

Riparian Corridor Management Strategy for the West Dapto Urban Release Area

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Wollongong City Council would like to show their respect and acknowledge the Traditional Custodians of Dharawal Country, Elders past and present, and extend that respect to other Aboriginal and Torres Strait Islander people.

Wollongong City Council would further like to acknowledge the community of West Dapto and State Government Agencies and the Development Industry who have given their time in responding to project surveys, attending workshops and providing feedback on reports and materials.

Executive Summary

The main purpose of this study is the preparation of a Riparian Corridor Management Strategy specific to the West Dapto Urban Release Area (WDURA) and is largely based on a contemporary review and assessment of the 2004 Riparian Corridor Management Study (RCMS) by the Department of Infrastructure Planning and Natural Resources (DIPNR, 2004), in addition to the consideration of other key documentation, including Local and State Government regulation, planning policy and other relevant strategy such as the West Dapto Vision (2018).

The update is timely given the extent of land development identified within the West Dapto Vision (2018) and the revised West Dapto Structure Plan 2018 and makes proactive protection of waterways within the WDURA essential for preserving water quality, waterway condition, biodiversity and public amenity.

The updated report is guided by current best practice in catchment and water cycle management which has evolved significantly over the past 20 years, principally under the banner of Water Sensitive Urban Design (WSUD).

The updated Strategy was completed via review of the RCMS (2004) in the context of existing legislation and policy, including the Mullet Creek Floodplain Risk Management Study and Plan (2023) and a review of existing waterway condition. Existing waterways throughout the WDURA are largely modified and vary in condition from generally good in the upper catchment to fair to very poor in the lower catchment. Agricultural land use and progressive urbanisation has caused loss of riparian vegetation, changed creek flows – generally an increase in the intensity of catchment runoff – and altered sediment regimes. The impacts include eroded creek beds and banks, aquatic habitats smothered by sediments, weedy riparian zones, often poor water quality and a patchy riparian zone which offers limited biodiversity value in many subcatchments.

Extensive consultation within and beyond Council has been completed in the preparation of the updated strategy, which has assisted in understanding challenges in implementing the existing strategy and confirming an appropriate scope of the new strategy. Key outcomes of consultation included:

Council and State government agencies remain supportive of the review of the RCMS (2004) with respect to the WDURA and the need to protect and maintain riparian corridors.

Council has no desire to reduce the scope of the RCMS (2004), and stressed the review must respond to not just the current condition of waterways but also a desired future condition.

State government agencies stressed that the RCMS (2004) would have greater effect by being referenced in the Wollongong LEP, not just the DCP.

The consulting and development sector find implementing the RCMS (2004) challenging and at odds with standard requirements for waterway works associated with the *Water Management Act (2000)*. Many felt that buffers prescribed within the RCMS (2004) are inconsistently applied or often not based on obvious environmental values – or even the presence of a stream in some instances.

The three stream categories (as described in the RCMS (2004) and DCP Chapter E23) are:

Table 1.0 - Summary of Stream Category Objectives

Stream Category	Objectives
1 Environmental Corridor	Maximise the protection of terrestrial and aquatic habitat to: Provide a continuous corridor width for the movement of flora and fauna Provide extensive habitat (and connectivity between habitat nodes) for terrestrial and aquatic fauna Maintain the viability of native riparian vegetation

Stream Category	Objectives
	Manage edge effects at the riparian/urban interface Provide bank stability Protect water quality <u>40m min core riparian zone + 10m min vegetated buffer from top of bank</u>
2 Terrestrial & Aquatic Habitat	Maintain/restore as much as possible the natural functions of a stream to: Maintain the viability of native riparian vegetation Provide suitable habitat for terrestrial and aquatic fauna Provide bank stability Protect water quality <u>20m min core riparian zone + 10m min vegetated buffer from top of bank</u>
3 Bank Stability & Water Quality	Minimise sedimentation and nutrient transfer to: Provide bank stability Protect water quality Protect native vegetation <u>10m min vegetated buffer from top of bank</u>

Opportunities and Constraints associated with implementing the RCMS (2004) and an updated Strategy have been investigated, with key issues identified including:

A need for ongoing training and awareness raising within Council and the broader development sector around the purpose of the RCMS (2004).

A need to ensure best practice methods and appropriately qualified experts assist in waterway health assessments and design responses.

A need for proactive communication with Council to ensure the intent of the Strategy is understood and incorporated within the design of new urban areas as early as possible in the planning process.

The need to communicate Council expectations around the holistic role of riparian corridors and the standards to which they should be rehabilitated and managed prior to handover to Council.

In light of these findings, recommendations made as part of the updated Strategy include:

Ongoing training and awareness raising within Council and the consulting sector around the purpose of the strategy, its relation to WSUD and excellent urban design.

Ensuring that waterway assessments and rehabilitation strategies are completed by practitioners with demonstrated expertise in ecology and geomorphology.

Proactively communicating Council's expectations around Stream Categories and Waterway Management.

An Implementation Plan has been created in support of recommendations along with funding opportunities.

In summary the new Riparian Corridor Management Strategy confirms the importance of riparian zones within the WDURA and the role that the riparian buffers prescribed within Stream Categories play in delivering multiple benefits for water quality, stream stability, biodiversity and public amenity.

Note: This report does not recommend a retrospective view, that is, riparian corridor mapping within this Strategy does not apply to prior Council or State Government decisions made on riparian outcomes as part of approved Neighbourhood Plans, Concept Development Applications and Development Applications. In addition, this strategy does not apply to current Planning Proposal, Neighbourhood Plan, Concept Development Applications or Development Application Assessments submitted prior to the adoption of this strategy and does not apply to the Calderwood Urban Development Project, approved by the NSW State Government in 2010.

Table of Contents

1	Introduction and Background	7
1.1	Introduction	7
1.1.1	Purpose of this Study	7
1.1.2	Status of the Existing Report	7
1.1.3	Challenges with Implementation	7
1.1.4	Response to New Legislation	7
1.1.5	Scope of the Updated Strategy	8
1.1.6	Study Area: West Dapto Urban Release Area	8
1.1.7	Future Land Use	8
1.2	Background Documentation	12
1.2.1	West Dapto Vision 2018	12
1.2.2	West Dapto Structure Plan	14
1.2.3	Mullet Creek Floodplain Risk Management Study and Plan (2023)	14
1.2.4	Duck Creek Flood Study (2019)	15
1.2.5	Lake Illawarra CMP (2020)	15
1.2.6	Climate Change Adaption Plan (2022)	17
1.3	Report Objectives and Guiding Principles	17
2	Riparian Land: Values and Functions	19
2.1	Definition of Riparian Land	19
2.2	The Value and Services of Riparian Land	19
2.3	Catchment and Riparian Processes	20
2.4	Role of Riparian Land for Enhancing and Maintaining Biodiversity	21
2.5	Impacts of Urbanisation on Waterway Health	23
2.6	Stream Categories & Objectives	26
2.7	Principles of Riparian Management	27
3	Planning and Legislative Context	29
3.1	Introduction	29
3.2	Legislation Relevant to Flood Management	34
4	Catchment Characteristics	35
4.1	Geomorphic Assessment Methods	35
4.2	Managing Floodplain Risk	35
4.3	Mapping Methods	36
4.3.1	Data Sources	36
4.3.2	Methods For Defining Riparian Zones	36
4.3.3	Limitations	38
4.4	Criteria for Re-Categorising Streams	38
4.5	Biodiversity Corridors	39
5	Community and Stakeholder Consultation	40
5.1	Consultation Plan	40
5.2	Consultation Results and Discussion	40
5.3	Public engagement strategy	42
5.3.1	Community engagement results	43
6	Riparian Corridor Characteristics and Mapping	44

6.1	Geomorphic Characteristics	44
6.1.1	Rapid Geomorphic Assessment.....	46
6.2	Flooding.....	47
6.3	Riparian Corridor Delineation	48
6.4	Riparian Management Objectives Maps	51
6.4.1	Mapping review results.....	51
6.4.2	Applicant Review.....	52
7	Strategy and Implementation	54
7.1	Riparian Corridor Management Strategy	54
7.1.1	Vision for Waterways within West Dapto Urban Release Area	54
7.2	Managing Floodplain Risk	55
7.3	Stormwater Management.....	56
7.3.1	Policy Context.....	56
7.3.2	Current Water Quality.....	56
7.4	Recommendations	58
7.5	Implementation Plan.....	61
7.6	Funding Pathways	63
8	References.....	65
	Appendix A – Riparian Management Objectives Maps.....	69
	A.1 – Top of Bank Mapping	69
	A.2 – Stream Categories	77
	A.3 – Stream Buffers	85
	Appendix B - Stream Types	93
	Appendix C – Consultation	97
	C.1 – Stakeholder Engagement Summary.....	97
	C.2 – Community Engagement Report.....	100
	Appendix D – Assessment Location Sites.....	115
	Appendix E - Site Assessment Photos	123

List of Figures

Figure 1.1	Regional context.....	10
Figure 1.2	Significant hydrological features	11
Figure 1.3	Structure & Staging (West Dapto Vision 2018)	16
Figure 2.1	Adapted from: ecological processes in a healthy riparian zone (Source Beesley et al., 2017)	21
Figure 2.2	Schematic depiction of a degraded urban stream (Source Beesley et al., 2017).....	24
Figure 2.3	Morphological trajectory	25
Figure 6.1	Modelled flood extents.....	49
Figure 6.2	Existing flood constraints	50
Figure 6.3	Example riparian buffer updates.....	53

List of Tables

Table 1.1 Watercourse catchments relative to future urban development	8
Table 1.2 West Dapto Vision 2018 – Key principles	12
Table 1.3 West Dapto Vision 2018 – Water Management Principles	13
Table 1.4 West Dapto Vision 2018 – Environmental Conservation Principles	13
Table 1.5 Five (5) key themes for stormwater management and biodiversity	14
Table 1.6 Report Objectives and Guiding Principles	17
Table 2.1 Modelled pre-European vegetation communities and alignment with associated TEC in the WDURA	23
Table 2.2 Summary of category objectives	26
Table 2.3 Commentary on RCMS (2004) general riparian management principles.....	27
Table 3.1 Relevant federal legislation	29
Table 3.2 Relevant NSW legislation	29
Table 3.3 Relevant local legislation, planning instruments and documents.....	31
Table 4.1 Step-wise method for mapping	37
Table 4.2 Stream categorisation criteria	38
Table 5.1 Stakeholder groups	40
Table 5.2 Summary of key perspectives from consultation	40
Table 6.1 Riverstyles of the Lake Illawarra catchment.....	45
Table 6.2 Summary of findings for rapid stream assessment	46
Table 7.1 Stream categories and associated riparian buffer widths, adopted from Wollongong DCP Ch E23.....	55
Table 7.2 Stormwater pollution reduction targets (source: Table 40; DCCEEW, 2024).....	57
Table 7.3 Recommendations schedule	58
Table 7.4 Implementation plan	62
Table C.1 Interest groups	97
Table C.2 Stakeholder engagement themes	97

1 Introduction and Background

1.1 Introduction

1.1.1 Purpose of this Study

The main purpose of this study is the preparation of a Riparian Corridor Management Strategy specific to the West Dapto Urban Release Area and shall be largely based on a contemporary review and assessment of the 2004 Riparian Corridor Management Study (RCMS) by the Department of Infrastructure Planning and Natural Resources (DIPNR 2004), in addition to the consideration of other key documentation, including Local and State Government regulation, planning policy and other relevant strategy such as the West Dapto Vision (2018).

1.1.2 Status of the Existing Report

The RCMS (2004) was developed to protect riparian zones and encapsulate a management framework. In many respects the RCMS (2004) remains a highly practical resource, particularly with respect to defining the roles and relationships between riparian corridors and urban development; to an extent that there remains a strong relationship to the Wollongong 2009 Development Control Plan (DCP), within this context specifically chapter E23: Riparian Land Management. Moreover, the framework within the RCMS (2004) was utilised by other Local Councils and implemented within their statutory documents.

Since the RCMS (2004) was published however, there have been significant regulatory movements at both a State and Local Government level, which has resulted in a level of misperception amongst those seeking to understand how to best navigate the various legislative considerations, in addition to some misalignment with other Council strategic documentation. This misperception is particularly felt by Local Government staff, industry professionals and urban developers. Therefore, a contemporary review of the RCMS (2004) is required, and to provide a level of direction for subsequent strategic documentation that will ultimately guide urban development which is considerate to the roles of riparian zones.

1.1.3 Challenges with Implementation

There have been and still exist significant challenges to having the RCMS (2004) and the DCP adhered to, for example, one ongoing challenge faced by Council is that consulting professionals largely rely on NSW State Government regulations for Controlled Activity approvals to determine the nature of riparian buffers, rather than seek the framework and guidelines required by the Wollongong DCP Chapter E23: Riparian Corridor Management. Many professionals preferred to operate under the NSW Department of Climate Change, Energy, the Environment and Water (Water Group) guidelines' somewhat 'one size fits all' approach, which in many cases is not suitable for certain geomorphological situations.

This RCMS is a strategic document for making decisions in the WDURA, with buffers based on an integrated approach to multiple waterway objectives which are specifically relevant to the characteristics of the catchment in which each waterway is located. In contrast, the WM Act guideline is a generic statewide approach for the purpose of activity approvals and not specifically designed as a strategic planning tool.

1.1.4 Response to New Legislation

Since the adoption of the RCMS (2004), there has been a notable increase in the quantity of legislation and strategic policy relating to urban development; largely published to manage the outcomes of large-scale urban development/residential subdivision. This has led to a divergence between State regulatory mechanisms and

local policy. The Wollongong DCP Chapter E23: Riparian Land Management for instance, was updated to ensure the guidance for riparian corridors was based on the RCMS (2004) and not the State Government guidelines.

1.1.5 Scope of the Updated Strategy

The existing or RCMS (2004) covers the whole Wollongong local government area (LGA) as well as Calderwood Valley and the Shellharbour LGA. This updated report exclusively covers the West Dapto Urban Release Area (WDURA) as illustrated in Figure 1.1.

Note: It is beyond the scope of this document to complete an in-depth assessment of all the waterways within the study area due to its geographically expansive and complex characteristics. All other waterways would be subject to specific in-depth assessments at the residential subdivision Development Application stage.

1.1.6 Study Area: West Dapto Urban Release Area

The study area encompasses the entirety of the West Dapto Urban Release Area (WDURA) within the Wollongong City Council (WCC) LGA. The study area is positioned between Lake Illawarra and the Illawarra escarpment predominantly west of the Princes Highway and Illawarra Railway and from Kembla Grange in the north to Yallah and Marshall Mount in the south along the Wollongong-Shellharbour LGA boundary, as depicted in Figure 1.1.

The area encompasses approximately 4,700ha (47km²) of rapidly urbanising rural lands largely cleared of native vegetation and dominated by three powerful and dynamic catchments flowing from the escarpment (>500m asl) to Lake Illawarra (<10m asl). Mullet Creek covers the northern two-thirds of the study area with four major tributaries. Duck Creek covers the majority of the southern third while Marshall Mount Creek occurs along the southern border.

