Whitehaven

2025

Maules Creek Continuation Project

Environmental Impact Statement

Appendix D
Aquatic Ecology Assessment

Maules Creek Continuation Project
Aquatic Ecology Assessment

Maules Creek Coal Pty Ltd

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Template 2.8.1

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Executive Summary

The Maules Creek Coal Mine (MCCM) is an open cut coal mine located approximately 17 kilometres (km) north-east of Boggabri, New South Wales (NSW). Maules Creek Coal Pty Ltd (MCC) is seeking approval to continue open cut mining operations within the MCCM mining and exploration tenements for a further 10 years (from 2035 to 2044).

Eco Logical Australia (ELA) was commissioned by MCC to prepare this aquatic ecology assessment for the Project.

Assessment Approach

Back Creek and Maules Creek are ephemeral streams that are part of the Namoi River catchment. Back Creek enters Maules Creek downstream of the existing Maules Creek Coal Mine, and enters the Namoi River a further 8 km downstream.

Study sites were established along Back Creek, Maules Creek, and the Namoi River and sampled between summer 2022 and autumn 2024 for macroinvertebrate communities, physico-chemistry, riparian vegetation condition and aquatic habitat. Database searches were also undertaken to inform whether any threatened fish species were likely to occur.

Previous monitoring reports, in addition to recent ecological surveys indicate that the aquatic macroinvertebrate communities of all creeks have a low diversity. Four surveys between December 2022 and March 2023 collected between 2 and 19 taxa per site, with most taxa being tolerant of disturbance. At most sites, the Stream Invertebrate Grade Number-Average Level (SIGNAL) score indicated severe disturbance (score <4), while at others it indicated moderate disturbance (>4). Invertebrate communities of low diversity, and tolerant of disturbance are not unusual for ephemeral streams, with diversity generally increasing with the duration of flow period.

Back Creek had water at most sites during summer 2022, although water was present in fragmented pools rather than as a continuous connected flow on all subsequent surveys. In autumn 2023, only four sites in Back Creek had water in them. Flow in Maules Creek and Namoi River was continuous for both of the first survey periods, but some sites in Maules Creek began to dry up in summer 2023 and dried further into 2024.

Aquatic Ecology Habitat

Riparian vegetation along Back Creek and much of Maules Creek is *Black Tea-tree-River Oak-Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion* (Plant Community Type [PCT] 112). Near the confluence of Maules Creek and Back Creek the riparian community is *River Red Gum riparian tall woodland/open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion* (PCT 78).

The desktop and field-based assessments indicate that Back Creek has an aquatic ecosystem similar to other ephemeral streams in the area, in that it has a low macroinvertebrate diversity. The depauperate fauna is largely determined by the frequency of drying in the main channel, and the long distances needed to travel for re-colonisation.

Threatened Species and Communities

The Namoi River and its tributaries, including Maules Creek and Back Creek, are part of the Lowland Darling River Aquatic Ecological Community, an endangered ecological community (EEC) in New South Wales. This endangered ecological community includes all native fish and aquatic invertebrates in all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River in NSW.

Five species of fish with potential habitat in the study area, are listed as vulnerable or endangered under the NSW or Commonwealth legislation. Of these, eel-tailed catfish, silver perch, and Murray-cod are known to occur in the Namoi River, with natural populations supplemented by stocking. Eel-tailed catfish is mapped by Department of Primary Industries (DPI) Fisheries as theoretically occurring in Maules Creek. Purple-spotted gudgeon is mapped as theoretically occurring in Maules Creek and Back Creek, while olive perchlet is theoretically mapped as having suitable habitat in Maules Creek and Namoi River. There are no records in the Atlas of Living Australia of any threatened fish species occurring in Back Creek, and it is very unlikely that any would occur there as there is no suitable habitat as it is dry most of the time. There are also no records of any threatened fish species in Maules Creek.

Stygofauna

Samples from one bore in the lower reaches of Back Creek sediments (MOR2), and one bore in the Maules Creek alluvium (REG16) had stygofauna. MOR2 had 5 individuals of the syncarid crustacea genus of *Notobathynella* sp. It is likely that the *Notobathynella* sp. collected here is the same species as others known to occur in the Maules Creek alluvium. REG16 had Copepoda, Isopoda, Amphipoda, and Psammaspididae, all crustacean taxa previously collected from the Maules Creek alluvium. None of the bores sampled further upstream along Back Creek had stygofauna, and the likelihood of stygofauna occurring in these bores is low given the lack of suitable alluvial aquifers.

Impact Assessment

No direct impact is expected to the bed, banks, or riparian zone of Back Creek or Maules Creek. Modelling indicates that the drawdown in the Maules Creek alluvium is well within the seasonal fluctuations.

There is likely to be a small reduction in the Back Creek catchment area, which may reduce the total volume of runoff to Back Creek and mean less flow at times. However, the impacts on this to aquatic ecology is expected to be minimal since the ecological community is adapted to the existing ephemerality of the waterway, and consists of taxa that have adaptations to frequent drying. Further, the area of excised catchment following rehabilitation of the site would be less than current (2025) and the approved MCCM.

Impact Avoidance and Mitigation

Impacts to the aquatic ecology of Back Creek can be mitigated by ensuring all mine water is intercepted before entering the waterway. Sediment retention devices should be installed at drainage lines, and regularly inspected and maintained. Water draining from the base of waste rock dumps should be channelled to settlement ponds and only released off-site once it meets water quality guidelines. Any chemicals used on-site (oil, fuel, other chemicals) should be stored appropriately to reduce the chance of them entering waterways.

It's recommended that existing gauging stations installed along Back Creek continue to be monitored to provide data on flow patterns of the creek. In particular, it can be important to know at what level flow in the creek is continuous. This would inform when fish are able to migrate upstream, invertebrates move between pools, and potential contaminants spread along the creek.

Current monitoring (spring and autumn) of macroinvertebrate communities, habitat features, and riparian vegetation should continue for the Project.

Conclusion

The aquatic ecological community of Back Creek and Maules Creek consist of robust and disturbance-tolerant invertebrate taxa. No threatened species are likely to occur in Back Creek, nor are they likely in Maules Creek. This is because both waterways dry regularly, with Back Creek being dry most of the time and having several barriers to fish passage. However, both waterways are part of the Lowland Darling Aquatic Ecosystem, which is considered an endangered ecological community.

Groundwater modelling indicates that there would be no significant drawdown of the Maules Creek alluvium, and the reduction in groundwater contribution to surface flow compared to the approved operations would be approximately 0.2% of the median flow recorded in Maules Creek at the Avoca East flow gauging station. While the Maules Creek alluvium has a stygofauna community, impacts to this community would be negligible.

Although there may be a slight reduction in runoff to Back Creek due to the removal of part of the catchment area, the Project is unlikely to have a significant impact on any of the waterways in the region.

1. Introduction

Eco Logical Australia (ELA) were engaged by Maules Creek Coal Pty Ltd (MCC) to prepare this aquatic ecology assessment for the Maules Creek Continuation Project (MCCP) (the Project).

1.1. Background

The Maules Creek Coal Mine (MCCM) is an open cut coal mine located approximately 17 kilometres (km) north-east of Boggabri, New South Wales (NSW) (Figure 1). MCCM is a joint venture between Aston Coal 2 Pty Ltd (a wholly owned subsidiary of Whitehaven Coal Limited [Whitehaven]) (75 per cent [%]), ICRA MC Pty Ltd (a wholly owned subsidiary of Itochu Corporation) (15%) and J-Power Australia Pty Ltd (a wholly owned subsidiary of Electric Power Development Co. Ltd) (10%). MCCM is operated by MCC.

Mining operations at MCCM are currently approved until 31 December 2034 with a coal extraction rate of up to 13 million tonnes per annum (Mtpa) in accordance with Project Approval (PA) 10_0138 (as modified). The existing MCCM comprises a single open cut pit, Northern Emplacement and Southern Emplacement areas, and Mine Infrastructure Area (MIA) (Figure 2). The MIA includes the Coal Handling and Preparation Plant (CHPP), run-of-mine (ROM) coal stockpiles, product coal stockpiles, train load-out infrastructure, workshops and administration buildings, hardstand and laydown areas, car parking, wash bays, and other associated infrastructure

1.2. Project Description

MCC is seeking approval to continue open cut mining operations within the MCCM mining and exploration tenements for a further 10 years (from 2035 to 2044). This is referred to as the Maules Creek Coal Project (MCCP). Development Consent for the Project is being sought under the State Significant provisions (i.e. Division 4.7) under Part 4 of the NSW *Environmental Planning and Assessment Act 1979*. The indicative Project general arrangement is provided on Figure 2.

Compared to the existing approved MCCM, the Project would include the following additional key activities (Figure 1 and Figure 2):

- extension of open cut mining operations within Coal Lease (CL) 375, Mining Lease (ML) 1719 and Authorisation (AUTH) 346 to allow mining and processing of additional coal reserves until approximately 31 December 2044;
- extraction of approximately 117 million tonnes (Mt) of ROM coal (in addition to the approved MCCM coal resource of 240 Mt of ROM coal);
- extraction of up to 14 Mtpa of ROM coal (i.e. a 1 Mtpa increase from the currently approved maximum ROM coal mining rate of 13 Mtpa);
- a revegetation program to establish approximately 2,300 hectares (ha) of native woodland in the vicinity of MCCM (i.e. in addition to any offset and rehabilitation obligations);
- an increase in the operational workforce to an average of approximately 940 people, with a peak operational workforce of approximately 1,030 people;
- continued operation of the existing CHPP and train load-out and rail spur infrastructure, with upgrades as required;
- continued transport of up to 12.4 Mtpa of product coal via rail (i.e. no change to the currently approved maximum product coal transport rate);

- development of an integrated waste rock emplacement landform that incorporates geomorphic design principles;
- construction and use of a remote go-line, access and infrastructure area;
- continued operation and extension of the MCCM water management system;
- upgrades to workshops, electricity distribution and other ancillary infrastructure;
- continued placement of coal rejects within the mined out voids and the out-of-pit overburden emplacement areas;
- construction and operation of a water transfer pipeline between the MCCM water pipeline network and the approved Vickery Coal Mine (VCM) to Tarrawonga Coal Mine (TCM) pipeline;
- ongoing exploration activities; and
- other associated infrastructure, equipment and activities.

1.3. Scope of works

The scope of works for this aquatic ecology assessment is designed to address the SEARs and relevant agency comments, and to determine the significance and condition of aquatic and aquifer ecosystems around the Project. The tasks within the assessment included:

- describe aquatic habitats, including significant features such as substrate, stream type, water quality, and surrounding land use;
- describe aquatic plants and animals that are present during sampling, or likely to occur at any time during the year;
- identify and describe any aquatic species listed under the *Fisheries Management Act 1994* (FM Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as threatened, that are likely to be present in the study area;
- consider State and Commonwealth guidelines associated with threatened species likely to occur in the study area (e.g. survey guidelines, referral guidelines, recovery plans and threat abatement plans);
- conduct a study using appropriate methods to identify stygofauna; and
- a description of the likely impacts on aquatic ecological values, including: − cumulative impacts with surrounding mining operations (i.e. Boggabri and Tarrawonga);
- assessments of significance in accordance with Division 12, Part 7A of the FM Act and the Threatened Species Assessment Guidelines - The Assessment of Significance as specified by the NSW *Biodiversity Conservation Act 2016* (BC Act) (Department of Primary Industries [DPI], 2008); and
- a description of proposed impact avoidance and mitigation measures and ongoing monitoring.

WHC-23-95_MCCP ER_AEA_201C

LEGEND

- MCCM Mining Tenement Boundary (CL and ML)
- Mine Site
- Local Government Boundary
- State Forest
- State Conservation Area, Aboriginal Area
- Rail Line

Source: NSW Spatial Services (2023); Geoscience Australia (2011)

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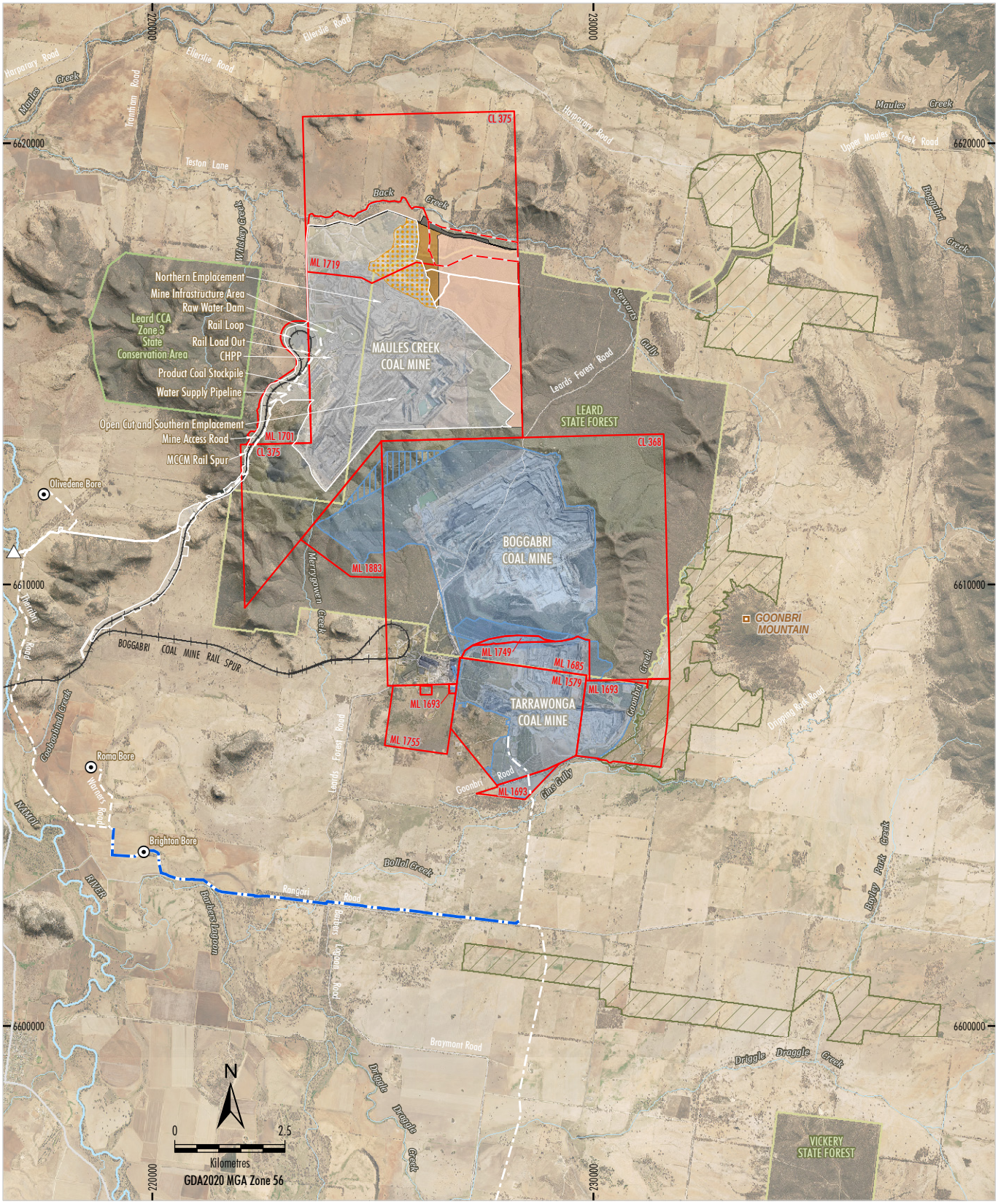
MAULES CREEK CONTINUATION PROJECT

Project Location

Figure 1



WHC-23-95 EIS_App CL_202A

LEGEND

- Rail Line
- State Conservation Area
- State Forest
- Mining Tenement Boundary (ML and CL)
- Provisional Mining Lease Application Area
- Other Mining Operation *
- Other Mining Operation - Proposed *
- VCM to TCM Water Transfer Pipeline

Existing/Approved MCCM Development

- Approximate Extent of Existing/Approved Surface Development
- MCCM Water Supply Pipeline
- MCCM Groundwater Supply Bore
- MCCM Namoi River Pump Station

Maules Creek Continuation Project

- Indicative Go-line, Access and Infrastructure Area
- Indicative Open Cut Extension Area
- Indicative Overburden Emplacement Extension
- Existing Overburden Rehabilitation to be Disturbed
- Indicative Landscape Revegetation Zones#
- Indicative Water Transfer Pipeline (Proposed)

Source: NSW Spatial Services (2024)
Orthophoto Mosaic: Whitehaven (2019-2024)

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MAULES CREEK CONTINUATION PROJECT

General Arrangement of the Project

** BCM boundary digitised from Figure 1 of the BCM Modification 10 Scoping Letter.*

#Landscape Revegetation Zones shown on this figure are approximate extents only.

Figure 2

2. Existing Environment

2.1. Regional Setting

MCCM is approximately 18 km north-east of Boggabri and 40 km south-east of Narrabri in the Gunnedah Coal Basin of northern NSW.

2.2. Land Use

The mine is in a northern section of Leard State Forest and surrounded to the west and south by native woodland (Figure 2). Beyond Leard State Forest, and to the north of the mine, the surrounding landscape is dominated by dryland irrigation for cropping and grazing.

2.3. Climate

The Gunnedah Airport (Number 55202) Bureau of Meteorology (BoM) meteorological station is located approximately 40 km south-east of the MCCM. Climate is mostly hot and dry in summer, with maximum temperatures between 32.7 degrees Celsius (°C) and 34.6 °C. Maximum temperatures in winter range from 17.4°C to 21.7°C, while minimums are between 2.1°C and 5.6°C. Rainfall is highest in December, with an average of 80.4 millimetres (mm), and summer thunderstorms are common. Temperature average is lowest in April and May, with measurements of 23.1°C and 27.1°C respectively.

2.4. Study Area

The study area for this assessment includes the current MCCM as well as the extended mine area and nearby streams Back Creek, Maules Creek, and the Namoi River.

2.5. Hydrology and Surface Water

MCCM is adjacent to Back Creek, a 5th Strahler Order ephemeral stream that flows west into Maules Creek approximately 9 km downstream of the mine, then into the Namoi River (Figure 3). Back Creek is mostly dry, though some of the larger pools persist for several months after large rainfall events. Since 2020, Back Creek has flowed continuously along most of its length several times each year. Most of the catchment north of Back Creek is agricultural land, while south of the creek the landscape is dominated by MCCM, Leard State Forest, and Leard State Conservation Area, with some agricultural land at its headwaters.

Maules Creek flows west through agricultural land and drains into the Namoi River. Maules Creek typically ceases to flow in the upper and middle reaches during dry periods, although maintains pools of water through connection to alluvial groundwater. The bed of Maules Creek is a mix of sand, gravel and cobble.

The Namoi River is the largest waterway in the region, flowing in a north-westerly direction through Boggabri and passing to the west of MCCM (Figure 3). Flow in the Namoi River is regulated by discharges from Keepit Dam north-west of Gunnedah, Chaffey Dam south of Tamworth and Split Rock Dam north of Tamworth. Environmental flows are released from the dams to maintain connectivity most of the time outside of high flow irrigation periods with the aim of maintaining downstream river health, but the river has dried to disconnected pools several times over the past decade during periods of drought.

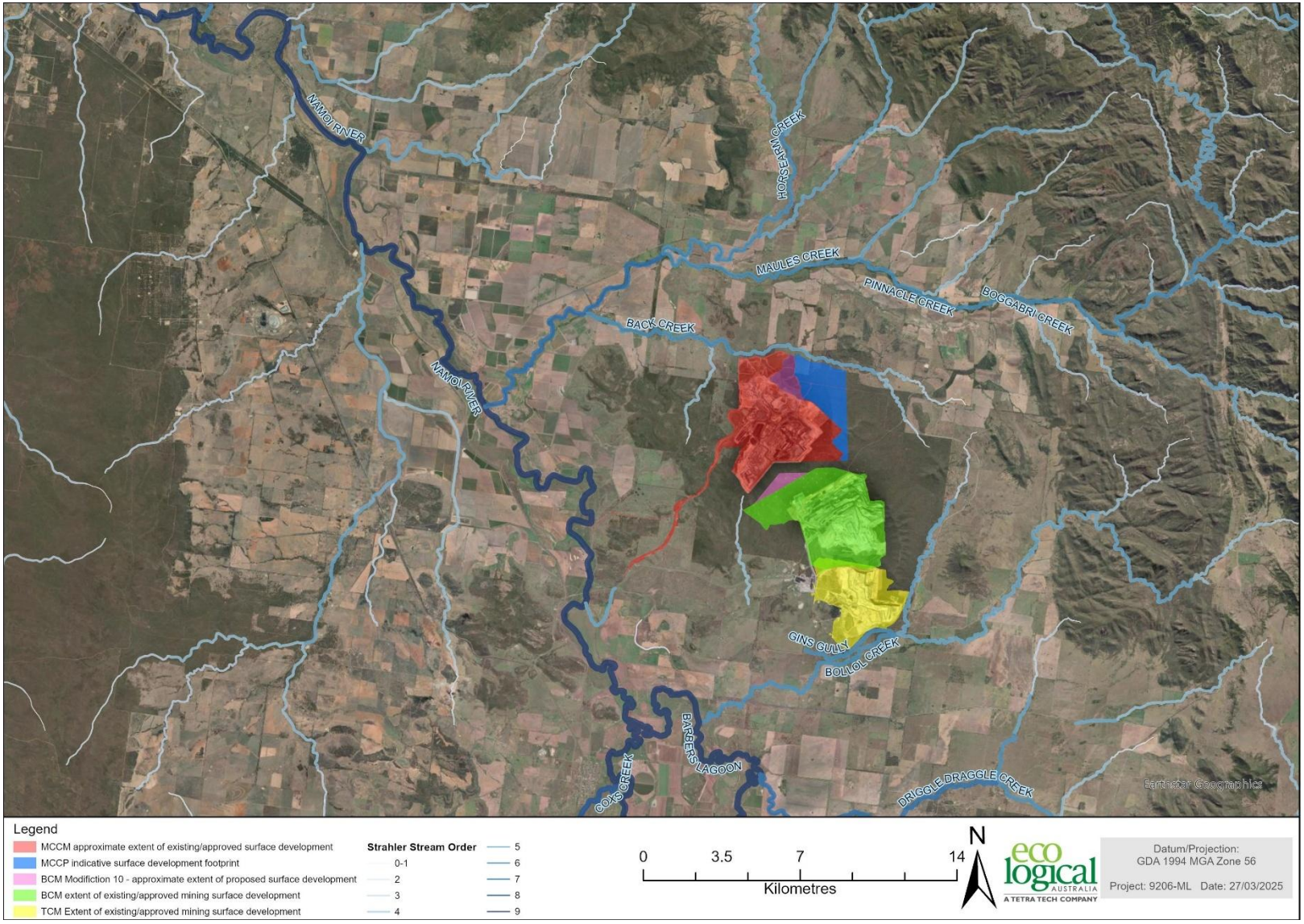

Figure 3: Watercourses in surrounding MCCM

2.6. Groundwater

Regional aquifers of the study area are described in detail in Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) (2011) and relevant sections are summarised below.

Alluvial aquifers

The Namoi River is the largest river near MCCM, about 10 km west of the Project boundary. The river flows north-west through a broad floodplain that is constricted north of Boggabri by an outcropping of the Boggabri Volcanics. The floodplain widens again as it merges with the Maules Creek alluvial plan. Beneath the floodplain, the alluvium forms an aquifer that extends to a maximum depth of approximately 125 metres (m), with thickness in most bore locations between 25 to 50 m. The aquifer consists of sands and gravel with interbedded clays (AGE 2011).

The Maules Creek alluvium consists of sand and gravel along the stream channel, clay sand/gravel on beds of the valley plains and slopes, and weathered/fractured rock under the alluvium/colluvium. The aquifer extends along Maules Creek and is constricted by an outcropping of Permian basement rock downstream of where Horesearm Creek and Middle Creek flow into Maules Creek. Groundwater levels in the Maules Creek alluvium are between 2.5 and 8 m below surface in the central area of Maules Creek alluvium, and 15-35 m to the north east (AGE 2011). Water levels are relatively responsive to rainfall and decline slowly during dry periods. There has been no evidence of drawdown influenced by mining based on the analysis of pre-mining groundwater levels and groundwater levels in 2023 by AGE (2025).

Back Creek contains a thin and relatively shallow bed of alluvial/colluvial sediments that acts as a shallow aquifer. Water in the aquifer is recharged by rainfall. Back Creek is ephemeral and flows following significant rainfall events. The shallow and narrow bed sediments deposits in Back Creek limit the water bearing system to a temporary perched system recharged by the ephemeral creek. The water table within the Back Creek area is well below the bed sediments, at between 10 and 25 m below surface within the weathered zone (AGE 2025).

Permian aquifers

Permian coal measures near MCCM consist of low yielding layered sandstone and conglomerate units with layers of low to moderately permeable coal seams that act as the main water-bearing strata, and underlying Boggabri Volcanics which forms the basement (AGE 2025). Water in the Permian aquifers is generally fresh to brackish close to the outcrop area (AGE 2025).

2.7. Riparian Vegetation

Vegetation of the Project Area is reported in more detail in the MCCP Biodiversity Development Assessment Report (Premise 2025). From the upper reach of Back Creek to the eastern boundary of MCCM, vegetation communities consist of four plant community types (PCTs), ranging in condition from very poor to good (Table 1, Figure 4). *Black Tea-tree Riparian Woodland* dominates the section of creek that runs parallel to the northern boundary of the mine. Outside of the immediate riparian corridor are areas of *Poplar Box-Yellow Box- Western Grey Box Woodland* in poor to moderate condition, and with Cypress Pine regeneration in some areas. Some areas beyond the riparian zone also consist of revegetated *Derived Native Grassland*. The riparian zone of sections upstream of MCCM included patches of *Poplar Box-Yellow Box- Western Grey Box Woodland*, *Derived Native Grassland, Silver-leaved*

Ironbark-White Cypress Pine Woodland and *White Box-White Cypress Pine Shrub Grass Hills Woodland* (Figure 4).

