea spicata
 - Pomaderris brunnea
 - Pultenaea pedunculata
 - Thesium australe
- * Flora sensitive species not displayed
 - Gyrostemon thesioides
 - Pterostylis saxicola

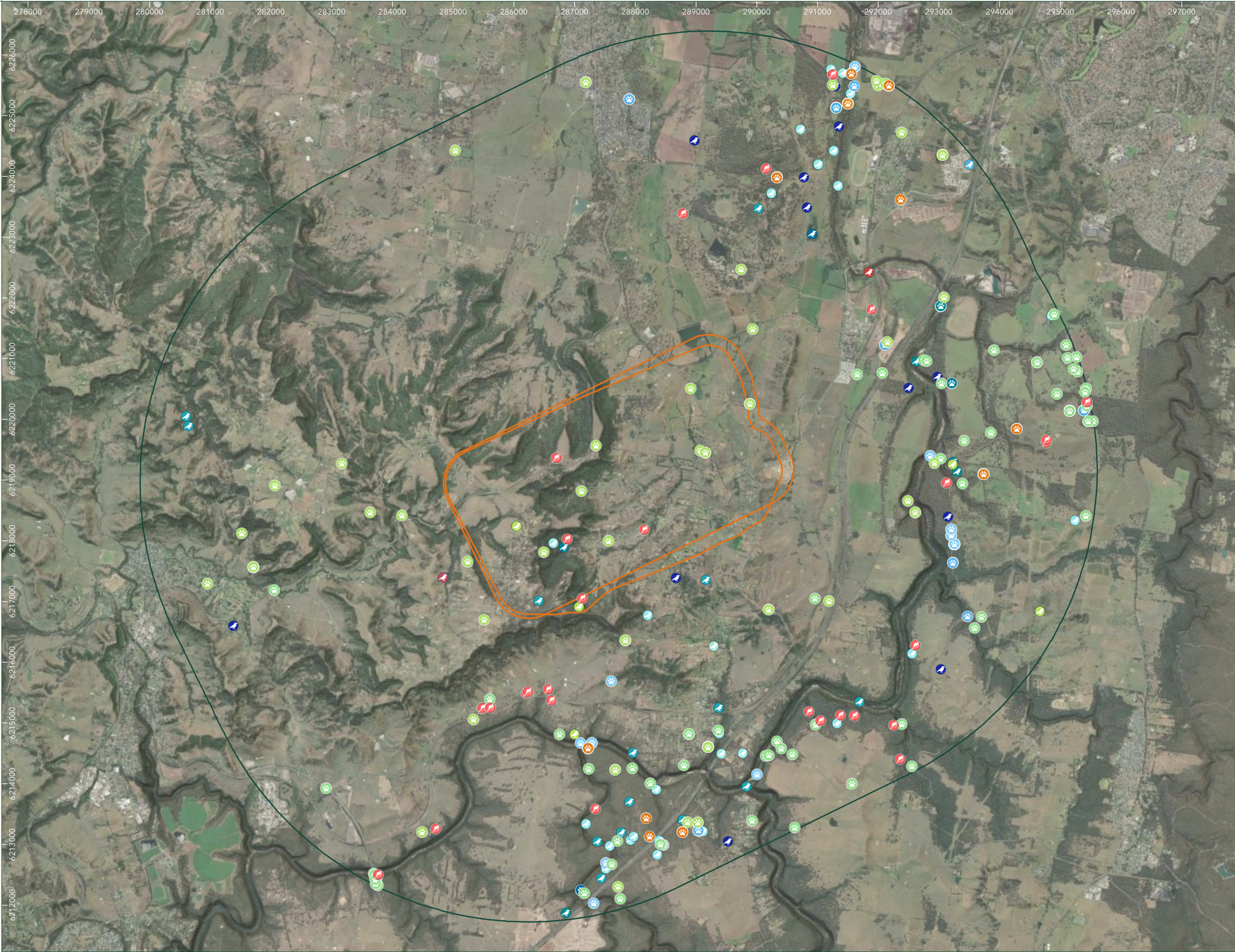


Figure 6
NSW Bionet Atlas Threatened Species 5km Search - Flora
Appin Long Walls 712-716 BIA

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Niche Proj. #: 8975
Client: GM3