The regional topography in the study area results in rainfall on the escarpment being delivered rapidly to the floodplain during flash or fast developing storm events. The waterways on this floodplain are unique in that they reduce in size closer to their mouth due to very high floodplain connectivity which spreads and slows flood flows across extensive floodplains. Consequently, impacts from flooding on new and established urban areas has been significant and is a key constraint on new urban development.

1.1.7 Future Land Use

Approximately 56,000 residents are expected to live in the West Dapto Urban Release Area once fully developed. Future land uses will include low, medium and high density residential. The urban release area will also facilitate the development of commercial, industrial and recreational areas as detailed in the West Dapto Vision (WCC 2018). Residual areas will remain rural or as conservation lands.

Riparian corridors will be incorporated with the urban design and form a central component of open space. There are numerous watercourses and several key waterways within the release area, and the degree of urban development will vary across the release area.

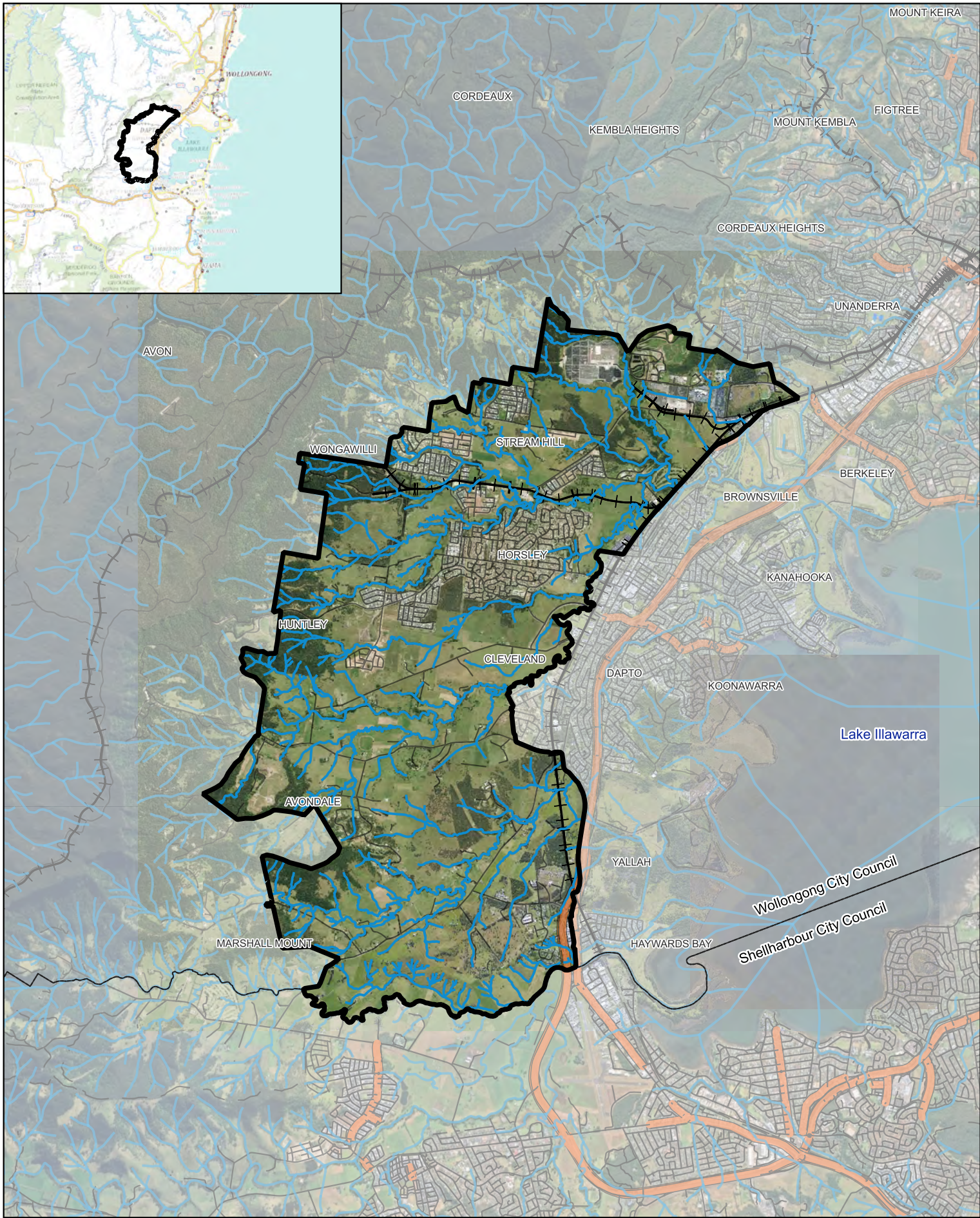
Generally, more open space is being retained in southern catchments compared those in the north. A summary of each waterway and the development associated within each catchment is provided in Table 1.1.. The relative location of significant watercourses is highlighted within Figure 1.2.

Due to the Future land use implementation of this strategy is expected to mainly occur via new development. However, it could also be implemented via projects initiated by Council, Land care groups or Landowners outside of the development process, where feasible and subject to the permission from affected landowners.

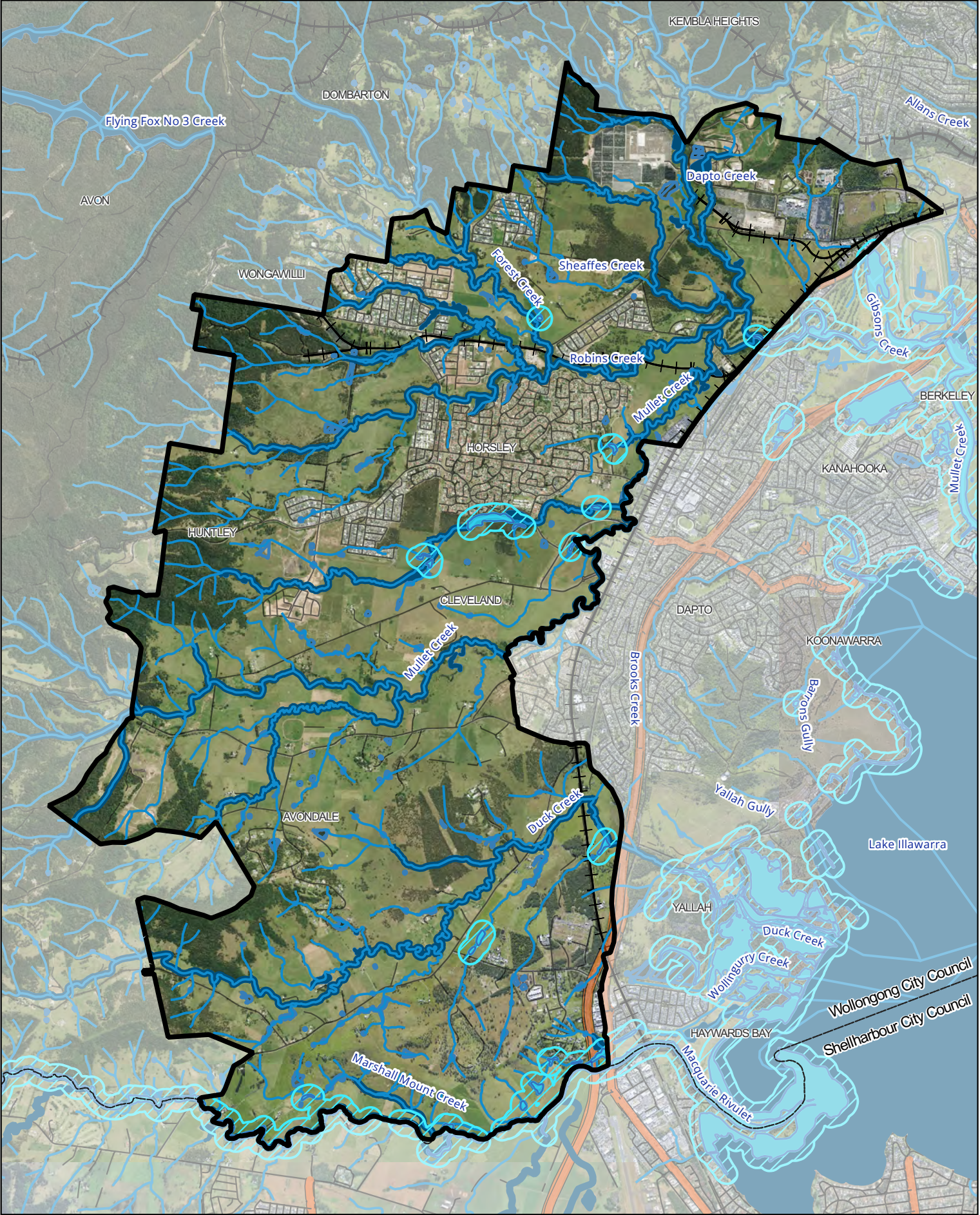
Table 1.1 Watercourse catchments relative to future urban development

Catchment Area	Watercourse	Summary and Comments
Dapto Creek	Dapto Creek	- Located in the North of the WDURA adjacent Kembla Grange, collecting flows from Dombarton west of Dapto - Stage 1 / 2, which shall include the development of two 'Town & Village Centres' to the south of Dapto Creek (West Dapto Structure Plan, 2018)
Robins Creek	Robins Creek	- Linking with Forest Creek, bounds with the north of the existing Horsley residential subdivision - Robins Creek is located to the very south of two proposed 'Town & Village Centres' as part of Stage 1 / 2. Significant development is proposed within the Robins Creek catchment
Mullet Creek	Mullet Creek	- Positioned centrally within the WDURA and flowing laterally west east, the Mullet Creek catchment shall encapsulate a significant proportion of WDURA Stage 1, 2 and 3 development, and include a series of 'Walkable Neighbourhoods' - Given the proposed urban development, Mullet Creek will be significantly bound by urban development to its west, north and south
Duck Creek	Duck Creek	- Duck Creek is located within the south of the WDURA and is positioned centrally to Stage 5, and in close proximity to a proposed 'Town & Village Centre' nearby Yallah Marshall Mount release - Duck Creek catchment will encompass the majority of Stage 5 urban lands
Calderwood Urban Release Catchments	Marshall Mount Creek and Macquarie Rivulet	Located on the southern border of the WDURA between the LGAs of Wollongong City Council and Shellharbour City Council, Marshall Mount Creek, flowing to Macquarie Rivulet and eventually outflowing to Haywards Bay, and shall encapsulate a significant proportion of WDURA Stage 5 bounding to its north

Note: Only named NSW Hydroline watercourses included



 	Legend  WDURA boundary  LGA boundary  Hydroline  Railway  Major road  Road / Track	Figure: 1.1 Regional context Scale: 1:75,000 @ A4 GDA2020 MGA56  	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © Google 2025 Drawn: GD Date: 15/05/2025 Checked: DM Job ref: 241959
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 wollongong city of innovation  AWC	Legend - WDURA boundary - Significant hydrological features - Key Fish Habitat - SEPP Coastal wetland - Coastal wetland proximity area - Waterbody - Hydroline - LGA boundary - Railway - Major road - Road / Track	Figure: 1.2 Significant hydrological features Scale: 1:50,000 @ A4 GDA2020 MGA56 0 0.5 1 1.5 km N	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © WCC 2024 Drawn: GD Date: 15/09/2025 Checked: DM Job ref: 241959
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1.2 Background Documentation

1.2.1 West Dapto Vision 2018

With respect to projected population increases, the NSW Government is seeking to implement policy which will facilitate the development of liveable urban places. The Illawarra-Shoalhaven Regional Plan 2015 recognises that by 2050 the region's population may increase to roughly half a million residents; many of which are forecast to reside in the Wollongong Local Government Area (LGA). In kind, Wollongong City Council has set population benchmarks for the West Dapto Urban Release Area (WDURA); over a 50-year period, the WDURA has the potential for around 19,500 new dwellings and a population increase of approximately 56,000 residents. Considerate of this significant expectation in urban uplift and population growth, the West Dapto Vision 2018 has been developed to manage and drive the strategic development direction of West Dapto. The West Dapto Vision 2018 encompasses 8 key urban development principles listed below in Table 1.2. Key to this report are those principles which impact on riparian zones Water Management and Environmental Conservation.

Table 1.2 West Dapto Vision 2018 – Key principles

No.	Principle	Overview
1	Transport	Development of transport network and infrastructure which supports proposed land uses, urban connectivity, is considerate of environmental features, has a sustainability focus and supports active transportation.
2	Water Management	Integration of floodplain and stormwater management, water quantity management (potable and waste), water quality, sustainable development for the floodplain, preserve watercourses and floodplain function, integration with the natural and urban environment.
3	Conservation	Environment conservation: including retention of high value ecological areas, habitat connectivity, protection of environmental values. Heritage Conservation: Prioritise Aboriginal and historical items of significance, consideration of the cultural landscape, embed local history and character in new urban places and communities.
4	Open Space	Development of open space which is: functional, accessible (e.g. active transport and diverse community needs), facilitates connectivity, movement and placemaking.
5	Community & Education Facilities	Support the development of communities which are: healthy, diverse, resilient and sustainable. Safe and efficient urban places and communities. Vibrant, accessible, diverse and equitable.
6	Town Centres	Ensure the development of liveable places through urban hierarchy (regional centres, town centres, village centres). Considerate of transportation and movement, especially related to transit between home – work – recreation. Reflective of regions diversity and identity.
7	Housing	Promote: housing diversity (low, med, high density etc), facilitate improved housing affordability, sustainable and energy efficient housing, ensure there is local amenity / placemaking, considers urban development impacts on the escarpment.
8	Employment	Develop and support local employment, support, improve business development and innovation in West Dapto, ensure Village and Town Centre employment is a priority, best use of existing employment areas, ensure employment in West Dapto is accessible.

Riparian zones are central to effective management of flood event impacts and heavy stormwater runoff from new urban areas, with riparian zones ultimately receiving and conveying a high percentage of these flows. The ability of riparian zones to cope with changes in hydrology and hydraulics resulting from urbanisation will depend upon appropriate planning and design of flood mitigation and stormwater infrastructure.

Drawing upon the West Dapto Vision (2018) document, water management principles adopted within this updated strategy are detailed in Table 1.3.