Table 1. Vegetation zones and PCTs in the riparian zone of Back Creek

PCT	Vegetation Zone Condition	PCT Name
112	Good	Black Tea-tree Riparian Woodland
101	Good	Poplar Box-Yellow Box-Western Grey Box Woodland
101	Moderate	Poplar Box-Yellow Box-Western Grey Box Woodland
101	Dense Cypress Pine Regeneration	Poplar Box-Yellow Box-Western Grey Box Woodland
101	Very Poor	Poplar Box-Yellow Box-Western Grey Box Woodland
101	Cypress Pine Regeneration	Poplar Box-Yellow Box-Western Grey Box Woodland
101	Derived Native Grassland with scattered Poplar Box	Poplar Box-Yellow Box-Western Grey Box Woodland
101	Derived Native Grassland with scattered Yellow Box	Poplar Box-Yellow Box-Western Grey Box Woodland
413	Good	Silver-leaved Ironbark-White Cypress Pine Woodland
413	Derived Native Grassland	Silver-leaved Ironbark-White Cypress Pine Woodland
435	Derived Native Grassland (Revegetated)	White Box-White Cypress Pine Shrub Grass Hills Woodland
435	Derived Native Grassland (Revegetated) (Poor)	White Box-White Cypress Pine Shrub Grass Hills Woodland

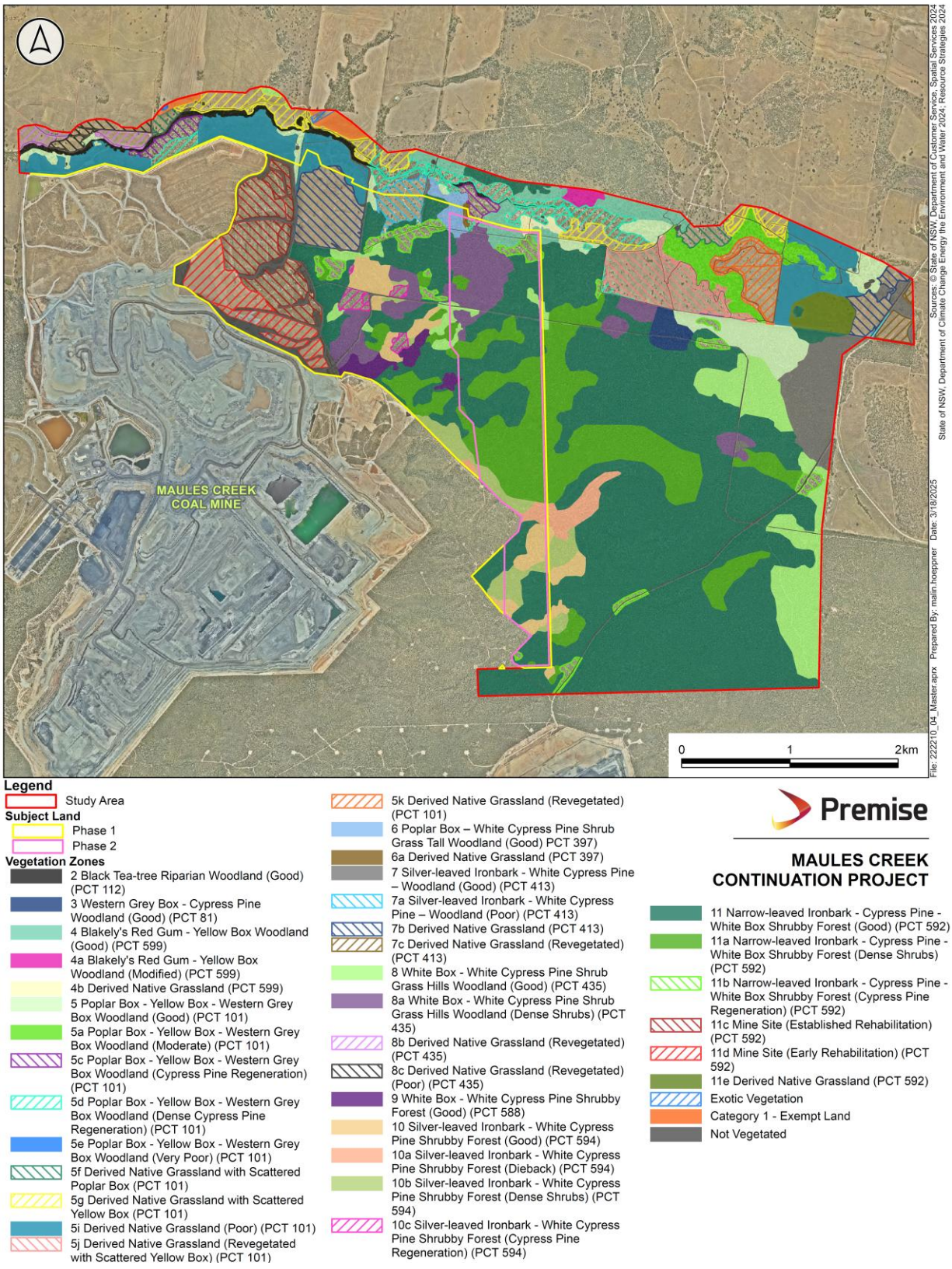

Figure 4. Vegetation zones in the Maules Creek Continuation Project, including riparian vegetation along Back Creek.

2.8. Previous Aquatic Ecology Surveys and Monitoring

Aquatic Ecology

Cumberland Ecology (2015-2020) conducted aquatic ecology assessments for MCCM between 2015 and 2020. Over the duration of these surveys, Back Creek was frequently dry at all sites at least once except site BCPX (which is artificially enlarged) (Section 3.4), and Maules Creek occasionally dry at all sites except site BCP7 (Section 3.4). This indicates that migration upstream along these waterways is likely to be limited.

Eco Logical Australia began monitoring aquatic ecology for MCCM in 2021. This program included the sites sampled by Cumberland as well as additional sites to bring the total to 17 sites on the Namoi River, Maules Creek, and Back Creek. Not all sites have been sampled continuously during that period, as many along Back Creek and Maules Creek cease to flow in dry periods. During most of the survey period, Back Creek has not had continuous flow, and was either dry or consisted of isolated pools. Maules Creek also had periods of no flow, although these were less frequent than Back Creek. This lack of connectivity between upstream and downstream reaches limits the ability of fish and some macroinvertebrates to move along the creeks. Exceptions to this occurred for brief periods between 2020 and 2023, when there was continuous flow for periods along Back Creek and Maules Creek.

Macroinvertebrate communities in ephemeral waterways generally have low diversity and consist of relatively disturbance-tolerant taxa (Stubbington *et al.* 2017). This has been the case for Back Creek and Maules Creek since sampling commenced, with macroinvertebrate communities having fewer than 15 taxa at most sites. Analysis of macroinvertebrate community indices sampled in autumn and spring since 2022, indicate that there was no detectable impact to aquatic ecosystems in Back Creek, Maules Creek, and Namoi River. Macroinvertebrate communities had low diversity, as expected in ephemeral waterways, and there were no distinct differences between sites upstream and downstream of the mine (Eco Logical Australia 2024).

Back Creek is ephemeral and only flows during periods of high rainfall. Maules Creek flows more frequently, though still has periods of fragmented flow when sections dry up. Both waterways have had many years of impact from historical agricultural management in their catchment, which has resulted in long-term inputs from catchment-derived sediment. Both creeks are generally in poor ecological condition, with a robust though depauperate invertebrate community. There has been no indication that mining at MCCM to date has had an impact on aquatic macroinvertebrate communities in Maules Creek and Back Creek.

Stygofauna

A stygofauna survey was conducted for MCCM in 2015 (Stygoecologia 2015). This survey sampled three bores in the Back Creek sediments, and three in Maules Creek alluvium. No stygofauna were collected from the Back Creek sediments, but all three Maules Creek bores contained stygofauna. The taxa collected that were definite stygofauna included Neoniphargidae amphipods, Janiridae and Phreatoicidae isopods, Candonidae ostracods, Psammaspidae and Bathynellidae syncarids, and Elmidae and Dytiscidae beetles. This backs up the findings of Anderson (2008) and Dr Grant Hose (*pers comm*) that the Maules Creek alluvial aquifer has a diverse stygofauna community.

It is noted that four bores have been added to the BCM monitoring network as stygofauna monitoring sites. These include Bellview 3, Cooboobindi MB, GW3115 and Victoria Park.

Groundwater syncarids, amphipods, and copepods have been collected from the Namoi alluvial aquifer by the NSW Office of Water, and the alluvial aquifer of the Peel River, a tributary of the Namoi, also has a rich stygofauna community with at least 20 species (Hancock and Boulton 2008). In a study conducted between 2007 and 2008, Korbel (2012) collected at least seven stygofauna taxa from 15 monitoring bores near Wee Waa, approximately 50 km west-northwest (and downstream) of Narrabri. The taxa collected included Ostracoda, Cyclopoida, Harpacticoida, Amphipoda, Oligochaeta, and three genera of Bathynellaceae.

3. Methods

3.1. Desktop assessment

Searches were made of the NSW Fisheries Spatial Portal (DPI 2024b) and BioNet (NSW Department of Environment 2024) to determine whether there are any threatened fish or significant aquatic habitat mapped in Maules Creek, Back Creek, and the Namoi River. This information was used in an initial desktop assessment of aquatic habitat quality.

The 'Probable Vegetation Groundwater Dependent Ecosystems- Namoi' dataset (initially published 2018) was downloaded from the Sharing and Enabling Environmental Data (SEED) website (NSW Government 2024). The study area was searched for groundwater dependent terrestrial vegetation.

3.2. Licences and permits

The spring surveys were conducted under ELA's Scientific Collection Permit Number P09/0038-3.0, issued by the DPI under Section 37 of the FM Act.

3.3. Survey conditions

ELA Aquatic ecologists, Dr Peter Hancock and Ronnie Hill, collected the stream health samples for summer 2022 between 5 and 9 December 2022. During the survey period, temperatures ranged from 7.2°C to 32.7°C, and there was no rain (Table 2). Dr Peter Hancock and Eliza Biggs collected the autumn 2023 samples between 20 and 24 March 2023, when temperatures were between 15.6°C and 34.7°C. There was no rain during the survey period (Table 2). Samples in summer 2023 were collected by Dr Peter Hancock and Jessica York from 12 to 14 December 2023. Temperatures during this survey period were between 21.8 and 38°C. Autumn 2024 samples were collected by Dr Peter Hancock and Alice Bauer between 7 and 10 May, when air temperature ranged from 8.1 and 25.3 °C. There was no rain during this period.

Between the end of July and end of November 2022, the Namoi River had seven high flow events where the river level peaked above 4 m, with the largest of these being 8.55 m on 26 October. Spates were also common in Maules Creek over the four months preceding sampling, with eight events exceeding 1 m. The largest flow event peaked at 3.7 m on 22 October (Figure 5). During the spring sampling period, flow level in both waterways was receding.

Between the spring and autumn surveys, flow in Maules Creek remained consistently low (Figure 5). Flow also remained low in the Namoi River, although there were some minor fluctuations in river level.

Table 2: Temperature and rainfall data during the 2022 and 2023 survey periods. Data from Gunnedah Airport AWS (55202)

Survey season	Date	Rainfall (mm)	Minimum Temp (°C)	Maximum Temp (°C)
Summer 2022	5/12/2022	0	11.8	32.3
	6/12/2022	0	16.2	32.7
	7/12/2022	0	8.7	31.9
	8/12/2022	0	12.7	28.9
	9/12/2022	0	7.2	28.8
Autumn 2023	20/03/2023	0	15.9	34.7
	21/03/2023	0	17.6	30.0
	22/03/2023	0	15.6	32.3
	23/03/2023	0	17.5	31.8
	24/03/2023	25.4	16.0	30.9
Summer 2023	12/12/2023	0	21.8	37.0
	13/12/2023	0	23.6	34.7
	14/12/2023	0	22.3	38.0
Autumn 2024	07/05/2024	0	10.5	24.1
	08/05/2024	0	8.1	23.8
	09/05/2024	0	10.2	25.3
	10/05/2024	0	13.8	24.7

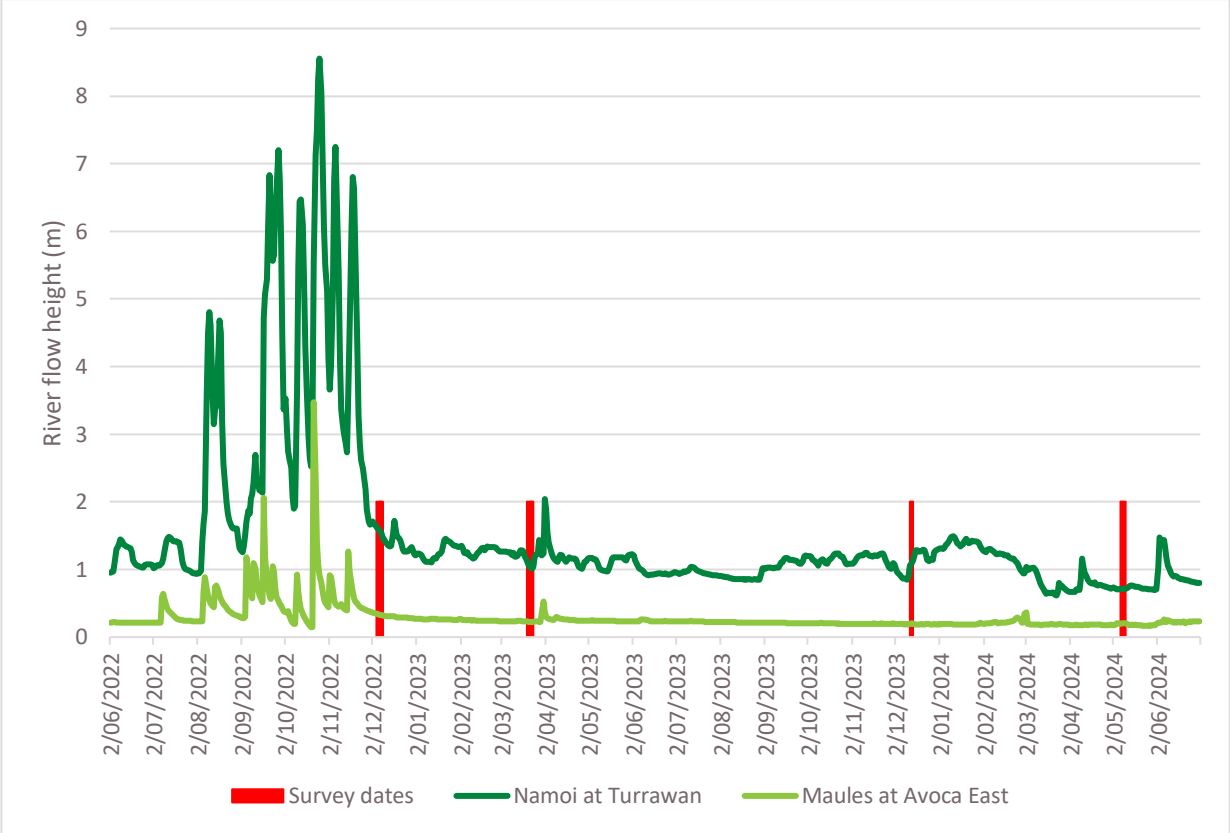

Figure 5: River levels in the Namoi River at Turrawan and Maules Creek at Avoca East (near Elfin Crossing). Red rectangle indicates sampling periods

3.4. Sampling sites

The aquatic ecology assessment determined baseline condition along Back Creek, Maules Creek, and Namoi River using 17 sites established previously for ecological monitoring (ELA 2021). Water quality and macroinvertebrate samples and habitat assessments were made at 16 sites in 5-9 December 2022 and at 12 sites 20-24 March 2023 (Table 3). One site was not accessible in December 2022 due to boggy tracks, and five sites were dry in March 2023.

MCCM is adjacent to Back Creek, an ephemeral stream that enters Maules Creek approximately 9 km downstream of the Project. Aquatic ecology surveys occurred at the following sites (Table 3, Figure 6).

Table 3: Location of aquatic ecology sites (coordinates given as GDA94, Zone 56 except SW8 and NRDS1 in Zone 55)

Site	Waterway	Easting (mE)	Northing (mS)
BCP1	Back Creek	231609	6617003
BCP2	Back Creek	226733	6618236
BCUS2	Back Creek	230541	6617449
BCP3	Back Creek	222942	6618904
BCP4	Back Creek	221140	6619142
BCP5	Back Creek	220386	6619179
BCPX	Back Creek	219793	6619166
BCP6	Back Creek	219447	6619187
BCP8	Back Creek	217210	6619908
BCP7	Maules Creek	219980	6622608
MCUS1	Maules Creek	216978	6620486
MCUS5	Maules Creek	227062	6622377
BCP9	Maules Creek	214321	6618105
SW8	Namoi River	787661	6616204
NRDS1	Namoi River	779818	6633693
Henriendri TSR	Namoi River	213595	6613629
SW5	Namoi River	218517	6598517

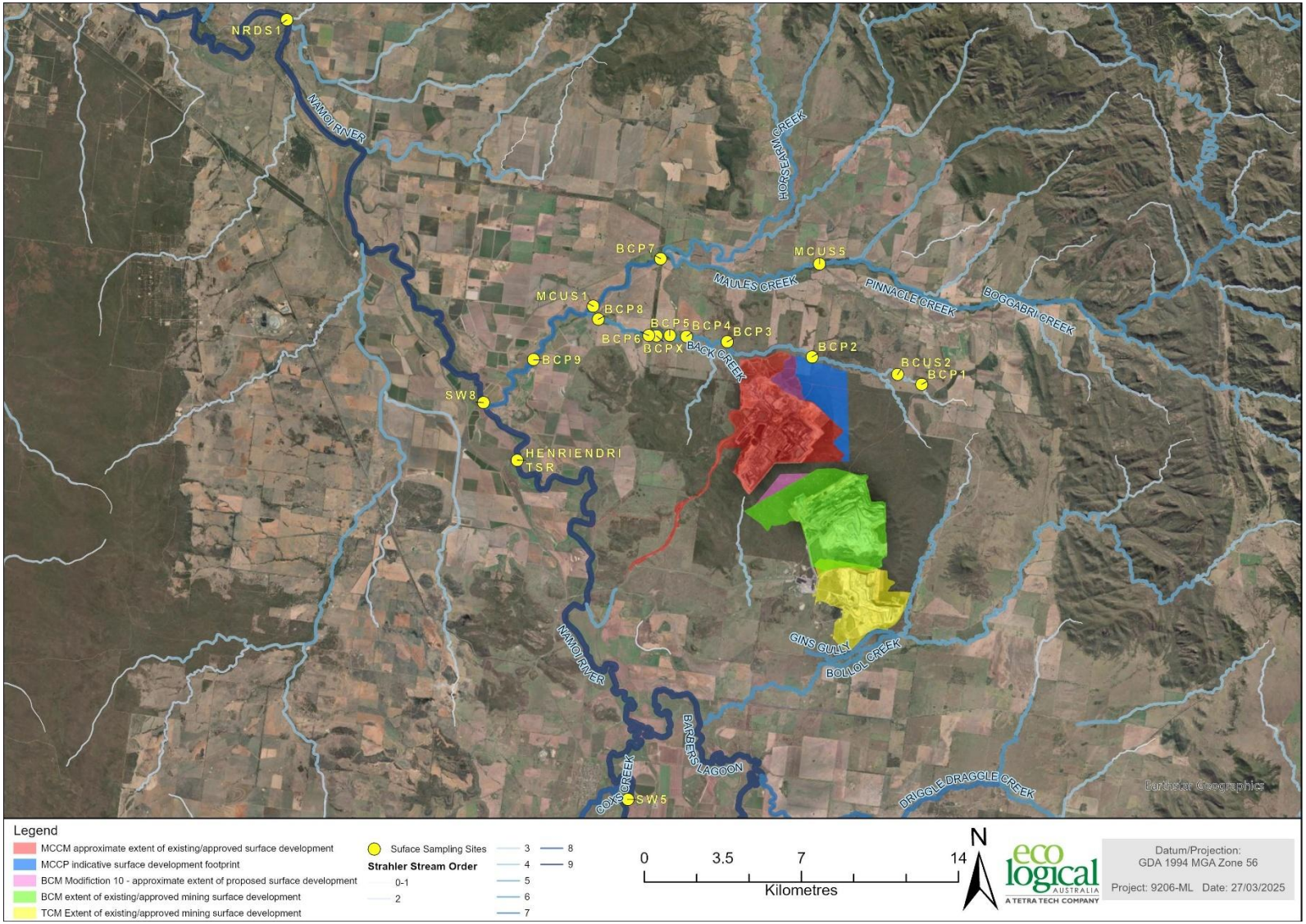

Figure 6: Location of aquatic ecology survey sites sampled in this assessment

3.5. Macroinvertebrate sampling and analysis

Macroinvertebrate samples were collected using the Australian River Assessment System (AUSRIVAS) protocols with a standard 250 micrometre (µm) sweep net (Turak *et al*. 2004). Samples were collected from edge habitats, as riffles were not present at all sites. At each site, the net was moved through a total length of 10 m. Net contents were emptied into a white sorting tray and scanned for 40 minutes so that representatives from each invertebrate taxon could be removed and preserved in a jar of 70% ethanol. If additional taxa were still being collected after 40 minutes, the sample was scanned for an additional 20 minutes.

SIGNAL Score

Invertebrates were identified to family in the laboratory using a Leica M80 dissecting microscope. Each family was assigned a Stream Invertebrate Grade Number-Average Level (SIGNAL) score based on Chessman (2003). The SIGNAL score indicates how sensitive an invertebrate family is to disturbance and is used as an indication of habitat health. Families that are sensitive to disturbance have scores between six and ten and are likely to only occur in healthy habitats, while those with scores below six can tolerate disturbance and would occur in impacted stream habitats (Gooderham and Tsyrlin 2002).

EPT Ratio

The Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) (EPT) taxa richness is the number of EPT taxa present in each sample. The families in these three insect orders are generally sensitive to disturbance so would be absent in degraded water bodies. The EPT Ratio is the total number of EPT taxa expressed as a proportion of the total taxonomic richness at each site.

Macroinvertebrate community data

Macroinvertebrate community data was analysed using the Primer v7 software package (PRIMER-E Ltd 2006). Prior to analysis, data was grouped in factors based on date, and location relative to MCCM (upstream/downstream). Data was transformed for presence/absence and a Bray-Curtis similarity matrix developed. Non-metric multidimensional scaling (nMDS) plots were generated to visually display data. Sites with similar communities overlap or appear close together in nMDS plots while those with communities that have different community compositions are further apart (Clarke and Gorley 2006).

Analysis of Similarities (ANOSIM) was used to test for similarities between the pre-selected factors of habitat, year and location relative to the mine. ANOSIM tests are multivariate approximations of the standard univariate analysis of variance (ANOVA) tests and use the same similarity matrix generated for nMDS (Clarke and Gorley 2015).

3.6. Physico-chemistry

To complement biological data, physico-chemical parameters were measured at two points for each site. Temperature, dissolved oxygen (DO), electrical conductivity (EC) and pH were measured with a calibrated YSI-556 meter. Turbidity was measured with a Hach 2100Q Turbidimeter and alkalinity was measured with a Hanna HI755 Freshwater Alkalinity Checker. The meters were calibrated in the laboratory prior to the field survey and the DO was calibrated at the start of each field survey day.

The *Australian and New Zealand Guidelines for Fresh and Marine Waters 2018* (ANZG) replaced the *Australian Water Quality Guidelines for Fresh and Marine Waters 2000* (ANZECC) in August 2018. The physico-chemistry data was compared to the ANZG (2018) guidelines for the protection of aquatic ecosystems in slightly disturbed upland rivers in southeast Australia and used to provide an indication of water quality in aquatic habitats.

3.7. Aquatic habitat assessments

Aquatic habitat assessments were based on the *Policy and Guidelines for Fish Habitat Conservation and Management* (Fisheries NSW 2013), which outlines the features important for fish habitat in freshwater, estuarine, and marine areas. The guidelines recognise the importance of links between upstream and downstream reaches, and the potential impact of riparian management and in-stream barriers to the ongoing health of fish and aquatic communities.

Aquatic habitat variables (environmental data) were recorded using the AUSRIVAS datasheets at each site. This included brief descriptions of characteristics such as:

- general signs of disturbance;
- habitat type;
- channel topography;
- current water level;
- bank and bed slope;
- degree of river shading;
- amount of detritus;
- macrophyte type and extent;
- riparian zone width;
- snags and large woody debris coverage;
- stream width and depth;
- surrounding land use;
- description of the natural substrate;
- extent of bank overhang; and
- amount of trailing bank vegetation.

3.8. Riparian vegetation assessment

RARC

The riparian vegetation assessment determined the health of the riparian community and the functional role that riparian vegetation has on stream ecology.

Riparian condition was assessed using the Rapid Appraisal of Riparian Condition (RARC), which provides an indication of riparian biodiversity and function. It also assessed the degree to which human-altered ecosystems diverge from local semi-natural ecosystems (Jansen *et al*. 2005). The RARC index is made of five sub-indices:

- habitat continuity and extent;
- vegetation cover and structural complexity;

- dominance of natives versus exotics;
- standing dead trees, hollows, fallen logs, leaf litter and debris; and
- indicative features such as regeneration, reeds, and tussocky grass.

Vegetation Survey

Vegetation assessments occurred at four selected sites along Back Creek, with the purpose of monitoring riparian vegetation health through time. Permanently marked 20 m x 50 m vegetation plots were established in the riparian zone of Back Creek at BCUS2, BCP2, BCP3 and BCP4. Within each plot, the following data was collected:

- native species richness - within 20 m x 20 m vegetation plot nested within the 20 m x 50 m plot;
- native tree cover and native mid-storey cover – at regular 5 m intervals along 50 m transect (10 points);
- native ground (grass, shrub, other) and exotic cover – at regular intervals along 50 m transect; and
- habitat features (number of trees with hollows, length of fallen logs) and proportion of over-storey species regeneration – within 20 m x 50 m plot.

3.9. Stygofauna sampling

Stygofauna samples were collected following the protocols outlined in *Risk assessment guidelines for groundwater dependent ecosystems* (NSW DPI 2012), *Technical guidance- sampling methods for subterranean fauna* (Government of Western Australia 2016), and *Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems* (Doody *et al.* 2019).

Six bores were sampled in summer 2022, three bores were sampled in autumn 2023, and four were sampled in autumn 2024 (Table 4, Figure 7). An additional eight were visited but were dry or could not be found at the location given.

Groundwater invertebrates were sampled using a down-bore net of 63 µm-mesh. Nets were selected with the largest diameter suitable to fit inside bore casing. The net was lowered to the bottom of each bore (depth recorded as metres below ground level [mBGL]) and bounced several times to dislodge any resting fauna, before being slowly retrieved. At the top of each haul, net contents were washed into a 63 µm-mesh sieve for temporary storage. The net was lowered into the bore five more times and emptied into the sieve until it contained the cumulative contents of six hauls. These were washed into a sampling jar and stored in 100% ethanol for sorting.

Stygofauna samples were sorted under microscope and identified as far as possible using taxonomic keys.