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- Study area
5km buffer
- Bionet Threatened Fauna**
- Gastropoda**
- Meridolum corneovirens*
- Mammalia**
- Cercartetus nanus*
 - Chalinolobus dwyeri*
 - Dasyurus maculatus*
 - Falsistrellus tasmaniensis*
 - Micronomus norfolkensis*
 - Miniopterus australis*
 - Miniopterus orianae oceanensis*
 - Myotis macropus*
 - Petauroides volans*
 - Petaurus norfolkensis*
 - Phascolarctos cinereus*
 - Pteropus poliocephalus*
 - Saccolaimus flaviventris*
 - Scoteanax rueppellii*
- Aves**
- Artamus cyanopterus cyanopterus*
 - Calidris acuminata*
 - Chthonicola sagittata*
 - Circus assimilis*
 - Climacteris picumnus victoriae*
 - Daphoenositta chrysoptera*
 - Ephippiorhynchus asiaticus*
 - Glossopsitta pusilla*
 - Haliaeetus leucogaster*
 - Hieraaetus morphnoides*
 - Hirundapus caudacutus*
 - Lathamus discolor*
 - Melanodryas cucullata cucullata*
 - Melithreptus gularis gularis*
 - Petroica boodang*
 - Stagonopleura guttata*
 - Thalasseus bergii*
- * Fauna sensitive species not displayed
- Gang-gang Cockatoo
 - Masked Owl
 - Powerful Owl
 - Regent Honeyeater
 - South-eastern Glossy Black-Cockatoo
 - Square-tailed Kite

Figure 7
NSW Bionet Atlas Threatened Species 5km Search - Fauna
Appin Long Walls 712-716 BIA



Niche PM: Itzel Gonzalez
Niche Proj. #: 8975
Client: GM3





Threatened species likelihood of occurrence



E = Endangered; V = Vulnerable, CE = Critically Endangered, EP = Endangered Population, M = Migratory, MA = Marine, X = Extinct, C = Camba, J = Jamba, K = Rokamba

Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	The Giant Burrowing Frog has been recorded breeding in a range of water bodies associated with more sandy environments of the coast and adjacent ranges from the Sydney Basin south the eastern Victoria. It breeds in hanging swamps, perennial non-flooding creeks and occasionally permanent pools, but permanent water must be present to allow its large tadpoles time to reach metamorphosis. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based	Moderate
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V	-	Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. After rain these creeks are characterised by a series of shallow pools lined by dense grasses, ferns and low shrubs and usually contain leaf litter for shelter. Eggs are terrestrial and laid under litter, vegetation or rocks where the tadpoles inside will reach a relatively late stage of development before waiting for flooding waters before hatching will occur.	Moderate
Birds					
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE, M	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. The distribution of the species has contracted dramatically in the last 30 years to between north-eastern Victoria and south-eastern Queensland. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	
<i>Apus pacificus</i>	Fork-tailed Swift	-	M,Ma,C,J,K	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines.	Low
<i>Artamus cyanopterus cyanopterus</i>	Dusky Woodswallow	V	-	Dusky Woodswallows are widespread in eastern, southern, and southwestern Australia. The species occurs throughout most of New South Wales, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and groundcover of grasses or sedges and fallen woody debris.	High
<i>Burhinus grallarius</i>	Bush Stone-curlew	E	-	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. It inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber, it's diet consists of insects and small vertebrates, such as frogs, lizards and snakes. It is largely nocturnal, being	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				especially active on moonlit nights and nests on the ground in a scrape or small bare patch.	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	-	V, M, MA, C, J, K	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh, or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgeland and other ephemeral wetlands, but leave when they dry.	Low
<i>Calidris canutus</i>	Red Knot	-	V,M,Ma,C,J,K	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.	Low
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	E	E	In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (<i>Eucalyptus pauciflora</i>) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 7 cm in diameter or larger in eucalypts and 3 metres or more above the ground.	Moderate



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
<i>Calyptrorhynchus lathamii lathamii</i>	Glossy Black-Cockatoo	V	V	Inhabits forest with low nutrients, characteristically with key Allocasuarina spp. Tends to prefer drier forest types with a middle stratum of Allocasuarina below Eucalyptus or Angophora. Often confined to remnant patches in hills and gullies. Breed in hollows stumps or limbs, either living or dead. Endangered population in the Riverina.	Moderate
<i>Chthonicola sagittata</i>	Speckled Warbler	V	-	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive. The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies, typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	High
<i>Circus assimilis</i>	Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. The species occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Moderate
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper (south-eastern)	-	V	The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the	High