Table 1.3 West Dapto Vision 2018 – Water Management Principles

No.	Water Management Principle
1	Integration of Floodplain and Stormwater Management <i>Integrate floodplain and stormwater management into the urban development process.</i>
2	Improved Water Quantity Management <i>Improve the management of water quantity relating to urban development inclusive of stormwater, wastewater, water supply and recycled water.</i>
3	Sustainable Floodplain Development <i>Create sustainable development around and within the floodplain.</i>
4	Preservation of Floodplain Function and Natural Corridors <i>Preserve the natural function of the floodplain, natural waterways and riparian corridors.</i>
5	Protection from Flooding <i>Protect people and property from flooding in a strategic way.</i>
6	Protect Water Quality <i>Protect water quality of surface and groundwater from urban development and any adverse effects on water quality to downstream watercourses and Lake Illawarra.</i>
7	Integrate Stormwater with the Environment <i>Integrate stormwater management into the natural and urban landform in an unobtrusive way.</i>
8	Efficient and Sustainable Infrastructure <i>Provide efficient and sustainable stormwater infrastructure for the urban release area.</i>
9	Preserve and Enhance the Environment <i>Preserve the natural environment and enhance where possible in keeping with stormwater quantity and quality management objectives and targets</i>
10	Promote Liveability using Water <i>Promote liveability and amenity for the community by using water in all environments.</i>

A key objective of the RCMS (2004) is the protection of riparian zones for the purposes of supporting and maintaining biodiversity for aquatic and terrestrial fauna and flora. The West Dapto Vision (2018) also seeks to strengthen this objective through the development of Environment Conservation principles, as per extract below in Table 1.4.

Table 1.4 West Dapto Vision 2018 – Environmental Conservation Principles

No.	Environment Conservation
1	Prioritise Areas That Offer High Environmental Value For Conservation <i>Consider information that identifies areas of threatened ecological communities or stands of habitat greater than 4ha (considered to present high environmental value in terms of habitat size and location) and avoid impacts as a result of land use changes to these areas.</i>
2	Connectivity Of Habitat Areas <i>Connecting patches of habitat that have high biodiversity value will provide opportunity for ecological migration over time as well as opportunity for improvement to habitat quality and values. These are more commonly known as biodiversity corridors providing strategic connection of larger and better condition patches of vegetation either by re-establishing continuous native vegetation cover or designing stepping stones of habitat that traverse local corridors..</i>
3	Protect Environmental Values <i>Provide complimentary land uses alongside conservation sites to assist in improving and protecting the ecological function of the site and enhancing its resilience. Secure areas that present high environmental value as areas for conservation and long-term management (ideally through a bio certification process).</i> <i>Figure 5 illustrates key conservation documents and their relationships. The BCS will provide the direction and framework while the BCSSP will outline the actions to guide the implementation of conservation measures. Implementation of these documents and achieving bio-certification creates opportunity to improve biodiversity values of the West Dapto Urban Release Area.</i> <i>Further detail, including environment and heritage conservation objectives, the role of West Dapto Environmental Principles, bio certification process and conservation priority areas will be developed as part of the next steps in implementing the West Dapto Vision.</i>

For consistency, the above Water Management and Environmental Conservation Principles are fundamental to the development of this Strategy. From the key principles and sub-principles, five (5) key themes for stormwater management and biodiversity have been developed:

Table 1.5 Five key themes for stormwater management and biodiversity

No.	Theme	Description
1	Preserve Existing Waterways	Preserve existing waterways and their natural features, and areas of high conservation value.
2	WSUD Water Quality Targets	Water quality targets addressed through implementation of Water Sensitive Urban Design.
3	Natural Hydrological Processes	Hydrology is natural and unobstructed; riparian zone assists in connecting habitat areas.
4	Repair Degraded Environments	Protect and repair degraded streams and riparian zones, aligned with environmental values.
5	Urban Development Integration	Integrate the riparian zone with urban development.

1.2.2 West Dapto Structure Plan

The 2018 West Dapto Structure Plan can be found within various WCC strategic documents, including Part D – Locality Based DCPs / Precinct Plans in Chapter D16: West Dapto Release Area of the Wollongong Development Control Plan 2009.

The West Dapto Structure Plan was originally developed in 2008 in response to the rezoning proposal of the West Dapto Urban Release Area, which sought the implementation of residential-specific development. As WCC progressed the development of the West Dapto Vision (2018), the structure plan was also amended in alignment with WDURA development principles and objectives. Staging and proposed centres identified in the updated 2018 West Dapto Structure Plan is depicted in Figure 1.3.

The Structure Plan is focussed on the strategic planning of urban development, and thus sets out the proposed location, type and scale of key urban infrastructure, for example arterial roads, major urban centres and employment centres.

The Structure Plan, along with the Staging Plan, provide a high-level indication of where urban development shall be located, and thus allow an understanding of how the proposed urban development shall impact on the existing riparian zones and catchments.

1.2.3 Mullet Creek Floodplain Risk Management Study and Plan (2023)

In 2023 Wollongong City Council adopted the Mullet Creek Floodplain Risk Management Study and Plan which was based on the data and assessments presented within the Mullet Creek Flood Model Update (2018). Both are representative of the Mullet Creek catchment (positioned within the WDURA) and floodplain exclusively. The primary objective for the 2023 report was threefold; to better understand flooding behaviour within the catchment, to document the flood risks that might impact on the community in such an event, and to address flood management strategies within a community risk context (WCC, 2023), and therefore the report can be utilised in the development of a targeted floodplain risk management plan.

Within the context of this report, the Mullet Creek Floodplain Risk Management Study and Plan provides an indication of flood behaviour and risk, for the majority of West Dapto / the WDURA, especially considerate of

the region's overall diverse geomorphology of very steep escarpment slopes, moderately graded rural holdings, and to relatively flat floodplains. This topographic diversity results in flood behaviour which is erratic and therefore considered high-risk. This report therefore considers these risks in the formulation of recommendations, particularly related to the categorisation of riparian zones and their associated widths which greatly impact on the how stormwaters can be managed.

1.2.4 Duck Creek Flood Study (2019)

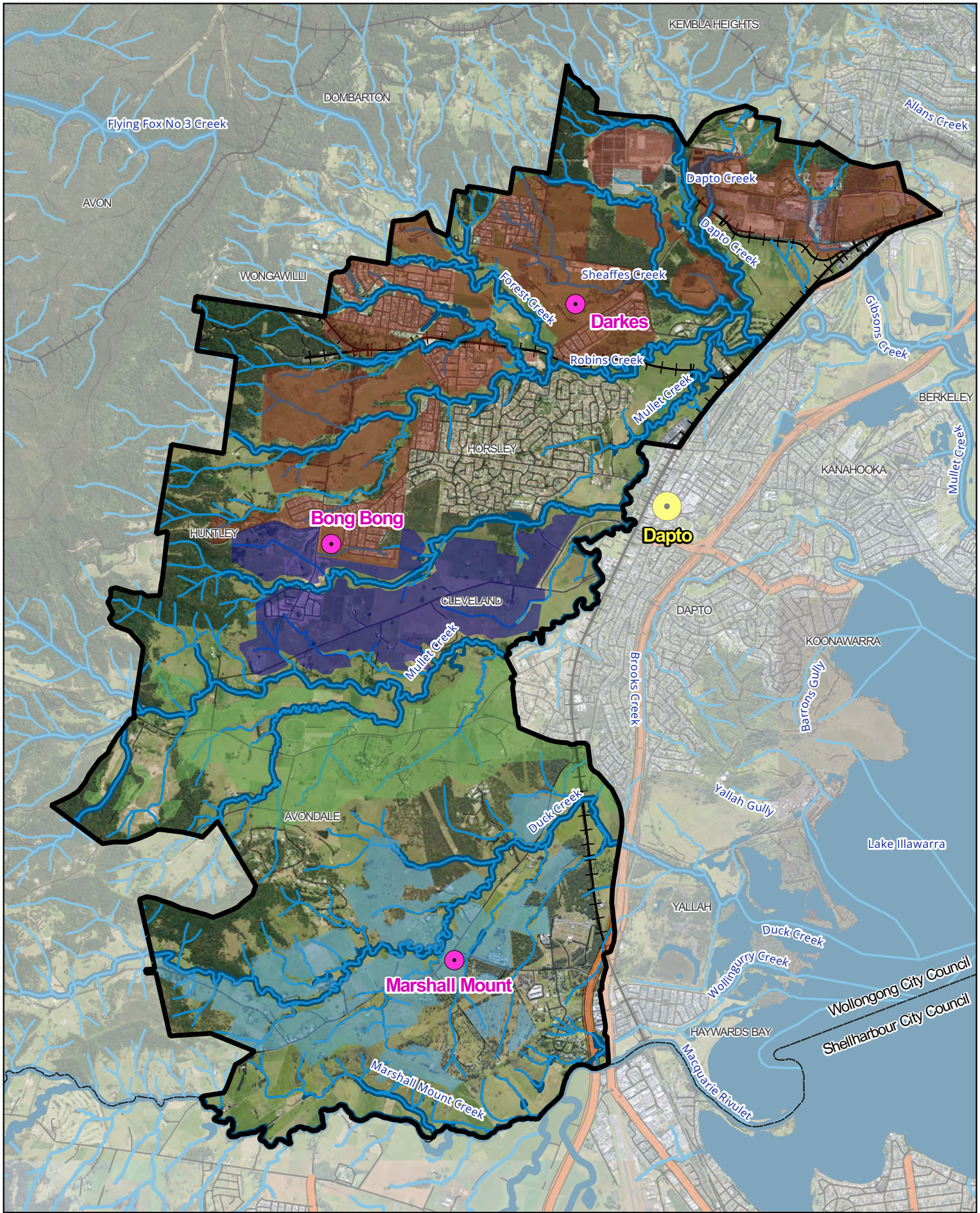
The Duck Creek Flood Study (Rhelm 2019) was prepared for Wollongong City Council to define the existing flood behaviour in the Duck Creek catchment and establish the basis for subsequent floodplain management activities. Reflecting the Mullet Creek Floodplain Risk Management Study and Plan the Duck Creek catchment can be classified into three categories (very steep escarpment slopes, moderately graded rural holdings, and to relatively flat floodplains). The study concludes macro-channels in the steep upper catchment has a high capacity for containing flood flows. Increased risk of overtopping occurs in the mid-lower catchments with cross catchment flow between creeks. Consideration of flood risks has been a primary concern in this riparian strategy review.

1.2.5 Lake Illawarra CMP (2020)

Shellharbour City and Wollongong City Councils have developed the Lake Illawarra Coastal Management Program 2020-2030 (CMP), a strategic plan designed to address the threats facing the Lake over the next decade. Among the key management actions outlined, Strategy 4: Protect and Rehabilitate Estuarine and Riparian Vegetation (EV) focuses on enhancing the health of the Lake through targeted actions. Highly relevant management actions include:

- EV1 – Rehabilitating vegetation and managing public access along the foreshore
- EV2 – Controlling damage to foreshore vegetation like seagrasses
- EV4 – Implementing programs to monitor and map estuarine macrophytes

Additionally, the strategy aims to promote vegetation migration and raise community awareness about the Lake's catchment area (EV3, EV5). These actions are critical in preserving riparian habitats and improving overall water quality, which forms a critical nexus with this riparian strategy.



 Document Set ID: 26920787 Version: 1, Version Date: 02/10/2025	Legend  WDURA boundary  Staging - West Dapto Vision  1-2  3  4  5  Centres - West Dapto Vision  Major centre  Town centre  Major road  Road / Track  Key Fish Habitat  Hydroline  Railway	Figure: 1.3 Structure & Staging (West Dapto Vision 2018) Scale: 1:50,000 @A4 GDA2020 MGA56  0 0.5 1 1.5 km	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2018, 2024 Imagery: © WCC 2024 Drawn: GD Date: 13/08/2025 Checked: DM Job ref: 241959
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1.2.6 Climate Change Adaption Plan (2022)

Declaring a climate emergency in 2019 Wollongong City Council has developed plans aiming to facilitate mitigation of and adaptation to conditions of a changing climate (WCC 2022). Riparian management has a key role to play in achieving objectives for both flood and heat risk. This includes

- Ensuring developments are considerate of projected increased rainfall intensities
- Increasing canopy cover in public spaces
- Providing habitat for translocation of threatened flora susceptible to increased temperatures

1.3 Report Objectives and Guiding Principles

Now over 20 years old, the RCMS (2004) requires a peer review in response to contemporary issues related to the WDURA with regard to evolving approaches to urban development, updated legislation and contemporary environmental issues. The review and development of the current Strategy has relied on contemporary ecological and geomorphic understanding to provide a rigorous science-based Riparian Corridor Management Strategy for the West Dapto Urban Release Area.

Wollongong City Council have developed targeted objectives for the updated RCMS, provided below in Table 1.6.

Table 1.6 Report Objectives and Guiding Principles

No.	Topic / Item	Long Description
1	RCMS contemporary review	Provide a contemporary riparian corridor management strategy for the WDURA based on a review of relevant strategies (such as Illawarra Shoalhaven Regional Plan 2041, Illawarra Biodiversity Strategy, Lake Illawarra Coastal Management Program (LICMP), floodplain risk management plans), riparian management practices and available information.
2	Integrated approach to stormwater management	Pursue an integrated approach to riparian corridor, floodplain risk and stormwater management, without causing additional flooding problems to existing flood liable development, and without compromising core riparian zones.
3	Review original principles	Review the general principles of riparian management identified within the RCMS (2004) in view of current strategies, knowledge and best practice, and update where required.
4	Review stream category management objectives	Review the riparian management objectives for each stream category identified in the RCMS (2004) and update/map these objectives where required.
5	Review minimum riparian widths per stream category	Review the minimum riparian corridor widths for each stream category as identified in the RCMS (2004) and update/map these widths where required
6	Identify priority riparian corridors against RCMS and current work	Identify the priority riparian management corridors recommended for protection, rehabilitation, and enhancement in the study area, based on the RCMS (2004) and current work.
7	Review future directions for riparian outcomes	Review the recommendations and future directions for riparian outcomes identified within the RCMS (2004), and update where required.
8	Develop implementation plan	for the final Riparian Corridor Management Strategy specific to the WDURA, including prioritised timeframes.
9	Sustainable management recommendations	Provide recommendations on how designated riparian corridors can be sustainably managed, in either private or public ownership.
10	Funding pathways	Provide recommendations on feasible funding pathways for ongoing maintenance of public/private riparian corridors.

No.	Topic / Item	Long Description
11	Transfer riparian zones to public management	Provide recommendations on how to transfer designated riparian lands into public ownership.
12	Riparian zone / urban development interface	Provide recommendations on any specific measures to ensure better interfaces between riparian corridors and developments.
13	Stakeholder engagement and awareness	Provide awareness and engage with the community and other stakeholders on the intended outcomes of this project.
14	Local Government regulatory context	Provide recommendations to update relevant Council policies including the Wollongong Local Environmental Plan (LEP), supporting documents and processes relating to riparian management, where required.
15	Guide consultants and Government on riparian corridor assessment	Provide recommendations to guide consultants and Council on the assessment of riparian corridors and waterways as part of development proposals at the Planning Proposal, Neighbourhood Planning and Development Application Stage.
16	Challenges implementing RCMS	Identify the current challenges with implementing the outcomes of the RCMS (2004) for the WDURA.
17	RCMS implementation recommendations	Provide recommendations for the successful implementation of the outcomes from the proposed strategy.

