



Macarthur Grange - Riparian Constraints Assessment

Toscuz Investments

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1. Introduction

Eco Logical Australia Pty Ltd (ELA) has been engaged by FPD Planning Pty Ltd on behalf of Toscu Investments to prepare a riparian assessment on the updated illustrative masterplan for the Macarthur Grange Golf Course at Raby Road, Varroville (Lot 3900 DP 1170905), comprising of 52 environmental living lots suitable for development with a single dwelling ranging from 0.5 ha to 3.2 ha (Figure 1). ELA has assessed the waterways within the site (Figure 2), mapping the Top of Bank (TOB) and condition of riparian vegetation, to confirm the current condition of the waterways within the study area. This report provides an overview of the waterways, riparian corridors and statutory framework, specific to the lots above, to support the application to rezone this area. This report also outlines the basis for the future rehabilitation of the identified riparian areas.

1.1 Subject site

The subject site is referred to as Macarthur Grange, Varroville being Lot 3900, DP 1170905 and has an area of 129.5 ha. The land is located approximately eight kilometres west of the Campbelltown CBD and is bounded by Raby Road to the north and Gregory Hills Drive to the South. The land borders the Camden-Campbelltown Local Government Area boundary to the west and is situated within the Scenic Hills Protection Area.

The site is occupied by an operational golf course known as Macarthur Grange Golf Club which utilises approximately 71.9 ha of the northern most land. The balance of the land comprises largely degraded Cumberland Plain vegetation and cleared low density grazing patches.

1.2 Planning proposal

The site is subject to a Planning Proposal which seeks to rezone the site from C3 Environmental Management to a range of zones including C2 Environmental Conservation, C4 Environmental Living and RE1 Public Recreation and to allow additional permitted uses on part of the site fronting Raby Road to support a future function centre, restaurant and café use.

The Planning Proposal would facilitate development of the site for:

- 52 rural residential / environmental living lots with lots sizes ranging from 0.5ha to 3.2ha
- A large lot fronting Raby Road of around 6ha to support a function centre / restaurant / cafe use in the location of the existing club house
- A conservation reserve and open space to be dedicated to Council comprising around 50% of the site.

The Planning Proposal seeks to deliver a long-term sustainable land use strategy for an important component of Campbelltown local government area's long established and highly valued Scenic Hills landscape unit.

On 12 July 2022 Campbelltown Council determined to support and forward the Planning Proposal to the Department of Planning, Housing and Infrastructure for Gateway Determination. A Gateway Determination was subsequently issued by Department of Planning, Housing and Infrastructure on the 6 December 2023 endorsing the Planning Proposal to proceed to public exhibition subject to conditions.

Macarthur Grange



Figure 1: Proposed lot layout and rezoning (Architectus 2024)

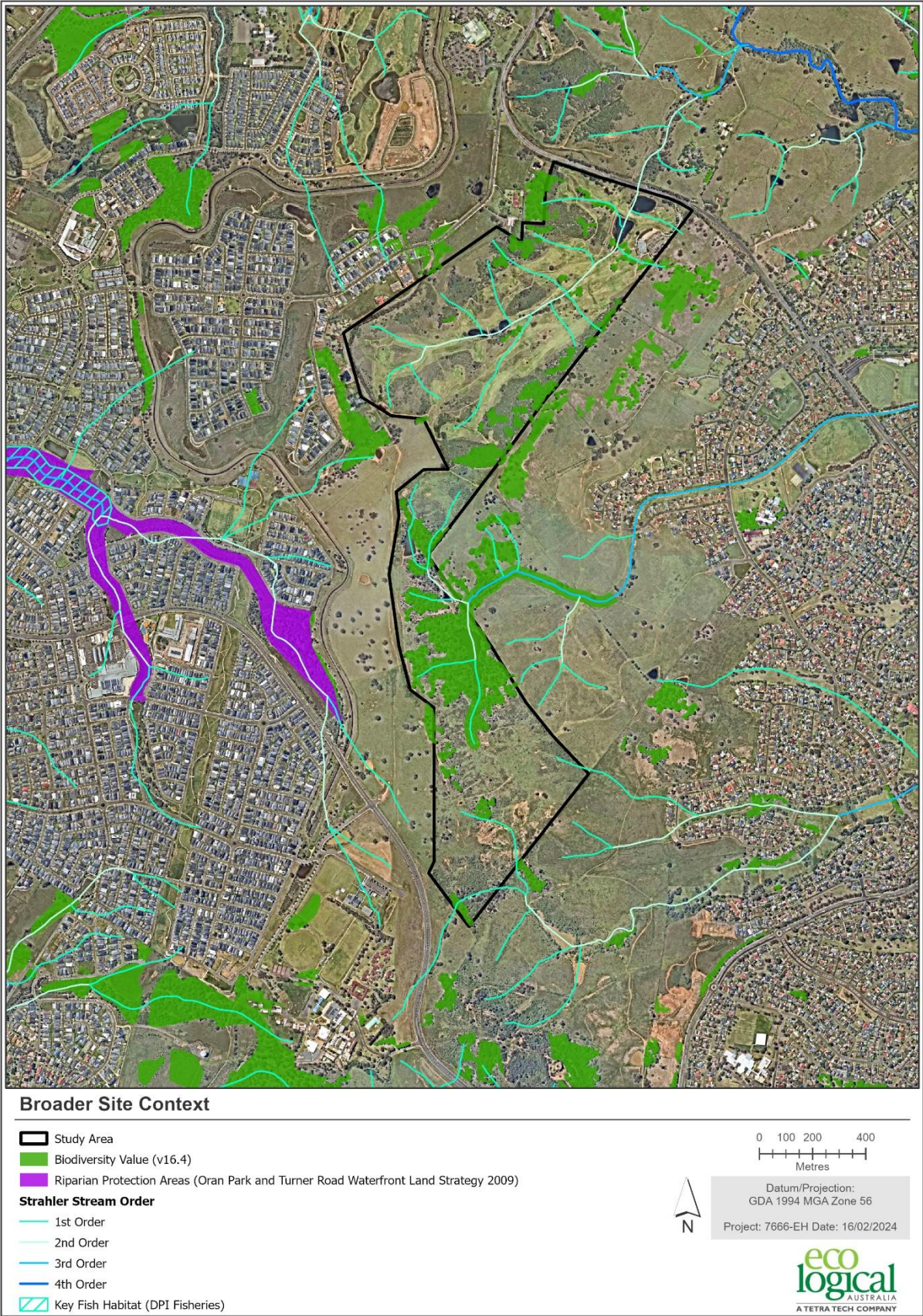


Figure 2: Site context

2. Legislative context

2.1 Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) governs the management of fish and their habitat in NSW. The FM Act applies to fish and marine vegetation and requires a separate assessment from the NSW *Biodiversity Conservation Act 2016* (BC ACT), which only relates to terrestrial animals and plants. The objectives of the FM Act are to conserve fish stocks and key fish habitats, conserve threatened species, populations and ecological communities of fish and marine vegetation and to promote ecologically sustainable development. The FM Act also regulates activities involving dredging and/or reclamation of aquatic habitats, obstruction of fish passage, harming marine vegetation and use of explosives within a waterway.

There was no Key Fish Habitat (KFH) mapped on site, however, to assess impacts to aquatic habitats, the regulatory framework of the FM Act and associated guidelines have been applied for this assessment. This allows consistent assessment of habitat presence and quality on site, whilst considering the broader catchment to determine the value of each creek.