Table 4: Location of bores sampled or visited during stygofauna surveys

Bore	Screen depth (mBGL)	Aquifer	Easting (MGA94, Zone 56)	Northing (MGA94, Zone 56)	Sampled December 2022	Sampled March 2023	Sampled May 2024
BCM01	6.75-9.75	Alluvium	223841.4	6618371	Dry	Dry	Not visited
BMC03	6.75-9.75	Alluvium	230085.3	6617546	Y	Dry	Not visited
REG10A	6.75-9.75	Alluvium	226717.1	6618260	Dry	Dry	Not visited
REG12	38.4-44.4	Volcanic rock	222632.4	6617358	Y	No access	Not visited
REG3	50.5-56.5	Boggabri volcanics	217164	6619558	No bore at location	NA	Not visited
REG4	65.50-71.50	Boggabri volcanics	219317	6612770	Y	No access	Not visited
REG4A	33.9-39.9	Alluvium	219318	6612775			Y
REG5A	18-21	Alluvium	220662	6609560	Dry	Dry	Not visited
REG7A	24-30	Alluvium	233545	6605350	No access	No access	Not visited
MOR1			226119	6619125	No bore at location	NA	Not visited
MOR2			219871	6618803	Y	Y	Not visited
Teston	45.4	Rock	222568	6619102	Y	Y	Not visited
Tralee		Basalt	224102	6618538	No bore at location	NA	Not visited
WOL2			226119	6618673	Dry	Dry	Not visited
Morse		Sandstone	228203	6617691	Y	Y	Not visited
BCM05	14-20	Weathered overburden	226653.1	6618293	Not visited	Not visited	Y
BCM04	14-20	Volcanics	224114.5	6618252	Not visited	Not visited	Y
REG16	24-30	Alluvium	227084.4	6622319	Not visited	Not visited	Y

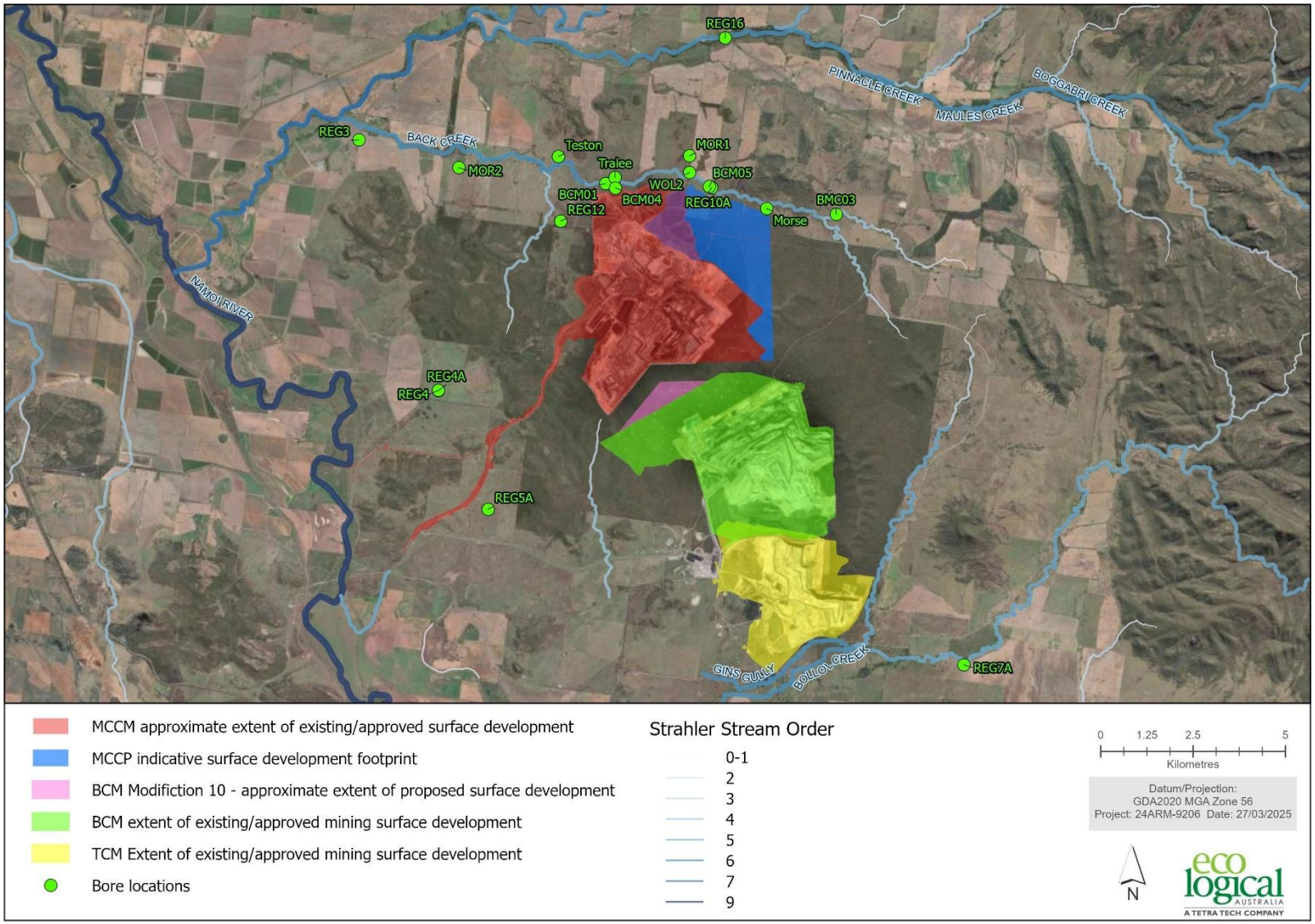

Figure 7: Location of stygofauna monitoring bores

4. Results

4.1. Aquatic Ecology Habitat

4.1.1. Back Creek

Back Creek is a small, ephemeral stream flowing east to west beyond the northern edge of the Project. The creek has a narrow band of riparian vegetation and flows through a predominantly agricultural landscape. Previous sampling by Cumberland Ecology indicates that the creek has been largely dry, or water present as a series of disconnected pools, until large rainfall events in 2020 caused the creek to flow continuously along its entire length. After the rainfall events, the creek alternated between continuous flow and fragmented isolated pools for approximately 10 months (ELA 2021). The summer 2022 aquatic surveys occurred following a period of high rainfall. Flow was not continuous along Back Creek in spring, but all sites except BCP8 contained water, and the creek had continuous flow not long before the surveys occurred. Flow had receded further in Back Creek by summer 2023, but again increased by autumn 2024, although was not continuous.

BCP1

This site is on Back Creek approximately 6.5 km upstream of MCCP. The site is crossed by a gravel road.

Summer 2022: Upstream of the road was a medium pool approximately 20 x 3 m, and 1.3 m deep. The bank appears mostly stable, and is well-vegetated with grass and sedges, which overhang into the water to create trailing vegetation. There were macrophytes growing in the pool to a moderate density. There was one large box eucalypt near the downstream end of the pool, but very few other trees in the immediate riparian community. A few scattered eucalypts (including *Eucalyptus crebra* [narrow-leaved ironbark] and *Callitris columellaris* [white cypress pine]) grew further back from the stream, but these did not overhang the water. A wire fence, with some sheets of corrugated iron, crossed the creek immediately upstream of the road. Downstream of the road the creek became a narrow run. There was no flow over the road, and the upstream pool was disconnected from the run downstream.

Autumn 2023: Isolated pool upstream of road was reduced in size to 5 m by 2 m and drying. Water in the creek was observed to be very turbid and shallow, with no oil or colour.

Summer 2023: There was no flow over the road, and one small, isolated pool of water remained (likely a puddle from recent rain) for this site. No macroinvertebrates were sampled however water quality parameters were sampled.

Autumn 2024: Downstream of the road the creek became a narrow run. There was no flow over the road, and one small, isolated pool of water remained for this site during the autumn 2024 sampling survey.

BCUS2

This site is approximately 4 km upstream of MCCP. The site consists of a pool immediately upstream of a dirt track crossing Back Creek.

Summer 2022: The pool was approximately 50 m long and 3 m wide. There was another pool 20 m upstream of the large one. Large woody debris was abundant at the site, and the banks were deeply incised, with the right bank undercut on the outside of a bend. Roots from a living box tree provide structure and aquatic habitat. The bed consists of gravel and cobble and was dry between the two pools. Grass grew down to the edge of the water.

Autumn 2023: Three isolated pools starting upstream of road. Pools were about 10 m, 6 m and 5 m long and 3 m wide. Water was turbid and coloured with tannins rather than cloudy. Lots of logs and woody debris. The bed floor consists of pebbles and sand.

Summer 2023: The pool was approximately 10 m long and 2 m wide. There was another larger pool upstream that is approximately 30 m long and 5 m wide. Both pools were included in the assessment for the site, with macroinvertebrate samples aggregated across both pools.

Autumn 2024: The site consists of a pool immediately upstream of a dirt track crossing Back Creek. The pool was approximately 10 m long and 2 m wide. There was another larger pool upstream that was approximately 30 m long and 3 m at the widest. Both pools were included in the assessment for the site, with macroinvertebrate samples aggregated across both pools.

BCP2

This site is adjacent to the MCCP. The site has a sand and gravel bed, and sand bars adjacent to both banks. This site has a healthy riparian zone, with *Melaleuca bracteata* (black tea-tree) overhanging the stream and *Callitris* sp. providing an overstorey that gives a large amount of shade to the bed.

Summer 2022: No continuous flow was observed through the site. Instead, water was present in a series of isolated pools, the largest being approximately 25 m long and 3 m wide. In-stream habitat consisted of woody debris provided by small sticks and branches. A barbed wire fence crossed the downstream end of the site, and this had trapped large amounts of woody debris and leaf matter. The bank was covered in rushes and grass. No macrophytes were seen in the water, and none of the bank grasses trailed into the water of the isolated pools. The bed consisted of sand and gravel sediment, with some low-lying areas having a thin crusting of silt.

Autumn 2023: One small pool of turbid green water remained. No odour, but a faint oily sheen present on the surface.

Summer 2023: During December, there was no water at this site, so no macroinvertebrate or water quality samples were collected.

Autumn 2024: There was no water at this site, so no macroinvertebrate or water quality samples were collected.

BCP3

This site is immediately downstream of MCCP. Beyond the immediate riparian zone, the site opens up onto agricultural land.

Summer 2022: Site consisted of a shallow pool about 40 m long and 2 m wide. The bed of the creek was mainly sand and gravel, with occasional cobbles, and there were many wooden roots extending across

the bed. The banks were relatively stable and show little signs of erosion. They were well-covered with grass and there were a few *M. bracteata* on the left bank. The right bank has denser stands of *M. bracteata*, which overhang the creek and provide shade for most of the reach. Flood debris (sticks and leaves) have been deposited on the upper banks on both sides of the creek, and along the main channel.

Autumn 2023: This site has good riparian cover and a well-defined channel but was dry in autumn 2023 so no macroinvertebrate samples were collected.

Summer 2023: During December this site was dry, and no water or macroinvertebrate sampling was completed.

Autumn 2024: The site was dry during this survey and no water or macroinvertebrate sampling was completed.

BCP4

BCP4 is downstream of MCCP. Beyond the immediate riparian zone (approximately 10-20 m wide on either side of the creek), land has been cleared for agriculture.

Summer 2022: The creek consisted of a long pool and was flowing gently during the December survey. Grass covers most of both banks, and *M. bracteata* dominates the shrub layer. Leaf and litter packs were common. Substrate is dominated by sand and contains small amounts of gravel. Sticks and logs lay across the creek. Creek flowing well, with water slightly turbid.

Autumn 2023: Site was dry when visited in March 2023. Muddy bottom with some pebble. Lots of roots and sticks, with some leaf litter. A vegetation survey plot was established in the riparian zone.

Summer 2023: The creek at this site was also dry during the December survey, so only habitat and riparian assessments were made. No macroinvertebrate or water quality samples were collected. Grass covered most of both banks, and *M. bracteata* dominated the shrub layer. Some large red gums and wilga covered the upper vegetation story. Leaf and litter packs were common with some dry tumbleweed also in the creek bed.

Autumn 2024: The creek at this site was also dry during the December survey, so only habitat and riparian assessments were made. No macroinvertebrate or water quality samples were collected.

BCP5

This site is 4.5 km downstream of MCCP on Back Creek in the upstream end of a sparsely forested patch of woodland. Between the woodland and MCCP, the riparian zone is a narrow band of *M. bracteata* vegetation up to 60 m wide with cleared agricultural land on either side.

Summer 2022: The creek consisted of a shallow, turbid pool approximately 30 m long and 2 m wide. A soft layer of silt had settled on the bottom of the pool and surrounding the edges. Further away from the puddle and beneath the silt was a sand and gravel substrate. The bed was approximately 5 m wide. The banks were incised and there was some erosion on the left bank. There was a small amount of woody debris (sticks) in the creek bed, but little other structure apart from overhanging vegetation and the roots of *M. bracteata* extending into the channel.

Autumn 2023: Creek was dry. Lots of flood debris (sticks), leaf litter. Muddy bottom with some sedges growing where the water once was. Gravel and sand dominant edge.

Summer 2023: The creek was dry for the summer 2023 survey, so no macroinvertebrate or water quality samples were taken.

Autumn 2024: The creek was dry for the May 2024 survey, so no macroinvertebrate or water quality samples were taken.

BCPX

The site is a further 300 m downstream of BCP5 along Back Creek. The site consists of a large pool, which appears to have been mechanically deepened and widened. Immediately upstream of the pool is a 1.5 m high vertical erosion cut.

Summer 2022: Pool was approximately 30 m long, 5 m wide and 1.2 m deep. High levels of erosion were present upstream of the pool and around the edges, particularly on the left bank. Upstream of the pool, the creek is crossed by a vehicular crossing, and between crossing and pool is a steep erosion cut approximately 2 m deep. Most of the riparian vegetation had been cleared, besides sparse *Eucalyptus* sp. and Wilga. Water was highly turbid and was disconnected to the creek upstream of the cutting at the head of the pool. Edges of the pool featured dense grasses, rushes and sedges, creating trailing vegetation. Macrophytes were present in the water. Small schools of western carp gudgeon (*Hypseleotris klunzingeri*) were present among the macrophytes.

Autumn 2023: Water turbid, surface largely covered in macrophytes. Steep edge, with roots in the water. Substrate of sand and silt.

Summer 2023: The pool was dry for this survey, so no macroinvertebrate or water quality samples were collected. High levels of erosion are present upstream of the pool and around the edges, particularly on the left bank.

Autumn 2024: The pool was 3-5 m wide for the May 2024 survey and isolated from upstream reaches by a deep headcut.

BCP6

This site is at the downstream end of the sparse woodland vegetation that includes BCP5 and BCPX. It is an impact site at the junction of two anabranches of Back Creek. Beyond the woodland area, the surrounding land has been cleared for agriculture.

Summer 2022: The creek was approximately 6-8 m wide when sampled in December and was much larger than previous visit. Plenty of water, with water in a highly turbid condition. Banks were sparsely vegetated with *M. bracteata,* which shaded the water and had roots extending from the bank to provide aquatic habitat. Grass grew along the banks, and a small amount of large woody debris lay on the bed. The bed consisted of a sand and gravel matrix, although sild lay over the top of this in depressions and around the edges and bottom of the remaining pool. There were some macrophytes present in the water, though thinly distributed.

Autumn 2023: Creek bed was mostly dry when visited in March 2023, apart from a small puddle not large enough to sample. Good riparian zone connected to patch of vegetation. No odour or oil but water was very turbid, with a muddy bottom. Some woody debris, with trailing vegetation and some overhanging vegetation from *Melaleuca bracteata.*

Summer 2023: This site was dry when visited in December. No macroinvertebrate or water quality samples were collected.

Autumn 2024: There was a large, isolated pool at this site for this survey. The pool had enough water to sample macroinvertebrates and water quality.

BCP8

This site is along Back Creek and 850 m upstream of the Maules Creek confluence and 8.7 km downstream of MCCP. The creek crosses Therribri Road at a small causeway.

Summer 2022: Site was dry when visited in December 2022. The banks are eroded on both sides, and there is very little woody riparian vegetation apart from one *M. bracteata* and a large *Casuarina*. Grass dominates vegetation on both banks upstream and downstream of the road. A wire fence crosses the creek upstream of the road and has trapped some grass debris. There is very little in-stream structure at this site.

Autumn 2023: Site was dry when visited in March 2023. No surface water available.

Summer 2023: This site was dry when visited in December. No macroinvertebrate or water quality samples were collected.

Autumn 2024: The creek was dry when visited in May 2024. No macroinvertebrate or water quality samples were collected.

4.1.2. Maules Creek

Flows in Maules Creek and the Namoi River experienced several large peaks in flow between August and December 2022, with the largest flood in the Namoi River reaching 8.5 m. Flow was receding from this period of intense flooding during the summer 2022 survey, but apart from a small flow increases in April 2023 and February 2024, Maules Creek maintained a moderate level of flow with frequent small fluctuations for the remainder of the survey period.

MCUS5

This is the most upstream site on Maules Creek and is located immediately downstream of a causeway on Harparary Road. The causeway consists of a gravel crossing over four large pipe culverts.

Summer 2022: The river was flowing well, though water level was moderate. There was a large cobble and gravel bed on the left side of the river. The river was shallow and approximately 20 m wide downstream of the causeway.

Autumn 2023: Water was clear and flowing, with no odour or oils. Macrophytes present, and algae present on edges and bed. Large cobble bar still present. Overhanging vegetation on left bank.

Summer 2023: The river was dry during December 2023 so no macroinvertebrate or water quality samples were collected.

Autumn 2024: The river was dry, so no macroinvertebrate or water quality samples were collected.

BCP7

BCP7 is at Elfin Crossing on Maules Creek, 5 km upstream of the Back Creek confluence. The site is dissected by a concrete causeway.

Summer 2022: In December, water flowed over the causeway. Maules Creek was approximately 18-25 m wide and 1 m deep. Riparian vegetation consisted of *Casuarina* spp., wilga, and *Eucalyptus* trees. *Phragmites australis* and *Typha orientalis* (cumbungi) grew in beds beside the river downstream of the causeway. Debris is stranded along the bank and in tree branches beside the river. Bed substrate consisted of gravel and cobble, with occasional sand bars downstream of slow-flowing areas. Occasional logs and branches provided in-stream habitat.

Autumn 2023: Gravel and sand bar same as last time. Relatively un-silted. Some riffles. Water level was shallower than last time, with the same amount of algae present.

Summer 2023: In December, water flowed over the causeway. Maules Creek was approximately 18-25 m wide and 0.5 m deep at the site.

Autumn 2024: Water flowed over the causeway, and Maules Creek was approximately 3-10 m wide and 0.5 m deep at the site.

MCUS1

This site is upstream of the Back Creek confluence with Maules Creek.

Summer 2022: There was a low, flat gravel and cobble bar adjacent to a narrow (2-3 m wide) riffle and run sequence which is densely vegetated with instream *Myriophyllum* sp. The gravel bar was well-vegetated at the upstream and downstream ends, with *Casuarina* sp. up to 5 m high. Riverbanks were steep and rose 3 to 5 m above the stream bed. The banks were well-vegetated with grass, *Casuarina* sp. and *Eucalyptus* sp.

Autumn 2023: The creek was flowing with low turbidity, and no oil or odour. Instream *Myrrhiopholum* present. A narrow run occurred beside the gravel bar. Woody debris, roots, trailing vegetation, sedges, and a steep bank present.

Summer 2023: There was a low, flat gravel and cobble bar adjacent to a narrow (2-3 m wide) riffle and run sequence as per previous survey seasons.

Autumn 2024: The creek was flowing at this site where there was a low, flat gravel and cobble bar adjacent to a riffle, spanning the width of the creek, and run sequence as per previous surveys.

BCP9

This site is located on Maules Creek at a causeway on Browns Lane, 4 km downstream of the Back Creek confluence.

Summer 2022: The creek was 12 to 15 m wide and there was 10 centimetres (cm) of water flowing over the causeway when sampled. Immediately downstream of the causeway on the right side of the creek, a large section of bank had been eroded, leaving a vertical drop of approximately 2 m into the water. On the left side of the river was a gently sloping sand and gravel bar. Riparian vegetation consisted of *Casuarina* sp. and *Eucalyptus blakeleyi* (Blakelys red gum), and grass grew along both banks and trailed into the water. The riverbed consisted of gravel and cobble. Both banks rose about 4 m above the creek.

Autumn 2023: Erosion on right bank. Long gravel bar remained on left bank. Water turbid. Fall of 40 cm downstream of causeway. Tree that once grew on right bank now fallen into the creek. Lots of carp schooling downstream of causeway. The riverbed consisted of pebble and gravel.

Summer 2023: The creek was dry, so no water quality or macroinvertebrate samples were collected.

Autumn 2024: The creek was dry, so no water quality or macroinvertebrate samples were collected. The eroded vertical drop immediately downstream of the causeway on the right side of the creek, has now become overgrown with water couch.

4.1.3. Namoi River

SW8

This site is on the Namoi River, approximately 100 m downstream of the Maules Creek confluence, and upstream of the Harparary Road bridge. The river is approximately 30 m wide.

Summer 2022: Water covered most of the bed. Flow appeared shallow and was less than 60 cm deep for most of the width. Banks on both sides rose to 2 m above the water, and a floodplain shelf extended back from the river. There was plenty of large woody debris (fallen trees, logs) in the water and along the banks. Bed substrate consisted of gravel, sand, and silt.

Autumn 2023: Flowing moderately fast. Water was turbid due to recent flooding. Sampled upstream of bridge, with only edge habitat being sampled. Noogoora burr (*Xanthium occidentale*) dominant on bank. Lots of bare bank near water, and left bank eroded and dropping off about 0.2-1 m straight down to water's edge. There was plenty of large woody debris. Bed substrate consisted of pebble and sand covered in silt.

Summer 2023: The river was approximately 30 m wide, and during the survey in December, water covered most of the bed.

Autumn 2024: The river is approximately 10-16 m wide, and during the current survey, water covered less of the bed than the previous survey in December (summer 2023).

NRDS1

This site is at Turrawan Travelling Stock Reserve (TSR), 26 km downstream of the Maules Creek confluence. This site occurs in a broad bend of the Namoi River and has a low mixed bar on the inside bend, and steep, eroded banks on the right side. The bar is approximately 450 m long and 50 m wide, and consists of mixed sand, cobble, and gravel-sized particles, and is partly covered with grass and other herbaceous vegetation. Both banks are sparsely vegetated with river red gums, and on the right bank roots extend into the water occasionally. The river is generally shallow close to the gravel bar and

deepens to approximately 2 m on the outside bend. Large logs and branches occurred frequently in the water at this site.

Summer 2022: Both banks are lined with large woody debris and show significant areas of recent erosion. The right bank rises 5 m above current flow level, and has riparian vegetation consisting of Blakely's red gum and *Casuarina* sp. The understorey is grassed at the top of the bank, but this has been removed on the bank slope by erosive flow. The left bank is well-covered with grass and is 1-2 m above the current water level.

Autumn 2023: Water was turbid and flowing. No trailing vegetation or macrophytes. Far bank steeply incised/eroded vertical to river for 3-4 m. Left hand side is a sand/gravel bar. Roots present along far bank. There were several logs lying in the water.

Summer 2023: When sampled in December, the river was approximately 20 m wide and flowing moderately.

Autumn 2024: When sampled, the river was approximately 12-25 m wide and flowing moderately.

Henriendi TSR

This site on the Namoi River is 3 km upstream of the Maules Creek confluence at Henriendi TSR.

Summer 2022: This site was not accessible in December 2022, as tracks leading through the TSR were too boggy.

Autumn 2023: The site has steep, muddy banks which are approximately 6 m above the river. Water was turbid and flowing with no oil or odour. There were snags and roots emerging from the water, and the river appeared to be relatively shallow. A gravel bar extended along the right side of the river, and beyond this the bank rose steeply from the water. The top of bank consisted of occasional large river red-gum trees.

Summer 2023: The site had running, deep water with snags throughout the river. The banks were steep with protruding roots. Riparian vegetation included scattered river red gum and *Acacia stenophylla* trees. A small island, vegetated with young river red gum, occurred in the river at this site.

Autumn 2024: The site had running, deep water with snags throughout the river. The water level had dropped to connect the small island to the left side bank. This site was vegetated with young river red gum and *Acacia steniphyla*.

SW5

SW5 is a reference site on the Namoi River upstream of Boggabri.

Summer 2022: During December the river was flowing steadily. A long, shallow-gradient gravel bar ran along the right bank. The left bank was steep and had roots reaching down to the water. Upstream of the site, the bank was eroded. Fallen trees emerged from the water. The banks were muddy, and bed consisted of gravel and sand. The water was turbid when visited, and no aquatic macrophytes were seen. Riparian vegetation was dominated by Blakely's Red Gum. Both banks are grassed, although there were large areas of bare sand and mud that were exposed by erosion.

Autumn 2023: Sample taken from side of bank among roots, with a steep edge. No trailing vegetation. Sample taken following an overnight storm and rain. Water was turbid and flowing, with snags, overhanging banks, roots present. The same gravel bar on the right bank remained from last survey.

Summer 2023: During December the river was flowing well.

Autumn 2024: Was flowing well during the autumn 2024 survey.

4.2. Water Quality

DO was consistently below ANZG for most sites across all four survey periods. Exceptions were NRDS1 and SW8 in the Namoi River. This could be a result of high suspended solid load (indicated by high turbidity), as well as the lack of moving water in isolated pools. pH was another variable that was frequently outside of ANZG preferred range for Maules Creek and Namoi River, but it was mostly inside the range for Back Creek sites.

Physico-chemistry in ephemeral streams is highly variable as they shift through phases of wetting and drying (Boulton *et al.* 2014). Although some of the variables measured in Back Creek are outside of the ANZG boundaries, this is not unexpected, nor cause for concern. Exceedances occurred in locations upstream of the current mine site as well as downstream and are a part of the natural process of drying in ephemeral streams. There is nothing to indicate that exceedances are due to current operations at MCCM.

Summer 2022: Back Creek had water at most sites, although water was present in fragmented pools rather than as a continuous connected flow. DO, measured as oxygen per milligrams per litre (mg/L), was below the recommended ANZG (2018) levels, with measurements between 20.6 and 77.7% saturation (Table 5). Back Creek temperature was between 19.2 and 26.2 °C, and EC was between 202 and 342 microsiemens per centimetre (µS/cm). All Back Creek pH measurements were within the ANZG (2018) range except for at BCPX (Table 5). Turbidity was above the 50 Nephelometric Turbidity units (NTU) upper ANZG limit at 3 sites, although only marginally so at BCP6 (Table 5).

The physico-chemical variables measured along Maules Creek were relatively consistent between sites. All sites at Maules Creek had DO concentrations outside of the ANZG range, with high readings at MCUS5, MCUS1 and BCP9, and a low reading at BCP7 (Table 5). Flow along the creek was clear, with low turbidity between 1.7 and 3.8 NTU. pH in Maules Creek was above ANZG, with measurements between 8.1 and 8.9. EC and temperature measurements both varied little between sites, with ranges of 403-426 µS/cm and 22.1-24.4 °C (Table 5).

The Namoi River was flowing steadily during the survey and was turbid. Temperatures were between 21.2 and 23.9 °C at the three sites measured. pH and turbidity exceeded the recommended ANZG (2018) range at all sites (Table 5). DO was below recommended concentration at SW5 (Table 5).

Table 5: Physico-chemical measurements at sites sampled around MCCP in summer 2022. Red figures are those outside of water quality guidelines (exceedances are common for ephemeral streams due to the natural process of drying and re-wetting). There is nothing to indicate that exceedances are due to current operations at MCCM.

	Temperature	pH	EC	Turbidity (NTU)	DO	DO
	°C		µS/cm	NTU	mg/L	% Saturation
ANZG:		6.5-8.0	125-2200	6-50		85-110
Back Creek						
BCP1	20.8	7.8	202	31.9	1.84	20.6
BCUS2	23.0	7.7	261	4.2	3.65	42.6
BCP2	26.2	7.8	274	7.2	56.35	77.7
BCP3	21.7	7.6	342	29.9	4.9	55.3
BCP4	19.2	7.6	321	52.2	4.51	48.3
BCP5	20.7	7.9	305	40.7	5.35	59.8
BCPX	24.5	8.2	208	61.8	5.62	68.2
BCP6	24.6	7.9	290	50.7	5.06	60.2
BCP8			Dry			
Maules Creek						
MCUS5	24.4	8.2	421	3.6	9.82	119.1
BCP7	22.1	8.1	403	3.2	6.96	79.4
MCUS1	22.9	8.2	415	1.7	10.18	115.6
BCP9	22.6	8.9	426	3.8	10.82	127.6
Namoi River						
SW5	21.2	8.4	591	224	6	67.2
Henriendi TSR			No access			
NRUS1	23.9	8.1	540	148	7.79	92.2
SW8	23.8	8.2	541	146	7.21	85.9

Autumn 2023: Back Creek was dry at all sites downstream of MCCP, except for BCPX. This site had a DO concentration slightly higher than ANZG, likely due to photosynthesis in water column. At the three sites upstream of MCCP, turbidity was high at all sites, and DO concentration was below guideline concentrations at two of the sites (Table 6). Not enough sites were sampled in Back Creek downstream of MCCP to perform ANOVA analysis. EC, temperature, pH, turbidity, and DO were all higher at the downstream site than the three upstream sites (Table 6).

Maules Creek temperature was between 21.4 and 24.4 °C. DO concentration was below ANZG at BCP7 and MCUS1, and pH was above the guidelines at BCP9 (Table 6). Turbidity increased longitudinally from upstream to downstream in Maules Creek, and was between 1.7 and 31.5 NTU (Table 6).

In the Namoi River, pH and turbidity were higher than ANZG at all sites (Table 6). DO concentration was below the recommended range at SW5, and above at Henriendri TSR (Table 6).

Table 6: Physico-chemical measurements at sites sampled around MCCP in autumn 2023. Red figures are those outside of water quality guidelines (exceedances are common for ephemeral streams due to the natural process of drying). There is nothing to indicate that exceedances are due to current operations at MCCM.