2 Riparian Land: Values and Functions

2.1 Definition of Riparian Land

The RCMS (2004) defined riparian land as:

"The transition between terrestrial and aquatic environments"

While acknowledging there are numerous broader definitions of 'riparian land', all of which in general acknowledge riparian land as that which adjoins or directly influences a body of water. The *Water Management Act 2000* (WM Act), refers to 'Waterfront Land', rather than the 'riparian zone', with the definition within the Act stating that 'Waterfront Land' is:

A: The bed of any river or lake, and any land lying between the bed of the river or lake and a line drawn parallel to, and the prescribed distance inland of the following to a prescribed distance of 40m:

- i. In the case of non-tidal waters, the highest bank or shore above the river or lake, and*
- ii. In the case of tidal waters, the mean high-water mark of the river or lake.*

The WM Act defines a river as including:

- a. any watercourse, whether perennial or intermittent and whether comprising a natural channel or a natural channel artificially improved, and*
- b. any tributary, branch or other watercourse into or from which a watercourse referred to in paragraph (a) flows, and*
- c. anything declared by the regulations to be a river*

For the purposes and within the context of this report, riparian land has been defined as:

Any land (and its associated vegetation) that adjoins, directly influences, or is influenced by a watercourse.

From an ecological perspective, the extent of riparian land is considered the landward extent of any riparian vegetation including the ecotone.

2.2 The Value and Services of Riparian Land

Riparian lands, the interfaces between land and a river or stream, play a crucial role in maintaining the health and hydrological connectivity of aquatic ecosystems. These zones are vital for the conservation of water quality as they act as natural biofilters by trapping sediment and pollutants before they reach waterways and regulate natural flows by increasing the infiltration of water into soils. Biodiversity thrives in these habitats, with many species relying on the unique ecological conditions that riparian zones offer. Furthermore, riparian lands have significant socio-economic value, supporting activities such as agriculture, fishing, and recreation, which are integral to local economies. They also provide significant ecosystem services, such as the mitigation of flood impacts (Beesley et al., 2017), carbon sequestration, and the reduction of heat island effects through urban greening, a strategy formalised in WCC's *Urban-Greening-Strategy-2017-2037* (WCC 2017).

The vegetation found in riparian areas is often robust and diverse, contributing to soil stabilisation and preventing erosion. This vegetation also plays a critical role in carbon sequestration, helping to mitigate the effects of climate change.

Riparian zones are essential biodiversity corridors in ecological landscapes, providing both aquatic and terrestrial habitats and a wide array of flora and fauna. They serve as migration routes for animals, connect different

ecosystems, and facilitate gene flow between wildlife populations, enhancing genetic diversity. Re-establishing and conserving these corridors is vital for maintaining biodiversity, ecosystem services, groundwater connectivity and the resilience of natural communities against environmental changes.

Riparian zones play a critical role in flood mitigation whereby riparian vegetation can absorb and slow runoff, reducing peak flows and downstream flooding. The effectiveness of these zones can vary, with buffers in the mid to lower catchment areas potentially offering more flood protection than upstream areas due to steeper gradients and higher flow velocities which limit bank overtopping. However, buffers also slow flows in the upper catchment whenever banks are overtopped which in turn can reduce peak flows in downstream areas. Riparian zones provide several functions beyond simply flood mitigation and these must also be considered when setting buffers.

2.3 Catchment and Riparian Processes

Catchment processes operate at different scales and catchment character is a reliable predictor of stream condition, even more so than the presence of riparian vegetation.

Simply creating riparian zones without consideration of catchment could mean that objectives related to flooding, geomorphology, biodiversity and water quality may not be achieved. For example, sediment budgets (i.e. sediment added to or transported from the watercourse) will change as land use changes, typically agricultural land will have higher sediment yield and the transition to urban land use will alter this yield, with potentially a substantial increase in sediment transport during the construction phase followed by a decline in the occupation phase.

Multiple spatial scales must be considered when planning for catchment health. Planning which only considers an individual stage of land development may fail to appreciate cumulative impacts on water quality, sedimentary processes, hydrology and biodiversity encapsulated by the entire catchment. Natural hydrological conditions shape and alter stream morphology, transport sediments and create the variety of in stream features including pools, riffles and bars that characterise a stream (Vietz et al., 2014). These conditions also maintain floodplain connectivity and therefore the character of the riparian zone. This variability is responsible for the complexity and rich biodiversity associated with these "riverscapes". The components of a healthy riparian zone are illustrated in Figure 2.1.

2.4 Role of Riparian Land for Enhancing and Maintaining Biodiversity

Headwater streams can represent more than 70 percent of total stream channel length (Leopold et al., 2020) and on this basis the reduction in waterway buffers associated with 1st and 2nd order streams due to a tendency to perceive streams as linear systems can be detrimental to biodiversity outcomes by reducing protection of upland areas, (Clarke et al., 2008). The density of streams at this scale, combined with possibly high levels of endemism, mean that lower order (headwater and upland) streams potentially make a disproportionate contribution to biodiversity outcomes (Finn et al., 2011). The prevailing practice of reducing riparian buffers for lower order streams as identified by the Strahler method may place headwater streams at greater risk of biodiversity loss than higher order stream due to closer interfaces with adjoining terrestrial areas (Lowe and Likens, 2005).

Landscape ecology involves the patterns and interactions between ecosystems within a region. It includes the way such interactions affect ecological processes, especially the unique effects space acts on these interactions

(Clark, 2010). In the context of riparian landscape within the WDURA, the focus is on:

- Distribution patterns of landscape elements and ecosystems
- Movement patterns of biodiversity and water throughout the area

Enhancing the degree of connectivity between remaining habitat patches is essential and well-established for the conservation of biodiversity at a landscape scale (Diamond, 1975; Forman, 1995; Parker *et al.*, 2008). In doing so, establishment and maintenance of corridors is widely accepted (Osborn and Parker, 2003; Parker *et al.*, 2008). Within the context of an urbanising landscape riparian corridor provide a clear and obvious means to re-establish or improve such connections where structural and functional ecological connectivity have been degraded and fragmented by disruption to traditional land owner management practice in land use since European arrival. Within the WCC LGA two dominant habitat features exist immediately east and west of the WDURA (i.e. Lake Illawarra and the Illawarra escarpment respectively). These two features however remain directly linked by the three catchments draining from escarpment to lake. Therefore, it is clear that ecological co-benefits emerge from the establishment of suitable riparian corridors across the WDURA.

Results of a study developing a conceptual model of ecological connectivity in the neighbouring Shellharbour LGA Parker *et al.* (2008) reveal that:

“Riparian habitat has a particularly significant role to play in achieving connectivity between terminal habitat patches. Such areas, originally set aside during subdivision, were commonly found to possess superior levels of habitat quality and continuity”.

Focal species – minimum patch and linkage requirements

Two main approaches to establishing corridors are employed by landscape ecologists and managers. Firstly, a surrogate species approach focusing on managing the corridor for a small number of target species. In doing so, it is expected that benefits will flow to additional species and the wider community. However, it is acknowledged that selection of the most sensitive species or group of species in a given area is fraught with complexity (Parker *et al.*, 2008). The second option is a broad-brush approach whereby the aim is to maximise continuity and condition of habitat benefits suit a wide range of species. Whilst species benefits may not be evenly distributed, the broad-brush approach aims to restore the pre-disturbance condition of habitat. In doing so, it efficiently provides habitat requirements of the whole ecological community.

Given the strategic nature of riparian management in the WDURA (with ~165km of mapped hydrolines) a broad-brush approach is deemed most appropriate. This, however, does not preclude targeted management for sensitive species at a finer scale.

A broad-brush approach to connectivity is reflected in the *Illawarra Shoalhaven Habitat and Connectivity Modelling to Support Regional Planning* (DCCEEW 2023a) which utilises key habitat metrics in creating a connectivity model throughout the WDURA. This has classed native vegetation in five categories based on functionality as fauna settlement, living and breeding, or dispersal and movement through the landscape. The modelling is based on the findings of many studies of native fauna and how they use and move through native habitat in fragmented landscapes. As well as fauna habitat connectivity values, smaller patches of native vegetation have been shown to be critically important for the conservation of all biodiversity (Lindenmayer, 2019, Wintle et al., 2019).

Principles identified in a systematic review of field-based studies (Doerr et.al., 2010; 2011) reveal the following: Native fauna sensitive to habitat fragmentation are more likely to use areas as ‘settlement habitat’ with patch sizes of $\geq 10\text{ha}$. Movement between ‘settlement habitat’ patches are more likely with patch separation of $\leq 1.1\text{km}$. Smaller stepping-stones are more likely to be used by fauna for dispersal if gaps between stepping stones are $\leq 100\text{m}$.

Unsurprisingly, riparian corridors hold substantial value in the modelling reflecting the relatively lower levels of clearing on riparian lands compared to the surrounding environment.

Threatened species and Threatened Ecological Communities (TECs) associated with riparian lands

Ecological communities modelled to exist in the area prior to clearing are provided in Table 2.1. Modelling of pre-clearing vegetation in the WDURA shows habitat for 19 Plant Community Types (PCTs) of which 14 conform to TECs. Overlaying riparian lands on the modelled PCTs highlights the potential of restored riparian corridors to support a diverse array of ecosystems including those listed as threatened. In this regard a broad-brush approach to riparian corridor management restoring pre-disturbance conditions will likely have strong benefits for TECs and sensitive species.

Table 2.1 Modelled pre-European vegetation communities and alignment with associated TEC in the WDURA

PCT (modelled pre-clearing)	NSW listed TEC	Federal listed TEC	Modelled Area (ha)
3013 - Illawarra Lowland Subtropical Rainforest	Yes	Yes	0.18
3036 - South Coast Warm Temperate-Subtropical Rainforest	Yes	Yes	29.33
3056 - Central Eastern Ranges Riparian Dry Rainforest	Yes	-	66.04
3077 - Illawarra Complex Dry Rainforest	Yes	Yes	241.28
3078 - Illawarra Lowland Wet Vine Forest	Yes	Yes	491.1
3153 - Illawarra Escarpment Bangalay x Blue Gum Wet Forest	-	-	269.24
3154 - Illawarra Blackbutt Moist Forest	-	-	1.76
3213 - Illawarra Southern Escarpment Wet Forest	-	-	0.09
3327 - Illawarra Lowland Red Gum Grassy Forest	Yes	Yes	1629.24
3330 - South Coast Lowland Woollybutt Grassy Forest	Yes	Yes	837.46
3598 - Woronora Plateau Scribbly Gum Woodland	-	-	0.35
3872 - Illawarra Basalt Melaleuca Scrub	Yes	-	25.77
3975 - Southern Lower Floodplain Freshwater Wetland	Yes	-	6.49
4009 - Shoalhaven Lowland Flats Wet Swamp Forest	Yes	-	785.05
4020 - Coastal Creekflat Layered Grass-Sedge Swamp Forest	Yes	Yes	39.72
4027 - Estuarine Swamp Oak-Mangrove Forest	Yes	Yes	7.95
4028 - Estuarine Swamp Oak Twig-rush Forest	Yes	Yes	11.74
4049 - South Coast Floodplain Grassy Swamp Forest	Yes	Yes	234.25
4084 - Southern Escarpment River Oak Forest	-	-	29.35

2.5 Impacts of Urbanisation on Waterway Health

It is well established stream condition is strongly determined by prevailing land use, with even small amounts of urban development are known to influence stream hydrology and geomorphic condition (Vietz et al., 2014). Adverse impacts include:

- Changes in sediment regime which can either deprive a waterway of sediment required to maintain geomorphic processes, or an excess of sediment which can smother in stream habitats
- Increases in the volume and intensity of stormwater discharge leading to scour of creek bed and banks
- Reduced infiltration to groundwater with adverse effects for groundwater dependent ecosystem
- Changes in water quality, salinity and turbidity with adverse effects for instream biota
- Loss of biodiversity within riparian corridors due to loss of linkages, edge effects, weed incursion and introduction of feral animals

The variety and variability seen in riparian zones are linked to broader catchment conditions with human activities often reducing heterogeneity and complexity. The challenge then is to manage urban development while not compromising the ecological, geomorphic and hydrological function of waterways (Walsh et al., 2012).

Urban land use often represents only a small proportion of the majority of a stream's catchment but exerts a significant influence over catchment processes. Further at the local scale, urbanisation is often the major influence on stream health. Increased imperviousness within a catchment as a result of urbanisation is a reliable predictor of a reduction in instream values including fish assemblages, macroinvertebrate richness, weed presence and weed cover. Decoupling these impacts from land development is a key priority for urban designers. Changes that urban land use exert on a waterway are shown schematically and described in Figure 2.2, while the trajectory of a stream from intact, to degraded to restored is represented in Figure 2.3. This figure also includes buffer requirements consistent with Stream Category One (refer to Section 2.6 below).

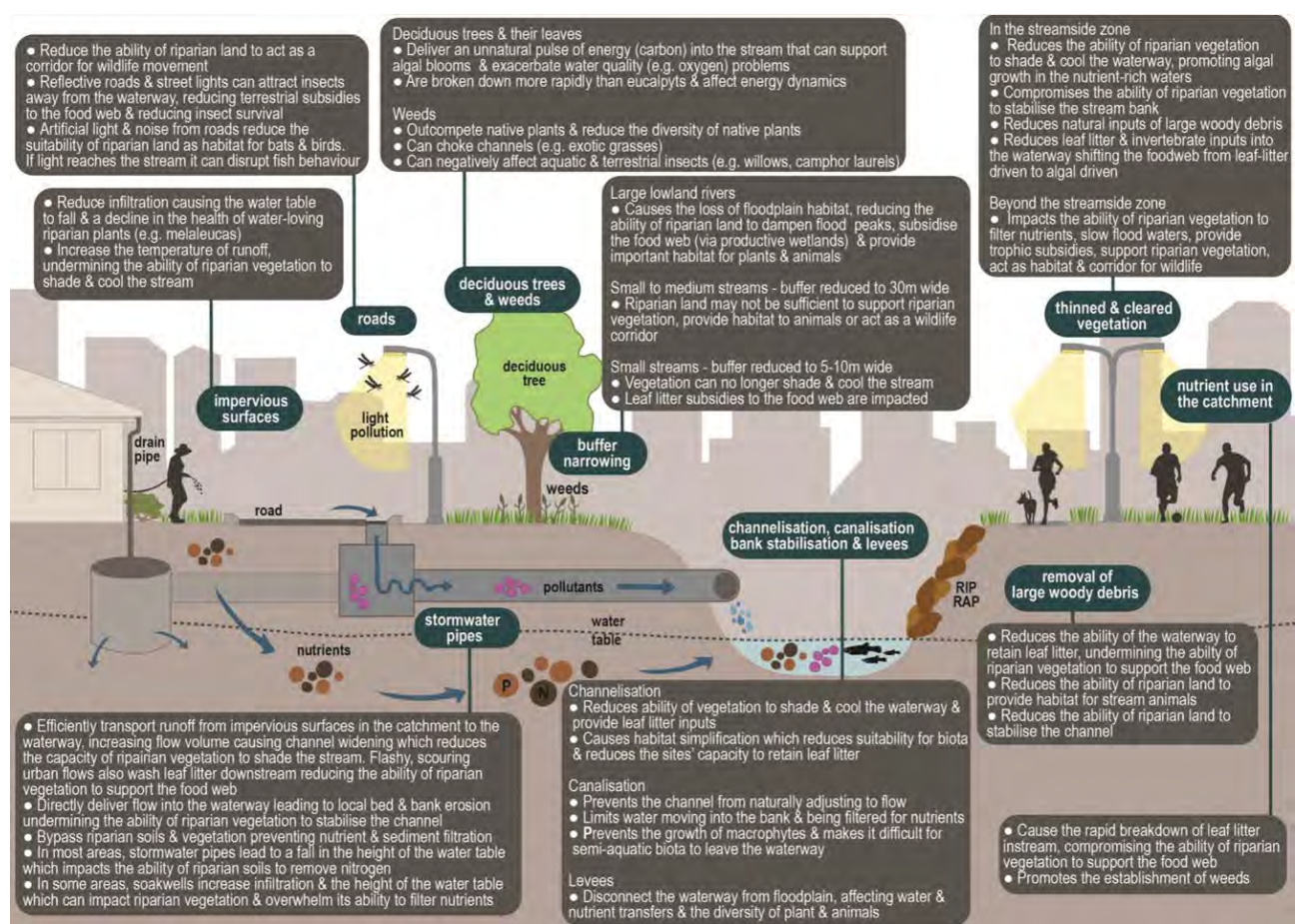


Figure 2.2 Schematic depiction of a degraded urban stream (Source Beesley et al., 2017)