A search of the Commonwealth Protected Matters Search tool, DPIE BioNet database search, DPI Primefacts and Fisheries Threatened Species distribution maps (DPI 2013; DPI 2016; Riches et al, 2016) identified three species of fish with the potential to be found within the study area (Table 1). However, there are no records within 5 km of the study area or in major creeks connected to the site (Bunbury Curran Creek).

As there is lack of suitable habitat and connectivity to other known occurrences of these species, it is unlikely that these species would be found within the study area.

Table 1: Threatened aquatic species with a modelled habitat distribution within 5 km of the site

Species	FM Act	EPBC Act	Habitat Associations	Records within 5 km	Likelihood of occurrence
<i>Archaeophya adamsi</i> – Adam’s Emerald Dragonfly	CE	-	Habitat is narrow, shaded riffle zones with abundant moss and riparian vegetation (often with a closed canopy). Benthic habitat is usually gravel or sand.	0	No, no suitable habitat.
<i>Austrocordulia leonardi</i> – Sydney Hawk Dragonfly	E	E	Aquatic larvae have been found under rocks in deep and shady riverine pools with cooler water.	0	No, no suitable habitat.
<i>Macquaria australasica</i> - Macquarie Perch	E	E	Habitat for this species is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie Perch also do well in some upper catchment lakes.	0	No, no suitable habitat.
<i>Prototroctes maraena</i> - Australian Grayling	E	V	Historically, this species inhabited coastal streams from the Grose River southwards through NSW, VIC and TAS. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and	0	No, no suitable habitat.

Species	FM Act	EPBC Act	Habitat Associations	Records within 5 km	Likelihood of occurrence
			riffles, and granite outcrops. Grayling migrate between freshwater streams and the ocean.		

2.2 Water Management Act 2000

The main objective of the *Water Management Act 2000* (WM Act) is to manage NSW water in a sustainable and integrated manner that will benefit current generations without compromising future generations' ability to meet their needs. The WM Act is administered by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) and establishes an approval regime for activities within waterfront land, defined as the land 40 m from the highest bank of a river, lake or estuary.

Under WM Act framework, activities and works proposed on waterfront land are regulated. These activities include:

- the construction of buildings or carrying out of works
- the removal of material or vegetation from land by excavation or any other means
- the deposition of material on land by landfill or otherwise
- any activity that affects the quantity or flow of water in a water source.

To inform a comparative and acceptable assessment of riparian impacts, the regulatory framework of the WM Act and associated guidelines have been adopted for this assessment.

The DCCEEW – *Water Controlled activities – Guidelines for riparian corridors on waterfront land* (DCCEEW 2022a) outlines the need for a Vegetated Riparian Zone (VRZ) adjacent to the channel to provide a transition zone between the terrestrial environment and watercourse. This vegetated zone helps maintain and improve the ecological functions of a watercourse whilst providing habitat for terrestrial flora and fauna. The VRZ plus the channel (bed and banks of the watercourse to the highest bank) constitute the 'riparian corridor' (Figure 3). To be consistent with the guidelines VRZ widths should be based on watercourse order as classified under the Strahler System of ordering watercourses and using Hydroline Spatial Data which is published on the department's website (Table 2).

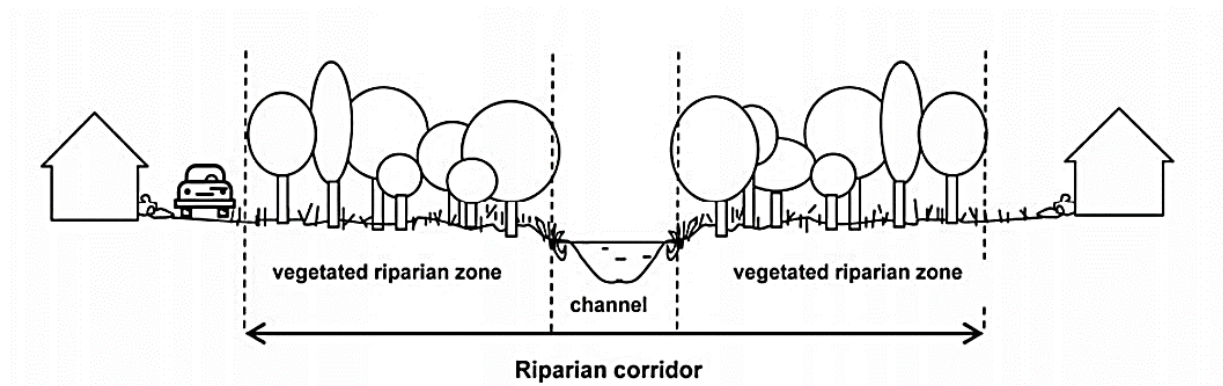


Figure 3: Vegetated Riparian Zone and watercourse channel comprising the riparian corridor (DCCEEW 2022a)

Table 2: Recommended riparian corridor widths relative to Strahler Order (DCCEEW 2022a)

Watercourse type	VRZ width (each side of watercourse)	Total riparian corridor width
1 st order	10 m	20 m + channel width
2 nd order	20 m	40 m + channel width
3 rd order	30 m	60 m + channel width
4 th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 m	80 m + channel width

Certain works are permissible within the riparian zone (Table 3). Non-riparian uses are consistent with DCCEEW's guidelines in the outer 50% of the VRZ as long compensation (1:1 offset) is achieved within the site. The outer VRZ that is impacted must be offset elsewhere on site using the 'averaging rule' (Figure 4). Section 5 further outlines how the proposed rezoning relates to the WM Act objectives and guidelines.

Table 3: Riparian corridor (RC) matrix of permissible use (DCCEEW 2022a)

Stream order	VRZ	RC offsetting for non-RC uses	Cycleways and paths	Detention Basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1 st	10m	•	•	•	•	•	•	•		
2 nd	20m	•	•	•	•	•		•		
3 rd	30m	•	•	•		•			•	•
4 th +	40m	•	•	•		•			•	•

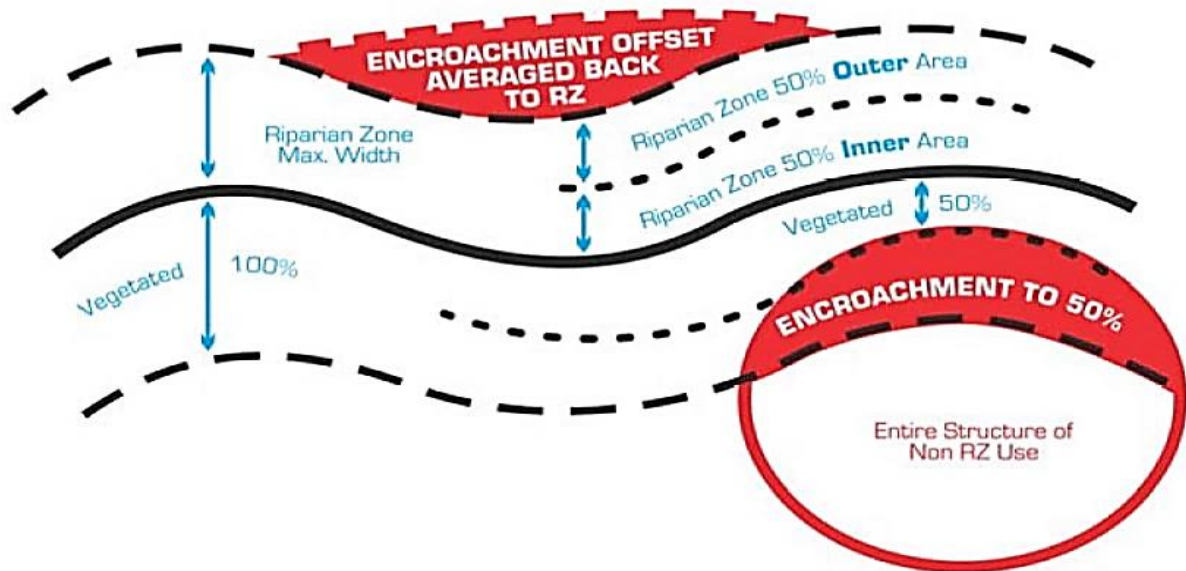


Figure 4: Riparian 'averaging rule' for offsetting encroachment into the outer 50% of the VRZ (DCCEEW 2022a)