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	
<i>Cuculus optatus</i>	Oriental Cuckoo	-	C,J,K	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	Low
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V	-	Inhabits wide variety of dry eucalypt forests and woodlands, usually with either shrubby under storey or grassy ground cover or both, in all climatic zones of Australia. Usually in areas with rough-barked trees, such as stringybarks or ironbarks, but also in paperbarks or mature Eucalypts with hollows.	High
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E	-	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.	Low
<i>Falco subniger</i>	Black Falcon	V	-	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				Falcons' on the tablelands and coast of New South Wales are likely to be preferable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities. Breeding occurs along timbered waterways in in land areas.	
<i>Gallinago hardwickii</i>	Latham's Snipe	V	J,K, Migratory Wetland	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Low
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. The species forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	High
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	M, Ma	Inhabits coastal and near coastal areas, building large stick nests, and feeding mostly on marine and estuarine fish and aquatic fauna.	Moderate
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. The species occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. It	High



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	
<i>Hirundapus caudacutus</i>	White-throated Needletail	V	V, M, MA, C, J, K	An aerial species found in feeding concentrations over cities, hilltops, and timbered ranges.	Low
<i>Lathamus discolor</i>	Swift Parrot	E	CE	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen, and associated insects. The Swift Parrot is dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and also nomadic, moving about in response to changing food availability.	Moderate
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.	Low
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	V	-	Occupy a wide range of eucalypt woodlands, Acacia shrublands and open forests.	High
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V	-	In NSW the Black-chinned Honeyeater is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. The species occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Blakely's Red Gum (<i>E.</i>	Moderate



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				blakelyi) and Forest Red Gum (<i>E. tereticornis</i>). It also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.	
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Low
<i>Ninox connivens</i>	Barking Owl	V	-	The Barking Owl is found throughout continental Australia except for the central arid regions. Although still common in parts of northern Australia, the species has declined greatly in southern Australia and now occurs in a wide but sparse distribution in NSW. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. Many populations crashed as woodland on fertile soils was cleared over the past century, leaving linear riparian strips of remnant trees as the last inhabitable areas. Surveys in 2001 demonstrated that the Pilliga Forest supported the largest population in southern Australia. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland.	Moderate
<i>Ninox strenua</i>	Powerful Owl	V	-	Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within red turpentine in tall open forests and black she-oak within open forests. Large mature trees with hollows at least 0.5 m deep are required for nesting. Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials. Nest	Moderate



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				trees for this species are usually emergent with a diameter at breast height of at least 100 cm.	
<i>Petroica boodang</i>	Scarlet Robin	V	-	The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs.	High
<i>Petroica phoenicea</i>	Flame Robin	V	-	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes.	Low
<i>Pluvialis squatarola</i>	Grey Plover	-	C,J,K	The Grey Plover breeds around the Arctic regions and migrates to the southern hemisphere, being a regular summer migrant to Australia, mostly to the west and south coasts. It is generally sparse but not uncommon in some areas. It is occasionally found inland. The Grey Plover is almost entirely coastal, being found mainly on marine shores, inlets, estuaries and lagoons with large tidal mudflats or sandflats for feeding, sandy beaches for roosting, and also on rocky coasts.	Low
<i>Pycnoptilus floccosus</i>	Pilotbird	V	V	Pilotbirds are strictly terrestrial, living on the ground in dense forests with heavy undergrowth. Largely sedentary, they are typically seen hopping briskly over the forest floor and foraging on damp ground or among leaf-litter.	Low
<i>Stagonopleura guttata</i>	Diamond Firetail	V	V	The Diamond Firetail is endemic to south-eastern Australia, extending from central Queensland to the Eyre Peninsula in South Australia. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and	Moderate



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW, though is very rare west of the Darling River.	
<i>Stictonetta naevosa</i>	Freckled Duck	V	-	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times.	Low
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	The Masked Owl occurs from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. This species lives in dry eucalypt forests and woodlands from sea level to 1100 m and often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Low
Invertebrates					
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E	-	Lives in small areas on the Cumberland Plain west of Sydney, from Richmond and Windsor south to Picton and from Liverpool west to the Hawkesbury and Nepean Rivers at the base of the Blue Mountains. The species primarily inhabits Cumberland Plain Woodland (a critically endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. It is also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest, which are also listed	High