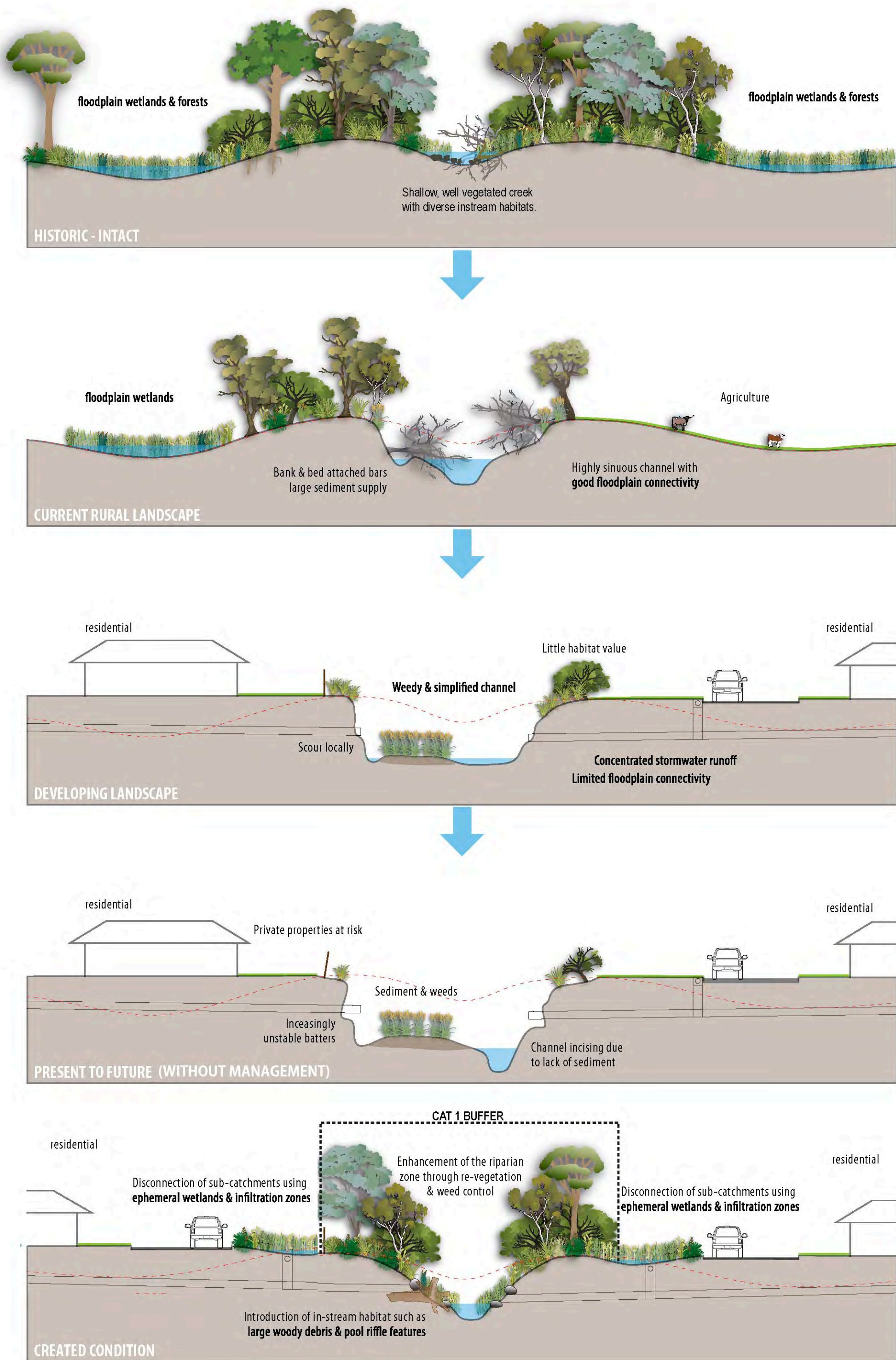


Figure 2.3 Morphological trajectory

2.6 Stream Categories & Objectives

The RCMS (2004) established three stream categories based on characteristics and objectives. In operation for over 20 years these categories are incorporated into numerous local and regional planning policies and documents. In urban development where these categories have been implemented, the resulting outcomes are widely acknowledged to be positive. Table 2.2 details the category objectives, with further descriptions provided in Section 3 of the 2004 RMCS. A new objective for each stream category has been added to Table 2.2 to acknowledge community feedback received for the protection and enhancement of cultural values of waterways and their riparian corridors..

Table 2.2 Summary of category objectives

Category	Objectives
1 Environmental Corridor	Maximise the protection of terrestrial and aquatic habitat to: • Provide a continuous corridor width for the movement of flora and fauna • Provide extensive habitat (and connectivity between habitat nodes) for terrestrial and aquatic fauna • Maintain the viability of native riparian vegetation • Manage edge effects at the riparian/urban interface • Provide bank stability Protect water quality Protect and enhance the cultural values (of the waterway and riparian corridor) Requirement 40m minimum core riparian zone + 10m minimum vegetated buffer from top of bank
2 Terrestrial & Aquatic Habitat	Maintain/restore as much as possible the natural functions of a stream to: • Maintain the viability of native riparian vegetation • Provide suitable habitat for terrestrial and aquatic fauna • Provide bank stability Protect water quality Protect and enhance the cultural values (of the waterway and riparian corridor) Requirement 20m minimum core riparian zone + 10m minimum vegetated buffer from top of bank
3 Bank Stability & Water Quality	Minimise sedimentation and nutrient transfer to: • Provide bank stability • Protect water quality Protect native vegetation Protect and enhance the cultural values (of the waterway and riparian corridor) Requirement 10m minimum vegetated buffer from top of bank

2.7 Principles of Riparian Management

The RCMS (2004) identifies 13 riparian management principles. These are provided in Table 2.3 below with commentary. The commentary aims to provide further understanding and context to the aim to deliver on the stream category objectives detailed in section 2.6.

Table 2.3 Commentary on RCMS (2004) general riparian management principles

RCMS principle	Comment
1. Decision making should be undertaken within the context of objectives set for riparian land which recognise their environmental and cultural significance.	Fundamental to the implementation of riparian corridor strategies
2. Adequate set back between riparian land and new development is to be provided.	To achieve stream category objectives minimum riparian buffers are required. Buffer distances supported by this review are considered the minimum to achieve the stated objectives. Any encroachment should be compensated for within the conflicting development as near to the encroachment as practicable.
3. Asset Protection Zones are to be located within the defined limits of the development site and not be located in the riparian zone.	Standard expectation for all environmental assessments is that the development footprint includes all impacts related to the development. There may be scope for encroachment (and compensation within the development area) of an Asset Protection Zones with minimal management requirements (e.g. outer zone of an Asset Protection Zone) as preferential to the asset where full avoidance cannot be achieved. A discussion of the scope for encroachment would only be considered in exceptional circumstances and would not apply to any riparian land proposed to be dedicated to the Council.
4. Subdivisions (via perimeter roads) and new development should front onto riparian land and not back onto it.	This achieves a reduction in indirect impacts, provides access for riparian management and opens riparian land for community benefit.
5. Wherever possible services should be located on the outer edge of the riparian corridor.	As per Principle 3, all infrastructure associated with development is expected to avoid impacts to the riparian corridor. Where service crossings of watercourses are necessary, measures must be taken to ensure impacts on the riparian function are minimised.
6. Limit crossings of the riparian corridor to maximise connectivity.	Riparian corridors exist as the most valuable connectivity features as discussed in section 2.4. Fragmenting features including roads and services directly reduce the value riparian lands serve to the WDURA and surrounding landscape.
7. Consider alternative means of crossings e.g. direct drill for pipelines, piered crossings for roadways.	All infrastructure associated with development is expected to avoid impacts to the riparian corridor. Where service crossings of watercourses are necessary, measures must be taken to ensure impacts on the riparian function are minimised.

RCMS principle	Comment
8. Locate bike and walking tracks sensitively so they do not compromise the integrity of the riparian corridor.	Active transport features can provide a low impact option to movement in the region while also providing connection with nature. Alignments of such features need to adhere to the principles and not affect the stream category objectives. This includes preferential avoidance of the core riparian zone or additional design features to reduce impacts.
9. Stream bank stability to be promoted by retaining and establishing well vegetated riparian zones.	Vegetation is key to healthy riparian corridors, for habitat provision, water quality and bank stability. For best results vegetation must reflect the structure and diversity of the indigenous plant community(s) at the location.
10. If required, stream bank stabilisation works should be of a soft-engineered design with the regeneration and/or rehabilitation of appropriate local native riparian vegetation and ecological amenity.	Hard engineering features generally fail to deliver water quality and habitat objectives. Soft engineering including revegetation works enable achievement of bank stability, water quality and habitat. Where hard engineering features are required these should occur only as a last resort and in combination with revegetation.
11. Water quality treatment should occur prior to surface water runoff entering the riparian land (where possible sediment/litter runoff needs to be resolved at source).	As per Principle 3 all infrastructure and impacts related to a development is expected to avoid or minimise impacting the riparian corridor (incl indirect impacts). WSUD principles as per DCP Chapter E15 are a key method to meet water quality objectives.
12. Water quantity and quality treatment controls (eg flood storage structures, constructed wetlands, gross pollutant traps) should not be located on a watercourse or within the core riparian zone and vegetated buffer.	As per Principle 3 all infrastructure and impacts related to a development is expected to avoid or minimise impacting the riparian corridor (incl indirect impacts). WSUD principles as per DCP Chapter E15 are a key method to meet water quality objectives.
13. Access to the watercourse should be at strategic locations where the ecological integrity of existing riparian vegetation and stream bed and bank stability will not be compromised.	Considerations include but not limited to: direct impacts, fragmentation, shading and key ecological values.

3 Planning and Legislative Context

3.1 Introduction

Management of riparian zones sits within a hierarchy of policy and legislation and the Riparian Strategy must work within these parameters. The majority of applications will follow the local development pathway under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which is the overarching legislation guiding land use planning in New South Wales. Subsidiary legislation and policies address specific matters relating to waterways, fish habitat, biodiversity, stormwater management and flood risk and must be considered in combination. Council is generally the assessor of Part 4 applications however work in and around waterways will typically trigger the need for concurrence approvals from NSW State departments.

Table 3.1 Relevant federal legislation

Legislation	Relevance
<i>Environmental Protection & Biodiversity Conservation Act 1999</i> (EPBC Act)	
The EPBC Act is a federal piece of legislation used to protect Matters of National Environmental Significance (MNES). The act is administered by the Federal Government's Department of Climate Change, Environment, Energy and Water (DCCEEW).	Many flora and fauna species and threatened ecological communities within West Dapto are listed under the EPBC Act and an impact on these entities may need approval for a Controlled Action. MNES can be triggered even in instances where Council and State agencies have approved an application.
<i>Biosecurity Act 2015</i>	
The <i>Biosecurity Act 2015</i> aims to manage biosecurity risks, including invasive species, to protect the environment, agriculture, and human health. It is particularly relevant to riparian corridors by regulating the control and eradication of aquatic weeds, which can harm water quality, biodiversity, and ecosystem health. The Act provides a framework for managing invasive species like water hyacinth, salvinia, and alligator weed, through monitoring, removal, and treatment efforts. By preventing the spread of these weeds, the Act helps maintain the ecological integrity of riparian zones, ensuring the survival of native vegetation and aquatic habitats.	More relevant to construction and occupation phases, however will also inform preparation of site-specific plans such as Vegetation Management Plans (VMPs).

Table 3.2 Relevant NSW legislation

Legislation	Relevance
<i>Environmental Planning and Assessment Act 1979</i> (EP&A Act)	
The EP&A Act is key in regulating land use and development within NSW. Through environmental impact assessments and the use of Local Environmental Plans (LEPs), the EP&A Act plays a role in minimizing degradation of riparian zones during land development. The EP&A Act 1979 and associated Regulations do not explicitly reference "riparian" areas or "riparian corridors." However, the Act provides a framework for the environmental assessment of development proposals, within which potential impacts to watercourses may be considered. Protection of riparian values is typically achieved through statutory planning instruments such as Local Environmental Plans (LEPs) and Development Control Plans (DCPs), rather than directly through the Act itself.	This is the overarching legislation which provides the framework for environmental planning and assessment. Most development applications within the WDURA will follow the development pathway detailed within Part of the EP&A Act.