2.3 NSW Wetlands Management Policy

The NSW Wetlands Management Policy (DECCW 2010) aims to provide for the protection, ecologically sustainable use and management of NSW wetlands. Wetlands include lakes, lagoons, estuaries, rivers, floodplains, swamps, bogs, billabongs, marshes, coral reefs and seagrass beds. For the sustainable management of wetlands, the NSW Government adopts 12 principles to guide decision-making. The themes of these 12 policies include:

- Catchment scale
- Water regimes
- Floodplain connectivity
- Wetlands of significance
- Land management practices
- Cultural values
- Rehabilitation
- Climate change
- Research
- Protection and offsetting
- Cooperation and incentives
- Monitoring and reporting.

There are no wetlands on site, however, the rezoning would be undertaken in line with the policy's guiding principles.

2.4 Campbelltown City Council Development Control Plan (DCP) and Local Environmental Plan 2015 (LEP).

Under the LEP the study area is zoned as C3 – Environmental Management. The relevant objective to this report is *‘to protect bushland, wildlife corridors and natural habitat, including waterways and riparian lands’* and *‘to ensure the preservation and maintenance of environmentally significant and environmentally sensitive land’*. Additionally, under Part 7.3 the objectives of the riparian land and watercourses outline the objective to protect and maintain:

- Water quality within watercourses
- The stability of the bed and banks of watercourses
- Aquatic and riparian habitats, including those with KFH value
- Ecological processes within watercourses and riparian areas
- Groundwater systems.

The planning proposal aligns with the objectives of the LEP, by largely retaining natural watercourses and large waterbodies (dams), along with their respective riparian corridors (Figure 1). Most first order watercourses within the northern portion of the site are proposed for removal, however, the majority of mapped watercourses do not have bed and banks, ecological processes or riparian habitat of value (see Section 4, for an analysis of these).

2.5 Policy and guidelines for fish habitat conservation and management

The *Policy and guidelines for fish habitat conservation and management* (Fairfull 2013) (herein referred to as the ‘Policy’) is a supplementary document that outlines the requirements and obligations under the FM Act and the *Fisheries Management (General) Regulation 2010* and was developed to maintain and enhance fish habitat and assist in the protection of threatened species. The Policy defines key fish habitat and assigns a rating for waterway classification for fish passage (Table 4) and the type of key fish habitat (Table 5).

Table 4: Classification of waterways for fish passage (Fairfull 2013)

Table 2 - Classification of waterways for fish passage	
Classification	Characteristics of waterway class
CLASS 1 Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or ‘critical habitat’.
CLASS 2 Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.
CLASS 3 Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats.
CLASS 4 Unlikely key fish habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).

Table 5: Key Fish Habitat sensitivity types (Fairfull 2013)

Table 1 – Key fish habitat and associated sensitivity classification scheme
(for assessing potential impacts of certain activities and developments on key fish habitat types)

TYPE 1 - Highly sensitive key fish habitat:

- *Posidonia australis* (strapweed)
- *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds >5m² in area
- Coastal saltmarsh >5m² in area
- Coral communities
- Coastal lakes and lagoons that have a natural opening and closing regime (i.e. are not permanently open or artificially opened or are subject to one off unauthorised openings)
- Marine park, an aquatic reserve or intertidal protected area
- SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia²
- Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants
- Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act
- Mound springs

TYPE 2 – Moderately sensitive key fish habitat:

- *Zostera*, *Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds <5m² in area
- Mangroves
- Coastal saltmarsh <5m² in area
- Marine macroalgae such as *Ecklonia* and *Sargassum* species
- Estuarine and marine rocky reefs
- Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g. managed in line with an entrance management plan)
- Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area
- Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna
- Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1
- Weir pools and dams up to full supply level where the weir or dam is across a natural waterway

TYPE 3 – Minimally sensitive key fish habitat may include:

- Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna
- Coastal and freshwater habitats not included in TYPES 1 or 2
- Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

3. Methods

The Strahler stream order classification was extracted from the State Government's GIS dataset. Top of bank was estimated using aerial photographs and 0.5 m contours before being field validated on 17th of March 2020 by two aquatic ecologists. The watercourses and riparian zone were visually assessed for ecological value regarding physical form, benthic substrate, fish habitat, instream woody debris and vegetation condition.

Each watercourse that met the definition of a 'river' under the WM Act was assigned the appropriate riparian corridor width in accordance with the Strahler stream order. Where a watercourse met the definition of a river upstream but was not defined downstream, the downstream 'channel' was mapped using a width similar to the upstream channel. Riparian widths were mapped in ArcGIS Pro. Online dams were included in the VRZ, as they provide good habitat for frogs, fish, reptiles and birds.

4. Preliminary results

Waterways ranged from undefined overland flow across existing golf course fairways, to incised channels with vegetated riparian land. There were 21 first-order and three second-order creeks in the study area. Creeks bordering the site were assessed to determine if their riparian buffers would encroach. Where dams were present along creek lines, the TOB was mapped along the bank of the dam. The current condition of the creeks is summarised in Table 6 using reach names in Figure 5 (overview), Figure 6 (northern extent) and Figure 7 (southern extent). None of the creeks on-site were identified to comprise of key fish habitat. The riparian vegetation along the existing golf course (northern extent, Figure 6), was highly modified with manicured grass being the dominate vegetation. Shrubs and canopy layers were present along the hilltops and in small, planted areas between fairways. Along the hilltops, the canopy species were predominately native including *Eucalyptus* spp. And *Angophora* sp., with dense exotic shrubs including *Olea europaea* (African Olive), *Lantana camara* (Lantana) and *Gomphocarpus fruticosus* (Narrow-leaf Cotton Bush). The low-lying areas and planted zones between the fairways had native canopy species including *Casuarina* sp., *Melaleuca styphelioides* (Prickly Paperbark), *Melaleuca* sp., and sparse *Eucalyptus* spp. The shrub layer was dominated by the exotic *Lycium ferocissimum* (African Boxthorn).

The riparian vegetation along the southern extent (Figure 7), outside of the boundary of the golf course, was predominately native with exotic species scattered throughout. The dominate canopy species were *Eucalyptus* and *Angophora*, with shrubs dominated by native *Bursaria spinosa* (Native Blackthorn) and scattered exotics African Olive, Boxthorn and *Opuntia stricta* (Prickly Pear).