	Temperature	pH	EC	Turbidity (NTU)	DO	DO
	°C		µS/cm	NTU	mg/L	% saturation
ANZG:		6.5-8.0	125-2200	6-50		85-110
Back Creek						
BCP1	26.65	7.45	153	162	7.82	96.9
BCUS2	21.06	7.81	384	132	2.77	31
BCP2	21.62	7.95	357	>1000	4.95	56.3
BCP3				Dry		
BCP4				Dry		
BCP5				Dry		
BCPX	32.36	8.81	606	225	8.16	112.2
BCP6				Dry		
BCP8				Dry		
Maules Creek						
MCUS5	23.52	7.76	498	1.7	9.38	109.6
BCP7	21.42	7.61	417	5.3	6.1	69.3
MCUS1	22.85	8	438	14.1	5.86	68.1
BCP9	24.4	8.23	468	31.5	7.65	92.1
Namoi River						
SW5	23.24	8.86	703	68.7	7.09	82.7
Henriendi TSR	26.73	9.11	729	101	9.55	118.3
NRDS1	26.53	8.9	586	75.5	8.31	103.7
SW8	25.18	8.99	746	87.5	7.52	91.4

Summer 2023: Two of nine sites along Back Creek had enough water for sampling. Back Creek had water at site BCUS2, although water was present in fragmented pools rather than as a continuous connected flow. There was also some water present at BCP1 however it was likely a large puddle from recent rain and not representative of usual flow. DO was above the recommended ANZG (2018) levels, with one measurement of 161.4% saturation (BCP1). Back Creek water temperature was 32.5 °C, and EC was within ANZG limits at 327 µS/cm. The one Back Creek pH measurement was not within the ANZG (2018) range at 8.26. Turbidity was above the 50 NTU upper ANZG limit, reading 184 NTU (Table 7).

The physico-chemical variables measured along Maules Creek were relatively consistent between sites, however only two of four sites had enough water for sampling. Both sites at Maules Creek had DO concentrations outside of the ANZG range, with low readings at MCUS1 and BCP7. Flow along the creek was clear, with low turbidity between 11.2 - 11.4 NTU. pH in Maules Creek varied, with BCP7

(pH = 7.76) being within the ANZG range and MCUS1 (pH = 8.19) being higher than the ANZG range. EC and temperature measurements both varied little between sites, with ranges of 319 - 465 µS/cm and 23.9 - 25.5 °C (Table 7).

The Namoi River was flowing well during the survey and was turbid. Temperatures were between 27.1 and 32.1 °C at the four sites measured. pH and turbidity exceeded the recommended ANZG (2018) range at all sites. DO was below recommended concentration at SW5 and Henriendi TSR, and within the recommended ANZG range at NRDS1 and SW8 (Table 7).

Table 7: Physico-chemical measurements at sites sampled around MCCP for summer 2023. Red figures are those that are outside of water quality guidelines (exceedances are common for ephemeral streams due to the natural process of drying). There is nothing to indicate that exceedances are due to current operations at MCCM.

	Temperature	pH	EC	Turbidity (NTU)	DO	DO
	°C		µS/cm	NTU	mg/L	% saturation
ANZG:		6.5-8.0	125-2200	6-50		85-110
Back Creek						
BCP1	32.5	8.26	327	184	11.68	161.4
BCUS2	33.93	8.06	228	26.1	4.66	65.1
BCP2	Dry					
BCP3	Dry					
BCP4	Dry					
BCP5	Dry					
BCPX	Dry					
BCP6	Dry					
BCP8	Dry					
Maules Creek						
MCUS5	Dry					
BCP7	23.9	7.76	319	11.4	6.54	77.7
MCUS1	25.5	8.19	465	11.2	5.77	68.7
BCP9	Dry					
Namoi River						
SW5	27.1	8.45	432	118	5.69	70.6
Henriendi TSR	28.2	8.56	458	111	6.04	76.9
NRDS1	32.1	8.87	616	93.7	6.7	91.3
SW8	30.9	8.66	634	84.4	7.62	101.8

Autumn 2024: Water quality was measured at all ten of the 17 sites that had water (Table 8). Along Back Creek, four of nine sites were measured for water quality and five sites were dry. This is wetter than summer 2023, when only 2 sites had water. Back Creek had water at BCUS2, although water was present in fragmented pools rather than as a continuous connected flow. There was also some water present at

BCP1, similar to the previous survey being a small, isolated pool. Further, sites BCP6 and BCPX had water at the sites when sampled during autumn 2024, unlike in summer 2023 when they were dry. BCP6 consisted of a large, isolated pool and BCPX contained water upstream of the crossing. DO was below the recommended ANZG (2018) levels for all four Back Creek sites measured, with the lowest measurement being 27.4 % at BCP1. Back Creek water temperature ranged from 14.7 °C at BCP1 to 21.4 °C at BCPX. EC was within ANZG limits for all sites (range = 125-193 µS/cm). pH was also within the ANZG (2018) range and was similar for all sites at Back Creek (range = 7.44 – 7.52). Turbidity was within the ANZG limit at site BCUS2 (37.9 NTU) and above the 50 NTU upper ANZG limit at the other three sites (range = 76.2 – 187 NTU).

The physico-chemical variables along Maules Creek were relatively consistent between sites, however only two of four sites had water and could be measured. BCP7 and MCUS1 both contained water as per the summer 2023 survey although BCP7 was slightly lower in flow than reading at MCUS1. Flow along the creek was clear, with turbidity between 24.1 - 25.1 NTU. pH in Maules Creek varied slightly, with BCP7 (pH = 6.87) and MCUS1 (pH = 7.32) being within the ANZG range. EC and temperature measurements both varied little between sites, with ranges of 326 - 489 µS/cm and 18.23 - 19.37 °C.

The Namoi River was flowing well during the survey and was turbid. Temperatures were between 17.37 and 19.65 °C at the four sites measured. pH and turbidity exceeded the recommended ANZG (2018) range at all sites (pH range = 8.29 – 8.99, turbidity = 76.6 – 220 NTU). DO was below recommended concentration at SW5 and SW8, and within the recommended ANZG range at sites NRDS1 and Henriendri TSR (Table 8).

Table 8: Physico-chemical measurements at sites sampled around MCCP for autumn 2024. Red figures are those that exceed water quality guidelines (exceedances are common for ephemeral streams due to the natural process of drying). There is nothing to indicate that exceedances are due to current operations at MCCM. *Indicates sites downstream of MCCP.

	Temperature	pH	EC	Turbidity (NTU)	DO	DO
	°C		µS/cm	NTU	mg/L	% saturation
ANZG:		6.5-8.0	125-2200	6-50		85-110
Back Creek						
BCP1	14.72	7.52	183	76.2	2.85	27.4
BCUS2	17.03	7.44	144	37.9	5.27	53.2
BCP2	Dry					
BCP3*	Dry					
BCP4*	Dry					
BCP5*	Dry					
BCPX*	21.42	7.45	125	175	4.47	50.2
BCP6*	18.92	7.5	193	187	3.56	38.2
BCP8*	Dry					
Maules Creek						
MCUS5	Dry					
BCP7	19.37	6.87	326	24.1	5.6	60.4

	Temperature	pH	EC	Turbidity (NTU)	DO	DO
MCUS1	18.23	7.32	489	25.1	8.51	89.5
BCP9*	Dry					
Namoi River						
SW5*	17.37	8.29	679	76.6	7.84	81.6
Henriendi TSR*	19.65	8.7	617	220	8.16	88.8
NRDS1*	19.63	8.99	607	83.1	9.63	102.5
SW8*	18.54	8.48	619	105	7.62	81.1

* indicates sites downstream of MCCM

4.3. Macroinvertebrate communities

Macroinvertebrate communities differed between the three waterways and generally indicated poor ecological condition, with low macroinvertebrate diversity, and low SIGNAL scores at all sites. Sensitive macroinvertebrate taxa (those with a SIGNAL score greater than 7, and vulnerable to the sudden changes in flow velocity or water quality caused by flooding and drying) were scarce in Back Creek and Namoi River, and are unlikely to occur. The continuous flow in Maules Creek, and the absence of large-scale flooding after December 2022 potentially explains why Maules Creek had higher SIGNAL Scores than the other two waterways, and why the invertebrate community was in better ecological health.

The main factor driving macroinvertebrate community composition was the hydrological regime of each waterway. Eight flood peaks exceeding 4.5 m occurred within this three-month period, allowing invertebrate communities little time to recover. Following the period of flooding, flow in the Namoi River receded gradually, and the return to relatively stable flows allowed more sensitive taxa to return to the sites. Flow in Maules Creek, although it had some fluctuations corresponding with rainfall events, did not experience the extreme high flows of Namoi River, nor the low flow and extended drying that occurred in Back Creek. Maules Creek did dry out at some sites towards the end of 2023 and into 2024. Regular flooding between August and November would have been the main disturbance influencing macroinvertebrate communities in the Namoi River.

In contrast to the Namoi River, the main disturbance affecting the biota of Back Creek is the continued drying and isolation of pools along the creek. This fragmentation reduces the ability of invertebrates to disperse between sites along the waterway. Pools in the headwaters of Back Creek appear to maintain water for longer periods than downstream pools, providing a source for downstream colonisation when flow becomes connected. However, after prolonged periods of no rainfall even these pools dry up.

4.3.1. Macroinvertebrate indices

TAXONOMIC RICHNESS

In summer 2022 there were between 6 and 18 taxa per site (Table 9). Taxonomic richness was lowest in the Namoi River sites, likely due to the impacts of recent high flow. The two sites with highest taxonomic richness were BCP5 and BCPX along Back Creek downstream of MCCP (Table 9).

For the autumn 2023 surveys there were between 7 and 14 taxa (Table 10). Taxonomic richness was lowest at BCPX and NRDS1. The sites with highest taxonomic richness were MCUS1, MCUS5 and BCP7 along Maules Creek and upstream of MCCP.

Table 9: Macroinvertebrate community indices for sites sampled in summer 2022

	BCP1	BCP2	BCUS2	BCP7	MCUS1	MCUS5	SW5	
Richness	16	10	10	13	10	12	7	
SIGNAL	3.69	3.50	3.10	3.92	4.90	3.83	4.00	
%EPT	31.3	30.0	10.0	30.8	60.0	33.3	57.1	
	BCP3	**BCP4**	**BCP5**	**BCPX**	**BCP6**	**BCP9**	**SW8**	**NRDS1**
Richness	15	15	18	17	11	11	7	6
SIGNAL	3.60	3.73	3.28	3.59	3.00	4.82	3.71	3.33
%EPT	26.7	33.3	22.2	17.6	18.2	45.5	42.9	50

Table 10: Macroinvertebrate community indices for sites sampled in autumn 2023

	BCP1	BCP2	BCUS2	Henriendri TSR	BCP7	MCUS1	MCUS5	SW5
Richness	9	8	7	6	14	13	13	6
SIGNAL	2.25	2.13	2.4	4	3.57	4.23	3.33	4.17
%EPT	11.11	0	0	16.67	35.71	30.77	30.77	33.33
	BCPX	**BCP9**	**SW8**	**NRDS1**				
Richness	3	11	10	4				
SIGNAL	3	3.64	3.8	3				
%EPT	0	36.4	10	0				

For the summer 2023 survey, there were between 4 and 18 taxa (Table 11) identified at the survey sites. Taxonomic richness was lowest in the two Namoi River sites, likely due to flooding in 2022 and decreasing water levels in 2023. The two sites with highest taxonomic richness were BCUS2 along Back Creek, upstream of MCCP and MCUS1 along Maules Creek, upstream of the confluence with Back Creek.

For the autumn 2024 survey, sites had between 6 and 19 taxa (Table 12). BCP1 contained the highest taxa richness (19) of all sites, while the Namoi River site, Henriendri TSR, contained the lowest taxonomic richness. This is likely due to flooding in 2022 and decreasing water levels in 2023-2024.

Table 11: Macroinvertebrate community indices for sites sampled in summer 2023

	BCP1	BCP2	BCUS2	BCP7	MCUS1	MCUS5	SW5	Henriendi TSR
Richness	Dry	Dry	18	10	14	Dry	9	5
SIGNAL			3	3	3.9		3.9	3.6
%EPT			11.1	30	21.4		11.1	0

	BCP3	BCP4	BCP5	BCPX	BCP6	BCP9	SW8	NRDS1
Richness	Dry	Dry	Dry	Dry	Dry	Dry	4	5
SIGNAL							3	4
%EPT							0	40

Table 12: Macroinvertebrate community indices for sites sampled in autumn 2024

	BCP1	BCUS2	Henriendri TSR	BCP7	MCUS1	SW5	NRDS1
Richness	19	15	6	12	9	8	9
SIGNAL	3	2.8	4	3.9	3.6	4	4
%EPT	10.5	0	16.7	25	22.2	12.5	33.3
	BCPX	**SW8**	**BCP6**				
Richness	17	10	15				
SIGNAL	2	3.78	2.3				
%EPT	5.9	30	0				

SIGNAL SCORE

Results from the summer 2022 surveys show SIGNAL Scores were between 3.0 and 4.9 (Table 9). At all sites except MCUS1, SW5, and BCP9 the SIGNAL Scores indicate severe pollution. At these sites, disturbance level was moderate. All sites are likely to have been impacted by recent high flows.

For the autumn 2023 surveys SIGNAL Scores were between 2.1 and 4.2 (Table 10). At all sites except Henriendi TSR, MCUS1 and SW5 the SIGNAL Scores indicate severe pollution. At these sites, disturbance level was moderate.

For the summer 2023 surveys, SIGNAL scores were between 3 and 4 (Table 11). The minimum SIGNAL scores decreased in the following autumn 2024 survey where they ranged from 2 to 4 (Table 12). All sites had SIGNAL Scores indicating severe to moderate pollution, with invertebrate communities likely impacted along Back Creek and Maules Creek, and lower water levels in the Namoi. There is also likely to be some residual impact on communities from the large floods that occurred in late 2022.

EPT PROPORTION

The proportion of EPT taxa to total taxonomic richness ranged from 10 to 60% in summer 2022 (Table 9), 0 to 36.4% in autumn 2023 (Table 10), 0 to 40% in summer 2023 (Table 12), and 0 to 33.3% in autumn 2024 (Table 12). Overall, the proportion of EPT to total taxonomic richness was variable between survey periods.

4.3.2. Community similarity

Multivariate ANOSIM analysis of macroinvertebrate community data indicates that communities differed between survey periods (ANOSIM R = 0.17, P <0.01) and waterways (ANOSIM R = 0.39, P <0.01, Figure 8). Samples collected from sites in summer 2022 were dominated by the three main mayfly families, Baetidae, Leptophlebiidae, and Caenidae, as well as the caddisfly family Leptoceridae. In

4.3.2. Community similarity

Multivariate ANOSIM analysis of macroinvertebrate community data indicates that communities differed between survey periods (ANOSIM R = 0.17, P <0.01) and waterways (ANOSIM R = 0.39, P <0.01, Figure 8). Samples collected from sites in summer 2022 were dominated by the three main mayfly families, Baetidae, Leptophlebiidae, and Caenidae, as well as the caddisfly family Leptoceridae. In autumn 2023 Micronectidae, Atyidae, and Chironomidae occurred at more sites than other taxa. Spring 2024 samples had Micronectidae, Hydrochidae, and Baetidae as the dominant taxa, while in autumn 2024.

Sites along Back Creek frequently had Notonectidae, Dytiscidae, and Culicidae, which are all common residents in contracting isolated pools. In Maules Creek, faunal assemblages are dominated by taxa more frequently encountered in flowing water, including Baetidae, Leptophlebiidae, and Chironomidae. The larger, permanent Namoi River more frequently had Micronectidae, Baetidae, and Atyidae at sites when sampled.

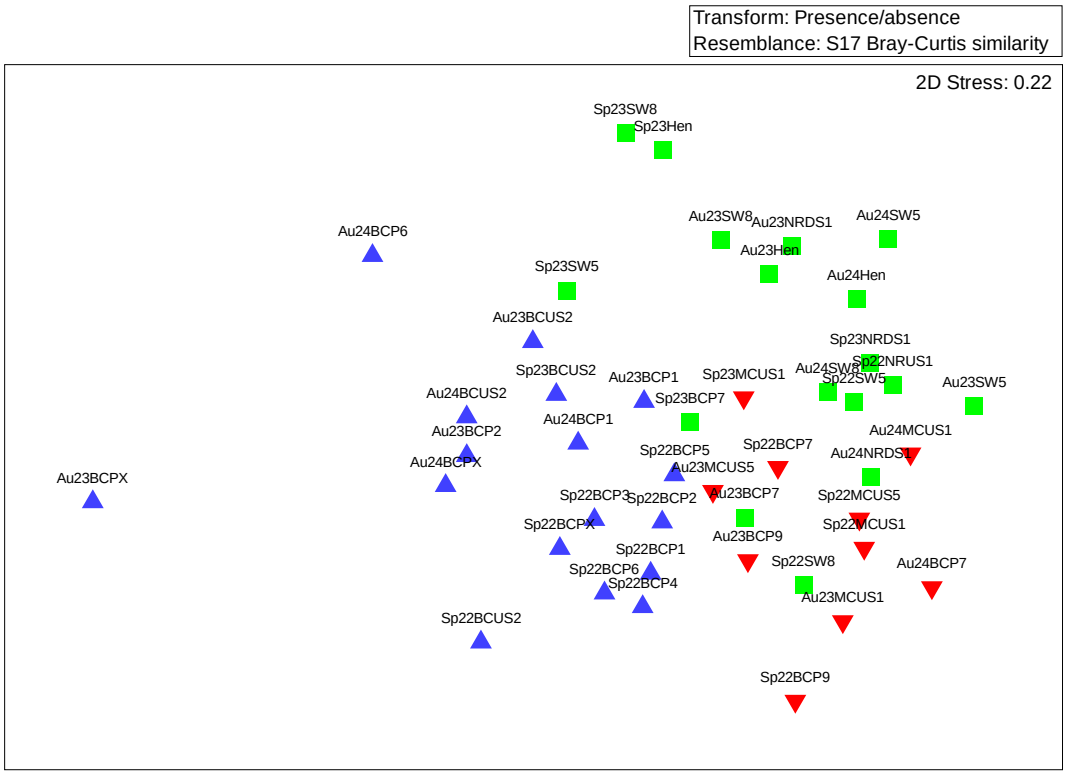

Figure 8: nMDS plot for four macroinvertebrate surveys from summer 2022 to autumn 2024. Blue triangles represent Back Creek sites, green squares represent Namoi River sites, and red triangles represent Maules Creek sites.

4.4. Riparian vegetation

4.4.1. RARC

Rapid Appraisal of Riparian Condition (RARC) data were collected for 16 sites during the summer 2022 and 17 sites during autumn 2023, summer 2023 and autumn 2024 (Appendix C). The total RARC score varied over the sites, although at most sites the scores show little change between the spring and autumn surveys. Henriendri TSR was not sampled in summer 2022 because access tracks were too boggy but scored 42% in all other surveys.

The highest total RARC score was at BCP2 on Back Creek, with an RARC percentage of 76% for all surveys. RARC at the three sites along Back Creek upstream of MCCP were similar to the sites downstream. BCP2 scored the highest out of the sites within all sub-indices (Habitat, Cover, Natives) except for Debris and Features. The lowest total RARC score was at BCP8 along Back Creek, with an RARC percentage of 20 - 26% for all surveys. BCP8 scored the lowest out of all sites for all sub-indices.

Sites along Maules Creek and Back Creek have similar average RARC scores for all survey seasons (range = 53.3 – 54.4%) compared to sites along the Namoi which have lower average RARC scores (range = 46.5 – 50.6%) (Table 13).

Table 13: The average RARC% per survey for each waterway.

Average RARC (%)	Maules Creek	Back Creek	Namoi River
Summer 2022	53.5 ± 10.2	53.3 ± 17.1	48.7 ± 6.4
Autumn 2023	53.5 ± 10.2	54 ± 16.9	50.6 ± 6.2
Summer 2023	54.4 ± 10.2	53.8 ± 16.0	46.5 ± 6.6
Autumn 2024	53.5 ± 10.25	54.22 ± 16.9	47.5 ± 5.97

4.4.1.1. Habitat continuity and extent (Habitat)

For all surveys (summer 2022, autumn 2023, summer 2023 and autumn 2024), BCP2 and BCP6 scored highest in the Habitat sub-index, with scores of 9. Both sites had continuous, wide riparian zones and were close to intact vegetation. NRDS1 had similar habitat features, scoring 8. Lowest scores were at BCP8 with 0, and MCUS1 with 1. Riparian vegetation was minimal at both of these sites, and they were more than 1 km from larger patches of vegetation.

4.4.1.2. Vegetation cover and structural complexity (Cover)

For all surveys, BCP2 had the highest cover score with 12, with high percentage coverage in the canopy, understorey and ground layers. For the summer 2022, autumn 2023 and autumn 2024 surveys, four other sites had cover scores of 10 (BCP6, BCP4, BCP3, BCP7), with the main feature lacking at these sites being canopy cover. A fifth site (SW8) also scored 10 for this category during the summer 2023 survey season. BCP8, BCP9, NRDS1, and MCUS1 all scored 7 for cover, which was the lowest score during the summer 2022 and autumn 2023 surveys. These sites had low percentages of understorey and canopy cover. In the summer 2023 and autumn 2024 surveys, Henriendi TSR scored the lowest (5) due to low percentages of ground, understorey, and canopy cover.

4.4.1.3. Dominance of natives versus exotics (Natives)

During all surveys, BCP2 had the highest coverage of native species, scoring 9 compared to the next highest sites of BCP6, BCP4, and BCP3 with 7. During the summer 2022 and autumn 2023 surveys, natives were absent from the understorey at SW8, BCP8 and SW8. These sites scored 3 for the Natives sub-index. For the summer 2023 survey natives were absent from the understorey at SW8 and SW5, with SW8 scoring the lowest sub-index for natives on 1. Finally, for the autumn 2024 survey, natives were absent from the understorey at SW8 and SW5, with SW8, BCP8 and Henriendri TSR scoring the lowest sub-index for natives due to having overall low scores for the canopy, understorey, and ground indicators.

4.4.1.4. Standing dead trees, hollows, fallen logs, leaf litter and debris

During all surveys, BCP4, BCP6, BCP2, and BCP3 all scored 6 or above in the Debris sub-index. During the summer 2022 and autumn 2023 surveys these sites had 30-60% native cover and standing dead trees and fallen logs in the riparian zone. This decreased to 10-30 % native litter at most sites and standing dead trees, hollow bearing trees and fallen logs in the riparian zone and further dropped to 10-20 % native litter at most sites and standing dead trees, hollow bearing trees and fallen logs in the riparian zone during the autumn 2024 survey. In comparison, BCP8 scored the lowest with 1 for the summer 2022 and autumn 2023 survey, 2 for the summer 2023 survey and 0 in the autumn 2024 survey, with only a small amount of leaf litter present at the site to no debris present at the site.

4.4.1.5. Indicative features such as regeneration, reeds, and tussocky grass (Features)

Sites BCP7 and MCUS1 scored an RARC of 6 for sub-index features. Site MCUS1 riparian vegetation had abundant regeneration of native canopy and understorey species, whilst there was scattered regeneration of native canopy and understorey species at BCP7. However, site BCP7 recorded more abundant native tussock grasses and reeds. In comparison, site BCP8 scored the lowest on 0-1 during all surveys for this sub-index, with only a small amount of litter present. SW8 also scored the lowest during the summer 2023 survey.

4.4.2. Vegetation Survey

Vegetation survey was undertaken at the four select sites during spring only and site monitoring photos are provided in Appendix D. Surveys were conducted at the end of a period of high rainfall from 2020 to 2022, and again in autumn 2024, which followed from previous years in which drought conditions dominated. The riparian communities generally reflected this in the higher cover and species abundance, as well as general plant growth and vigour.

Riparian vegetation along Back Creek was mapped as PCT 112 *Black Tea-tree - River Oak - Wilga riparian low forest/shrubland wetland of rich soil depressions in the Brigalow Belt South Bioregion* Vegetation (Premise, 2025).

4.4.2.1. Species diversity

NATIVE

A total of 108 species were recorded across the four riparian sites in summer 2022. 83 of these species were native (Appendix C). Eight native species occurred across all four sites: *Austrostipa ramosissima* (stout bamboo grass), *Cyperus gracilis* (slender flat-sedge), *Dichondra repens* (kidney weed), *Geijera parviflora* (wilga), *Glycine tabacina* (variable glycine), *Juncus usitatus*, *Lachnagrostis filiformis* and *Rumex brownii* (swamp dock). One additional exotic species (*Bromus catharicus*) occurred at all 4 sites. This increased to a total of 128 species in autumn 2024, 103 of which were native. Eleven native species occurred across all sites: *Carex inversa* (knob sedge), *Chloris ventricosa* (tall chloris), *Commelina cyanea* (scurvey weed), *Cyperus gracilis* (slender flat-sedge), *Dichondra repens* (kidney weed), *Glycine tabacina* (variable glycine), *Juncus* spp., *Paspalidium gracile* (slender panic), *Rumex brownii* (Rumex), *Sida trichopoda* (hairy sida), *Sporobolus creber* (slender rat's tail grass).

The two sites upstream of MCCP had higher species richness than the two sites downstream during both surveys. For the upstream sites, species richness decreased from 61 and 74 species at BCP2 and BCUS2 (respectively) during the summer 2022 survey, compared to 58 and 59 species at BCUS2 and BCP2

(respectively) in the autumn 2024 survey. However, species richness increased over time at the downstream sites from 26 and 29 species for BCP4 and BCP3 (respectively) in the summer 2022 survey, to 29 and 37 species for BCP3 and BCP4 (respectively) in the autumn 2024 survey.

EXOTIC

A total of 24 exotic plant species were recorded across the four plots along Back Creek in summer 2022 and this increased to 25 exotic plant species recorded in autumn 2024. One exotic species *Bromus catharicus* (prairie grass) occurred in all four sites during summer 2022 compared to *Bidens pilosa* var. *pilosa* occurring across all four sites in autumn 2024. Exotic species occurred at all sites, contributing to 3.6-6.6 % cover in summer 2022 and decreasing to 1.4-6.1 % cover in autumn 2024 (Table 14). Exotic cover was predominately low across all four sites in 2022 and 2024. There were 85 - 185 exotic plants across all the sites in 2022 and this increased to 201 - 893 in 2024. One weed *Opuntia* sp. identified during summer 2022 and again in autumn 2024 (as *Opuntia tomentosa,* velvet tree pear) is listed under *North West Regional Weeds Plan 2017 – 2027* (North West Local Land Services [LLS] 2017) and as a Weeds of National Significance (WoNS).

Table 14: Exotic species data for Maules Creek riparian zone during the summer 2022 and autumn 2024 surveys.

Summer 2022	BCP4	BCUS2	BCP3	BCP2
% cover	6.6	4.2	6.1	3.6
Abundance	109	185	101	85
No. species	26	74	29	61
Autumn 2024	BCP4	BCUS2	BCP3	BCP2
% cover	6.1	3.9	2.7	1.4
Abundance	659	893	201	302
No. species	13	12	7	11

4.4.2.2. Native Vegetation Composition

There were between two and five tree species per site during the summer 2022 (Figure 9), and between 2 and 4 in autumn 2024 (Figure 10). Ground cover was calculated by combining the number of 'grass', 'forb' and 'fern' species. The groundcover layer was dominated by grass and forbs in summer 2022 and autumn 2024, with more species in the latter survey (Figure 10) than the former (Figure 9). The average number of ground cover species was 27.75 species per site in summer 2022 and increased to 38 in autumn 2024. The average number of species recorded in the 'other' growth form group (including palms and vines) was 2.25 in summer 2022 and increased to 2.5 in autumn 2024.