Legislation	Relevance
<i>Water Management Act 2000 (WM Act)</i>	
The WM Act governs the allocation and management of water resources in New South Wales, ensuring that water is used sustainably and equitably. The key regulation made under the WM Act is the <i>Water Management (General) Regulation 2018</i> , which establishes specific procedures, exceptions and approvals for control activities which have the potential to impact the State's water resources. In terms of riparian corridors, the Act supports the protection of water flows and water quality in rivers, streams, and wetlands, which are essential for maintaining the health of riparian zones. By setting minimum riparian buffer extents, it helps protect the ecological function of riparian ecosystems.	Any proposed works either instream or within the riparian zone will require consideration under this act and possibly submission of a Controlled Activity Application. Riparian buffers are guided by stream order, with the Strahler system shown in Schedule 2 of the Water Management Regulation and associated buffers for each stream order detailed within Controlled activities – Guidelines for riparian corridors on waterfront land (DPE, 2022)
<i>Fisheries Management Act 1994</i>	
The <i>Fisheries Management Act 1994</i> regulates the sustainable use of fisheries resources in NSW and is important for riparian corridor management as these areas are critical habitats for many fish species. The Act establishes rules for conserving aquatic ecosystems and protecting the habitats of native fish species, many of which rely on riparian zones for spawning, feeding, and shelter. Through the regulation of fishing practices, habitat protection, and the restoration of riparian vegetation, the Act contributes to the conservation of biodiversity in riparian corridors, ensuring healthy fish populations and aquatic ecosystems.	In-stream works that interfere with stream beds or banks, create obstructions (e.g. culverts, weirs, levees), or alter hydrology may significantly impact fish habitats. Such activities may require referral or Part 7 permit under the Act to ensure that potential environmental impacts are properly assessed and mitigated, protecting riparian ecosystems and their biodiversity.
<i>Biodiversity Conservation Act 2016 (BC Act)</i>	
The BC Act focuses on the protection and management of biodiversity in NSW, with a key emphasis on conserving threatened species and ecosystems. The Act provides tools for the management of riparian corridors as critical habitats, especially in areas where native species are at risk. It facilitates the restoration of riparian vegetation through biodiversity conservation agreements and offsets, supports landholders in managing and protecting biodiversity on their properties, and helps ensure that riparian corridors are preserved and enhanced as part of broader conservation strategies.	Much of the vegetation associated with riparian corridors contains threatened ecological communities (TECs) and or is habitat for threatened flora and fauna. An ecological assessment will almost always be required, with the type of assessment determined by several factors including proposed works within Biodiversity Values (BV) mapped land, exceedance of clearance thresholds or other prescribed impacts.
<i>Local Land Services Act 2013</i>	
The <i>Local Land Services Act 2013</i> empowers Local Land Services (LLS) to provide advice and support to landholders on sustainable land management, biosecurity, and conservation. In managing riparian corridors, the Act assists landholders in maintaining healthy riparian zones through programs that encourage vegetation restoration, erosion control, and biodiversity conservation. It also supports riparian management by promoting best practices in land use, such as fencing waterways to prevent livestock access and planting native vegetation to protect the integrity of riparian ecosystems.	Strategic revegetation and exclusion of livestock in peri-urban riparian areas of the WDURA .
<i>Protection of the Environment Operations Act 1997 (POEO Act)</i>	
The POEO Act focuses on preventing pollution and managing environmental harm in NSW. It plays a critical role in protecting riparian corridors by regulating activities that may pollute waterways, such as industrial discharges, waste management, and	More relevant to construction and occupation phases of development.

Legislation	Relevance
agricultural runoff. The Act empowers regulators to enforce pollution control measures, ensuring that riparian zones are safeguarded.	
<i>Rural Fires Act 1997</i>	
The <i>Rural Fires Act 1997</i> provides for the co-ordination of fire prevention, mitigation and suppression measures in rural fire districts focused on the protection of infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires. In doing so, the Act requires certain activities to be carried out having regard to the principles of ecologically sustainable development.	Development located in a mapped bushfire zone must gain concurrence of the RFS.
<i>State Environmental Planning Policy (Biodiversity & Conservation) 2021</i>	
SEPP (BC) aims to protect the amenity and biodiversity values of native vegetation in non-rural areas of the State. The SEPP includes a strong focus on Koala habitat protection in both rural and non-rural zoned areas (Chapters 3 and 4 respectively), aiming to encourage proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline	Vegetation clearing for development particularly within areas designated as core Koala habitat.
<i>State Environmental Planning Policy (Resilience & Hazards) 2021</i>	
SEPP (R&H) aims to promote an integrated and co-ordinated approach to land use planning in the coastal zone in a manner consistent with the objects of the <i>Coastal Management Act 2016</i> , including the management objectives for each coastal management area, by— (a) managing development in the coastal zone and protecting the environmental assets of the coast, and (b) establishing a framework for land use planning to guide decision-making in the coastal zone, and (c) mapping the 4 coastal management areas that comprise the NSW coastal zone	Relevant for developments causing direct or downstream impacts to coastal wetlands and littoral rainforest as well as impeding the successful implementation of plans and strategies for coastal management in the region.

Table 3.3 Relevant local legislation, planning instruments and documents

Legislation	Relevance
<i>Wollongong Local Environmental Plan 2009 - 7.4 Riparian lands</i>	
(1) <i>The objective of this clause is to ensure that development does not adversely impact upon riparian lands.</i> (2) <i>This clause applies to land shown as “riparian land” on the Riparian Land Map.</i> (3) <i>Despite any other provision of this Plan, development consent must not be granted for development on land to which this clause applies unless the consent authority has considered the impact of the proposed development on the land and any opportunities for rehabilitation of aquatic and riparian vegetation and habitat on that land.</i>	The primary function of the LEP is to control if and/or what development can occur within a local government regulated land zone, in this instance the reference to riparian land. Further, the regulation stipulates no development shall occur, unless the respective authority has provided consent. In many instances within NSW, riparian land is regulated by the NSW State Government WM Act, where works to ‘waterfront land’, typically riparian zones, is regulated. Riparian Land is mapped on the LEP Riparian Lands Map.
<i>Wollongong Development Control Plan 2009 - Chapter D16: West Dapto Release Area</i>	

Legislation	Relevance
<i>The objectives of this chapter are to:</i> <i>enable the development of the West Dapto Urban Release Area for residential, employment, industrial and environmental conservation areas in a manner consistent with the Wollongong LEP 2009 the West Dapto Vision 2018 and the West Dapto Structure Plan (Figure 2).</i> <i>ensure development incorporates the principles of Ecologically Sustainable Development, promoting the retention and enhancement of the area's unique environmental features, to shape the desired future urban setting.</i> <i>support the provision of safe and efficient road networks that promotes long term sustainability and active transport, with public transport services linking surrounding areas.</i> <i>implement Water Sensitive Urban Design (WSUD) for effective water management and protect development in the area from flooding.</i> <i>recognise the existing environmental and landscape qualities of the release area and establish future urban characteristics to shape ongoing development.</i> <i>protect, conserve and enhance riparian and environmentally sensitive areas and only allow for development compatible with the conservation values of these areas.</i> <i>protect areas of high scenic value, notably the Illawarra Escarpment and Lake Illawarra with developments that contribute and promote the areas visual and aesthetic values.</i> <i>conserve and enhance the environmental, cultural and built heritage of West Dapto.</i> <i>guide the development of open space to meet future community needs and facilitate a network of open space connected by off road cycleways and shared paths throughout the release area.</i> <i>ensure that development in the Darkes Road, Bong Bong and Marshall Mount town centres contributes to the creation of retail, business, commercial and community hubs and provides significant local employment and community service opportunities.</i> <i>provide village centres with localised businesses and higher density residential opportunities at key places or intersections where bus stops, community facilities and open space come together as local urban focal points.</i> <i>ensure the community's social and cultural needs are met through the provision of a range of community facilities across the release area (co-located with other facilities in 'hubs', creating urban focal points).</i> <i>guide planning and development of well-located schools, childcare centres, and adult education facilities to support the community's educational needs.</i> <i>stimulate diversity in development types and styles to provide a range of different dwellings to increase housing choice and design quality in the Illawarra.</i> <i>ensure safe, secure, liveable, and resilient urban environments are established considering future climate and other potential environmental vulnerabilities.</i> <i>improve employment opportunities and economic growth in the Illawarra region whilst ensuring that commercial and industrial development is ecologically sustainable, energy efficient and of a high design standard.</i>	This DCP chapter was specifically implemented to control the proposed urban development within the WDURA and relates to the objectives and principles identified within the 2018 West Dapto Structure Plan. The DCP chapter covers a broad array of urban design criterium, from employment creation through to the communities' cultural requirements, for example. There are several items which relate to riparian zone management, including: • Urban development which is ecologically sustainable. • Water Sensitive Urban Design (WSUD) integration. • Protect and enhance riparian areas. • Ensure safe urban environments. The Riparian Corridors categories are mapped on the DCP Riparian Corridors Map.

Legislation	Relevance
Wollongong Development Control Plan 2009 - Chapter E23: Riparian Land Management	
<i>The objectives of this DCP Chapter are to:</i> <i>a) Protect watercourses, banks and riparian corridors and improve their environmental, ecological and hydrological function and stability.</i> <i>b) Protect and enhance native riparian vegetation and associated habitat.</i> <i>c) Protect and enhance the viability of threatened ecological communities and threatened species.</i> <i>d) Minimise the number and environmental impact of new waterway crossings to maximise connectivity.</i> <i>e) Enhance the aesthetic qualities and educational values of local creek landscapes.</i> <i>f) Ensure riparian management is compatible with, and does not adversely affect, floodplain risk management objectives in urban areas.</i> <i>g) Maintain or improve water quality; and</i> <i>h) Protect and enhance the cultural values of riparian corridors.</i>	The primary objective of this DCP chapter is to document Council's development requirements, to minimise impacts to riparian lands, including within riparian zones or adjacent riparian zones.
Illawarra Shoalhaven Regional Plan 2041	
<i>Summary of the Regional Plan > Themes:</i> <i>1. A productive and innovative region</i> <i>2. A sustainable and resilient region</i> <i>3. A region that values its people and places</i> <i>4. A smart and connected region</i>	The Illawarra-Shoalhaven Regional Plan 2041 guides the sustainable development and growth of the region through strategic urban management, including land use planning. The plan plays a critical role in integrating riparian protection and water quality outcomes into development. Strategy 11.1 promotes the preservation of riparian corridors, enhancing water quality and mitigating flood risks. Strategy 11.5 supports waterway management through the Risk-Based Framework, ensuring the long-term health of the region's water resource.
Lake Illawarra Coastal Management Program 2020–2030 (LICMP)	
The LICMP is a long-term strategy for the coordinated management of the Lake. It includes a set of actions to reduce threats to the Lake.	The LICMP is a long-term management plan which encompasses a range of management actions designed to protect the ecological and environmental qualities of the Lake, including Strategy 4: Protect and Rehabilitate Estuarine and Riparian Vegetation (EV).
2018 West Dapto Vision	
The 2018 West Dapto Vision plans for the creation of interconnected, sustainable communities set within the natural landscape of the Illawarra Escarpment and riparian corridors. Over a 50-year period, the area will accommodate around 19,500 new dwellings, supported by essential infrastructure, diverse housing, employment areas, and integrated strategies to protect environmental and cultural values.	The Water Management Principles in the West Dapto Vision emphasises the preservation of riparian corridors as part of integrated water management. It recognises their role in maintaining natural floodplain functions, protecting water quality, and supporting ecological connectivity within urban development. The Conservation Principles in the West Dapto Vision guide sustainable development by prioritising the

Legislation	Relevance
	protection of high environmental value areas, enhancing biodiversity corridors, and preserving ecological and cultural heritage, including riparian and habitat connectivity.
Wollongong Local Strategic Planning Statement 2020	
The Wollongong Local Strategic Planning Statement 2020 outlines a 20-year vision for land use planning in the Wollongong Local Government Area (LGA). In light of an anticipated 47,000 new residents over the next 20 years, the plan anticipates the challenge of protecting the areas unique escarpment and coastal landscapes.	The Wollongong Local Strategic Planning Statement 2020 guides urban development applications by ensuring alignment with long-term land use priorities. It influences zoning, infrastructure planning, and environmental protections, to ensure sustainable growth. Developer applications must demonstrate compliance with the plans stated objectives including those related to protection of the environment.
Wollongong Community Strategic Plan 2032	
The Wollongong Community Strategic Plan - Our Wollongong Our Future 2032 establishes a 10 year collective vision for safeguarding the natural environment and promoting sustainable development. It sets objectives across key areas such as environmental protection, economic innovation, urban vibrancy, community health, and accessible transport, aligning with broader regional and state priorities to ensure integrated and effective planning for future growth and resilience.	The Community Strategic Plan highlights key objectives relevant to riparian corridor management and West Dapto's urban growth. Objective 1.1 focuses on community involvement in preserving and enhancing waterways and green corridors. Objective 1.2 emphasises the management of land and water health, including creeks and lakes. As West Dapto develops (Objective 1.6), integrating these environmental goals into urban planning will ensure that urban expansion respects and enhances the natural ecosystems, balancing growth with environmental preservation.

3.2 Legislation Relevant to Flood Management

In New South Wales, several key pieces of legislation and guidelines address flooding and flood risk management:

- *Environmental Planning and Assessment Act 1979* (EP&A Act): This act includes provisions for considering flood risks in land use planning and development assessment.
- *State Emergency and Rescue Management Act 1989*: Outlines responsibilities for flood emergency management.
- *Flood Risk Management Manual*" (2023 - DPE: Provides guidelines for managing flood-prone land, including risk assessment and mitigation measures.
- *NSW Flood Prone Land Policy*: Focuses on managing flood risks through land use planning and development controls.

The relevance to the current strategy is to ensure that actions within waterways have no adverse impact on flooding, and that planning of new urban areas allows for assumptions made within the RCMS with regard to riparian zones, vegetated buffers.

4 Catchment Characteristics

4.1 Geomorphic Assessment Methods

Central to an updated strategy is to characterise streams across the study area, their function, condition and trajectory and therefore appropriate levels of protection and management. Waterways have been assessed at multiple scales of catchments and reaches, noting most of the waterways discharge into Lake Illawarra and so at the broadest scale comprise a single catchment.

Building upon RiverStyles prepared by the NSW Department of Planning and Environment (DPE, 2023), streams have been categorised for condition, capacity for recovery and prioritisation for management. RiverStyles is a geomorphic assessment method used to define waterways according to valley setting, planform, bed materials and assemblage of geomorphic units and is a valuable whole of catchment assessment (DPE, 2023). Additional geomorphic assessment has been completed within the Lake Illawarra Risk-Based Framework (DCCEEW, 2024).

For this report, rapid assessments have been completed at selected (12) locations using the AUSRIVAS physical assessment protocol to gain an understanding of condition and key management issues operating throughout the WDURA study area. Parameters assessed included valley shape, floodplain features, vegetation type and composition, bed and bank characteristics and instream habitat features. While not a comprehensive assessment of all waterways, the assessment is considered sufficient to ground truth mapping observations and confirm the range of conditions, geomorphic processes and threats present across the study area.

4.2 Managing Floodplain Risk

The most recent flood studies completed in the study area are the Mullet Creek Floodplain Risk Management Study and Plan (Rhelm, 2023) and the Duck Creek Flood Study (Rhelm, 2019).