All site dams were briefly assessed and are likely to provide habitat for common species such as turtles, eels, and wetland birds. The dams along the golf course (northern extent, Figure 6) all had fringing *Juncus* sp. and *Ludwigia peploides* (Water Primrose). Each dam was at or near capacity, with turbid water. Birds including *Chenonetta jubata* (Australian Wood Duck), *Fulica atra* (Eurasian Coot) and *Phalacrocorax varius* (Pied Cormorant) were observed using each dam. Frogs heard calling included *Crinia parinsignifera* (Eastern Sign-bearing Frog) and *Crinia signifera* (Common Eastern Froglet). Dams in the southern extent (Figure 7), were full of turbid water, with woody debris scattered along the edge. All dams had Australian Wood Duck, *Anas castanea* (Chestnut Teal), Pied Cormorant and *Tachybaptus novaehollandiae* (Australasian Grebe). Dams along 2B and 2C, had very little aquatic vegetation present, with a small amount of *Juncus* and Water Primrose scattered along the edges. There were dead standing trees (stags) present around the edges of both dams, which may provide habitat for birds and bats. The dams along 1R were densely vegetated with native macrophytes *Typha orientalis* (Typha), *Marsilea mutica* (Rainbow Nardoo) and *Ottelia ovalifolia* (Swamp Lily).