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				communities. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	
<i>Pommerhelix duralensis</i>	Dural Land Snail	E	E	The Dural Land Snail is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. The species is definitely found within the Local Government Areas of The Hills Shire, Hawkesbury Shire and Hornsby Shire. Records from the Blue Mountains City, Penrith City and Parramatta City may represent this species. Occurrence in Wollondilly Shire is considered unlikely in light of current knowledge. It favours sheltering under rocks or inside curled-up bark, it does not burrow nor climb.	Low
Mammals					
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V	-	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. They may occupy small patches of vegetation in fragmented landscapes and although the species prefers habitat with a rich shrub understory, they are known to occur in grassy woodlands and the presence of Eucalypts alone is sufficient to support populations in low densities.	Low
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range. Can also be found on the edges of rainforests and in wet sclerophyll forests. This species roosts in caves and mines in groups of between 3 and 37 individuals.	Moderate
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll	V	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Quolls use hollow-bearing trees,	Moderate



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				fallen logs, other animal burrows, small caves and rock outcrops as den sites	
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high. Two observations have been made of roosts in stem holes of living eucalypts. There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor. This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites.	Low
<i>Micronomus norfolkensis</i>	Eastern Coastal Freetail-bat	V	-	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.	Moderate
<i>Miniopterus australis</i>	Little Bent-winged Bat	V	-	Coastal north-eastern NSW and eastern Queensland. Little Bent-wing Bat is an insectivorous bat that roost in caves, in old mines, in tunnels, under bridges, or in similar structures. They breed in large aggregations in a small number of known caves and may travel 100s km from feeding home ranges to breeding sites. Little Bent-wing Bat has a preference for moist eucalypt forest, rainforest or dense coastal banksia scrub where it forages below the canopy for insects.	Moderate
<i>Miniopterus orianae oceanensis</i>	Eastern Bentwing-bat	V	-	Eastern Bent-wing Bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings, and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Moderate
<i>Myotis macropus</i>	Southern Myotis	V	-	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally, roost in groups of 10 - 15 close to water in caves, mine	High



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	
<i>Petauroides volans</i>	Greater Glider	E	E	The Greater Glider occurs in eucalypt forests and woodlands. The species nests in hollows and are typically found in older forests. Generally, the home range for the greater glider is between 0.7-3 hectares and tends to have a population density of 0.01-5 individuals per hectare. The home ranges of females can overlap with males and females however for the males the home ranges never overlap.	Low
<i>Petaurus australis</i>	Yellow-bellied Glider	V	-	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. The species occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Vegetation preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	Low
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Low
<i>Phascolarctos cinereus</i>	Koala	E	E	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate, and rainfall.	High
<i>Phoniscus papuensis</i>	Golden-tipped Bat	V	-	The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. The species is found in rainforest and adjacent wet and dry sclerophyll forest up to 1000 m. Also recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. The species roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes.	
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	-	V	The New Holland Mouse currently has a disjunct, fragmented distribution across Tasmania, Victoria, New South Wales, and Queensland. Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	Low
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	High
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V	-	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes.	Low
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m. In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat. This species roosts in hollow tree trunks and branches.	Low
Reptiles					
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Occurs almost exclusively in association with communities occurring on Triassic sandstone within the Sydney Basin. Typically found among exposed sandstone outcrops with vegetation types ranging from woodland to heath. Within these habitats they spend most of the year sheltering in and under rock crevices and exfoliating rock. However,	Low