Chapter D16 of the Wollongong DCP aims to minimise flood risk, support flood resilience and adaptation and protect environmental assets. From this information the defined flood event (DFE), 1% Annual Exceedance Probability (AEP), probable maximum flood (PMF) and flood planning area (FPA), have been incorporated into riparian zone assessment layers for Mullet and Duck Creek as they are a key consideration in the assessment of riparian corridors. In delineating riparian corridors for the Mullet Creek catchment, the defined flood event (DFE) has been adopted as a minimum when delineating riparian corridor widths. Rhelm (2023) define the DFE as follows:

$$\text{DFE} = 1\% \text{AEP} + \text{SLR} + \text{CC rainfall increase} + \text{blockage envelope} + \text{riparian roughness envelope}$$

Where:

- SLR = Sea Level Rise = 0.9m
- CC (climate change) rainfall increase = 16.3%
- Blockage envelope = Envelope of blocked and unblocked scenarios
- Riparian roughness envelope = Envelope of n = existing and n = 0.15 scenarios

The FPA is defined as the DFE + 500mm freeboard. In revising riparian buffers as part of the current study, the FPA may alter in some locations due to the location of top of bank (ToB) being revised in updated digital terrain modelling and therefore riparian buffer extents. In comparison to the RCMS (2004) approach of buffering the watercourse centreline, this review has mapped the ToB extents for each watercourse on which the relevant riparian buffer has been applied. In doing so, mapped riparian corridors incorporate channel widths in a robust, methodical manner. In large macro-channels this approach allows for unimpeded fluvial processes to occur including the natural migration of watercourses within the macro channel.

4.3 Mapping Methods

The purpose of mapping within the current study is to show spatially the extent of values and constraints present within the study area as they relate to waterways, floodplains, corridors and biodiversity. Adopted Mapping Objectives include:

- To provide coherent and unambiguous spatial layers
- To accurately capture existing and future desired condition
- To ensure consistency in the application of stream categories across the West Dapto Urban Release Area

4.3.1 Data Sources

Mapping of riparian corridors has followed a revision of hydroline and top-of-bank mapping using GIS tools and data provided by WCC to refine the mapping presented in the RCMS (2004). These include:

- High-resolution (75mm) 2024 aerial imagery
- Flood planning data for Duck and Mullet Creek catchments
 - o 20% AEP
 - o 1% AEP
 - o DFE
 - o PMF
 - o FPA
- Contour mapping (0.5m interval) informing:
- Slope analysis model
- Hillshade model
- 1m Digital Elevation Model (DEM) (Geoscience Australia 2021)

4.3.2 Methods For Defining Riparian Zones

Section 4 of the RCMS (2004) provides a method for defining waterways and is adopted in the current study largely unchanged. Riparian boundaries were delineated using the combination of data sources listed above to identify the following elements:

- Waterway centrelines following the main, current channel within a macro-channel
- Geomorphic boundaries separating flatter hillsides and ridge lines from steep slopes descending to floodplains or streams
- Geomorphic boundaries separating the geomorphic floodplain and terrace (refer Figure 4 in RCMS (2004) derived from slope analysis and hillshade models
- Geomorphic hazard zones such as sediment fans or locations noted as highly susceptible to erosion as per RiverStyles mapping (DCCEEW, 2023b),
- Presence of geomorphic floodplain features reflecting the full plan form extent of the water course over time
- Flood extent mapping as per Section 4.2 above

Where no clearly identifiable top of bank (ToB) was discernible riparian corridors were created by buffering the stream bed width or centreline as per its assigned stream category. Lack of clearly discernible banks were most commonly found along small tributaries and water conveyances cleared of vegetation. To avoid geographic breaks in riparian zones (and the ability to achieve objectives) mapping has included all watercourses and conveyances including concrete channels and floodways where they satisfy the mapping criteria.

Following desktop mapping field investigations were completed to ground truth and refine the results of the analysis. Representative sites throughout the study area were selected to confirm observations made (refer

Appendix D).

It is important to note that assessments in support of future development applications may require ToB mapping to be repeated using the methods described in this Strategy. To inform future assessments a step-wise method used in this strategy is provided in Table 4.1.

Table 4.1 Step-wise method for mapping

No.	Riparian Mapping Methodology	Source / Method
1	Map each waterway centreline following the main channel within a macro-channel	2024 aerial imagery 2018 NSW hydroline spatial data 2004 RCMS
2	Mapping geomorphic boundaries between: - Flatter hillsides and ridge lines from steep slopes descending to floodplains or streams - Geomorphic floodplain and terrace - Geomorphic hazard zones or locations highly susceptible to erosion	1m Digital Elevation Model (DEM) 0.5m contour dataset - Creation of hillshade model in GIS 2024 aerial imagery
3	Mapping the presence of geomorphic floodplain features reflecting the full plan form extent of the waterway over time	- Aerial imagery – current and historic 2004 RCMS mapping
4	Overlay of Flood extent mapping to identify breaks in slope and confirm extent of land subject to hydrological/floodplain processes	- Modelled flood extents from Mullet and Duck Creek catchments 20% AEP – Active (low flow) channel readily identified 1% AEP - DFE - PMF - FPA
5	Mapping highest ToB for each waterway	1m DEM 0.5m contour dataset - Creation of hillshade model in GIS - Modelled flood extents from Mullet and Duck Creek catchments 2024 Aerial imagery
6	Mapping of stream bed width as ToB where no higher ToB is evident during site inspection or could be interpreted by desktop analysis	2024 Aerial imagery 1m DEM 0.5m contour dataset - Creation of hillshade model in GIS 20% AEP – Active (low flow) channel readily identified
7	Assignment of stream categories	Mapped waterway centrelines assigned and/or altered stream category on basis of criteria in Tables 2.2 and 4.2
8	Mapping of the core riparian zone and minimum vegetated buffers for each waterway from the highest ToB, according to the stream category	- Top of bank mapping split at confluences and assigned to correct category - Buffer ToB by appropriate distance - Where no ToB exists apply buffer to waterway centreline or edge of stream bed

9	Adjust the core riparian zone and/or minimum buffer width mapping to follow edge of existing developments	2024 Aerial imagery
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4.3.3 Limitations

Limitations of the assessment primarily relate to currency and effort summarised below:

- Mapping has relied primarily on best available tools, datasets and imagery at the time of assessment to redefine hydrolines and top of bank extents
- Waterways and riparian environments exist in spatial and temporal dimensions. The assessment reflects the environmental conditions at a discrete point in time
- Time and cost constraints meant ground truthing across the entirety of the WDURA was not feasible.
- Validation has occurred in ground-truthing a selection of sites representative of diverse geomorphic conditions and where ground-truthing could improve confidence of the desktop assessment
- Note: desktop mapping, in comparison to ground-surveys, allows a birds eye view of the locality especially useful in discerning extents of wide channels. Any ground-truthing should be supported by evidence from remotely sensed datasets (high resolution imagery, LiDAR etc)

4.4 Criteria for Re-Categorising Streams

As part of the updated strategy, stream categories have been reviewed in response to changing conservation values, planning strategies that have commenced since 2004 as well as updated spatial information from NSW and local government sources including:

- Biodiversity corridor mapping (WCC et al., 2011; DCCEEW, 2023a)
- State Vegetation Type Mapping (extant) (DCCEEW, 2025a)
- BioNet Vegetation Classification (DCCEEW, 2025b)
- Fisheries NSW Spatial Data Portal (DPIRD, 2025)
- Biodiversity Values mapping (DCCEEW, 2018)
- NSW River Styles spatial dataset (DCCEEW, 2023b)
- Visual / GIS assessment

Rationales for assigning or maintaining the stream categories 1, 2 or 3 are multifaceted. Criteria and their significance in the review decision making process are provided in Table 4.2. The criteria reflect objectives for each stream category. Strahler order (in the sense of stream size) is but one consideration of categorisation with others mentioned providing a more holistic valuation of the stream (eg. habitat, geomorphic value, contribution to achieving water quality objectives downstream). Updated categories are provided in the Riparian Management Objective Maps in Appendix A.

Table 4.2 Stream categorisation criteria

Criteria	Significance to Decision
Level of habitat connectivity (actual or potential)	High
Located within a mapped biodiversity corridor or key fish habitat	High
Located on Biodiversity Values (BV) mapped land	High
Presence of significant conservation values (threatened species or TECs)	High
Is the category consistent with surrounding streams?	High
Recovery potential of the stream in RiverStyles	Moderate
Geomorphic function (existing and potential)	Moderate

4.5 Biodiversity Corridors

A review of biodiversity corridors has occurred in reviewing stream categories defined by the RCMS. The key to the review is the objective of providing connection between the two dominant regional landscape features ie. Illawarra escarpment and Lake Illawarra. Such prioritisation reflects the findings of existing strategy documents. These include the Illawarra Biodiversity Strategy (WCC *et al.*, 2011) and the Illawarra Shoalhaven Regional Plan 2041 (2021), which aim to connect biodiversity corridors (Objective 11) and adopt targets for increased vegetation cover in urban areas (Objective 13).

It is important to note that corridors cannot be designated on the basis of Strahler order as Strahler order will naturally decrease towards a catchment's headwaters. Conversely, the integrity of a corridor must be maintained throughout its length between major habitat patches to avoid compromising integrity and function. Field assessment across the WDURA allowed for a qualitative assessment of riparian zones on the basis of corridor suitability and function. To stack benefits of riparian function corridors have been preferentially assigned to watercourses with high constraints on development including geomorphic risk and flood liability.

In emphasising the value of riparian corridors as links between high value habitat, Section 6.10 of the Illawarra Biodiversity Strategy Volume 2 (WCC *et al.*, 2011b) details biodiversity corridors in the Illawarra including the WDURA. The Appendices of the Illawarra Biodiversity Strategy in Volume 2 also highlight threatened and locally rare flora and fauna species that have a strong association with biodiversity corridors mapped in Volume 1 of the Illawarra Biodiversity Strategy (WCC *et. al.* 2011a), including a range of habitats such as Riparian Forests.

5 Community and Stakeholder Consultation

5.1 Consultation Plan

Consultation with several stakeholder groups has occurred in the early phase of the project and comprised the interest groups identified in Table 5.1. Meeting agendas are provided in Appendix C. In addition, engagement with community groups and collation of feedback has occurred as part of the public exhibition phase of the draft Strategy.

Table 5.1 Stakeholder groups

Interest Group	Representatives
Internal Project Stakeholders	Wollongong City Council Divisions and Teams: • Urban Release • Land Use Planning • Environmental Planning • Open Space and Environment Services • WCC Community Engagement Team
Industry	• Developer project managers • Flood engineers • Ecological consultants • Development engineers
State government agencies	• DCCEE Waterway Approvals • Sydney Water • DPI Fisheries • DCCEE Coast & Flooding
Community & Indigenous* (Conducted internally by WCC)	

5.2 Consultation Results and Discussion

Themes discussed and key points from the initial consultation process with targeted stakeholders have been summarised and presented in Table 5.2 below, more detailed discussion is provided in Appendix C. Further consultation including with Traditional Owner groups and the general public has been undertaken as part of the Public exhibition phase and presented in Section 5.3 and Appendix C of this Strategy.

Table 5.2 Summary of key perspectives from consultation

Group	Perspective	Key Area of Concern
Industry	Developer	• Values simplicity in planning process • Clarity of how RCMS applies and integrates with other legislation and policies • Seeks clarity for streams with no top of bank
	Development engineer	• Clarity and guidance on when and how to employ averaging suitably
	Ecology	• Flexibility makes for streamlined assessments and solutions • Seeks clarity / simplicity

Group	Perspective	Key Area of Concern
		- Frustrated by inconsistency with other regions, legislation, policies and mapping - WCC online mapping tool hard to use including layers with scale dependent visibilities - Waterways are mapped that do not exist or are highly ephemeral - Guidance for realigning of waterways - Situation where realignments are acceptable - Examples of appropriate solutions
	Flood engineer	Notes WDURA and Illawarra region typically subject to higher erosive forces than other regions in NSW due to landscape and topography
	General	- Seek improved clarity & guidance - Creek reconstruction examples helpful in achieving positive outcomes - Stream category review required including management of Category 3 streams to avoid buffers - Changing landforms will lead to stream changes.
WCC	Stormwater/ Flood/ Ecology	- Focused on improving flood & biodiversity outcomes of developments - Highlights high-velocity catchment - Stormwater devices and riparian vegetation can coexist when designed well - Increased roughness doesn't have a significant impact on flood extents - Acknowledge lack of industry understanding - Category buffers are minimums
	Natural Area team	10m buffer required for maintenance access around corridors
	Planning	- Supportive of 2004 RCMS and need for administrative changes - Take a strategic view - Many other local and regional policies support riparian corridor retention/restoration - Funding of works and financial risk to WCC could be managed by riparian bonds or a cost-plus system for WCC led works - Allows catchment scale management and developers to avoid ongoing obligations
	General	- Mapping updates and clarifications required - Industry feedback to WCC focused on categorisation method and Category 1 obligations
State Agencies	DCCEEW Water team	- Supportive of 2004 RCMS and need for administrative changes - Take a strategic view - Recommend RCMS is incorporated into LEP - Category 3 streams and increased stormwater quantity critical to water quality and bank stability - RCMS and NSW Riparian Management guidelines are minimums which should be exceeded by greenfield developments
	RCMS authors	- Supportive of 2004 RCMS and need for administrative changes - Take a strategic view - Strahler classification not used as it is not merit based

Group	Perspective	Key Area of Concern
		• RCMS a strategic plan guiding landscape activities compared to NSW Riparian Management guidelines which guide CAA • RCMS followed large floods and Commission of Inquiry
	DCCEEW Coast and Flood team	• Supportive of 2004 RCMS and need for administrative changes • Take a strategic view • WCC flood models incorporate vegetated riparian zones (VRZs) which show VRZ's allow attenuation downstream from increased upstream storage potential • NSW Flood Prone Land Policy – ecological solutions to be used wherever possible • DCCEEW science surveys of community values – RCMS a plan to meet long terms needs of the community
	NSW Fisheries	• Supportive of 2004 RCMS and need for administrative changes • Take a strategic view • Transition to urbanisation (ie. increased hardstand) is the biggest impact on water quality and marine environments • Marine Estate Management Policy considers catchments. Management best at strategic level

5.3 Public engagement strategy

WCC conducted consultation with the public via both targeted and broad public engagement. The engagement report is provided in Appendix C. The following provides a summary of the strategy and results

- Timing
 - Indigenous groups
 - 22nd April to 19th June 2025
 - 59days
 - Broader community
 - 22nd May to 19th June 2025
 - 29 days
- Awareness
 - 530 people viewed the webpage
- Submissions
 - 51 submissions via various modes including:
 - Online
 - Phone
 - Written
 - In-person meetings

5.3.1 Community engagement results

Most submissions were detailed and technical. All were shared in full with the team responsible for finalising the Strategy. Key themes included the following:

Cultural and environmental values

Traditional Custodians highlighted the cultural, spiritual, and ecological importance of waterways in the West Dapto area. They called for stronger protection of riparian corridors, joint management approaches, and formal recognition of Aboriginal cultural heritage. Environmental stakeholders supported wider buffers, habitat protection, and stronger legal enforcement through planning controls.

Mapping, clarity, and enforcement

While many supported the Strategy's intent, concerns were raised about mapping accuracy and stream classification. Respondents asked for clearer definitions, consistent enforcement, and a formal process for updating mapping with verified data.