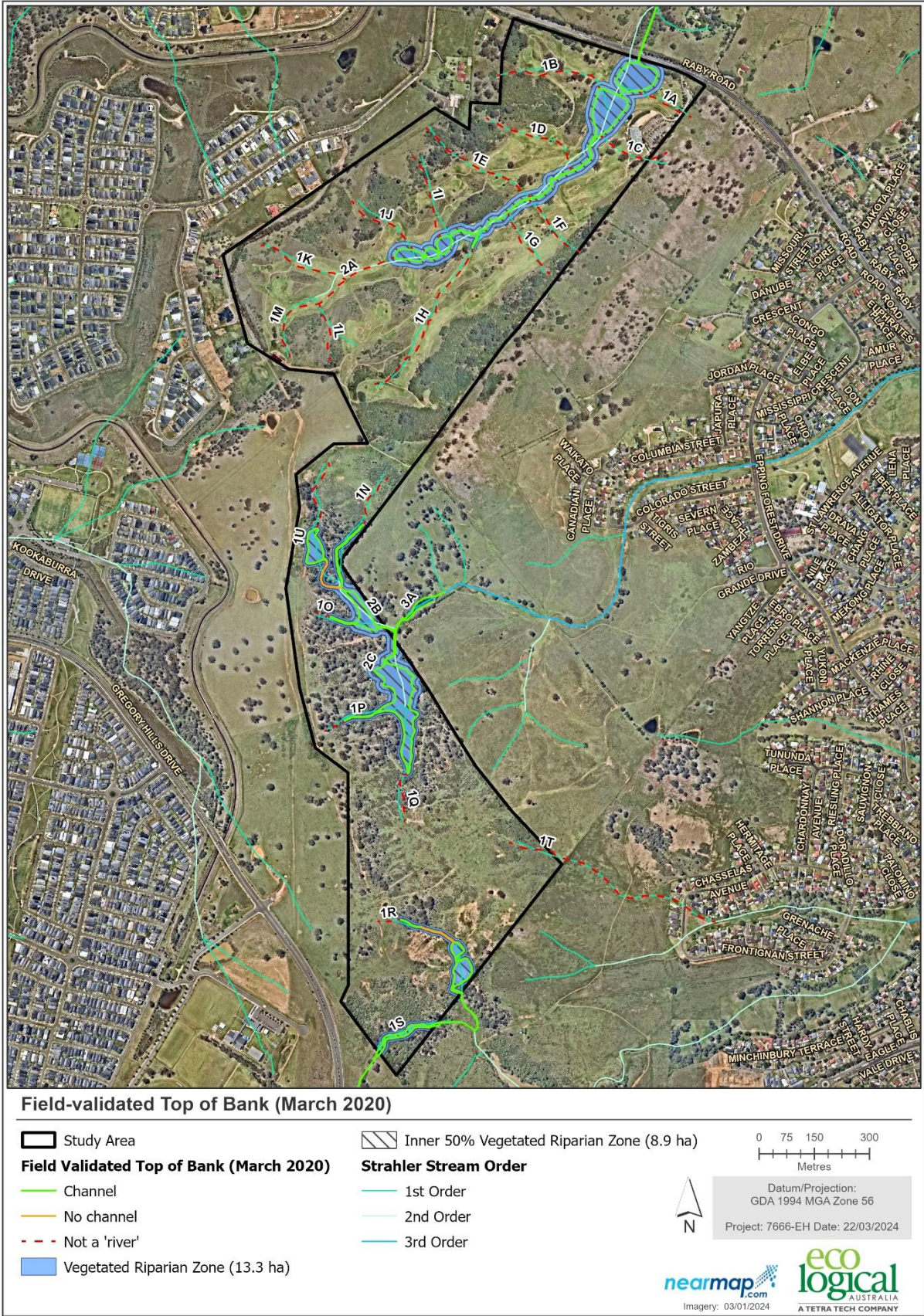


Figure 5: Top of Bank (validated March 2020) with reach numbers

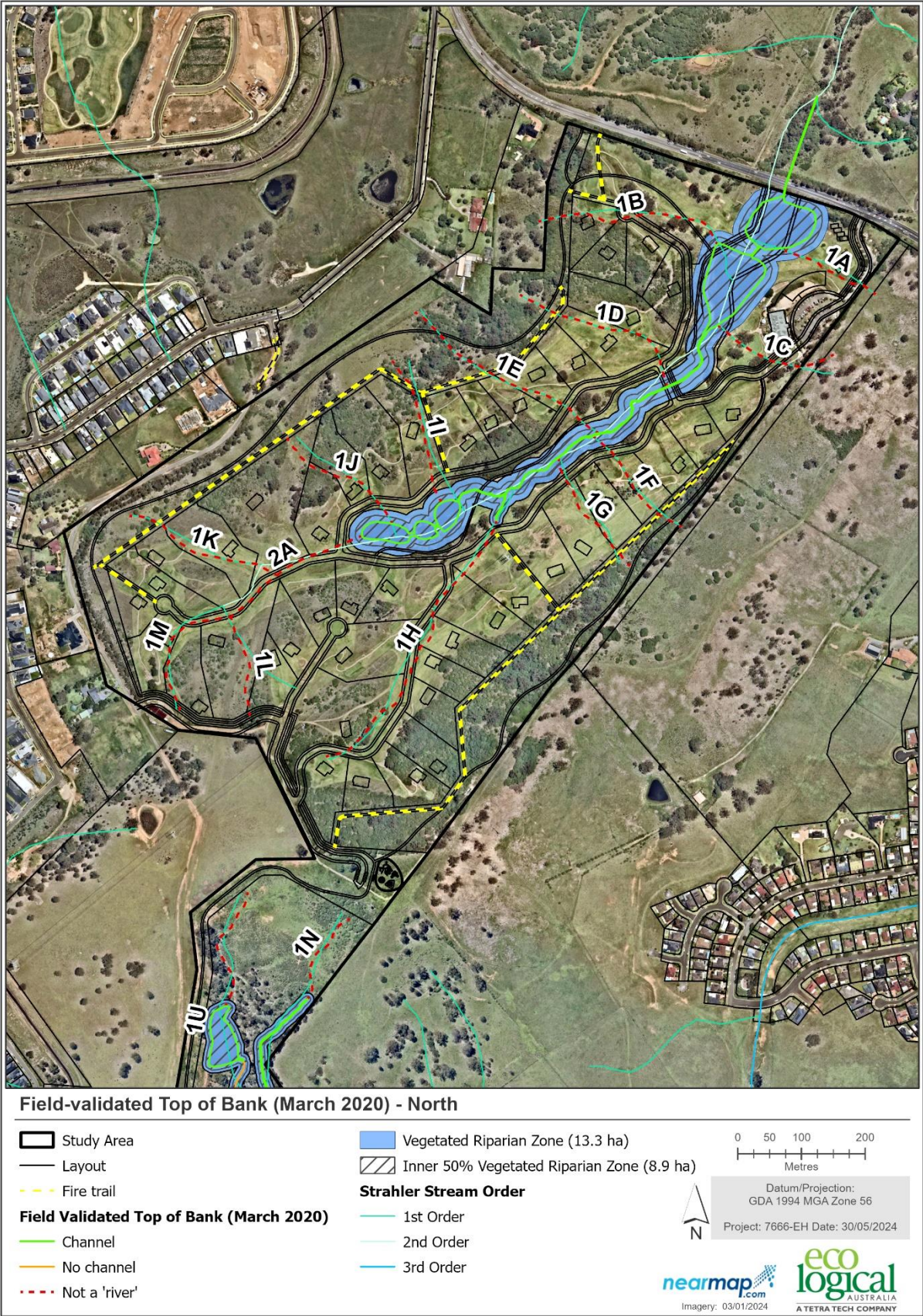


Figure 6: Northern extent – Top of Bank with reach numbers

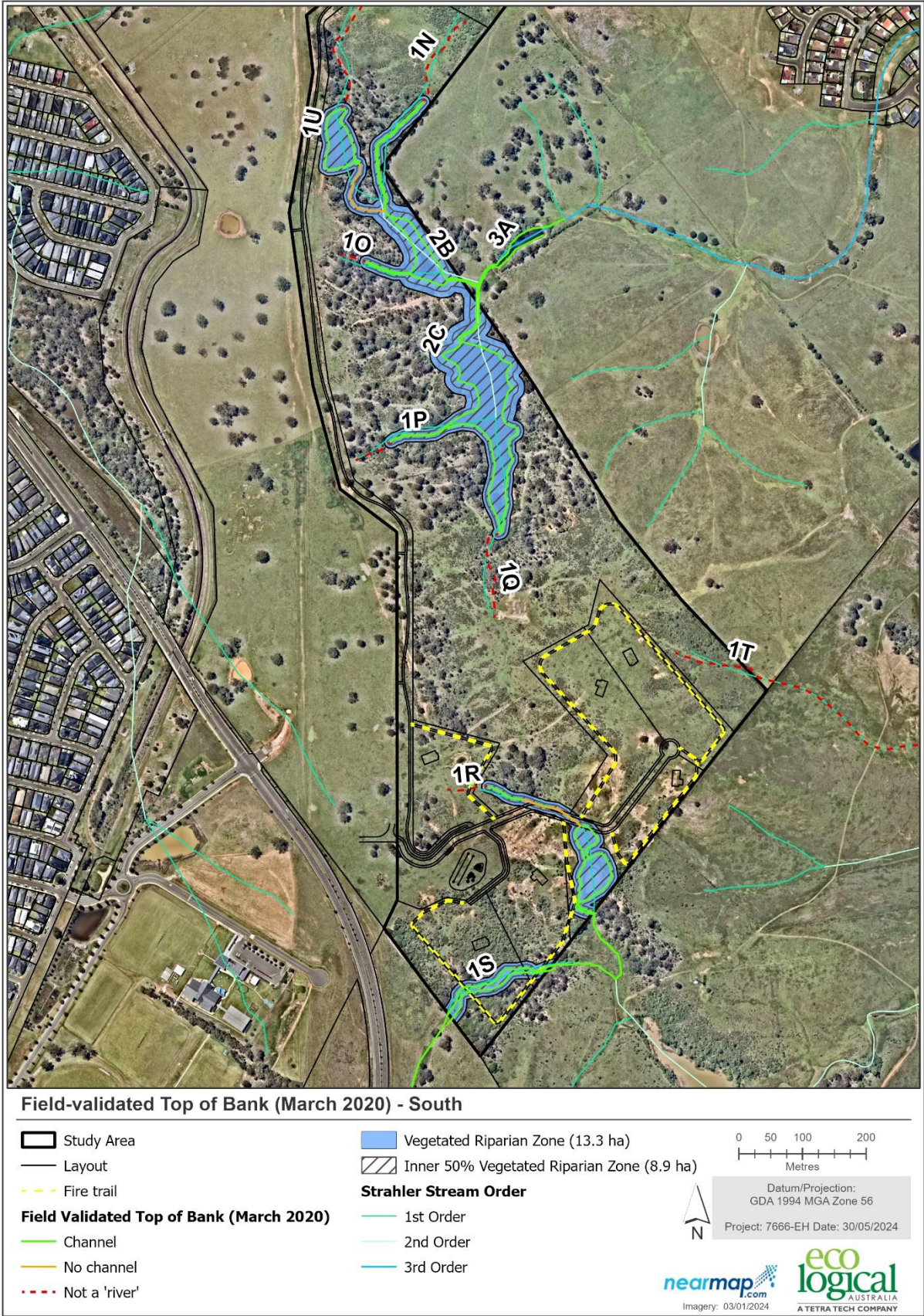








Figure 7: Southern extent – Top of Bank with reach numbers







Table 6: Reach descriptions







Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1A	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1B	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1C	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		







Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1D	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1E	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1F	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		







Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1G	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1H	1 st	River	No defined bed or bank for majority of mapped creek. Defined bed and banks 35 m upstream of the confluence with 2A. Channel is 0.5 m wide, meandering through fairway. Benthic habitat was clay with pebbles/gravel overlaid.		
1I	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		

Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1J	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1K	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		
1L	1 st	Not a 'river'	No defined bed or bank. Part of golf course fairway.		

Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1M	1 st	Not a 'river'	No defined bed or banks. Upstream was a golf cart track and downstream was fairway.		
1N	1 st	River	Channel began at a head cut and quickly became deeply incised. Banks were 3 m high and 4 m wide with severe undercutting. Woody debris was dense in the channel, with numerous trees and logs present. There were small pools of turbid water in the head cuts. No aquatic vegetation was present.		
10	1 st	River	The channel was filled with rubbish and woody debris. Both banks were densely vegetated, with no active erosion evident. The bed was dry, with no pooling water. No aquatic vegetation was observed. The downstream extent of the creek flowed into a dam.		

Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1P	1 st	River	Channel was 1 m wide, with gently sloping vegetated banks. There was no active erosion evident. No aquatic vegetation was observed, and the bed had scattered Box Thorn, Prickly Pear and grass,		
1Q	1 st	Not a 'river' upstream of dam. Mapped as 'river' in dam.	No defined bed or banks. A cattle track was the low point of the grassy swale and would increase flow of water into the dam.		
1R	1 st	River	Defined bed and banks evident in vegetated area. Channel was 0.5 m wide and dry. The benthic composition was silty clay and scattered gravel. No aquatic vegetation was present. Channel became a grassy swale where it flowed over a paddock, before entering two connected dams.		

Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
1S	1 st	River	The broader channel was approximately 10 m wide and flat. There was a smaller channel meandering through the wider channel with low areas with shallow turbid pools. The bed was clay silt with <i>Cyperus</i> sp. the dominate species. Common Eastern Froglet was heard throughout the reach. Woody debris was common throughout. Both banks were gently sloped and densely vegetated.		
1T	1 st	Not a 'river'	No defined bed or banks. Grassy overland flow only.		
1U	1 st	Not a 'river' upstream of dam. Mapped as River in dam and downstream.	No defined bed or banks upstream of the dam. Grassy overland flow only. In the dam, Common Eastern Froglets were heard calling. Downstream of the dam was a small spill channel before the water dispersed through the vegetation and no channel was evident.		

Reach name	Strahler stream order	Likely WM Act status (to be confirmed with DCCEEW – Water)	Description	Upstream photo	Downstream photo
2A	2 nd	Not a 'river' upstream of dam. Mapped as River in dam and downstream.	No defined bed or banks upstream of dams. Golf course fairway only. Downstream of the dams the channel, which meandered along the centre of the golf course, was incised with eroding vertical banks. The benthic habitat was clay with gravel/pebbles. There was no woody debris or aquatic plants observed. Pipes exiting periodically from banks funnelled water from surrounding fairways into the creek. No frogs were heard calling.		
2B	2 nd	River	The channel was mapped as the dam, which began at the confluence of 1N and 1U. The dam overflowed, to the east, through a large, deeply incised channel with significant erosion before dispersing into a wider grassy channel offsite.		
2C	2 nd	River	The channel was mapped as the downstream portion of the dam, north of the confluence of 1P and 1Q. The dam overflowed to the north, through a shallow grassy channel, before flowing offsite.		

5. Recommendations/discussion

5.1 Riparian corridors

The principles of the legislation addressed in Section 2, are to provide for the sustainable and integrated management of the waterways of the state. There were 13 first-order reaches that did not meet the definition of a 'river' under the WM Act, as they had no defined bed and banks. Of these, 12 were in the highly modified area of the golf course. There were three additional creeks which had no defined bed or bank upstream of the mapped dam. DCCEE – Water should be engaged to support the removal of creeks which did not meet the definition of a 'river', and therefore, the need to address these areas as waterfront land would be negated. All other reaches met the definition of a 'river'.

DCCEE – Water policy requires management and rehabilitation of the riparian land to a functional community, fully protected and vegetated with native endemic riparian plant species. If, however, the intention is to manage the vegetation for non-riparian purposes, such as Asset Protection Zones in the outer 50%, the riparian offsetting guidelines would apply to compensate the reduced VRZ. The inner 50% would still require protection. If offsets are required elsewhere, the average width of the riparian zone would need to be maintained to meet the DCCEE's guidelines. To be consistent with the guidelines, offset areas can be located on existing cleared land with priority given to preserve any native vegetation. There is the opportunity to rehabilitate with VRZ with native riparian species which will ultimately improve the instream habitat.

Reach status, condition and associated riparian corridors have been discussed in this report. Works within 40 m of a mapped watercourse would be considered integrated development and be subject to Controlled Activity Approval (CAA) under the WM Act at the DA stage.

Review of the Indicative Masterplan (Figure 1) found that the current proposal will retain the majority of the watercourses on site and keep corresponding riparian corridors in place. Potential watercourse realignment is proposed for portions of reaches 2A and 1R (Figure 8).

Reach 2A is the central riparian corridor which is planned to be retained and included as a feature in the future landscape. The two large dams adjacent to Raby Road are proposed to be removed and a natural creek line and corridor restored in their place. This reconstruction will occur north of the proposed road crossing and extend up to Raby Road. The proposed riparian corridor width is 42m (20m either side of future TOB and a 2m bed width). This width is in line with the stream order 2 guidelines.

In reach 2A, an encroachment area of 14.77 m² into the outer 50% of the VRZ requires offsetting, as highlighted in Figure 9. Three additional areas in reach 2A where the proposed footpath encroaches on the inner 50% of the VRZ would require redesign, as these structures are not permitted within this zone according to the DCCEE guidelines (2022a). The footpath crossing over reach 2A should be in line with the DCCEE guidelines, *Controlled activities – Guidelines for watercourse crossings on waterfront land* (DCCEE 2022b) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).

The portion of reach 1R identified as overland flow with no defined channel is proposed to be realigned to ensure the road does not impact on the outer 50% of the VRZ, negating the need for offsetting (Figure 10). The fire trail that encroaches on the riparian corridor (RC) of reach 1R is assumed to have a total

disturbance footprint of no greater than 4 metres wide, which is permitted in the outer 50% VRZ according to the guidelines (DCCEEW 2022a). However, this assumption is based on fire trail width in the indicative masterplan design. Crossings for the fire trails that intersect reach 1S must also be in line with the DCCEEW guidelines (2022b) and fish passage requirements for waterway crossings (Fairfull and Witheridge 2003).

Encroachments and offsets would be further assessed during future DA stages. Potential areas requiring review during final design stages include fire trail encroachment at reach 1R, dependent on the final total disturbance footprint width of the fire trail (Figure 10). However, the current Masterplan shows that there is capacity to accommodate a variety of averaging and offsetting options for the retained riparian corridors on site, should adjustments need to be made.

All future waterway crossings should be designed to minimise impact to fish passage and be in accordance with *'Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings'* (Fairfull and Witheridge 2003). As the creeks to be crossed in the current masterplan are unlikely to be fish habitat, culverts and fords are the recommended crossing type. The effective flow under the crossing should be at least equal to the natural flow area and a minimum of 300 mm of water should pool through the structure.

Any future earthworks within the riparian corridor would need to be undertaken in accordance with *Controlled Activities – Guidelines for instream works on waterfront land* (NSW DCCEEW 2022).

DCCEEW - Water should be consulted for feedback on the proposed rezoning application, to confirm the removal of first-order watercourses and proposed offsetting and/or realignment. A CAA would be required in the development phase, as there are works proposed within 40 m of watercourses. Conditions of a CAA would outline the need for a Vegetation Management Plan (VMP) to rehabilitate and restore riparian corridors along 'rivers' to functioning native communities.



Figure 8: Proposed vegetated riparian zones for whole of development.