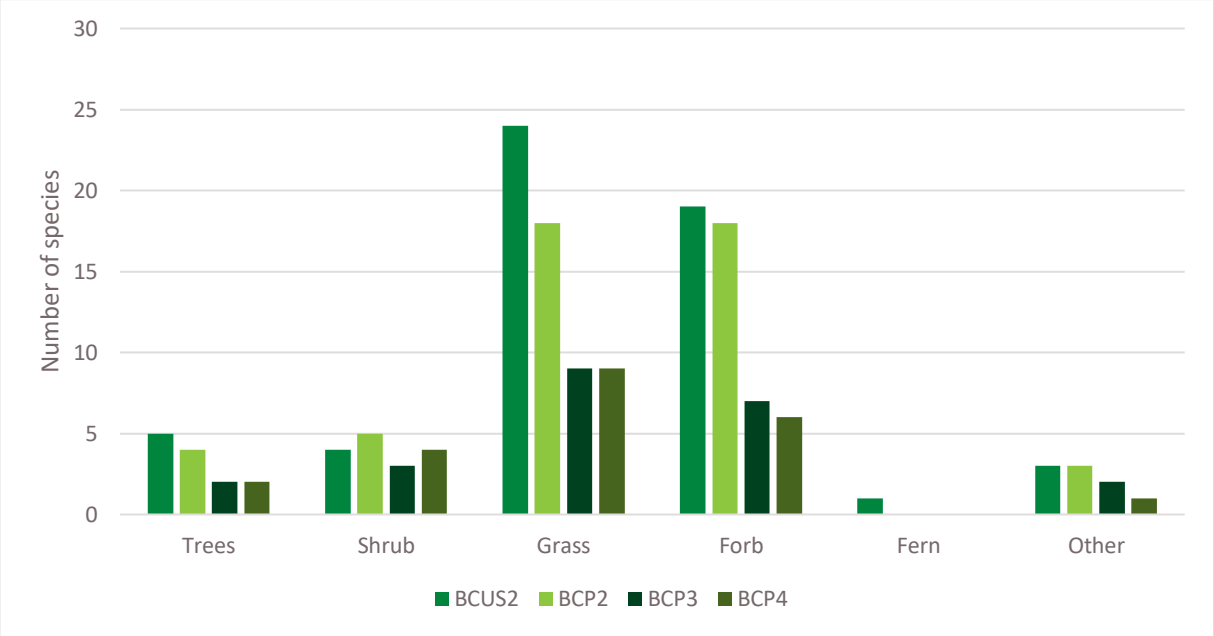

Figure 9: Native vegetation richness in riparian zone of Back Creek in summer 2022

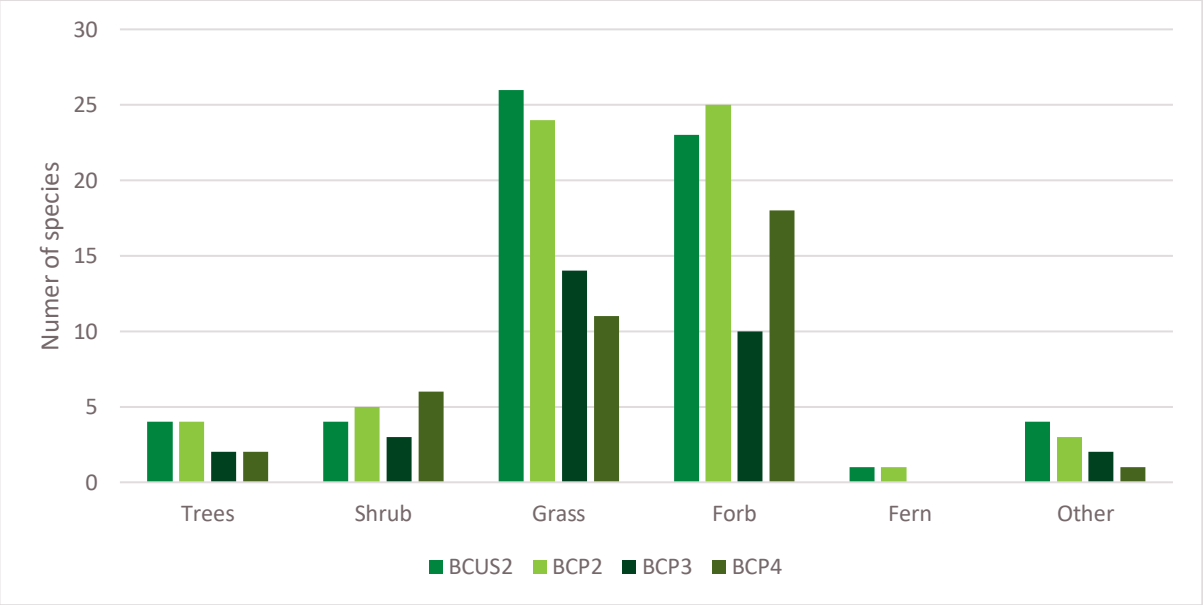

Figure 10: Vegetation richness in riparian zone of Back Creek in autumn 2024.

4.4.2.3. Vegetation Structure

During the summer 2022 survey, total cover (%) was highest at BCP3, and total abundance was highest at BCP4. Both these sites were downstream of MCCP (Table 15). The lowest species cover was at BCP2, but apart from this site, cover exceeded 90% (Table 15). This changed in the autumn 2024 survey where total cover (%) was highest at BCP4 and total abundance was highest at site BCUS2. BCUS2 is upstream of MCCP but BCP4 is downstream. The lowest species cover was at BCP3 (95.3%) however all sites cover still exceeded 90% (Table 15).

Table 15: Average % cover and total abundance for each site for the summer 2022 and autumn 2024 surveys.

Summer 2022	BCUS2	BCP2	BCP3	BCP4
Total % cover	93.8	73.4	101.2	91.2
Total abundance	1965	1007	1269	2132
Autumn 2024				
Total % cover	96.1	98.1	95.3	101.4
Total abundance	5726	3228	1009	3935

TREES AND SHRUBS

Average tree cover across the four monitoring sites was 19.5% in summer 2022 (Figure 11) compared to 6.6% in autumn 2024 (Figure 12). Tree cover was highest at the two upstream sites (BCUS2, BCP2) and lowest at the downstream sites (Figure 11) in summer 2022. Tree cover in autumn 2024 was highest at BCP2 and lowest at BCUS2. In summer 2022, average shrub cover across the four monitoring sites was 27.2%, but cover varied considerably between upstream and downstream sites. BCP3 and BCP4 each had more than four times the shrub cover than the other two upstream sites. *Melaleuca bracteata* (Black Tea-tree) dominated the shrub layer at all sites expect BCUS2, where it was absent in the plot during summer 2022. Average shrub cover had increased to 40.6% for the autumn 2024 survey. BCP3 had the highest shrub cover of 60.1%. Black Tea-tree dominated the shrub layer at all sites expect BCUS2. Site BCUS2 has the lowest shrub cover of 7.3% of the entire plot in autumn 2024.

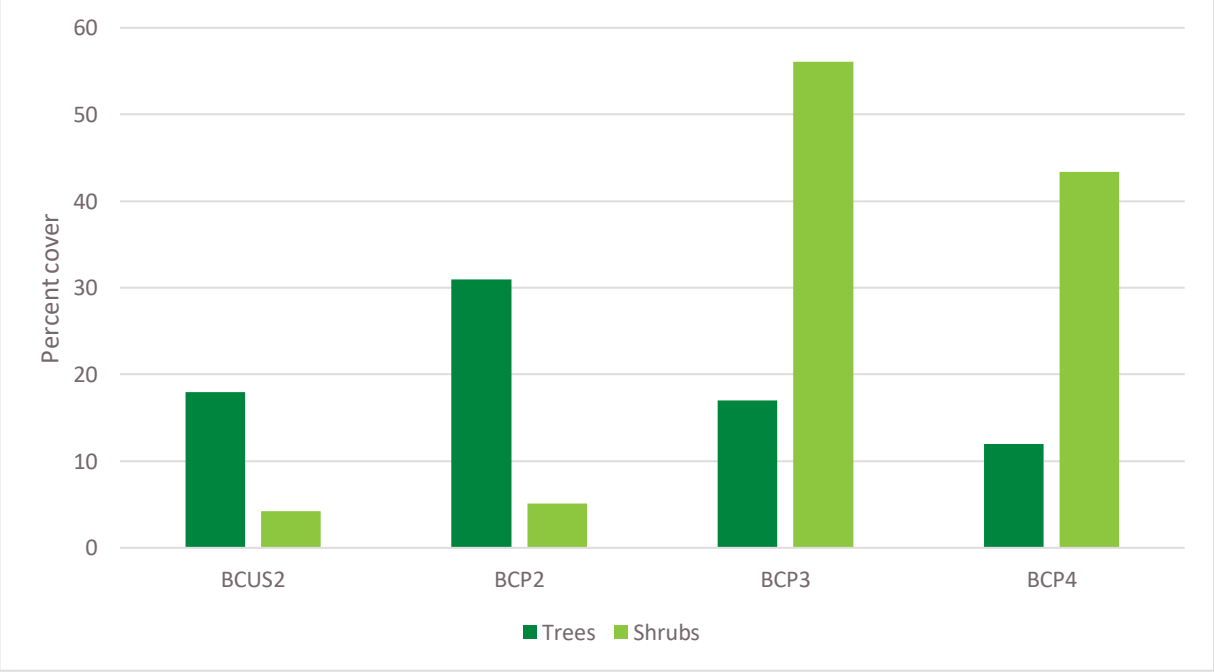

Figure 11: Tree and shrub cover in the riparian zone of Back Creek during summer 2022

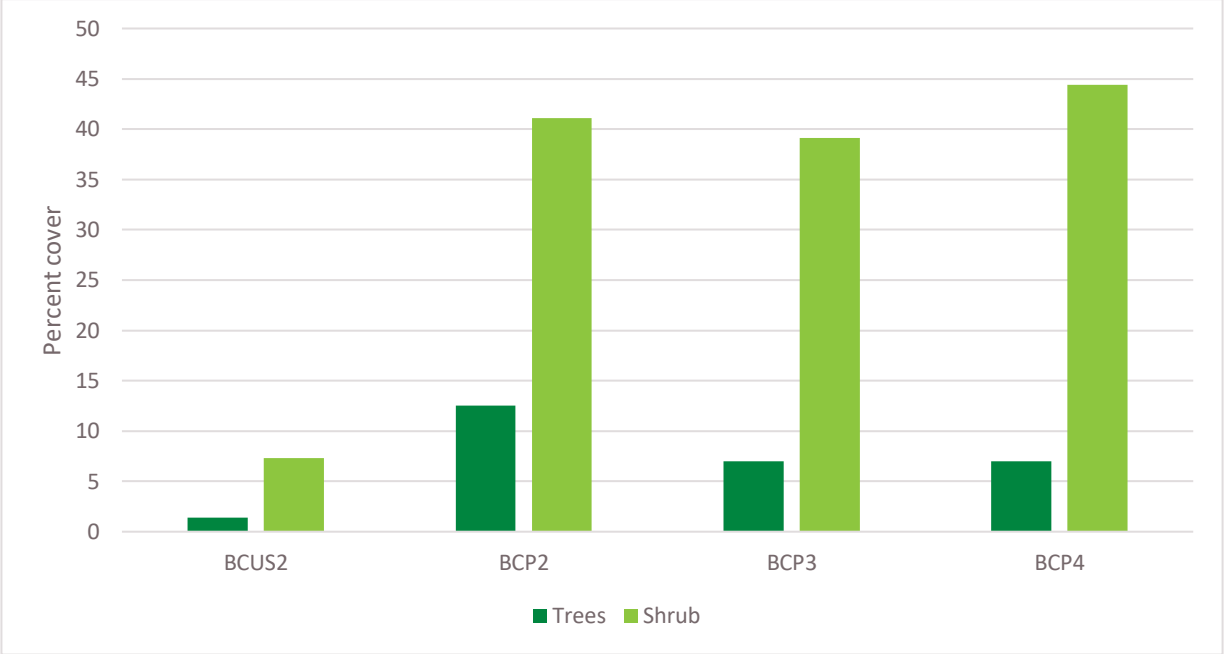

Figure 12: Tree and shrub cover in the riparian zone of Back Creek during autumn 2024.

GROUND COVER (GRASS, FORBS, FERNS)

Ground cover was calculated by combining the % cover provided by the 'grass', 'forbs' and 'ferns' growth groups. In the summer 2022 survey, combined cover averaged 37.6% across all four sites, with a range of 21.6% to 66.7% (Figure 13). The average ground cover increased to 50% across all sites in autumn 2024 (Figure 14). In summer 2022, all sites were dominated by grass, which made up between 16 and 59.9% of cover (Figure 13).

Grass cover was higher at downstream sites than upstream sites. Forb cover was between 2.6 and 6.7%, while ferns occurred only at BCUS2 with a cover 0.1% (not visible in Figure 14). In autumn 2024, two sites were dominated by groundcover, ranging from 29.7% to 87%, the other two sites were dominated by shrub cover. Ferns only occurred at BCUS2 and BCP4 with a cover 0.1% in autumn 2024 (not visible in Figure 14).

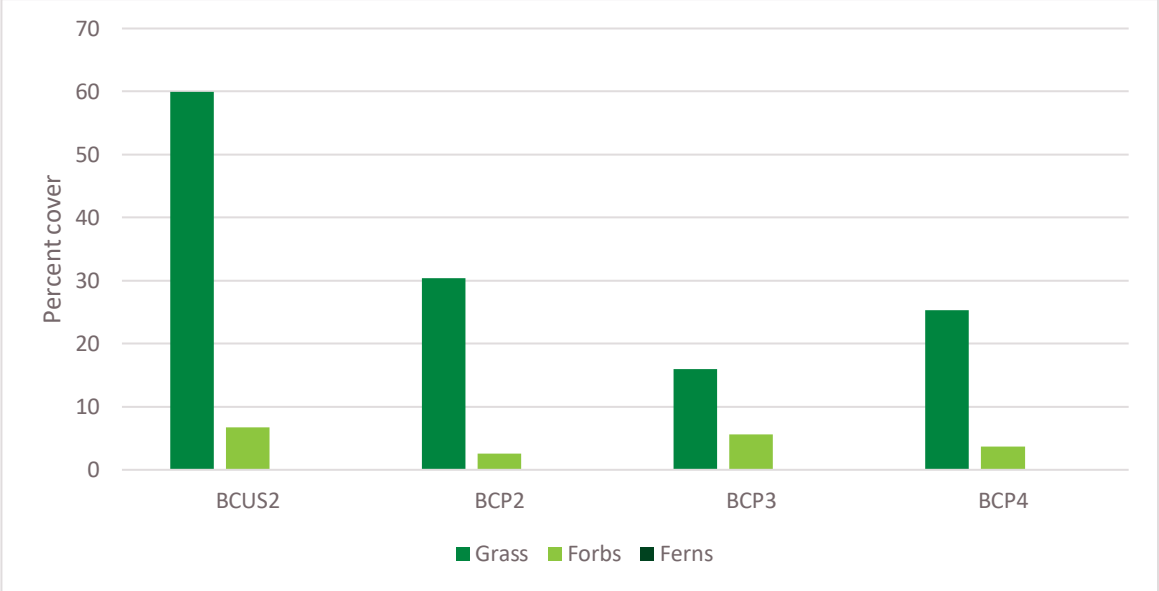

Figure 13: Ground cover (Grass, forbs, ferns) in the riparian zone of Back Creek during summer 2022. Ferns present at BCUS2 but make up less than 0.1% cover.

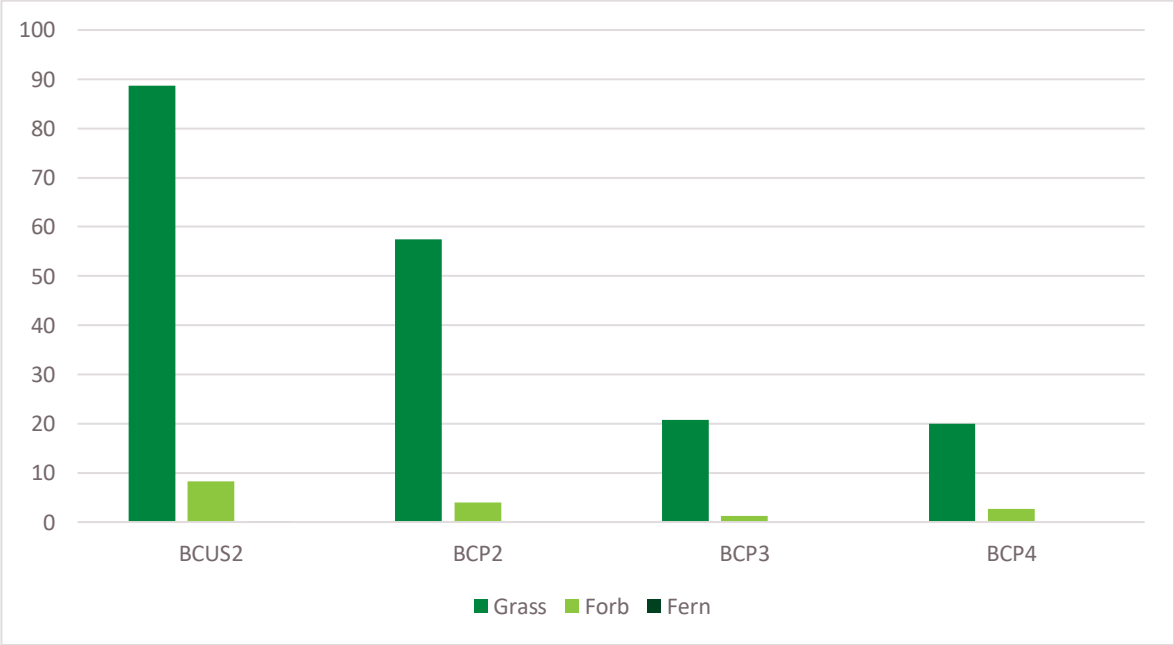

Figure 14: Ground cover (Grass, forbs, ferns) in the riparian zone of Back Creek during autumn 2024. Ferns present at BCUS2 and BCP2 but make up less than 0.1% cover at each site.

OTHER COVER

Native species included in the 'other' growth form group category include vines such as *Desmodium varians* and *Glycine tabacina,* in both surveys, and *Clematis microphylla* in autumn 2024. The average 'other' cover across the four sites was 0.4 in summer 2022 (Figure 15) and 0.5 in autumn 2024 (Figure 16).

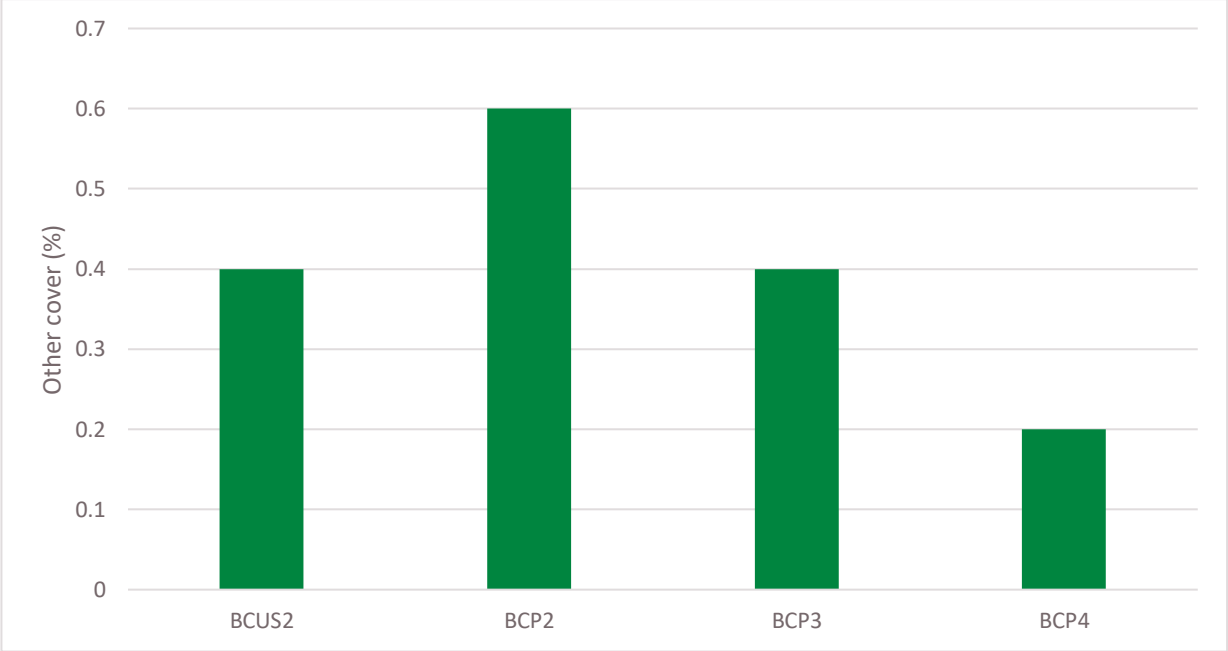

Figure 15: 'Other' cover in the riparian zone of Back Creek in summer 2022

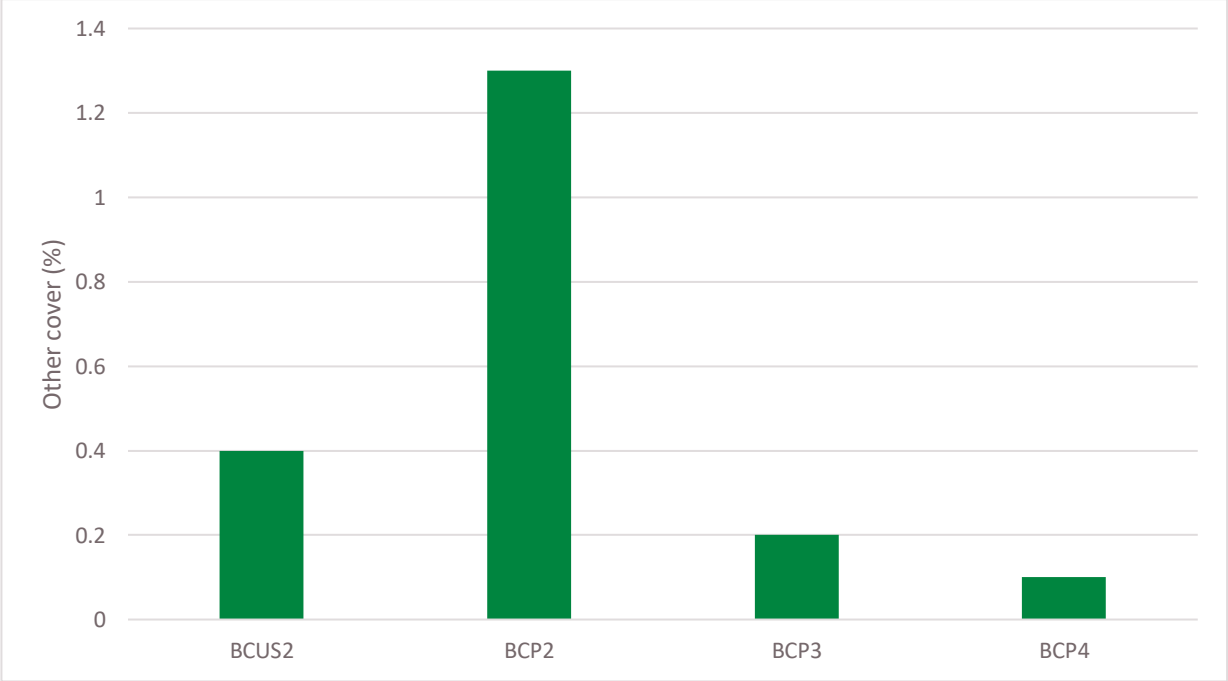

Figure 16: Other cover in the riparian zone of Back Creek in autumn 2024

4.5. Groundwater Dependent Aquatic Ecosystems

The BoM Groundwater Dependent Ecosystem (GDE) Atlas (BoM 2024) identifies some of the lower reach of Maules Creek as a known GDE based on a regional study (Figure 17). Upstream of this, it is classified by a national assessment as having a moderate or low potential for groundwater dependence. Groundwater contributing to surface flow in Maules Creek comes from the Maules Creek alluvial aquifer and is proportionally higher during periods of low rainfall. In dry periods, the upper reaches cease to flow.

Namoi River has reaches classified as high, moderate, and low potential GDEs in the national assessment (Figure 17). The high potential reach of Namoi River includes the confluence of Maules Creek, and extends from downstream of Boggabri for approximately 30 km downstream of the Maules Creek Confluence. Groundwater contribution to baseflow in the Namoi River comes from the Namoi alluvium.

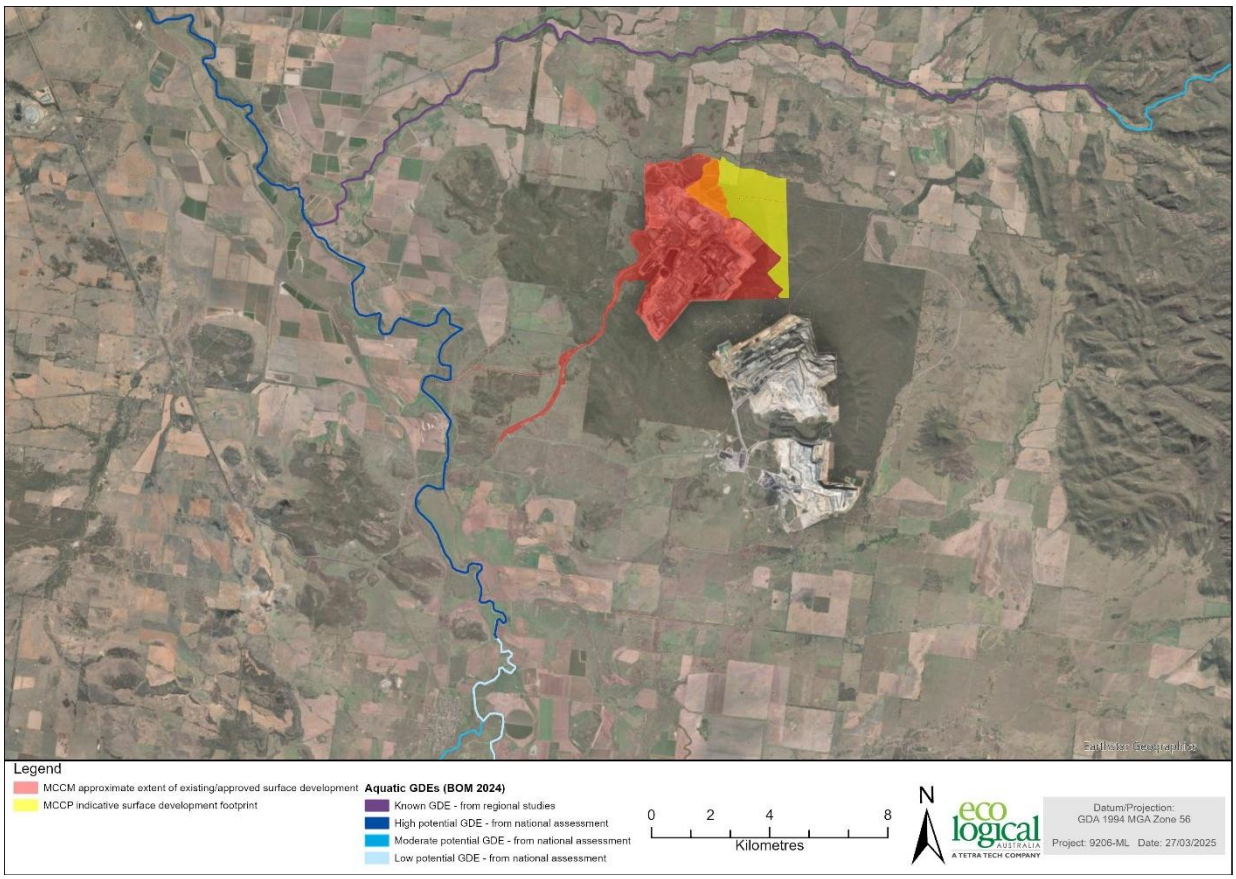

Figure 17: Groundwater dependant waterways (BoM 2024)

4.6. Key Fish Habitat

Key Fish Habitat (KFH) are those habitats that are crucial to the survival of native fish stocks (Fairfield 2013). It excludes constructed habitats such as agricultural drains, off-stream dams and ponds, as well as natural waterways that are dry for most of the time or have limited habitat value (Fairfield 2013).