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				some individuals will migrate to tree hollows to find shelter during hotter parts of summer.	
<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V	-	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River and found in heath, open forest and woodland. Rosenberg's Goanna is associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat and shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Runs along the ground when pursued (as opposed to the Lace Monitor, which climbs trees). Feeds on carrion, birds, eggs, reptiles and small mammals.	Low
Flora					
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park.	Low
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V	-	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers from spring to summer	Low
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	V	V	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum, Silvertop Ash, Red Bloodwood and Black Sheoak appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid and the Tartan Tongue Orchid. Little is known about the	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site.	
<i>Cynanchum elegans</i>		E	E	Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley. Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> - Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Corymbia maculata</i> aligned open forest and woodland; and Bracelet Honeymyrtle <i>Melaleuca armillaris</i> scrub to open scrub.	Known. 2 records within the Study Area.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V	-	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.	High
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). Two major subpopulations in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment.	Moderate
<i>Eucalyptus macarthurii</i>	Paddys River Box	E	E	Paddy's River Box has a moderately restricted distribution. It is currently recorded from the Moss Vale District to Kanangra-Boyd National Park. In the Southern Highlands it occurs mainly on private	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				land, often as isolated individuals in, or on the edges of roads and paddocks. It is not well reserved but does occur within Cecil Hoskins Nature Reserve in the Southern Highlands. In Kanangra-Boyd National Park isolated stands occur in the north west part of the range on the Boyd Plateau. Occurs on grassy woodland on relatively fertile soils on broad cold flats	
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree well outside its range. Grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock.	Low
<i>Eucalyptus sp. Cattai</i>		CE	CE	Occurs in The Hills Local Government Area, with known populations occurring within the area bounded by Kellyville - Maraylya - Glenorie. Occurs as a rare emergent tree in scrub, heath and low woodland on sandy soils, usually as isolated individuals or occasionally in small, clustered groups. The sites at which it occurs are generally flat and on ridge tops. Associated soils are laterised clays overlying sandstone.	Low
<i>Galium australe</i>	Tangled Bedstraw	E	0	Tangled Bedstraw has been recorded historically in the Nowra (Colymea) and Narooma areas and is extant in Nadgee Nature Reserve, south of Eden. Range of habitats in NSW including a valley floor, alluvial soil beside a creek, heathland in a rocky gully, and the top of an escarpment above a creek. In other states known from a range of near-coastal habitats.	Low
<i>Genoplesium baueri</i>		E	V	The species has been recorded from locations between Ulladulla and Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. Currently the species is known from just over 200 plants across 13 sites. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments.	
<i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	E	-	Occurs along the coast of NSW and as far west as Narrabri. Grows in small colonies in moist places, usually near streams, on rocks and in trees in rainforest and moist eucalypt forest.	Low
<i>Grevillea parviflora</i> <i>subsp. parviflora</i>	Small-flower Grevillea	V	V	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks.	Moderate
<i>Gyrostemon thesioides</i>		E	-	Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. The most recent sighting was of a single male plant near the Colo River within Wollemi National Park. Despite searches, the species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively. Grows on hillsides and riverbanks and may be restricted to fine sandy soils.	Low
<i>Hibbertia puberula</i>		E	-	Distribution extending from Wollemi National Park south to Morton National Park and the south coast near Nowra. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. Flowers from October to January	Low
<i>Isotoma fluviatilis</i> <i>subsp. fluviatilis</i>		-	X	Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance.	None. Considered extinct



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
				Possibly out competed when overgrown by some species such as <i>Cyndon dactylon</i> .	
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	Occurs along the upper Georges River and in Heathcote NP, Royal NP and is also known from the Blue Mountains along the Grose River. Grows in woodland on sandstone and prefers rocky hillsides along creek banks up to 100 m altitude. Associated species include Sydney Peppermint and Silvertop Ash and Graceful Bush-pea, Flaky-barked Tea-tree and <i>Dillwynia retorta</i> .	Low
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP	-	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	None
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Low
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Occurs from Nowra to St Albans and west to the Blue Mountains, with most records in Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath- open forest, often in sandstone ridgetop woodland communities.	None
<i>Persicaria elatior</i>	Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW from Ulladulla to the Victorian border. In northern NSW it is known from Raymond Terrace and the Grafton area. This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	None



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
<i>Persoonia bargoensis</i>	Bargo Geebung	E	V	Restricted to the western edge of the Woronora Plateau and the northern edge of the Southern Highlands, bounded by Picton, Douglas Park, Yanderra and the Cataract River. Occurs in woodland or dry sclerophyll forest on sandstone and clayey laterite on heavier, well drained, loamy, gravelly soils of Hawkesbury Sandstone and Wianamatta Shale. Tends to occur in disturbed areas e.g. roadsides and trail margins.	Moderate
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600 m above sea level.	Low
<i>Persoonia nutans</i>	Nodding Geebung	E	E	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Low
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	Confined to area between north Sydney in the south and Maroota in the north-west. Grows on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Low
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	Disjunct populations within the Cumberland Plain ((Marayong and Prospect Reservoir south to Narellan and Douglas Park) and Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the Cumberland Plain sites, it is associated with Grey Box communities. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland.	High



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
<i>Pomaderris brunnea</i>	Brown Pomaderris	E	V	Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.	Moderate
<i>Prostanthera marifolia</i>	Seaforth Mintbush	CE	CE	Only known from a 2 x 2 km area in Seaforth, northern Sydney. Associated with the endangered Duffys Forest ecological community. Located on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.	Low
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Moderate
<i>Pultenaea aristata</i>	Prickly Bush-pea	V	V	Restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong. Occurs in either dry sclerophyll woodland or wet heath on sandstone.	Low
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E	0	In NSW there are three disjunct populations in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn. NSW populations typically among woodland vegetation but also found on road batters and coastal cliffs. In Windellama it is largely confined to loamy soils in dry gullies.	Moderate
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	Occurs in narrow coastal strip from Upper Lansdowne to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Low