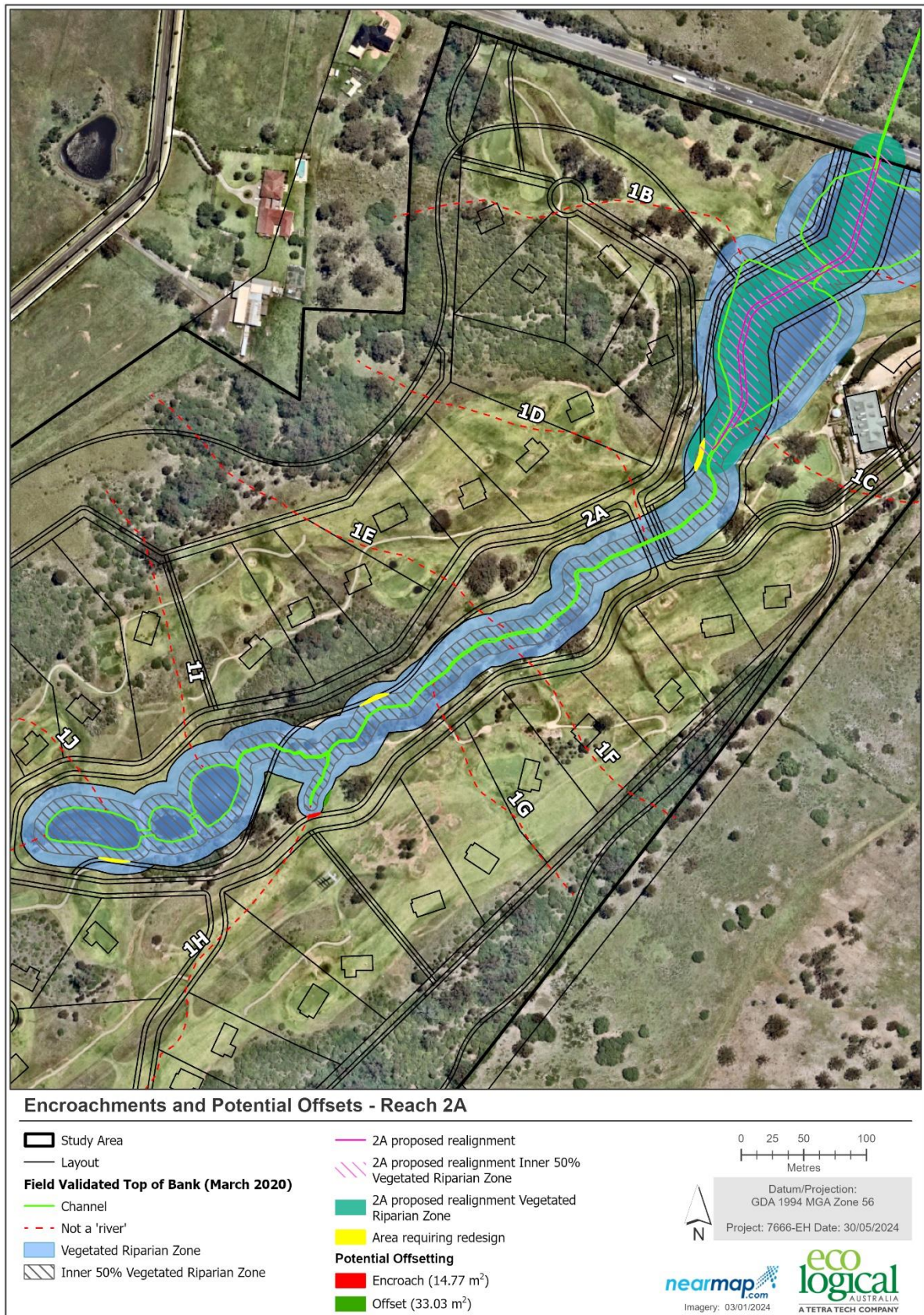


Figure 9: Encroachment, potential offsetting, and areas requiring redesign – reach 2A

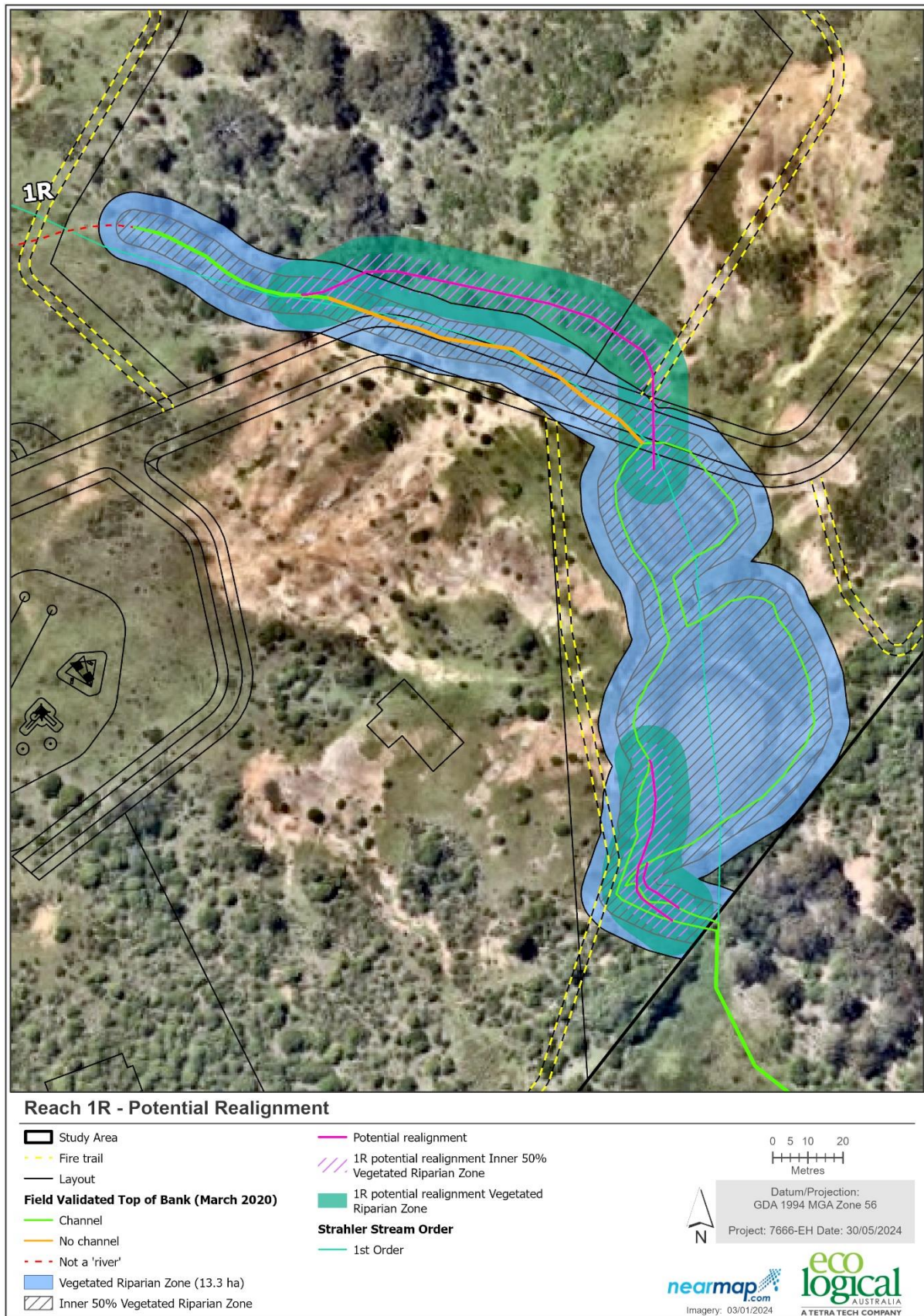


Figure 10: Reach 1R potential realignment.

5.2 LEP and DCP Provisions

The current design is consistent with Council's LEP and DCP, by retaining natural watercourses, large waterbodies and their respective riparian corridors (Figure 11). Riparian corridors are proposed to be retained within future C2 – environmental conservation and C3 Environmental management zonings which provides clear objectives for the protection and management of the riparian corridors. The permissible uses within the Environmental Conservation zone are shown below.