Back Creek, and its tributaries Whiskey Creek and Stewarts Gully, are mapped on the DPI Fisheries Spatial Portal (DPI 2024b) as being KFH (Figure 18), despite these all being ephemeral and dry except for periods after large rainfall events. KFH designation generally applies to waterways that are 3rd Order

Strahler streams and above, and to those that are potential/theoretical habitat for threatened species regardless of whether the species has been confirmed from the location or not (Fairfield 2013). Back Creek has been mapped as potential habitat for purple spotted gudgeon upstream to just beyond the current western extent of MCCM (Figure 21). The waterways are also part of the Lower Darling River Aquatic Ecological Community, an endangered ecological community (EEC) (Section 4.8) so retains its classification of KFH.

Maules Creek and Namoi River are mapped as KFH (Figure 18). Namoi River is permanent, and potential habitat for four species listed as threatened under the FM Act, one listed under the EPBC Act, and one listed under both (Table 16). The upper reaches of Maules Creek are largely ephemeral but are part of the Lower Darling River Aquatic Ecological Community (Section 4.8) so retains its classification of KFH.

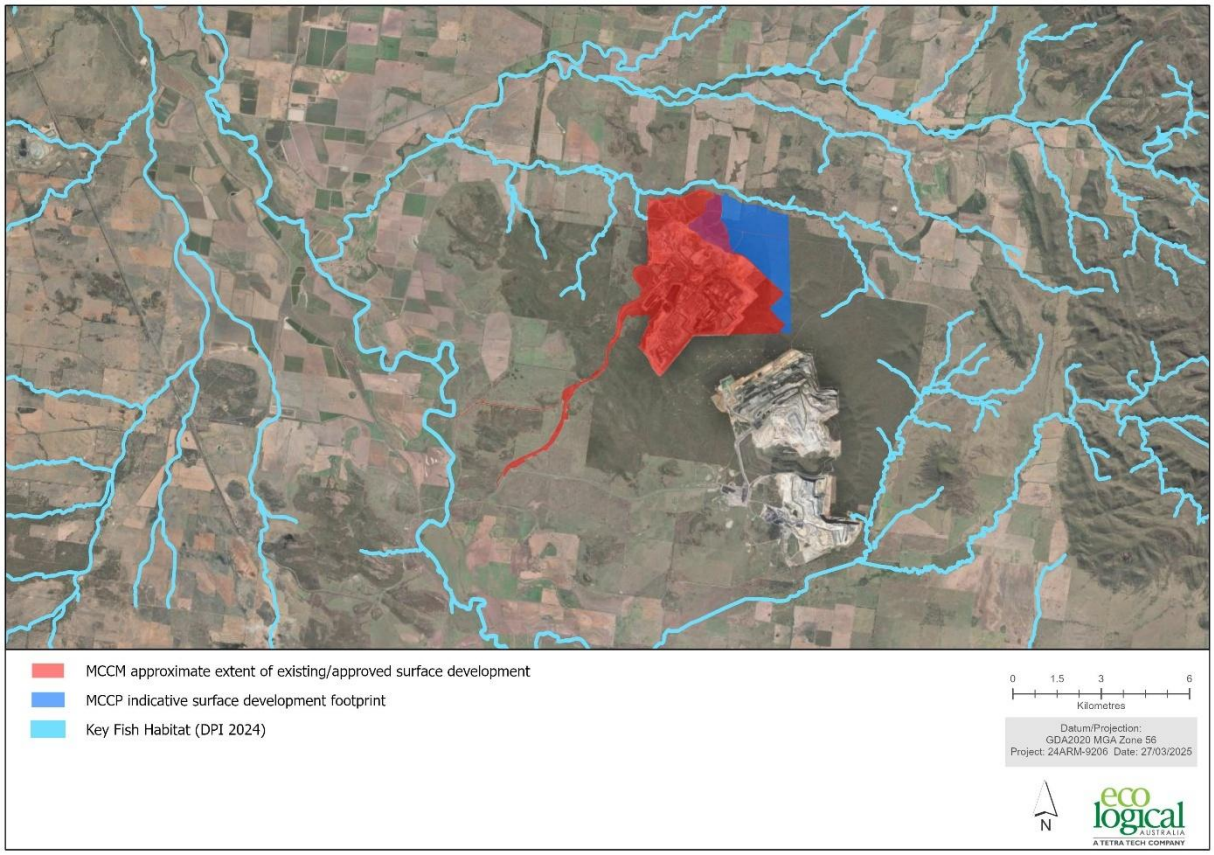

Figure 18: Key Fish Habitat as displayed in Fisheries NSW Spatial Data Portal (DPI 2024b).

4.7. Threatened Species under the FM Act

The following databases were searched for threatened aquatic fauna with the potential to occur in the study area:

- DPI Fisheries Spatial Data Portal (DPI 2024b);
- NSW BioNet search (NSW Department of Environment and Heritage 2024); and
- Atlas of Living Australia (2024).

Four species of fish with the potential to occur in the study area are listed by NSW Fisheries as threatened or endangered (Table 16). Eel-tailed catfish, olive perchlet, and purple-spotted gudgeon are mapped as occurring in Maules Creek (Figure 19 to Figure 21). As Maules Creek is dry for prolonged periods, any fish inhabiting this creek would need to swim upstream from Namoi River during periods of flow. This is unlikely given the poor upstream swimming capability of these three species, and the relatively brief periods of flow.

Eel-tailed catfish and silver perch occur in the Namoi River (Figure 19, Figure 22), with populations boosted by stocking (DPI 2024a).

Only purple-spotted gudgeon is mapped as occurring in Back Creek. However, as this creek dries frequently and for long periods of time, it is very unlikely that the species occur. Any migration from Maules Creek would be significantly impaired by the 1.5 m high headcut erosion upstream of the pool at BCPX.

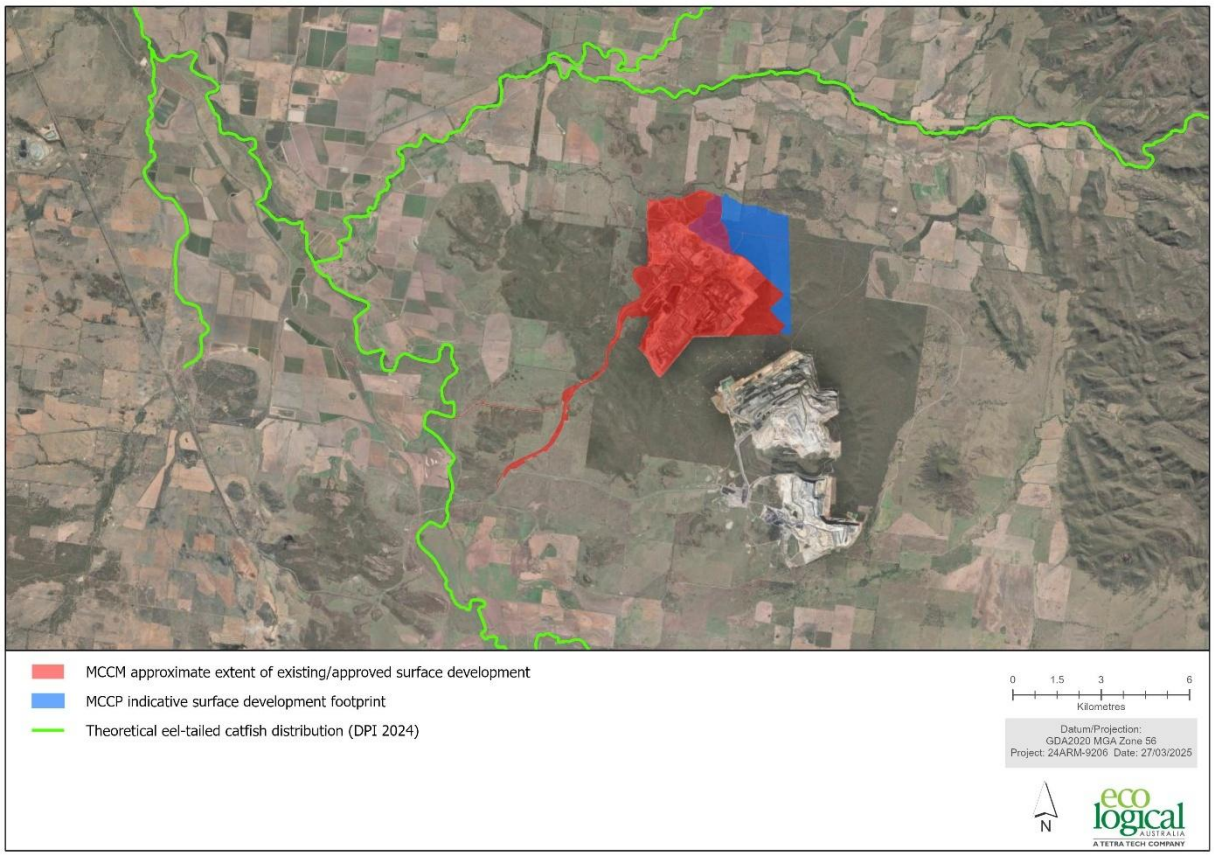

Figure 19: Theoretical distribution of eel-tailed catfish (green line) as displayed on Fisheries NSW Spatial Data Portal (DPI 2024b).

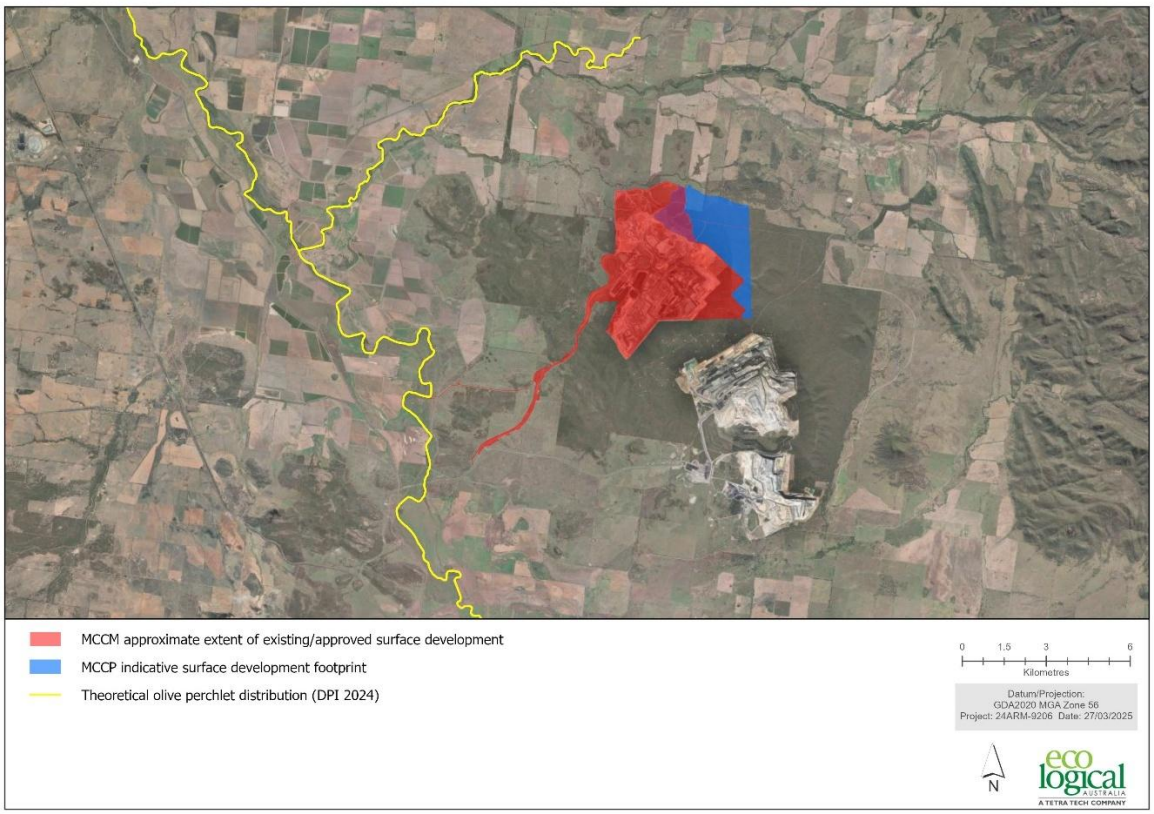

Figure 20: Theoretical distribution of olive perchlet (yellow line) from Fisheries NSW Spatial Data Portal (DPI 2024b).

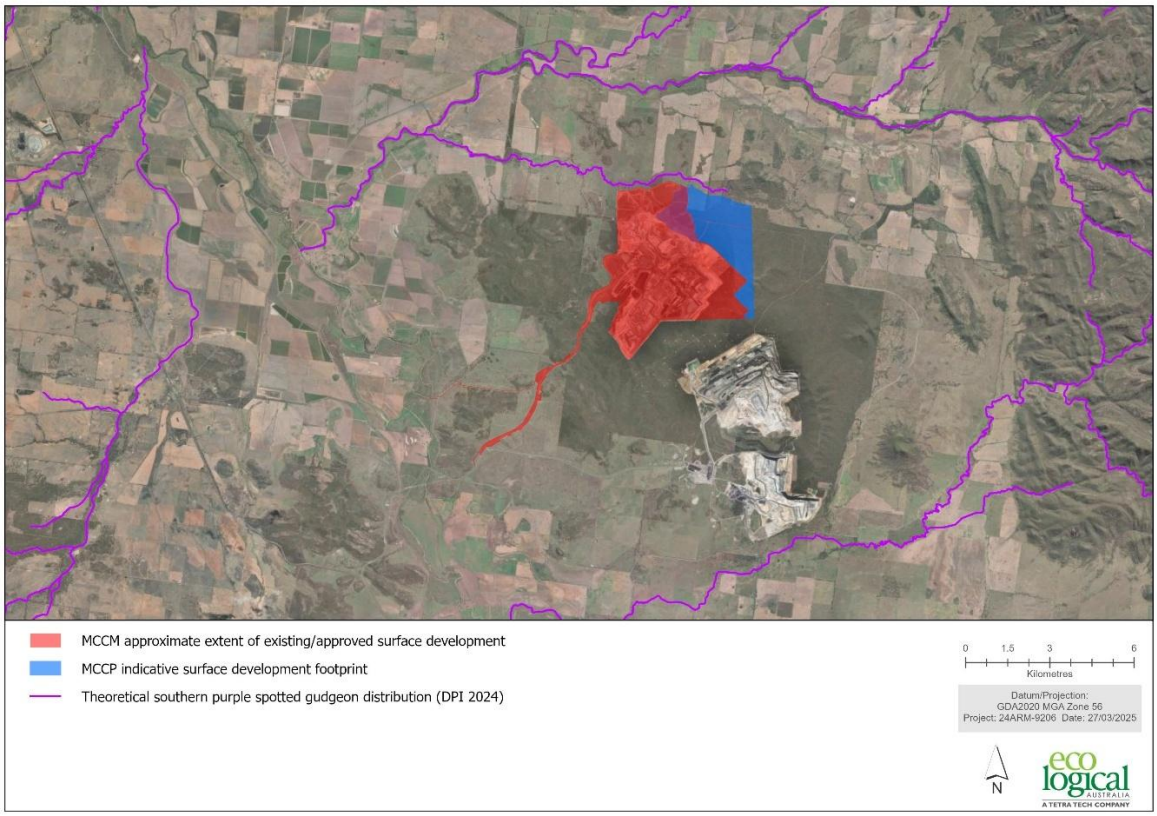

Figure 21: Theoretical distribution of southern purple-spotted gudgeon (purple line) from Fisheries NSW Spatial Data Portal (DPI 2024b).

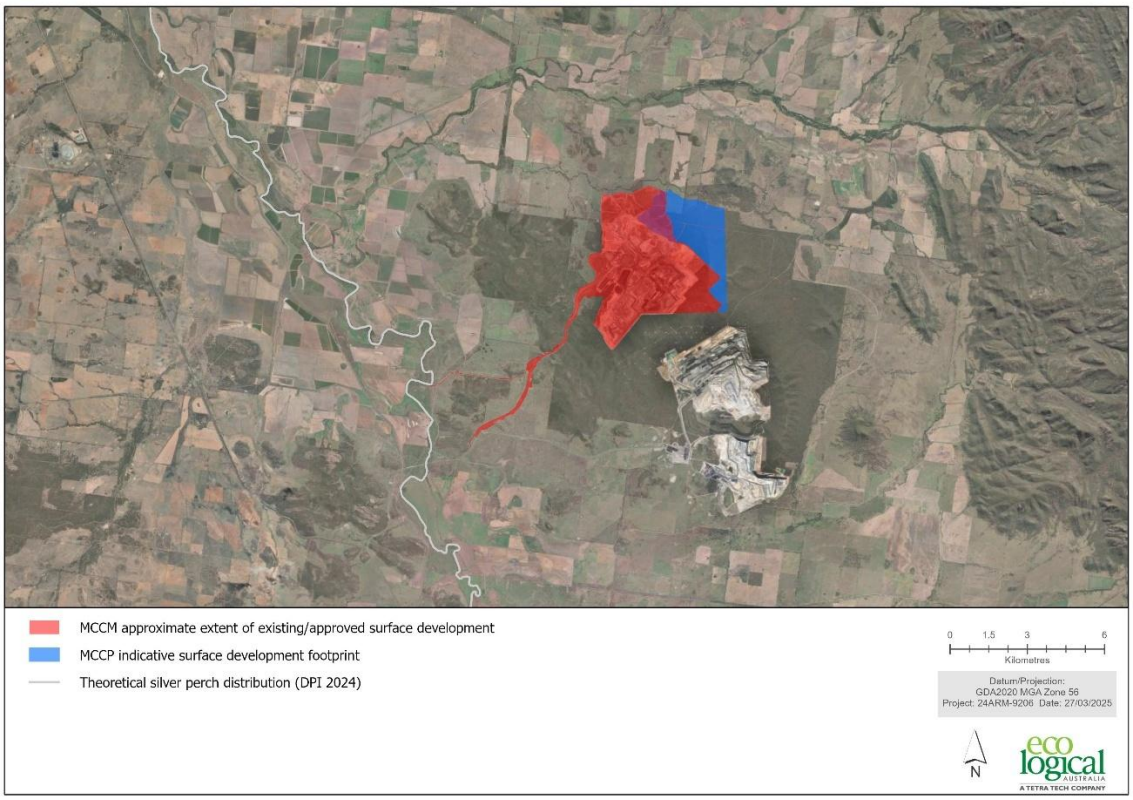

Figure 22: Theoretical distribution of silver perch (grey line) from Fisheries NSW Spatial Data Portal (DPI 2024b).

Table 16. Threatened species listed under the FM and/or EPBC Acts

Common Name	Scientific Name	Status		Habitat Description	Likelihood Of Occurring in The Study Area
		EPBC Act[1]	FM Act[2]		
FISHES					
Eel-tailed Catfish	*Tandanus tandanus*		EP	Non-migratory benthic species. Inhabits diverse range of habitats including billabongs, lakes, large rivers. Prefers sluggish, still water and can tolerate turbid water.	Mapped as potentially occurring in Maules Creek and Namoi River, but not Back Creek. Likely to occur in Namoi River, and potentially in lower reaches of Maules Creek. May occur in upper reaches of Maules Creek when there is flow, although the frequent drying of Maules Creek precludes permanent populations. This species is non-migratory and has a relatively poor ability to swim upstream. Catfish are not mapped as occurring in Back Creek, and it is very unlikely that any would occur there given the long periods of no-flow. Occur in the Namoi River, with records in the Atlas of Living Australia north of Gunnedah. Natural populations are supplemented with stocking (DPI 2024a).
Olive perchlet	*Ambassis agassizii*		EP	Inhabit inland rivers, creeks, ponds and swamps, usually slow-flowing or still water. Prefer sheltered areas such as overhanging vegetation, aquatic macrophytes, logs, dead branches, and boulders.	Mapped as theoretically occurring in Maules Creek and Namoi River, but not Back Creek. No records from project area, nor in Namoi River or any of its tributaries. There is suitable habitat in the Namoi River and Maules Creek, although populations in Maules Creek are unlikely because the creek dries up periodically.
Southern purple-spotted gudgeon	*Morgunda adspersa*		E	Found in a variety of habitats, including creeks, rivers, streams, billabongs, with slow-flowing or still water. Prefer cover from aquatic vegetation, overhanging vegetation, and litter, rocks or snags are also preferred.	Mapped as potentially occurring in Back Creek, Maules Creek, and Maules Creek tributaries. Very unlikely in Back Creek, as this dries too frequently to sustain viable populations. No records in Atlas of Living Australia for the Project area, nor in Namoi River and tributaries. Nearest record is Gwydir River at Bingara. There is some potential habitat in lower reaches of Maules Creek during wet periods, but this species is unlikely because Maules Creek dries out and this species is poor at disbursing upstream. Potential habitat in Namoi, but the lack of records of this species in the river suggests it does not occur there. Very unlikely to occur in project area.
Murray cod	*Maccullochella peelii*	V		Occur in large, slow rivers and lakes. Habitat preference for	Occurs in Namoi River, with records in the Atlas of Living Australia upstream and downstream of the Maules Creek confluence. There are no records from Back Creek or Maules Creek, and it is very

Common Name	Scientific Name	Status		Habitat Description	Likelihood Of Occurring in The Study Area
		EPBC Act[1]	FM Act[2]		
				snags, rocks, overhanging banks, deep pools.	unlikely that cod would occur there because these creeks aren't deep enough, and they are not permanent enough. Natural populations are boosted by stocking programs (DPI 2024a)
Silver perch	*Bidyanus bidyanus*	E	V	Found in faster-flowing water in a wide range of habitats in the Murray-Darling basin.	Mapped as potentially occurring in the Namoi River, but not Maules Creek or tributaries, including Back Creek. Likely to occur in the Namoi, though reliant largely on stocking (DPI 2024a). Not likely in Back Creek and Maules Creek.

1 Conservation status under the BC Act (current as at May 2025). V = Vulnerable, E = Endangered.

2 Conservation status under the EPBC Act (current as at May 2025). V = Vulnerable, E = Endangered, EP = Endangered Population.

4.8. Endangered Ecological Communities under the FM Act

The Namoi River is part of the Lowland Darling River Aquatic Ecological Community, an EEC in New South Wales (DPI 2007). This EEC includes all native fish and aquatic invertebrates in all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River in NSW. The listing includes:

- the Menindee Lakes;
- the Barwon River;
- the main Barwon-Darling channel from Mungindi to the convergence with the Murray River;
- the arid zone intermittent section streams (Warrego, Culgoa, and Narran rivers);
- the border rivers (Macintyre, Severn and Dumaresq rivers); and
- the regulated tributaries (Gwydir, Namoi, Macquarie, Castlereagh, and Bogan rivers).

The EEC listing does not include artificial canals, water distribution and drainage works, farm dams and off-stream reservoirs.

As part of the Lowland Darling River Aquatic Ecological Community, native aquatic species of the Namoi River and its tributaries, including Maules Creek and Back Creek, are given the status of endangered species.

4.9. Threatened Species under the EPBC Act

A search of the Protected Matters Search Tool indicates there are two species of threatened fish listed under the EPBC Act that have the potential to occur in the region. These are the Murray cod (*Maccullochella peelii*) listed as Vulnerable, and silver perch (*Bidyanus bidyanus*) listed as Endangered. A review of the DPI Fisheries stocking records accessed 15 June 2023 (DPI 2024a) show that both species are currently stocked in the Namoi River between Gunnedah and Narrabri. The species may move up into Maules Creek when it is flowing but are not likely in Back Creek because it is mostly dry and is too shallow and constricted for both of these species when flowing.

4.10. Stygofauna

Six bores were sampled for stygofauna in summer 2022, three were sampled in autumn 2023 and four were sampled in autumn 2024 (Table 4). Of these, MOR2 and REG16 were the only bores containing taxa that were definitely stygofauna.

MOR2 is approximately 350 m south of Back Creek and potentially samples the alluvium of Back Creek/Maules Creek (Figure 23). MOR2 had five individuals of the syncarid crustacea genus of *Notobathynella* sp. (Table 17, Figure 24) in summer 2022 and two in autumn 2023. MOR2 is an old stock bore, which potentially samples the Back Creek sediments, making this the first record of stygofauna in Back Creek sediments. No construction data was available for this bore. Six-monthly sampling by MCCM between January 2017 and August 2022 indicates that the water level in this bore is relatively stable at 13 to 13.31 m below ground level (MCCM groundwater monitoring data). EC was low, ranging from 59.1 to 175.3 µS/cm, and pH was between 7.38 and 8.29.

Stygofauna including *Notoathynella* are known to occur in the Namoi and Maules Creek alluvium (Kath Korbel, Macquarie University, *pers comm.*) so it is likely that the range of this taxon extends from Maules Creek up into the downstream reaches of Back Creek. This genus is relatively widespread through the Namoi and Peel River alluvial aquifers, and other aquifers in NSW (Kath Korbel, *pers comm.*).

Bore REG16 is located approximately 40 m south of Maules Creek off Harparary Road (Figure 23). Bore REG16 contained another syncarida, this time from the family Psammaspidae (3 individuals). It also had Copepoda (69 individuals), Isopoda (Janiridae) (5 individuals) and Amphipoda (4 individuals) (Figure 25 and Table 17).

The four stygofauna taxa collected from REG16 are also known from the Maules Creek and Namoi River alluvial aquifers (Kath Korbel, *pers comm.*). This bore was completed in March 2023 and is screened from 24 to 30 m below ground. The drill log for this bore shows that the aquifer here is deeper than 37 m, and that it consists of mixed alluvial sand, gravel and cobble down to 31 m. Below this depth, clay content increases to 50 %. When developed, water level in the bore was 2.6 m below ground level, pH was 7.5, EC was 3097 µS/cm, and temperature was 19.7 °C.