Scientific Name	Common Name	BC Act	EPBC Act	Habitat	Likelihood
<i>Thesium australe</i>	Austral Toadflax	V	V	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland and is often found in association with Kangaroo Grass.	Low



Protected Matters Search Tool report



Australian Government

Department of Climate Change, Energy,
the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 28-Jul-2025

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	13
Listed Threatened Species:	78
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	35
Commonwealth Heritage Places:	2
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	6
Regional Forest Agreements:	None
Nationally Important Wetlands:	2
EPBC Act Referrals:	36
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties			[Resource Information]
Name	State	Legal Status	Buffer Status
Greater Blue Mountains Area	NSW	Declared property	In buffer area only

National Heritage Places			[Resource Information]
Name	State	Legal Status	Buffer Status
Natural			
The Greater Blue Mountains Area	NSW	Listed place	In buffer area only

Listed Threatened Ecological Communities			[Resource Information]
For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.			
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.			

Community Name	Threatened Category	Presence Text	Buffer Status
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion	Endangered	Community may occur within area	
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community may occur within area	
Coastal Upland Swamps in the Sydney Basin Bioregion	Endangered	Community likely to occur within area	In buffer area only
Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community may occur within area	
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	Critically Endangered	Community likely to occur within area	In feature area
Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area	In feature area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community may occur within area	
Shale Sandstone Transition Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area	In feature area
Southern Highlands Shale Forest and Woodland in the Sydney Basin Bioregion	Critically Endangered	Community may occur within area	In buffer area only

Community Name	Threatened Category	Presence Text	Buffer Status
Turpentine-Ironbark Forest of the Sydney Basin Bioregion	Critically Endangered	Community likely to occur within area	In buffer area only
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Endangered	Community may occur within area	In buffer area only
Western Sydney Dry Rainforest and Moist Woodland on Shale	Critically Endangered	Community likely to occur within area	In feature area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area	In feature area

Listed Threatened Species

[[Resource Information](#)]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In feature area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat known to occur within area	In feature area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area	In buffer area only
Erythroriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area
FISH			
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat known to occur within area	In feature area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area	In buffer area only
FROG			
Heleioporus australiacus australiacus Giant Burrowing Frog, Eastern Owl Frog [92013]	Endangered	Species or species habitat known to occur within area	In feature area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area	In feature area
Litoria littlejohni Northern Heath Frog, Littlejohn's Tree Frog [64733]	Endangered	Species or species habitat known to occur within area	In buffer area only
Litoria watsoni Southern Heath Frog, Watson's Tree Frog [91509]	Endangered	Species or species habitat may occur within area	In buffer area only
Mixophyes balbus Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
INSECT			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Austrocordulia leonardi Sydney Hawk Dragonfly [84741]	Endangered	Species or species habitat known to occur within area	In feature area
MAMMAL			
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In feature area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In buffer area only
Notamacropus parma Parma Wallaby [89289]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat known to occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In feature area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In feature area
PLANT			
Acacia baueri subsp. aspera [18662]	Endangered	Species or species habitat may occur within area	In buffer area only
Acacia bynoeana Bynoe's Wattle, Tiny Wattle [8575]	Vulnerable	Species or species habitat known to occur within area	In feature area
Acacia pubescens Downy Wattle, Hairy Stemmed Wattle [18800]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Allocasuarina glareicola [21932]	Endangered	Species or species habitat may occur within area	In feature area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Calochilus pulchellus Pretty Beard Orchid, Pretty Beard-orchid [84677]	Endangered	Species or species habitat may occur within area	In buffer area only
Commersonia prostrata Dwarf Kerrawang [87152]	Endangered	Species or species habitat known to occur within area	In feature area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Cynanchum elegans White-flowered Wax Plant [12533]	Endangered	Species or species habitat known to occur within area	In feature area
Eucalyptus benthamii Camden White Gum, Nepean River Gum [2821]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Genoplesium baueri Yellow Gnat-orchid, Bauer's Midge Orchid, Brittle Midge Orchid [7528]	Endangered	Species or species habitat likely to occur within area	In feature area
Grevillea parviflora subsp. parviflora Small-flower Grevillea [64910]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grevillea raybrownii [65665]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Hakea dohertyi Kowmung Hakea [66701]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat may occur within area	In feature area
Hibbertia acaulothrix [87409]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Leucopogon exolasius Woronora Beard-heath [14251]	Vulnerable	Species or species habitat known to occur within area	In feature area
Melaleuca deanei Deane's Melaleuca [5818]	Vulnerable	Species or species habitat known to occur within area	In feature area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat known to occur within area	In feature area
Persoonia bargoensis Bargo Geebung [56267]	Endangered	Species or species habitat known to occur within area	In feature area
Persoonia glaucescens Mittagong Geebung [12770]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Persoonia hirsuta Hairy Geebung, Hairy Persoonia [19006]	Endangered	Species or species habitat known to occur within area	In buffer area only
Persoonia mollis subsp. revoluta [56094]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Persoonia nutans Nodding Geebung [18119]	Endangered	Species or species habitat may occur within area	In buffer area only
Pimelea curviflora var. curviflora [4182]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pimelea spicata Spiked Rice-flower [20834]	Endangered	Species or species habitat known to occur within area	In feature area
Pomaderris brunnea Rufous Pomaderris, Brown Pomaderris [16845]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pomaderris cotoneaster Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat known to occur within area	In feature area
Pterostylis saxicola Sydney Plains Greenhood [64537]	Endangered	Species or species habitat known to occur within area	In feature area
Pultenaea aristata [18062]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Rhizanthella slateri Eastern Underground Orchid [11768]	Endangered	Species or species habitat may occur within area	In feature area
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Syzygium paniculatum Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thelymitra kangaloonica Kangaloon Sun Orchid [81861]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area	In feature area