Zone	Permitted without consent	Permitted with consent	Prohibited
C2 – environmental conservation ¹	Nil	Building identification signs; Business identification signs; Eco-tourist facilities; Environmental facilities; Environmental protection works; Flood mitigation works; Information and education facilities; Oyster aquaculture; Roads	Business premises; Hotel or motel accommodation; Industries; Multi dwelling housing; Pond-based aquaculture; Recreation facilities (major); Residential flat buildings; Restricted premises; Retail premises; Seniors housing; Service stations; Tank-based aquaculture; Warehouse or distribution centres;
C3 – environment management ²	Home occupations	Animal boarding or training establishments; Bed and breakfast accommodation; Building identification signs; Business identification signs; Cellar door premises; Dual occupancies (attached); Dwelling houses; Educational establishments; Emergency services facilities; Environmental facilities; Environmental protection works; Extensive agriculture; Farm buildings; Farm stay accommodation; Flood mitigation works; Home-based child care; Home businesses; Home industries; Horticulture; Oyster aquaculture; Places of public worship; Pond-based aquaculture; Recreation areas; Restaurants or cafes; Roads; Roadside stalls; Rural workers' dwellings; Tank-based aquaculture; Viticulture; Water supply systems	Industries; Multi dwelling housing; Residential flat buildings; Retail premises; Seniors housing; Service stations; Warehouse or distribution centres; Any other development not specified in item 2 or 3

¹current zoning at reach 2B and 2C

²current zoning at reach 2A

Where multiple land uses are proposed, for example, public access for recreation, other zoning may be appropriate such as RE1 Public Recreation, as long as the management regime for the land has the primary objective of environmental protection and aligns with Council's LEP riparian objectives.

The conservation and management regime for the vegetation in the riparian zone should be outlined in a VMP that has been prepared to be consistent with the zone objectives and Council's LEP, with aims to rehabilitate all watercourses to natural functioning vegetation communities, which would in turn protect and improve the watercourse's aquatic values and stability.

It is understood that future maintenance of the rehabilitated riparian zones would rest with the management association attached to a future Community Title Scheme.

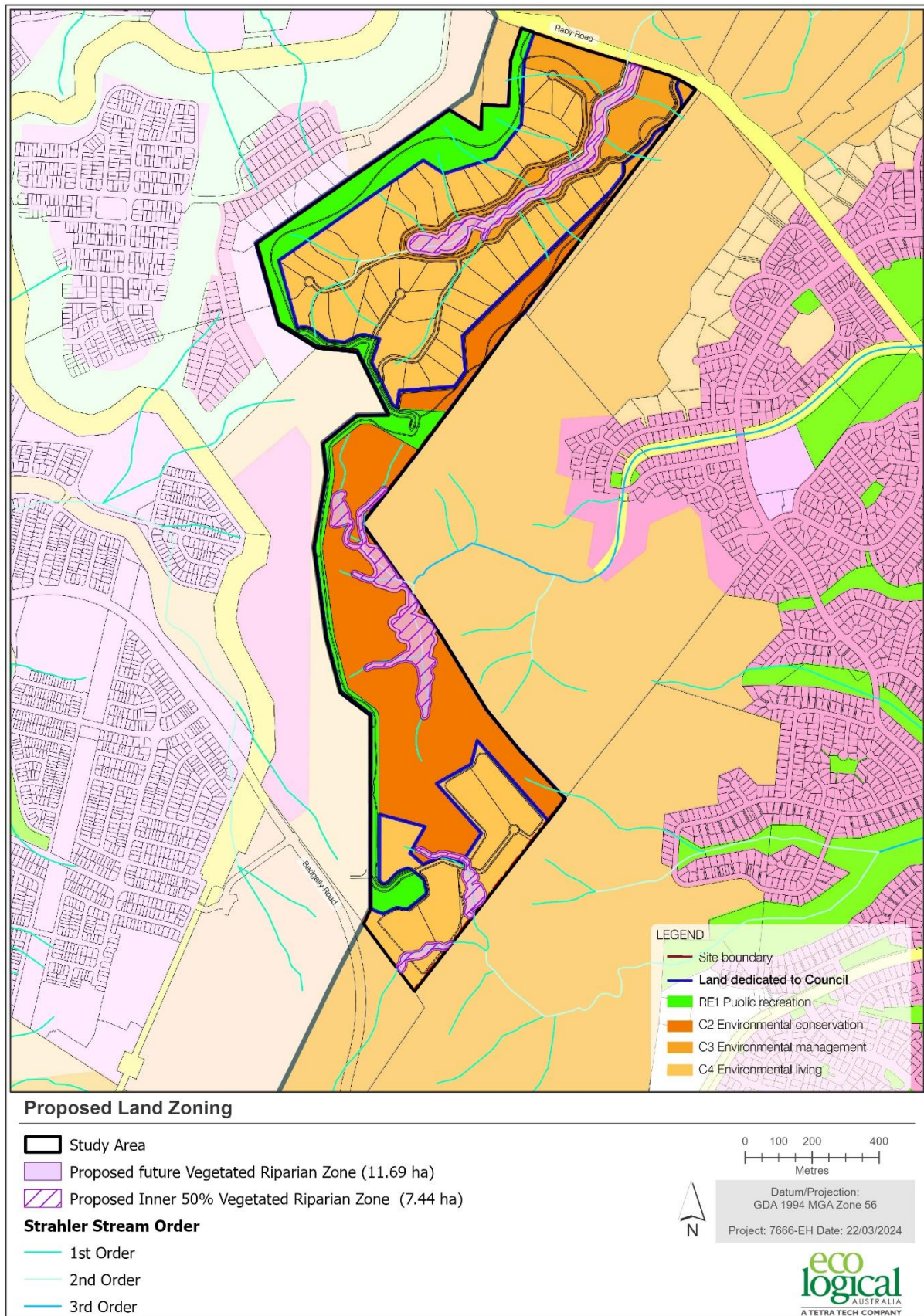


Figure 11: Proposed land zoning and riparian corridors

6. Conclusion

There were 21 first-order and three second-order creeks in the study area. No KFH was mapped on site, and there is a lack of suitable habitat and connectivity to locations where threatened species have been recorded.

There were 13 first-order reaches that did not meet the definition of a 'river' under the WM Act, as they had no defined bed and banks. Of these, 12 were in the highly modified area of the golf course. DCCEEW – Water should be engaged to support the removal of creeks which did not meet the definition of a 'river', and therefore, to remove any further obligations for these streams under the WM Act.

For the reaches that did meet the definition of a 'river', works within 40 m would be subject to Controlled Activity Approval (CAA) under the WM Act. Conditions of a CAA would outline the need for a Vegetation Management Plan (VMP) to be implemented to restore the riparian zone to a functional native community (widths in Table 2). Additionally, permissible uses (Table 3) and encroachment/offsetting rules apply (Figure 4). Departures from the guidelines will require a merit-based assessment by DCCEW, and no guarantee of their response can be provided in our advice.

Based on a constraints level review of the Planning Proposal, as per Section 5.1, it is recommended that:

- Any non-riparian purposes proposed in the outer 50% VRZ follow the riparian offsetting guidelines, to compensate the reduced VRZ, with priority given to preserve native vegetation.
- Any encroachments to the inner 50% VRZ, such as areas of paths within the Reach 2A corridor, are redesigned to avoid the inner 50%.
- Footpaths and fire trails encroaching the VRZ of any stream should be no greater than 4 metres wide, which is permitted in the outer 50% VRZ (DCCEEW 2022a). Areas where paths cross streams must be in line with DCCEEW guidelines, *Controlled activities – Guidelines for watercourse crossings on waterfront land* (DCCEEW 2022b) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).
- VRZ encroachments and offsets, as well as direct and indirect impacts to existing riparian and aquatic habitat, must be further assessed during future DA stages in an impact assessment, based on a final design.
- DCCEEW should be consulted for feedback on the proposed rezoning application, to confirm support of the removal of first-order watercourses, and proposed offsetting and/or realignment.

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