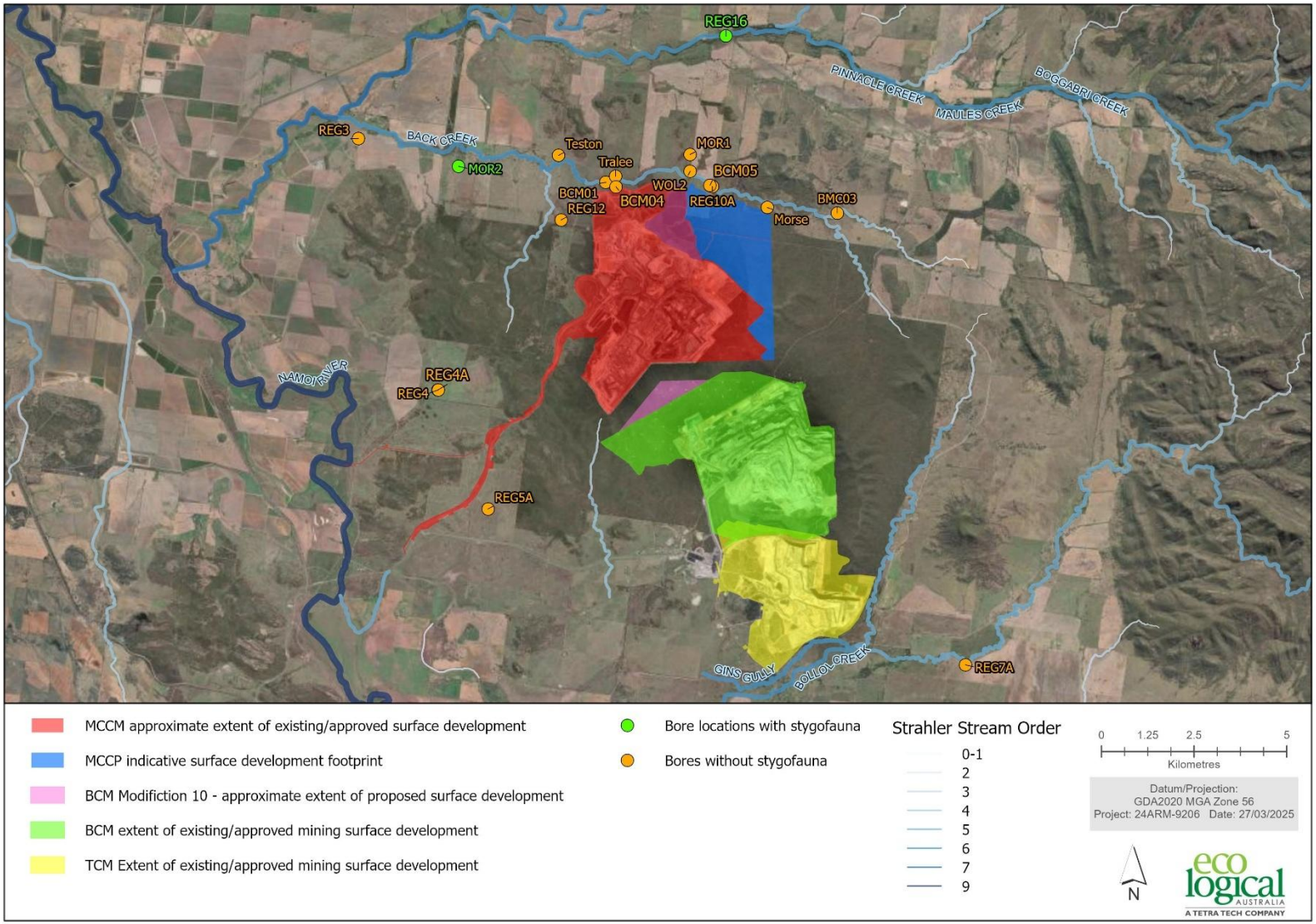

Figure 23: Bores with and without stygofauna

Table 17: Invertebrates collected from bores at MCCM in summer 2022

Survey	Taxon	Classification	REG 12	MORSE	REG4	MOR2	TESTON	BCM 05	REG 16
Summer 2022	*Notobathynella* sp.	stygofauna				5			
	Oligochaeta	unlikely stygofauna					14		
	Chironomidae	not stygofauna		42		3			
	Sciomyzidae	not stygofauna		3					
	Astigmatid	not stygofauna		1					
Autumn 2023	*Notobathynella* sp.	stygofauna				2			
	Oligochaeta	unlikely stygofauna					2		
	Chironomidae	not stygofauna		12					
Autumn 2024	Oligochaeta	unlikely stygofauna						3	3
	Copepoda	stygofauna							69
	Isopoda (Janiridae)	stygofauna							5
	Amphipoda	stygofauna							4
	Syncarida (Psammaspidae)	stygofauna							3

Oligochaeta worms were collected from Teston Bore and REG16 during all surveys, and while some oligochaetes have been classified previously as stygofauna, they are more common in soil and aquatic communities, and this is the likely origin of these specimens. The oligochaetes collected from these bores are not considered stygofauna.

Chironomidae and Sciomyzidae are both midge families that occur in surface water environments, although occasionally occur in bores or wells that are open, allowing aerially dispersing adults to lay eggs, or larval stages to wash in during floodwater ingress. This appears to have happened to these bores, as these taxa are not stygofauna. The Astigmatid mite in Morse bore is also a soil invertebrate.

Figure 24: *Notobathynella* sp. collected from MOR2

Figure 25: Stygofauna collected from REG16. Top: Syncarida, Psammaspidae; lower left: Isopoda, Janiridae; lower right: Amphipoda.

5. Impact assessment

This section provides an assessment of the potential impacts and mitigation measures from the Project on aquatic ecology. This assessment considers the proposed Project water management system as described in the Environmental Impact Statement (EIS). The EIS describes that the objectives of the Project water management system would be generally consistent with the existing water management system at the MCCM, as follows:

- *clean water runoff from undisturbed catchment areas is diverted away from the disturbed mining area, where possible and practical to do so;*
- *sediment laden runoff from disturbed areas is re-used in the water management system or released into the receiving environment (if the runoff does not need to be re-used in the water management system and the water quality meets the Environment Protection Licence (EPL) requirements)*
- *mine water and groundwater collected within the open cut pit is contained and reused on-site;*
- *no discharge of mine water off-site; and*
- *on-site water demands are satisfied whilst minimising offsite water requirements.*

To meet these objectives, the Project water management system would comprise the following:

- *clean water diversion drains and dams (including highwall dams) to divert runoff from undisturbed catchments around areas disturbed by mining where reasonable and feasible;*
- *sediment dams to collect and treat runoff from overburden emplacement areas and other operational areas;*
- *surface water drains to divert sediment-laden runoff from overburden emplacement areas and other operational areas to sediment dams;*
- *a mine-affected water system to store water from active mining areas and infrastructure areas; and*
- *other ancillary water management infrastructure (including pumps, piping and drains), as required.*

This assessment also considered the key findings from the ground water and surface water assessments (AGE 2025; WRM Water and Environment Pty Ltd [WRM] 2025). The cumulative impacts are considered through-out this section. For example, the groundwater assessment (AGE 2025) modelled the cumulative impacts from the approved MCCM, the proposed Project, the BCM (including the proposed Mod 10) and TCM.

5.1. Aquatic Habitat Clearance

There would be no direct clearance of aquatic habitat. All watercourses draining to the Project area are steep and ephemeral. Most of the Project area is drained by two small unnamed tributaries of Back Creek, located within the Project mine site footprint. A site visit to inspect these drainage lines was undertaken by WRM (2025) in April 2023. The upper reaches of these tributaries consist of steep gullies with poorly defined channel banks and moderate vegetative cover. The gradient decreases as the tributaries flow northwards, discharging onto flatter land adjacent to Back Creek, which has been predominantly cleared for agriculture (WRM, 2025).

Bollol Creek would be traversed by the water transfer pipeline. At this location, Bollol Creek has a shallow gradient and crosses Rangari Road immediately south of the proposed water transfer pipeline. Bollol Creek has not been subject to extensive survey compared to Back Creek and Maules Creek due to the nature of disturbance associated with the water transfer pipeline (i.e. the pipeline would be placed in a trench which is rehabilitated following construction).

The proposed water transfer pipeline would be placed within a trench and rehabilitation of disturbed areas would be undertaken following construction. Upon completion of the rehabilitation, there would be no change to the surface water flows or quality in Bollol Creek as a result of the proposed water transfer pipeline.

There would be no direct clearance of riparian vegetation, and no works in the bed or banks of Back Creek as part of the Project. The proposed open cut expansion area is at least 200 m from Back Creek.

5.2. Surface Water Quantity – Creek Catchments

Consistent with the approved MCCM operations, disturbed areas would continue to be progressively rehabilitated throughout the Project life. Where surface water runoff from rehabilitated land meets the water quality requirements in the MCCM Environment Protection Licence, it would be directed off-site (primarily to Back Creek).

The Back Creek catchment area to the confluence with Maules Creek was approximately 9,606 ha (prior to mining in the catchment). The Project would result in a slight decrease in area reporting to Back Creek (an additional 5% of catchment area is excised) during peak operations. However, following closure, the Project would result in an additional 5% of total catchment area being returned to Back Creek (compared to approved conditions) due to the revised final landform and final void (WRM 2025). The final void catchment area for the Project would be approximately 440 ha[1]. This is a significant improvement on the originally approved MCCM final void of 904 ha post-mining (WRM 2025).

The drawdown due to the Project would result in negligible changes in Back Creek surface water flows, as the regional water table is well below Back Creek (AGE 2025).

[1] Approximately 44 ha of the Back Creek catchment would be diverted to an unnamed tributary of the Namoi River.

The groundwater model simulations demonstrates that there will be negligible baseflow loss due to the Project (compared to the approved scenario) at the Lower and Middle reaches of Maules Creek (AGE, 2025). The ephemeral Upper Maules Creek reach is typically disconnected from the groundwater table as groundwater levels in the alluvium are below the base of the creek. Predicted drawdown due to the Project would likely have no or negligible impact on the surface water flows in the ephemeral Upper Maules Creek reach (AGE, 2025).

5.3. Surface Water Quality

Changes to surface water quality can occur through soil disturbance (sedimentation and mobilisation of nutrients and saline materials), unexpected overflow or breach of sediment dams, nutrient leachates, leaching from beneath stockpiles, and pollution leaks (e.g. associated with heavy vehicles and machinery).

The removal of vegetation in the Back Creek catchment could expose soil and sediment to erosion, which could wash in to Back Creek if sediment control measures are not correctly implemented. Portions of Back Creek catchment that have been impacted from mining operations would be revegetated to reduce erosion.

Drainage channels should be constructed at the base of stockpiles to channel water into sediment dams.

The surface water assessment (supported by site water balance modelling) by WRM (2025) concludes that:

- No uncontrolled spills are expected from mine water storages (WRM, 2025).
- Some overflow of treated water from sediment dams (designed in accordance with the Landcom [2004] and Department of Environment and Climate Change [2008] guidelines) may occur during wet periods, however it is unlikely that this would have a significant impact on receiving water quality as releases would meet the EPL requirements.
- Modelling (AGE 2025; WRM 2025) indicates that the Project would not result in any adverse impacts to catchment flows, water quality or flooding of Namoi River, Maules Creek and Back Creek.

To mitigate against pollution from vehicle leaks, all vehicles should be serviced regularly in workshops that are properly designed to contain chemicals. Fuel, oil, and other chemicals should be kept in appropriately bunded storage areas.

Pre-stripping of topsoil ahead of the open cut mining operations would result in the exposure of soil. This could become a potential source of sediment for Back Creek if there is a large rainfall event. To prevent this, appropriate runoff management and sediment retention measures should be taken. This should include silt retention devices, and drainage into a sediment pond. Once mining commences, it is anticipated that drainage to a sediment retention pond would mitigate any impact to aquatic ecology.

5.4. Final Landform

The Project final landform design principles are generally consistent with the approved MCCM mining area due to similar pre-mining landforms.

The Project would result in one final void remaining in the rehabilitated landform. The mine sequencing has been designed to locate the final void away from Back Creek. The final mine void pit walls and in-pit waste rock emplacement would be designed to remain geotechnically stable and non-polluting in the long-term.

To maximise the ecological value of the area associated with the final void, the low walls of the final void would be reshaped to a gradient suitable for creating habitat for fauna known to occur in the area (e.g. establish native vegetation on the low walls).

5.5. Key Fish Habitat and Fish Passage under the FM Act

There would be no direct impacts to KFH along Back Creek, Maules Creek, and Namoi River as there are no crossings proposed for these waterways, and works would be kept back from the creek banks by at least 200 m. Following rehabilitation of the trenched water transfer pipeline, there would also be no impact to Bollol Creek that would affect key fish habitat or fish passage.

Risks associated with the Project include an increased sediment load in Back Creek from the Indicative Open Cut Extension Area during clearing and subsequent operation, and from dirt washed in from roads. Increased sediment in Back Creek could reduce the depth of pools and create a smoother bed profile. There is already some evidence of this occurring due to historical clearing and agricultural activity. Significant amounts of additional sediment could also wash into Maules Creek and subsequently, the Namoi River.

To mitigate impacts, runoff along the northern edge of the mine would be channelled into a suitably sized sediment retention pond (WRM, 2025). Sediment retention devices would also be used strategically along roads at locations where road runoff is likely to be channelled. However, with the implementation of appropriate drainage, sediment retention, and stormwater management measures, there should be no significant impact to KFH.

5.6. Threatened Species under the FM Act

Assessments of significance in accordance with Division 12, Part 7A of the FM Act and the Threatened Species Assessment Guidelines - The Assessment of Significance (DPI, 2008) are included in Appendix E.

Eel-tailed catfish (Endangered population under the FM Act) are mapped as having habitat in Maules Creek and the Namoi River, and it is possible that the species occurs in both waterways. However, distribution in Maules Creek is likely to be limited to the lower reaches because upper sections dry up for long periods of time. Eel-tailed catfish can persist in isolated pools along the creek, so as long as these don't dry out, Eel-tailed catfish can disburse along the creek once flow commences. However once the creek dries completely, the presence of catfish in the waterway becomes dependent on migration upstream from the Namoi River.

The DPI Spatial Portal (DPI 2024b) indicates that the olive perchlet (*Ambassis agassizii*) (Endangered population under the FM Act) may occur in Maules Creek (approximately 3.5 km north of the Project).

Back Creek is mapped as theoretical habitat for southern purple-spotted gudgeon (Endangered species under the FM Act) in the DPI Spatial Portal (DPI 2024b). However, Back Creek is dry most of the time, and southern purple-spotted gudgeon are poor swimmers so do not rapidly colonise ephemeral

streams. Back Creek is not suitable habitat for southern purple-spotted gudgeon because it is mostly dry, and there are no deep refuge pools in the upper reaches. Similarly, Maules Creek is mapped as theoretically having suitable habitat for southern purple-spotted gudgeon, and has the potential for suitable habitat when water is present. However, this is unlikely to occur there as the creek dries out along much of its length and dries out completely during extreme periods of not rainfall.

Silver perch is mapped for the Namoi River, but not for Maules Creek or Back Creek (DPI 2024). In the Namoi, silver perch populations rely largely on stocking for recruitment. They may occur in the lower reaches of Maules Creek during periods of flow, but are unlikely to extend far upstream, and would not enter Back Creek. Long periods of no flow in Maules Creek and Back Creek make it unlikely that silver perch would be impacted by mining at MCCP.

It is concluded that the Project is unlikely to impact (or significantly impact) any threatened species or population listed under the FM Act.

5.7. Threatened Ecological Communities under the FM Act

Back Creek, Maules Creek, and the Namoi River are all part of the Lowland Darling River Aquatic Ecological Community, an EEC in NSW (DPI 2007). Assessments of significance in accordance with Division 12, Part 7A of the FM Act and the Threatened Species Assessment Guidelines - The Assessment of Significance (DPI 2008) are included in Appendix E.

The Project would not have a direct impact on the aquatic ecological communities of these waterways, apart from a small temporary loss of flow due to the excision of Back Creek catchment area (up to an additional 5% of catchment area is excised compared to the approved MCCM). The fauna community of Maules Creek and Back Creek consists of disturbance-tolerant taxa, so a small reduction in flow volume resulting from these changes would have a negligible impact on the aquatic ecology community of these waterways. Following closure, the Project would result in an additional 5% of total catchment area being returned to Back Creek (compared to approved conditions) (WRM 2025).

5.8. Threatened Species under the EPBC Act

The Namoi River has been stocked with Murray cod and silver perch (DPI 2024a; 2025a) and could potentially swim up into the lower reaches of Maules Creek when it is flowing. Impacts to the hydrology and water quality of these two waterways are negligible (AGE 2025; WRM 2025), so the Project would not have a significant impact on any aquatic species listed under the EPBC Act.

5.9. Groundwater Dependent Aquatic Ecosystems - Stygofauna

The typical fluctuations in groundwater levels in the Maules Creek alluvium are between approximately 2 and 8 m (AGE 2025), meaning any GDEs drawing water from the alluvium is already subject to varying groundwater depths/availability.

The maximum predicted drawdown in the Maules Creek alluvium due to the approved mining is approximately 0.3 m (AGE 2025). The predicted drawdown due to the Project in the Maules Creek alluvium is generally less than 0.5 m at the end of operations. The maximum predicted drawdown due to the Project is expected to be approximately 1 m in part of the Maules Creek alluvium. The incremental increase in groundwater drawdown (i.e. less than 1 m) is not expected to result in a significant change in groundwater levels and availability when considered in the context of the changes in levels due to seasonal variations (AGE 2025).

Due to the outcropping of the Permian Boggabri Volcanics west of the open cut pit, drawdown reduces with increasing distance west of the Project. Groundwater drawdown in the Permian Measures beneath the downstream section of Back Creek, where stygofauna have been identified, is expected to be negligible (AGE 2025). Stygofauna are resilient to levels of fluctuation that occur naturally in their aquifers.

While stygofauna occur in the aquifers associated with the Namoi River, drawdown associated with the Project would not impact stygofauna community in the Namoi River alluvium (AGE 2025).

5.10. Groundwater Dependent Aquatic Ecosystems – Surface Water Features

As described in Section 4.5, Namoi River has reaches classified as high, moderate, and low potential GDEs in the national assessment (Figure 17). The high potential reach of Namoi River includes the confluence of Maules Creek, and extends from downstream of Boggabri for approximately 30 km downstream of the Maules Creek Confluence. Groundwater contribution to baseflow in the Namoi River comes from the Namoi alluvium. AGE (2025) predicts no drawdown and negligible baseflow losses in the Namoi River.

AGE (2025) modelled the change in baseflow along three sections of Maules Creek: Upper, Middle and Lower Maules Creek. The Lower reach extended from the Namoi River to the confluence of Back Creek and Maules Creek. The Middle reach comprised the section of Maules Creek between the Back Creek confluence and Elfin Crossing. The upper reach was the longest and extended from Elfin Crossing to the eastern perimeter boundary of the model, which is conceptualised to be ephemeral.

The groundwater model simulations demonstrates that there will be negligible baseflow loss due to the Project (compared to the approved scenario) at the Lower and Middle reaches of Maules Creek (AGE, 2025). The ephemeral Upper Maules Creek reach is typically disconnected from the groundwater table as groundwater levels in the alluvium are below the base of the creek. Predicted drawdown due to the Project would likely have no or negligible impact on the surface water flows in the ephemeral Upper Maules Creek reach (AGE, 2025). This would have negligible impacts to aquatic ecological communities in Maules Creek.

The drawdown due to the Project would result in negligible changes in Back Creek surface water flows, as the regional water table is well below Back Creek (AGE 2025), so there would be no impacts to groundwater-dependent aquatic ecosystems in Back Creek.

6. Impact Mitigation and Monitoring Measures

6.1. Mitigation measures

Table 18: Impact mitigation measures

Activity	Potential Impact	Severity	Avoidance measure
Clearing of vegetation	Erosion of exposed soil and increase in sediment load to creek	Sediment smothering bed of creek, infilling deep holes. Higher turbidity at downstream sites in Back Creek and potentially Maules Creek and Namoi River	Use appropriate drainage channels and sediment retention ponds. Implementation of a Water Management Plan which describes erosion and sediment controls. Progressive rehabilitation.
	Accidental spills	Moderate impact to ecology. Chemical spills are unlikely but may occur during refuelling, if there is a hydraulic fluid leak, or if the vehicle is carrying a chemical (e.g. herbicide). Spilt chemicals have the potential to disperse into waterway and downstream. This could kill or impair fish and invertebrates.	Vehicles avoid riparian zone where possible. Oil/fuel/chemical storage and spill management. Machinery maintenance Implement pollution response plan. Further details on spill prevention and controls are provided in Appendix R of the EIS.
	Spread riparian weeds.	Moderate impact to ecology. Vehicles may be a vector for movement of weeds not from the local area.	Vehicles avoid riparian zone where possible. Wash down vehicle where required.
	Vehicle use along creek and at crossings	Low impact to banks. Temporary increases in turbidity when crossing creeks.	Operators drive to conditions per Whitehaven standards.
Drawdown in alluvial aquifers	Loss of sediment volume for stygofauna	Minor. Partial drawdown of Maules Creek alluvium could result in less suitable habitat for stygofauna. It could also reduce connectivity to surface, affecting availability of nutrients, organic matter, and dissolved oxygen. However, drawdown should impact only a small part of the aquifer, so would not be significant.	AGE (2025) indicate the incremental increase in drawdown due to the Project is expected to be less than 1 m in the Maules Creek alluvium at the end of mining, and approximately 1 m post-mining in the fringes of the alluvium. This increase in groundwater drawdown is not expected to result in a significant change in groundwater levels and availability when considered in the context of the changes in levels due to seasonal

Activity	Potential Impact	Severity	Avoidance measure
			variations of between approximately 2 and 8 m there would be negligible drawdown on Maules Creek alluvium. Groundwater monitoring in the alluvium would continue throughout the Project. No specific stygofauna monitoring program is required.
	Less connectivity between ground surface and water table	A deeper water table would mean that less oxygen and fewer nutrients and organic matter would reach the aquifer. This could potentially have a minor impact on stygofauna communities.	No additional measures needed, other than to maintain current groundwater monitoring program.
	Reduction in baseflow, and potential increase in no flow days in Maules Creek and Back Creek.	Minor, as the additional impact would have minimal effect on hydrograph of both creeks, which are ephemeral and have an ecology adapted to periods of wetting and drying.	Continued monitoring of the ecological condition along Maules Creek and Back Creek for signs of long-term decline in biological diversity.
Reduced catchment area for Back Creek	Temporary loss of Back Creek catchment area during mining operations.	Potential increase in no flow periods and less water in Back Creek. However, after post-mining rehabilitation flow in Back Creek could potentially increase.	Impact to creeks, which are ephemeral, would be minimal. Establish clean water diversions to reduce excised catchment during mining operations. Implement progressive rehabilitation on mined landforms to reduce excised catchment during mining operations and post-mining.
Runoff from mine site and waste dumps to Back Creek	Increased contaminant/pollution input to Back Creek	Moderate. Potential increase in sediment load and inflow of polluted water entering Back Creek during wet periods. However, the impact of mine water entering creek would likely be diluted/masked by pollutants/sediment load of water draining from the catchment.	Implementation of a Water Management Plan which describes erosion and sediment controls.

6.2. Monitoring measures

The aquatic ecological communities of Maules Creek, Back Creek, and the Namoi River are part of the *Lowland Darling River aquatic ecological community*. The current aquatic ecology monitoring program at MCCM, which samples for macroinvertebrate communities, water physico-chemistry, aquatic habitat, and riparian vegetation condition, would be continued in spring and autumn every year, and the performance of each indicator type tracked through time.

In many ephemeral pools, invertebrate community diversity and composition is partly determined by the duration of pool persistence (Datry *et al.* 2017). The longer a pool persists, the more time invertebrate taxa have to reproduce. Similarly, pools that are full would more-frequently be connected to upstream and downstream neighbours by small increases in water level, so dispersal between pools occurs more regularly. When flow is continuous, there is a hydrological connection between Maules Creek and the upper reaches of Back Creek. This means that fish and other species able to move upstream, can migrate from Maules Creek until the steep head-cut at BCPX.

The typical fluctuations in groundwater levels in the Maules Creek alluvium are between approximately 2 and 8 m (AGE 2025), meaning any GDEs drawing water from the alluvium is already subject to varying groundwater depths/availability. The maximum predicted drawdown in the Maules Creek alluvium due to the approved mining is approximately 0.3 m. The maximum predicted drawdown due to the Project is expected to be approximately 1 m in part of the Maules Creek alluvium. The incremental increase in groundwater drawdown (i.e. less than 1 m) is not expected to result in a significant change in groundwater levels and availability when considered in the context of the changes in levels due to seasonal variations (AGE 2025). This amount of drawdown is within the range of climatically induced groundwater fluctuations (AGE 2025) and would not have a significant impact on stygofauna communities.

The Project would not require any biodiversity offset or compensatory measures for potential impacts to aquatic ecology in accordance with the *NSW Policy and Guidelines for Fish Habitat Conservation and Management* (Update 2013) (Fairfull 2013) or the *EPBC Act Environmental Offsets Policy* (Department of Sustainability, Environment, Water, Population and Communities, 2012).

7. Conclusion

The aquatic ecological community of Back Creek is typical of that occurring in ephemeral streams, with the macroinvertebrate community made up of few species, tolerant of disturbance and poor water quality. Taxa making up the community remain similar through time, although the community of Back Creek differs to that of Maules Creek and Namoi River largely because of the ephemeral nature of flow in Back Creek. Flow in Back Creek re-commenced in 2020 following drought, and since then there have been periods when flow has been continuous along the entire length, and periods when flow has been fragmented. The number of sites containing water declined through autumn and summer 2023, when most sites along Back Creek were dry, and the remaining pools were shrinking. However, rainfall in autumn 2024 meant that more sites along Back Creek contained water, although flow was not continuous.

It is unlikely that any threatened species of fish would occur in Back Creek because of the frequency with which Back Creek dries out, and the lack of suitable habitat nearby from which the fish can re-colonise. However, the Back Creek aquatic ecological community, and the community of Maules Creek are protected as part of the Lowland Darling River aquatic ecological community, so significant impacts to the hydrology, sediment load, and water chemistry of Back Creek should be avoided.

Riparian vegetation community along Back Creek consists mainly of native species (*Melaleuca bracteata, Eucalyptus blakelyi, E. populeana, E. meliodora*), but is impacted by recent and historical agriculture activities. Back Creek contains a thin and relatively shallow bed of alluvial/colluvial sediments that act as a shallow aquifer, which is temporarily recharged by rainfall, but it is nevertheless an important source of water for the dominant riparian species associated with the waterway, especially during prolonged dry periods.

The collection of *Notobathynella* from a bore near Back Creek on two occasions confirms that there are stygofauna in alluvial aquifers near MCCP. This bore is approximately 3.5 km west of the proposed project area. Four other stygofauna taxa were collected from the alluvium of Maules Creek. This bore was approximately 4 km from the Project boundary, and the nearest Maules Creek alluvium comes to the Project boundary is 3 km. Modelling indicates that the drawdown in the Maules Creek alluvium is well within the seasonal fluctuations, so stygofauna communities are unlikely to be affected.

Although there may be a slight reduction in runoff to Back Creek due to the removal of part of the catchment area during mining, the Project is unlikely to have a significant impact on any of the waterways in the region.