REPTILE

Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area	In feature area
Hoplocephalus bungaroides Broad-headed Snake [1182]	Endangered	Species or species habitat known to occur within area	In feature area

Listed Migratory Species [[Resource Information](#)]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Migratory Terrestrial Species

Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area

Migratory Wetlands Species

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
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Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]		
The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.		
Commonwealth Land Name	State	Buffer Status
Commonwealth Trading Bank of Australia		
Commonwealth Land - Commonwealth Trading Bank of Australia [12113]	NSW	In buffer area only
Communications, Information Technology and the Arts - Australian Postal Corporation		
Commonwealth Land - Australian Postal Commission [12112]	NSW	In buffer area only
Communications, Information Technology and the Arts - Telstra Corporation Limited		
Commonwealth Land - Australian Telecommunications Commission [12156]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - Australian Telecommunications Commission [12066]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12201]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12107]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12104]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12101]	NSW	In feature area
Commonwealth Land - Australian Telecommunications Commission [12102]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12103]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12108]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12109]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12105]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12124]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12199]	NSW	In buffer area only
Commonwealth Land - Australian Telecommunications Commission [12119]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [15889]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [12157]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [12115]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [12200]	NSW	In buffer area only
Commonwealth Land - Telstra Corporation Limited [12114]	NSW	In buffer area only
Defence		
Commonwealth Land - Defence Service Homes Corporation [12106]	NSW	In buffer area only
Defence - AIRTC CAMDEN [10146]	NSW	In buffer area only
Unknown		
Commonwealth Land - [15676]	NSW	In buffer area only

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [15677]	NSW	In buffer area only
Commonwealth Land - [12918]	NSW	In buffer area only
Commonwealth Land - [15634]	NSW	In buffer area only
Commonwealth Land - [15635]	NSW	In buffer area only
Commonwealth Land - [15587]	NSW	In buffer area only
Commonwealth Land - [15588]	NSW	In buffer area only
Commonwealth Land - [15679]	NSW	In buffer area only
Commonwealth Land - [15678]	NSW	In buffer area only
Commonwealth Land - [12121]	NSW	In buffer area only
Commonwealth Land - [12122]	NSW	In buffer area only
Commonwealth Land - [12123]	NSW	In buffer area only

Commonwealth Heritage Places			[Resource Information]
Name	State	Status	Buffer Status
Historic			
Camden Post Office	NSW	Listed place	In buffer area only
Indigenous			
Cubbitch Barta National Estate Area	NSW	Listed place	In buffer area only

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In feature area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Sterna striata White-fronted Tern [799]		Migration route may occur within area	In feature area
Symposiachrus trivirgatus as Monarcha trivirgatus Spectacled Monarch [83946]		Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Dharawal	National Park	NSW	In buffer area only
Dharawal	State Conservation Area	NSW	In buffer area only
Nattai	National Park	NSW	In buffer area only
Thirlmere Lakes	National Park	NSW	In buffer area only
Upper Nepean	State Conservation Area	NSW	In buffer area only
William Howe	Regional Park	NSW	In buffer area only

Nationally Important Wetlands			[Resource Information]
Wetland Name		State	Buffer Status
O'Hares Creek Catchment		NSW	In buffer area only
Thirlmere Lakes		NSW	In feature area

EPBC Act Referrals					[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status	
Macarthur Gardens North residential development, Macarthur, NSW	2017/8029		Post-Approval	In buffer area only	
Menangle Park, Site-wide Bulk Earthworks Development Application	2024/10074		Assessment	In buffer area only	
Mt Gilead Stage 2 Residential Development	2019/8587		Approval	In buffer area only	
Warragamba Dam Raising Project	2017/7940		Completed	In buffer area only	
Wilton Shearer Avenue Road and Stormwater Infrastructure	2022/09276		Post-Approval	In buffer area only	

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Airds and Bradbury Renewal Project	2011/6169	Controlled Action	Post-Approval	In buffer area only
Bingara Gorge staged residential development, NSW	2014/7400	Controlled Action	Post-Approval	In buffer area only
Clearing of vegetation for several facilities, Bargo, NSW	2009/5058	Controlled Action	Completed	In buffer area only
Construction of a ventilation shaft and access Road to service underground operations	2010/5722	Controlled Action	Post-Approval	In feature area
Cross Street Residential Development	2019/8537	Controlled Action	Further Information Request	In buffer area only
Dendrobium Coal Mining Project	2001/214	Controlled Action	Post-Approval	In buffer area only
Extension of Underground Mining Operations at The Bulli Seam Operations	2010/5350	Controlled Action	Post-Approval	In feature area
Harrington Grove 900-Lot Residential Development	2009/4862	Controlled Action	Post-Approval	In buffer area only
Mt Gilead residential development, NSW	2015/7599	Controlled Action	Post-Approval	In buffer area only
Residential development, 19 Tickle Drive, Thirlmere NSW	2018/8318	Controlled Action	Post-Approval	In buffer area only
Residential development, Lots 8-9 and Lot 2 Bronzewing St and Byron Road, Tahmoor, NSW	2016/7808	Controlled Action	Post-Approval	In buffer area only
Residential Development, St Helens Park, NSW	2009/5015	Controlled Action	Further Information Request	In buffer area only
Russell Vale Colliery Revised Underground Expansion Project	2020/8702	Controlled Action	Post-Approval	In buffer area only
Russell Vale Colliery Underground Expansion Project, NSW	2014/7268	Controlled Action	Completed	In buffer area only
South Sydney Freight Rail Line	2005/2393	Controlled Action	Post-Approval	In buffer area only
Tahmoor South longwall coal mining project, Southern Coalfields, NSW	2014/7162	Controlled Action	Completed	In buffer area only
Tahmoor South Project, NSW	2017/8084	Controlled Action	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Blair Athol Residential Subdivision	2001/198	Not Controlled Action	Completed	In buffer area only
Construction & operation of lead-in infrastructure for drinking water & wastewat	2009/4909	Not Controlled Action	Completed	In buffer area only
Construction of Access Road to Mount Annan Botanic Garden	2010/5485	Not Controlled Action	Completed	In buffer area only
Construction of a new rail track deviation of Main Southern Railway at Tahmoor	2011/5794	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Realignment of Link Road and residential development adjacent to Camden Bypass	2005/2181	Not Controlled Action	Completed	In buffer area only
Residential Subdivision	2002/762	Not Controlled Action	Completed	In buffer area only
Residential Subdivision & associated Infrastructure & Environmental Protection A	2002/632	Not Controlled Action	Completed	In buffer area only
subdivision of 22.84 ha of pasture and woodlands to provide for future large lot residential housing	2011/5818	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Residential development of 210 lots at Wivenhoe	2008/4352	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Northern Expansion of the Camden Gas Project	2012/6638	Referral Decision	Completed	In buffer area only
Residential development, Lot 61 off Appin Road, Mt Gilead	2016/7830	Referral Decision	Completed	In buffer area only

Bioregional Assessments			[Resource Information]
SubRegion	BioRegion	Website	Buffer Status
Sydney	Sydney Basin	BA website	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact us](#) page.

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Our expertise



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