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Appendix A Site Photos

Site BCP1 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP2 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP3 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

BCP4 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP5 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP6 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP7 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP8 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCP9 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCPX – facing downstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site BCUS2 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site MCUS1 – facing upstream

Summer 2022

Summer 2023

Autumn 2022

Autumn 2024

Site MCUS5 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site NRDS1 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site SW5 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Site SW8 – facing upstream

Summer 2022

Summer 2023

Autumn 2023

Autumn 2024

Appendix B Macroinvertebrate Data

Summer 2022:

Site		BCP1	BCP2	BCUS2	BCP7	MCUS1	MCUS5	SW5	SW8	NRUS1	BCP3	BCP4	BCP5	BCPX	BCP6	BCP9
Control/Impact		C	C	C	C	C	C	C	I	I	I	I	I	I	I	I
Waterway		Back	Back	Back	Maules	Maules	Maules	Namoi	Namoi	Namoi	Back	Back	Back	Back	Back	Maules
Family	**SIGNAL**															
Aeshnidae	4			1												
Atyidae	3	4	1		1		1	4				1	3		4	
Baetidae	5	6			12	6	12	5	10	6	1	4	4		1	18
Caenidae	4	1	1		3	1			1	1	7	2	5	1		1
Calamoceratidae	7										1					
Carabidae	3		1	2												
Ceratopogonidae	4						2									3
Chironomidae	3	1			4	15	12	6			1		5	1		4
Cladocera	2													1		
Coenagrionidae	2	3		3					1		1	8	6	6	8	
Copepoda	2								1	1			5			
Corduliidae	4				1											
Corixidae	2			2	5		3					4	5		3	
Culicidae	1			1							2		2		1	
Dytiscidae	2	3	2	2							4	3	4			
Georissidae	4													1		
Gripopterygidae	8															1

Site		BCP1	BCP2	BCUS2	BCP7	MCUS1	MCUS5	SW5	SW8	NRUS1	BCP3	BCP4	BCP5	BCPX	BCP6	BCP9
Gyrinidae	4					1										
Haliplidae	2	1			1											
Heteroceridae	4	3				1						2				
Hydracarina	6	2										4	1	5		
Hydrachnidae	6										2			3		
Hydraenidae	3	1													5	
Hydrochidae	4				1		1						10	1	4	
Hydrometridae	3		2	1								2		1		
Hydrophilidae	2	1														
Hydropsychidae	6															2
Hydroptilidae	4													1		
Hygrobiidae	1						1	1		1						
Leptoceridae	6	1	3			6	7	3	3	1		2	7	4	7	
Leptophlebidae	8	4	3	3	4	6	5				10	2	1			7
Micronectidae	2		2		6	3		7	1	2	4		14	4		
Nepidae	3	2									1					1
Noteridae	4						1						25	1		1
Notonectidae	1	7	1	1	3						2	5	5	1	7	
Ostracoda	2										1			7		
Pleidae	2											1				
Philopotamidae	8				2	1		1								
Physidae	1						1						5		1	
Pseudocorduliidae	5	1		2							3	3		1	1	
Simuliidae	5				1	17	5		2							6

Site		BCP1	BCP2	BCUS2	BCP7	MCUS1	MCUS5	SW5	SW8	NRUS1	BCP3	BCP4	BCP5	BCPX	BCP6	BCP9
Veliidae	3		2								3	6	12	7		1

Autumn 2023:

Site		BCP1	BCP2	BCP9	BCPX	BCUS2	Henriendri TSR	MCDS1	BCP7	MCUS5	NRDS1	SW5	SW8
Waterway		Back	Back	Back	Back	Maules	Namoi	Maules	Maules	Maules	Namoi	Namoi	Namoi
Family	**SIGNAL**												
Antipodeciidae	8							2					
Atyidae	3		3	2				4	2		7	8	4
Baetidae	5	1		4				39	24	5		6	
Caenidae	4			4				4	2	20			
Ceratopogonidae	4					2							
Chironomidae	3	5				16		6	8	2	1		
Coenagrionidae	2			3									
Corbiculidae	4												1
Corixidae	2		1				2		3	2			
Culicidae	1	3	2										
Dytiscidae	2	13	1			2			3	4			1
Ecnomidae	4							6					1
Gerridae	4												1
Gyrinidae	4											1	
Hydracarina	0					3							
Hydrochidae	4						3				1	2	1
Hydrophilidae	2			3									1
Hydropsychidae	6							3	2				
Hygrobiidae	1	4										1	
Leptoceridae	6			4			1		4	5			

Site		BCP1	BCP2	BCP9	BCPX	BCUS2	Henriendri TSR	MCDS1	BCP7	MCUS5	NRDS1	SW5	SW8
Leptophlebidae	8			1				2	1	26		4	5
Micronectidae	2	6	3	22		18	5	16	13	18	4		12
Naucoridae	2							11	4				
Nepidae	3	1	1		1								
Notonectidae	1	5	6			3			5	15			
Odonata Sp.	3				1								
Physidae	1								2	6			
Planorbidae	2			3				3					
Scirtidae	6						1						
Simuliidae	5							4	2				
Syncarida	0	1			1	1	3			2			
Tabanidae	3			1						1			
Tipulidae	5												1
Veliidae	3		1	1				1		1			
Abundance		39	18	48	3	45	15	101	75	107	13	22	28
Richness		9	8	11	3	7	6	13	14	13	4	6	10
SIGNAL		2.25	2.13	3.64	3.00	2.40	4.00	4.23	3.57	3.33	3.00	4.17	3.8
%EPT		11.11	0.00	36.36	0.00	0.00	16.67	30.77	35.71	30.77	0.00	33.33	10

Summer 2023:

Site		BCUS2	Henriendri TSR	BCP7	MCUS1	NRDS1	SW5	SW8
Waterway		Namoi	Maules	Maules	Namoi	Namoi	Namoi	Namoi
Family	**SIGNAL**	12/12/2023	13/12/2023	13/12/2023	13/12/2023	13/12/2023	14/12/2023	12/12/202
Anostraca	1	1						
Antipodeciidae	8							
Acarina	6	14			1		1	
Ameletopsidae	7		1					
Atyidae	3			1	3	2		
Baetidae	5	9		6	7	1	1	
Caenidae	4			1	2			
Ceratopogonidae	4							
Chironomidae	3	14			1			
Cladocera		125						
Coenagrionidae	2			1	1			
Conchostraca	1	3						
Copepoda	n/a	21						1
Corbiculidae	4							
Corixidae	2							
Culicidae	1	1		2				
Dytiscidae	2	4						
Ecnomidae	4					1		
Elmidae	7						1	
Gerridae	4				3		2	
Gyrinidae	4							
Hydracarina	0							
Hydraenidae	3						1	
Hydrochidae	4	14	2	1	1			5
Hydrophilidae	2	2		1				

Site		BCUS2	Henriendri TSR	BCP7	MCUS1	NRDS1	SW5	SW8
Hydropsychidae	6							
Hygrobiidae	1							
Leptoceridae	6	3		1	7	1		
Leptophlebidae	8							
Micronectidae	2	25	28	14	24	2	8	8
Naucoridae	2							
Nepidae	3	1						
Notonectidae	1	5	1	1			1	
Odonata Sp.	3	2			2			
Ostracoda	n/a	70						1
Palaemonidae	4		1				1	
Physidae	1							
Planorbidae	2							
Scirtidae	6				2			
Simuliidae	5							
Stratiomyidae	2				2			
Syncarida	0							
Tabanidae	3							
Tipulidae	5	1			1			
Veliidae	3						2	
Abundance		315	33	29	57	7	18	15
Richness		18	5	10	14	5	9	4
SIGNAL		3	3.6	3	3.9	4	3.9	3
%EPT		11.11	0	30	21.43	40	11.1	0

Appendix C RARC

Summer 2022

Sub-index	Indicator	Range	SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	NRDS1	BCP7	MCUS1
Habitat	Longitudinal continuity of riparian vegetation (≥5 m wide)	0-4	2	1	0	1	4	3	3	2	4	3	1	2	2	1	2	0
	Riparian vegetation width (VW)-scored differently for channel widths (CW) < or ≥ 10 m	0-4	1	1	0	0	3	1	1	3	4	2	1	3	1	4	2	1
	Proximity to nearest patch of intact native vegetation > 10 ha	0-3	1	0	0	2	2	1	0	1	1	1	1	1	1	3	2	0
	Subtotal		**4**	**2**	**0**	**3**	**9**	**5**	**4**	**6**	**9**	**6**	**3**	**6**	**4**	**8**	**6**	**1**
Cover	Canopy (> 5m tall)	0-3	2	1	1	1	1	1	1	1	3	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	2	1	1	1	3	2	3	2	3	3	1	2	1	1	2	1

Sub-index	Indicator	Range	SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	NRDS1	BCP7	MCUS1
	Ground (<1 m tall)	0-3	2	2	2	3	3	3	3	2	3	3	3	3	3	2	3	2
	Number of layers	0-3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Subtotal		**9**	**7**	**7**	**8**	**10**	**9**	**10**	**8**	**12**	**10**	**8**	**9**	**8**	**7**	**10**	**7**
Natives	Canopy (> 5m tall)	0-3	2	2	1	1	1	1	1	1	3	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	0	1	0	1	3	3	3	1	3	3	1	2	0	1	2	2
	Ground (<1 m tall)	0-3	1	2	1	2	3	2	3	2	3	3	3	3	3	2	1	2
	Subtotal		**3**	**5**	**2**	**4**	**7**	**6**	**7**	**4**	**9**	**7**	**5**	**6**	**4**	**4**	**5**	**5**
Debris	Leaf litter	0-3	1	1	0	1	1	1	2	1	1	1	1	1	1	1	1	1
	Native leaf litter	0-3	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
	Standing dead trees (> 20 cm dbh)	0-1	1	1	0	0	1	0	1	1	1	1	1	1	0	1	1	1
	Hollow-bearing trees (>20 cm)	0-1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
	Fallen logs (> 10 cm diameter)	0-2	1	1	0	0	2	1	1	1	2	2	1	1	1	1	1	1
	Subtotal		**5**	**5**	**1**	**3**	**6**	**4**	**7**	**5**	**6**	**6**	**5**	**5**	**4**	**5**	**5**	**5**

Sub-index	Indicator	Range	SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	NRDS1	BCP7	MCUS1
Features	Native canopy species regeneration (<1 m tall)	0-2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	2
	Native understorey regeneration	0-2	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	2
	Large native tussock grasses	0-2	0	0	0	0	2	1	0	0	0	0	0	2	1	1	2	1
	Reeds	0-2	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1
	Subtotal		**1**	**2**	**0**	**2**	**4**	**3**	**2**	**2**	**2**	**2**	**2**	**4**	**3**	**4**	**6**	**6**
	Total		**22**	**21**	**10**	**20**	**36**	**27**	**30**	**25**	**38**	**31**	**23**	**30**	**23**	**28**	**32**	**24**
	Total (%)		**44**	**42**	**20**	**40**	**72**	**54**	**60**	**50**	**76**	**62**	**46**	**60**	**46**	**56**	**64**	**48**

Autumn 2023

Sub-index	Indicator	Range	SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	Henriendi TSR	NRDS1	BCP7	MCUS1
Habitat	Longitudinal continuity of riparian vegetation (≥5 m wide)	0-4	2	1	0	1	4	3	3	2	4	3	1	2	2	1	1	2	0
	Riparian vegetation width (VW)-scored differently for channel widths (CW) < or ≥ 10 m	0-4		1	0	0	3	1	1	3	4	2	1					2	1
			1											3	1	1	4		
	Proximity to nearest patch of intact native vegetation > 10 ha	0-3	1	0	0	2	2	1	0	1	1	1	1	1	1	3	3	2	
	Subtotal		4	2	0	3	9	5	4	6	9	6	3	6	4	5	8	6	1
Cover	Canopy (> 5m tall)	0-3	2	1	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	2	1	1	1	3	2	3	2	3	3	1	2	1	1	1	2	1
	Ground (<1 m tall)	0-3	2	2	2	3	3	3	3	2	3	3	3	3	3	1	2	3	2

Sub-index	Indicator	Range	SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	Henriendi TSR	NRDS1	BCP7	MCUS1
	Number of layers	0-3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3
	Subtotal		9	7	7	8	10	9	10	8	12	10	8	9	8	5	7	10	7
Natives	Canopy (> 5m tall)	0-3	2	2	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	0	1	1	1	3	3	3	1	3	3	1	2	0	1	1	2	2
	Ground (<1 m tall)	0-3	1	2	1	2	3	2	3	2	3	3	3	3	3	1	2	1	2
	Subtotal		3	5	3	4	7	6	7	4	9	7	5	6	4	3	4	5	5
Debris	Leaf litter	0-3	1	1	0	1	1	1	2	1	1	2	1	1	1	1	1	1	1
	Native leaf litter	0-3	1	1	0	1	1	1	2	1	1	2	1	1	1	1	1	1	1
	Standing dead trees (> 20 cm dbh)	0-1	1	1	0	0	1	0	1	1	1	1	1	1	0	1	1	1	1
	Hollow-bearing trees (>20 cm)	0-1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Fallen logs (> 10 cm diameter)	0-2	1	1	0	0	2	1	1	1	2	2	1	1	1	1	1	1	1
	Subtotal		5	5	0	3	6	4	7	5	6	8	5	5	4	5	5	5	5
Features	Native canopy species regeneration (<1 m tall)	0-2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2

Sub-index	Indicator	Range	SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	Henriendi TSR	NRDS1	BCP7	MCUS1
	Native understorey regeneration	0-2	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	2
	Large native tussock grasses	0-2	0	0	0	0	2	1	0	0	0	0	0	2	1	1	1	2	1
	Reeds	0-2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1
	Subtotal		1	2	0	2	4	3	2	2	2	2	2	4	3	3	4	6	6
TOTAL RARC (score) =		**22**	**21**	**10**	**20**	**36**	**27**	**30**	**25**	**38**	**33**	**23**	**30**	**23**	**21**	**28**	**32**	**24**	
TOTAL RARC (%) =		**44**	**42**	**20**	**40**	**72**	**54**	**60**	**50**	**76**	**66**	**46**	**60**	**46**	**42**	**56**	**64**	**48**	

Summer 2023

			SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	Henriendi TSR	NRDS1	BCP7	MCUS1
Sub-index	Indicator	Range																	
Habitat	Longitudinal continuity of riparian vegetation (≥5 m wide)	0-4	2	1	0	1	4	3	3	2	4	3	1	2	2	1	1	2	0
	Riparian vegetation width (VW)-scored differently for channel widths (CW) < or ≥ 10 m	0-4		1	0	0	3	1	1	3	4	2	1					2	1
			1											3	1	1	4		
	Proximity to nearest patch of intact native vegetation > 10 ha	0-3	1	0	0	2	2	1	0	1	1	1	1	1	1	3	3	2	
			4	**2**	**0**	**3**	**9**	**5**	**4**	**6**	**9**	**6**	**3**	**6**	**4**	**5**	**8**	**6**	**1**
Cover	Canopy (> 5m tall)	0-3	2	1	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	2	1	1	1	3	2	3	2	3	3	1	2	1	1	1	2	1
	Ground (<1 m tall)	0-3	3	2	2	3	3	3	3	2	3	3	3	3	3	1	2	3	2

			SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	Henriendi TSR	NRDS1	BCP7	MCUS1
	Number of layers	0-3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3
			10	**7**	**7**	**8**	**10**	**9**	**10**	**8**	**12**	**10**	**8**	**9**	**8**	**5**	**7**	**10**	**7**
Natives	Canopy (> 5m tall)	0-3	1	2	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	1	1	1	1	3	3	3	1	3	3	1	2	0	1	1	2	2
	Ground (<1 m tall)	0-3	2	2	1	2	3	2	3	2	3	3	3	3	3	1	2	1	2
			4	**5**	**3**	**4**	**7**	**6**	**7**	**4**	**9**	**7**	**5**	**6**	**4**	**3**	**4**	**5**	**5**
Debris	Leaf litter	0-3	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1
	Native leaf litter	0-3	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1
	Standing dead trees (> 20 cm dbh)	0-1	0	1	0	0	1	0	1	1	1	1	1	1	0	1	1	1	1
	Hollow-bearing trees (>20 cm)	0-1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Fallen logs (> 10 cm diameter)	0-2	1	1	0	0	2	1	1	1	2	2	1	1	1	1	1	1	1
			3	**5**	**2**	**3**	**6**	**4**	**7**	**5**	**6**	**8**	**5**	**5**	**4**	**5**	**5**	**5**	**5**
Features	Native canopy species regeneration (<1 m tall)	0-2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2

			SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS2	BCP2	BCP3	BCP1	MCUS5	SW5	Henriendi TSR	NRDS1	BCP7	MCUS1
	Native understorey regeneration	0-2	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	2
	Large native tussock grasses	0-2	0	0	1	0	2	1	0	0	0	0	0	2	1	1	1	2	1
	Reeds	0-2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1
	TOTAL =		**1**	**2**	**1**	**2**	**4**	**3**	**2**	**2**	**2**	**2**	**2**	**4**	**3**	**3**	**4**	**6**	**6**
	Total RARC (%)		**42**	**42**	**26**	**40**	**72**	**54**	**60**	**50**	**76**	**66**	**46**	**60**	**46**	**42**	**56**	**64**	**48**

Autumn 2024

			SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS 2	BCP2	BCP3	BCP1	MCUS 5	SW5	Henriendi TSR	NRDS1 Turrawan	BCP 7	MCUS 1
Sub-index	Indicator	Range																	
Habitat	Longitudinal continuity of riparian vegetation (≥5 m wide)	0-4	2	1	0	1	4	3	3	2	4	3	1	2	2	1	1	2	0
	Riparian vegetation width (VW)-scored differently for channel widths (CW) < or ≥ 10 m	0-4		1	0	0	3	1	1	3	4	2	1					2	1
			1											3	1	1	4		
	Proximity to nearest patch of intact native vegetation > 10 ha	0-3	1	0	0	2	2	1	0	1	1	1	1	1	1	3	3	2	
	TOTAL		**4**	**2**	**0**	**3**	**9**	**5**	**4**	**6**	**9**	**6**	**3**	**6**	**4**	**5**	**8**	**6**	**1**

			SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS 2	BCP2	BCP3	BCP1	MCUS 5	SW5	Henriendi TSR	NRDS1 Turrawan	BCP 7	MCUS 1
Cover	Canopy (> 5m tall)	0-3	2	1	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	2	1	1	1	3	2	3	2	3	3	1	2	1	1	1	2	1
	Ground (<1 m tall)	0-3	2	2	2	3	3	3	3	2	3	3	3	3	3	1	2	3	2
	Number of layers	0-3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3
	TOTAL		**9**	**7**	**7**	**8**	**10**	**9**	**10**	**8**	**12**	**10**	**8**	**9**	**8**	**5**	**7**	**10**	**7**
Natives	Canopy (> 5m tall)	0-3	2	2	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1
	Understorey (1-5 m tall)	0-3	0	1	1	1	3	3	3	1	3	3	1	2	0	1	1	2	2
	Ground (<1 m tall)	0-3	1	2	1	2	3	2	3	2	3	3	3	3	3	1	2	1	2
	TOTAL		**3**	**5**	**3**	**4**	**7**	**6**	**7**	**4**	**9**	**7**	**5**	**6**	**4**	**3**	**4**	**5**	**5**
Debris	Leaf litter	0-3	1	1	0	1	1	1	2	1	1	1	1	1	1	1	1	1	1
	Native leaf litter	0-3	1	1	0	1	1	2	2	1	1	1	1	1	1	1	1	1	1
	Standing dead trees (> 20 cm dbh)	0-1	1	1	0	0	1	0	1	1	1	1	1	1	0	1	1	1	1

			SW8	BCP9	BCP8	BCPX	BCP6	BCP5	BCP4	BCUS 2	BCP2	BCP3	BCP1	MCUS 5	SW5	Henriendi TSR	NRDS1 Turrawan	BCP 7	MCUS 1
	Hollow-bearing trees (>20 cm)	0-1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Fallen logs (> 10 cm diameter)	0-2	1	1	0	0	2	1	1	1	2	2	1	1	1	1	1	1	1
	TOTAL =		**5**	**5**	**0**	**3**	**6**	**5**	**7**	**5**	**6**	**6**	**5**	**5**	**4**	**5**	**5**	**5**	**5**
Features	Native canopy species regeneration (<1 m tall)	0-2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2
	Native understorey regeneration	0-2	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	2
	Large native tussock grasses	0-2	0	0	0	0	2	1	0	1	0	0	2	2	1	1	1	2	1
	Reeds	0-2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	1
	TOTAL =		**2**	**2**	**0**	**2**	**4**	**3**	**2**	**3**	**2**	**2**	**4**	**4**	**3**	**3**	**4**	**6**	**6**
	Total (%)		46	42	20	40	72	56	60	52	76	62	50	60	46	42	56	64	48

Appendix D Vegetation Survey Photos

Plot 1 – BCP4 Start

Plot 1 – BCP4 End

Plot 2 – BCUS2 Start

Plot 2 – BCUS2 End

Plot 3 – BCP2 Start

Plot 4 – BCP3 Start

Appendix E Assessments of significance

The DPI Spatial Portal (DPI 2024b) indicates that the eel-tailed catfish (*Tandanus tandanus*) (Endangered population under the FM Act), olive perchlet (*Ambassis agassizii*) (Endangered population under the FM Act) and southern purple-spotted gudgeon (*Mogurnda adspersa*) (Endangered species under the FM Act) may occur in Maules Creek (approximately 3.5 km north of the Project). Silver perch (*Bidyanus bidyanus*), a vulnerable species under the FM Act, are mapped for the Namoi River, but not Maules Creek or Back Creek. The DPI Spatial Portal (DPI 2024b) indicates that only the southern purple-spotted gudgeon (*Mogurnda adspersa*) may occur in Back Creek (0.4 km north of the Project). Assessments of significance in accordance with Division 12, Part 7A of the FM Act and the Threatened Species Assessment Guidelines - The Assessment of Significance (Department of Primary Industries, 2008) are conducted below for these three species and the *Lowland Darling River aquatic ecological community* listed under the FM Act.

Eel-tailed Catfish (*Tandanus tandanus*) in the Murray-Darling Basin

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable as the eel-tailed catfish is an endangered population not a threatened species.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

The eel-tailed catfish are an endangered population in the Murray-Darling Basin. They are known to occur in the Namoi River and are mapped on the DPI Spatial Portal (2024b) as potentially occurring in Maules Creek, approximately 3.5 km north of the Project. Maules Creek has suitable habitat for eel-tailed catfish, including suitable substrate for breeding. However, Maules Creek dries up during periods of drought, and is otherwise either a series of disconnected pools or a continuously flowing creek. The creek was temporarily dry prior to 2019. It is possible that eel-tailed catfish move up into the Maules Creek from the Namoi River when flowing, but this is unlikely because the species is non-migratory and relatively sedentary (DPI 2015).

The Project would not directly or indirectly impact the aquatic habitat in Maules Creek (refer to Section 5) so, although unlikely, if the species were to occur in the creek (when water is flowing) it would not be adversely impacted by the Project. The Namoi River would not be impacted by the Project (refer to Section 5). The Project is not likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable as the eel-tailed catfish is an endangered population not an ecological community.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

As described above, the eel-tailed catfish are mapped on the DPI Spatial Portal (2024b) as potentially occurring in Maules Creek, approximately 3.5 km north of the Project. It is possible that eel-tailed catfish move up into the Maules Creek from the Namoi River when flowing, but this is unlikely because the species is non-migratory and relatively sedentary (DPI 2015).

The Project would not directly or indirectly impact the aquatic habitat in Maules Creek (refer to Section 5) so, although unlikely, if the species were to occur in the creek (when water is flowing) it would not be adversely impacted by the Project. The Namoi River would not be impacted by the Project (refer to Section 5).

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Project is unlikely to have an adverse effect on critical habitat of this species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with the objectives or actions of the *Priorities Action Statement- Actions for Murray-Darling population of Eel-tailed Catfish* because the Project would not directly or indirectly impact the species or its habitat (DPI 2025b).

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The Project does not constitute a key threatening process for Eel-tailed Catfish (DPI 2025b).

Olive Perchlet (*Ambassis agassizii*) Western Population

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable as the olive perchlet is an endangered population not a threatened species.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Olive Perchlet Western Population are a threatened population in the Murray-Darling Basin. They have not been collected from Maules Creek, but are mapped on the DPI Spatial Portal (2024b) as potentially occurring in Maules Creek, approximately 3.5 km north of the Project.

Maules Creek dries up during periods of drought, and is otherwise either a series of disconnected pools or a continuously flowing creek. Sections of the creek were dry prior to 2019 for an unknown duration. Olive perchlet may be able to colonise Maules Creek following the drought if continuous flow persists for long enough.

The Project would not directly or indirectly impact the aquatic habitat in Maules Creek (refer to Section 5) so if the species were to occur in the creek (when water is flowing) it would not be adversely impacted by the Project. The Namoi River would not be impacted by the Project (refer to Section 5). The Project is not likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable as the olive perchlet is an endangered population not an ecological community.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

As described above, the olive perchlet are mapped on the DPI Spatial Portal (2024b) as potentially occurring in Maules Creek, approximately 3.5 km north of the Project. It is possible that eel-tailed catfish move up into the Maules Creek from the Namoi River when flowing.

The Project would not directly or indirectly impact the aquatic habitat in Maules Creek (refer to Section 5) so, although unlikely, if the species were to occur in the creek (when water is flowing) it would not be adversely impacted by the Project. The Namoi River would not be impacted by the Project (refer to Section 5).

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Project is unlikely to have an adverse effect on critical habitat of this species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with the objectives or actions of the *Priorities Action Statement- Actions for Western Population of Olive Perchlet* because the Project would not directly or indirectly impact the species or its habitat (DPI 2025c).

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The Project does not constitute a key threatening process for the olive perchlet (DPI 2025c).

Southern purple-spotted gudgeon (*Mogurnda adspersa*)

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

The southern purple-spotted gudgeon is listed as an endangered species in NSW. It has been mapped on the DPI Spatial Portal (DPI 2024b) as potentially occurring in Back Creek (approximately 0.3 km north of the Project) and Maules Creek (approximately 3.5 km north of the Project). Back Creek is ephemeral while Maules Creek is described as having intermittent flow and irregular periods of no-flow conditions (AGE, 2025). When flowing, it is possible that the species is able to re-colonise the creeks from the Namoi River although the species is not mapped as occurring in the Namoi River on the DPI Spatial Portal (2024b), so this is unlikely. Even if the species did occur in the Namoi River, colonisation of Maules and Back Creeks are very unlikely as purple-spotted gudgeon are poor swimmers and generally only travel less than 2 km in a lifetime (Lintermans, 2023) so occurrence in either creek is unlikely.

The Project is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable as the southern purple-spotted gudgeon is a threatened species not an endangered population.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable as the southern purple-spotted gudgeon is a threatened species not an ecological community.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

The Project would not impact habitat for this species. The species is unlikely to occur in Back Creek or Maules Creek as described above.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No habitat for this species is unlikely to be impacted by the Project.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with the objectives or actions of the *Priorities Action Statement- Actions for the Southern Purple Spotted Gudgeon* because the Project would not directly or indirectly impact the species or its habitat (DPI 2025c).

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The Project does not constitute a key threatening process for the southern purple spotted gudgeon (DPI 2025d).

Silver Perch (*Bidyanus bidyanus*)

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Silver perch are a vulnerable species. They are known to occur in the Namoi River, where natural populations are supplemented by stocking. They are not mapped for Maules Creek or Back Creek, nor are they likely to occur.

The Namoi River would not be impacted by the Project (refer to Section 5). The Project is not likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable as the eel-tailed catfish is an endangered population not an ecological community.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

As described above, the silver perch are mapped on the DPI Spatial Portal (2024) as potentially occurring in Namoi River (Figure 22). The Namoi River would not be impacted by the Project (refer to Section 5).

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Project is unlikely to have an adverse effect on critical habitat of this species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with the objectives or actions of the Priorities Action Statement- Actions for Silver Perch because the Project would not directly or indirectly impact the species or its habitat.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The Project does not constitute a key threatening process for silver perch.

Murray cod (*Maccullochella peelii*)

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Murray cod are a not listed under the FM Act, but are listed as vulnerable under the EPBC Act. They are known to occur in the Namoi River, where natural populations are supplemented by stocking.

The Namoi River would not be impacted by the Project (refer to Section 5). The Project is not likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

As described above, the Murray cod are mapped on the DPI Spatial Portal (2024) as potentially occurring in Namoi River (Figure 22). The Namoi River would not be impacted by the Project (refer to Section 5).

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The Project is unlikely to have an adverse effect on critical habitat of this species.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with the objectives or actions of the National Recovery Plan for the Murray Cod (*Maccullochella peelii peelii*) because the Project would not directly or indirectly impact the species or its habitat (National Murray Cod Recovery Team 2010).

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The Project does not constitute a key threatening process for the Murray cod.

Lowland Darling River aquatic ecological community

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable to this ecological community.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Not applicable to this ecological community.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- **is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Maules Creek and the Back Creek are in the Namoi Catchment, which is part of the Lowland Darling River aquatic ecological community. This listing encompasses all native fish and aquatic invertebrates within all natural creeks, rivers, streams, and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River (DPI 2007).

It is likely that sediment retention dams and on-site water management would prevent impacts to downstream waterways. Exceptions may occur immediately following very large rainfall events that cause the dam to overtop. In these cases, sediment may wash into Back Creek from the mine and from the surrounding landscape. The overall impact of this from the mine would be negligible compared to background catchment sediment load.

In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

No aquatic habitat would be removed as part of the Project.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No critical habitat would be impacted.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

The Project is not inconsistent with the objectives or actions of the Priorities Action Statement- Actions for Lowland Darling River aquatic ecological community (DPI 2025e).

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The Project does not constitute a key threatening process.

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