Development and planning integration

Some developers supported riparian management in principle but opposed retrospective application of new rules to previously approved plans. There were concerns about reduced housing yields, financial viability, and conflicts with bushfire planning and asset protection requirements. Several called for provisions to protect existing approvals and greater clarity on who is responsible for long-term corridor maintenance.

Flooding, water quality, and maintenance

Concerns were raised about coal wash runoff, loss of land, and lack of coordination across properties. Suggestions focused on improved maintenance and better upstream protections. Some questioned Council's ability to enforce compliance and called for independent ecological assessments.

Public access and community involvement

There was support for low-impact public access in appropriate areas and stronger education to build community skills and knowledge. Good examples of corridor management were linked to active Bushcare and Landcare programs, committed landowners, and minimal development disturbance. However, others noted urban pressures have led to poor management outcomes in some areas.

6 Riparian Corridor Characteristics and Mapping

6.1 Geomorphic Characteristics

The Illawarra Escarpment, formed by the uplift of the region's geological strata reaches heights greater than 500m AHD from sea level over a distance of generally less than three kilometres. The extreme gradients created an extremely flashy and sometimes localised rainfall, with flooding in downstream floodplains even when there has been no rain (Nanson and Young, 1981). The upper escarpment is cliff lined while lower slopes contain steep foothills with steep, cobble and rock lined gullies. Floodplains contain various features including, instream and bank attached bars, terraces, oxbows and paleo channels with accreting sediments comprising sand, silt and clay.

An unusual feature of the waterways within the study area is an inverse relationship between channel size and basin area which provides a decrease in channel geometry moving downstream. This is made possible by very high connectedness to adjoining floodplains. "In the study area channel width, depth, channel area and slope all decrease moving downstream while floodplain width increases" (Nanson and Young, 1981). A reducing channel capacity means that bankfull discharge near the mouth of these streams is only between 10% and 20% of the total flow recorded upstream. For example, on Marshall Mount Creek, flows peak at approximately 160 m³/s in middle reaches before dropping to approximately 20m³/s at the confluence with Lake Illawarra (Nanson and Young, 1981) around an eight-fold reduction in flow made possible by floodplain engagement in middle to lower stream reaches. The implication of a loss of floodplain connectivity is substantial channel enlargement, erosion, scour and loss of riparian habitats.

All streams within the study area follow a similar pattern in having headwaters on the Illawarra escarpment, flowing to steep and confined valleys including waterfalls, cascades and rapids with creeks often bedrock controlled and/or containing large boulders and gravel. As valleys widen, the stream is partly confined by flood terraces, bars and benches, streams are increasingly sinuous but relatively steep stream grades mean there is some floodplain connectivity but stream energy remains high. Lower reaches of each stream transitions to a laterally unconfined floodplains ranging from a few hundred metres to more than three kilometres wide. Lower sections are highly sinuous, meandering channels with fine sediments comprising mud, sand and gravel and floodplain features including bank attached bars, flood chutes, backswamps and paleochannels.

Mapping against Riverstyles has been compiled as a first pass for characterising streams and to determine stream susceptibility to disturbance and potential for recovery. The consistency of stream types within each subcatchment is reflected in this mapping and is summarised within Table 6.1 below.

Table 6.1 Riverstyles of the Lake Illawarra catchment

River Style	Valley setting / Landscape Unit	Channel planform	Geomorphic units	Bed material texture	River Behaviour
Steep headwater	Confined uplands	Non-sinuuous, stable	Pools, riffles, glides and runs	Bedrock, boulder, gravel, sand	Fast flowing, entrained, sediment transported downstream
Gorge	Confined escarpment	Non-sinuuous, stable	Cascades, rapids, boulders and bars	Bedrock, boulders, gravel	High energy and highly confined, no scope for lateral adjustment, transport zone
Confined valley with occasional floodplain pockets	Confined/Rounded foothills	Non-sinuuous, generally stable	Pools, glides, riffles and runs	Bedrock, gravel, sand	Transport of sediments, creation of bedrock pools
Partly confined valley with bedrock controlled discontinuous floodplain	Partially confined with floodplain pockets	Sinuuous, often unstable in cleared and urbanised catchments	Floodplains, points bars, pools and riffles and benches with gravel and coarse sediments	Gravel, cobble sand	Dynamic instream environment, including instream and bank attached bars, overbank deposition of sand, gravel and cobble. Significant changes post flooding. Disturbed reaches often becoming enlarged, exacerbating bank scour
Laterally unconfined valley setting	Expansive floodplains	Meandering with multiple floodplain channels	Extensive wetlands, bed and bank attached bars, flood chutes and secondary channels	Alluvial deposits, sand	Low energy, highly sinuous, frequent bank overtopping and deposition of sediments on the floodplain

6.1.1 Rapid Geomorphic Assessment

To further characterise stream types, their behaviour and condition, rapid geomorphic assessments were completed at selected locations throughout the WDURA. This assessment was by no means comprehensive in detailing the condition of waterways, with inspections limited to 12 discrete locations. The inspections were sufficient however to confirm the results of desktop assessments and the range of conditions and management issues present. Assessment at each site used the AUSRIVAS physical assessment protocol focusing on a suite of geomorphic and habitat features to determine an overall habitat score (max. value = 200) seen in Table 6.2. Site locations are shown in Appendix D.

The results show significant impacts upon streams in the mid to lower reaches associated with past and ongoing agriculture and new urban development. Stream enlargement, bank slumping, bed lowering and channel modifications were observed in every waterway to varying degrees, along with heavy weed infestations throughout but particularly on alluvial floodplains where weed cover often exceeded 90% of all vegetation present. Stream reaches in better condition were generally in the upper catchments where steep terrain makes urban development and agriculture more difficult and native vegetation cover remains.

No rapid assessments were completed on the escarpment of steep gorges where future urban land release will not occur, though some of these locations could be useful reference sites to inform stream restoration and revegetation works, noting however floodplain areas have different vegetation communities and stream types.

The results of the rapid assessment are provided in Table 6.2 and photos for the majority of assessment locations provided in Appendix D. Habitat scores are compiled from 10 sub-scores totalling a maximum score of 200 and ranked Poor, Fair, Good and Excellent.

Table 6.2 Summary of findings for rapid stream assessment

Site	Stream	Assessment location	Habitat score	Comment
1	Mullet Creek	Pick a Part Wreckers	158 (Good)	Heavily weed infested floodplain
2	Forest Creek	Downstream of Sheaffes Road	122 (Fair)	Grazing land, largely cleared, bed and bank erosion
3	Robins Creek	Semi-confined valley with small floodplain	115 (Fair)	Downstream of Wongawilli Colliery, eroding channel, possibly excavated, may be a past deposition zone from the Colliery
4	Mullet Creek	Floodplain adjoining Fairwater Drive	132 (Good)	Adjoining residential area, very weedy, but generally stable bed and banks
5	Mullet Creek	Floodplain	110 (Fair)	Grazing paddock, straightened drainage line
6	Robins Creek	Upper Tributary	166 (Good)	Some grazing, few weeds, good native vegetation, rock/cobble/gravel bed, flood terraces with <i>Carex appressa</i> and pasture weeds
7	Mullet Creek	Upper Tributary	137 (Fair)	Ephemeral, creek with gravel and sand bed. Downstream is a significant head cut, scour and a Coral Tree infestation. Residential development immediately north.

Site	Stream	Assessment location	Habitat score	Comment
8	Mullet Creek	Tributary	116 (Fair)	First order stream with no instream geomorphic features. Pasture with occasional paddock trees including Coral Tree
9	Mullet Creek	Confluence	145 (Good)	Grazing paddock with native vegetation along a meandering channel, geomorphic features and floodplain features
10	Mullet Creek	Upper tributary	147 (Good)	Grazing paddock with native vegetation. Instream bars and intermittent pools, along with some bank erosion
11	Duck Creek	Floodplain	145 (Good)	Open paddock mostly cleared, weedy corridor, good instream features, the rail line culvert may be a constriction
16	Duck Creek	Flood	85 (Poor)	Grazed and slashed, degraded channel, limited geomorphic features

6.2 Flooding

As part of the Lake Illawarra catchment, the WDURA has two main sub-catchments, being Mullet Creek and Duck Creek. Mullet Creek is the larger catchment with an area of approximately 72km², most of which is still undeveloped. A drop in elevation from over 600m to sea level in the space of 3km to 5km results in frequent flash flooding. Duck Creek catchment area is around 19km² and similar in make up to Mullet Creek.

The largest recorded flood occurred in 1984 with rainfall intensities approaching probable maximum intensity at some locations. Residential flooding was widespread, along with extensive damage to private property and public infrastructure. It should be noted that even in smaller, more frequent events, local roads are inundated and access cut off. Latest flood planning that accounts for climate change scenarios predict more frequent and intense storm events and flash flooding can be anticipated (AR&R, 2019).

The most recent flood assessments for the WDURA are the - *Mullet Creek Floodplain Risk Management Study and Plan* (FRMS) (Rhelm Pty Ltd, 2023) and *Duck Creek Flood Study* (Rhelm Pty Ltd, 2019). The results of flood mapping are displayed in Figure 6.1 and include the PMF flood events. Building upon the DFE and the subsequent FPA, analysis shows that in general riparian zones are sufficient to incorporate the FPA and risks associated with the PMF.

The implication of the FPA is there are numerous locations that are isolated in flood events or become narrow peninsulas of land adjoining sections of creek line highly susceptible to channel migration, bank collapse and avulsion. It is essential these risks are factored into land use planning. Examples of isolated or constricted lands for the DFE are provided in Figure 6.2.

The FRMS supports the use of riparian setbacks and confirmed that rehabilitation of riparian corridors “will incrementally improve the flood impact at the lower end of the catchment.” (Rhelm, 2023)

6.3 Riparian Corridor Delineation

Delineation of riparian corridors followed the methods detailed in Section 4.3 to first define top of bank (ToB) extents across all watercourses followed by review of watercourse centrelines (NSW Hydrolines). Due to updated tools, techniques, comparatively smaller study area and increased computing power the review process has led to more refined ToB mapping and therefore better riparian corridor delineation. ToB in this context refers to the highest top of bank identified through analysis of digital terrain data, flood layers and methods for mapping waterways described in Section 4.3 of the RCMS (2004).

It is important to note, as previously discussed, watercourses are variable both spatially and temporally in response to long term climate cycles, major flood events, changes in land use, altered catchment hydrology and sediment regimes. While future development and significant landscape alterations are likely to occur in the medium to long-term and may require a review of TOB mapping in the future, the current ToB mapping is considered a robust approach to establish conditions in the short to medium term allowing for meanders and minor avulsions within the macro-channel which may follow significant depositional or erosive events. In the WDURA, since 2004, the major drivers for channel change are both migration due to natural processes and artificial changes to watercourses and drainage patterns from changed land use (eg. earthworks for urban or industrial development).

Since the RCMS (2004), ToB refinements for undeveloped watercourses have related to two areas.

1. Inclusion of small 1st and 2nd order tributaries in the Marshall Mount Creek and low-gradient agricultural land
2. Improved definition of the macro-channel throughout

The delineation of ToB and riparian buffers have been reduced in some areas to reflect existing urban developments, and is an exception to ToB and riparian buffers that would otherwise apply in the WDURA. Delineation of TOB and riparian corridors has not considered developments that have recently been approved by Council in the WDURA with respect to riparian outcomes.

It is important to note that the extent of riparian lands will increase throughout the study area as a result of improved digital technology available to enable mapping of macro-channels. The macro-channel is an important feature of the hydrological landscape allowing floods and a dynamic geomorphic environment to function without impacts upon future development.

Most substantial additions relate to inclusion of small 1st and 2nd order tributaries in the Marshall Mount Creek catchment. Further additions are generally located in low-gradient agricultural land.



 	Legend Flood Data Defined flood event (DFE) Waterbody Hydroline Road / Track Lot	Figure: 6.2 Existing flood constraints Scale: 1: @ A4 GDA2020 MGA56 0 25 50 75 100 m N	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2019, 2023 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/05/2025 Job ref: 241959
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6.4 Riparian Management Objectives Maps

A review of stream categories has been completed following on from revision of riparian corridors. The review followed initial stakeholder consultation and considered the perspectives and issues raised during workshops (refer Section 5) in addition to criteria detailed in Section 4.4. The review took the RCMS (2004) as the starting point and allowed for refinements based on the criteria stated in Section 4.4. Categorisation has taken a holistic view of the value of each watercourse. Strahler order, used in other jurisdictions, is a simple, repeatable system, however, is not sufficient to value each stream on its own. Indeed, no corridor would extend to escarpment habitat if the Strahler system were adopted unilaterally.

The review identified very few recategorisations were necessary. Those that did occur related to consistency along a stream between confluences. Overall, RCMS categorisations are seen to be robust; reasonably assigned reflecting the significance of each watercourse, provide for sensitive development opportunity and with an ability to achieve the category objectives. Riparian corridor mapping is provided in Appendix A.

Issues raised by industry including the inability to achieve minimum buffers where existing infrastructure occurs have been accounted for where the ability of the watercourse to achieve an objective is clearly affected. In certain cases (e.g. bridge crossing) the effects are localised and not expected to substantially de-value function of the riparian land along the entirety of the watercourse. The WDURA occurs adjacent to large linear infrastructure (e.g. M1 Princes Motorway and Illawarra Railway) significantly impeding movement and expansion for fauna and flora between the escarpment and Lake Illawarra. As such, the connectivity values of watercourses and riparian lands are heightened remaining as the sole link east and west of the infrastructure barrier for terrestrial fauna despite the constrictions.

6.4.1 Mapping review results

Figure 6.3 overlays RCMS mapping with alterations as part of this review. Map A depicts the effect of improved mapping data and tools allowing for refinement of location and extent of hydrolines and associated ToB extents. Improved riparian buffer consistency across the area has resulted from the use of ToB mapping as the base for riparian buffers.

Of the changes to RCMS mapping the most significant updates have occurred within the Marshall Mount Creek catchment (Map B). The northwestern tributary including 1st, 2nd and 3rd order streams were not originally captured as categorised hydrolines. This has now been amended. The context of the sub-catchment is characterised by steep, short (<500m) tributaries spaced regularly along a cleared ridgeline flowing into the northwest branch of Marshall Mount Creek. While the hydrolines were left unmapped by the RCMS, the riparian areas were broadly included indicating the RCMS approach identified the northwest branch as falling within a wide (>600m) macro-channel. Updated mapping has separated the macro-channel into two branches. In spite of the mapping increasing the area of non-riparian lands, these remain with poor development potential and connectivity to nearby non-riparian land. The buffers have been reduced in some areas to reflect the existing urban context and is an exception to the buffers that would otherwise apply elsewhere in the release area.

Categorising the Marshall Mount Creek tributaries as Category 2, has occurred to account for the high-velocity environment including numerous confluences. Here, bank stability and water quality is of great concern with a category 3 buffer unlikely to provide adequately for its objectives or sustain resilient native vegetation. Furthermore, a category 3 designation would diminish the ability of Marshall Mount Creek to achieve its category 1 objectives.

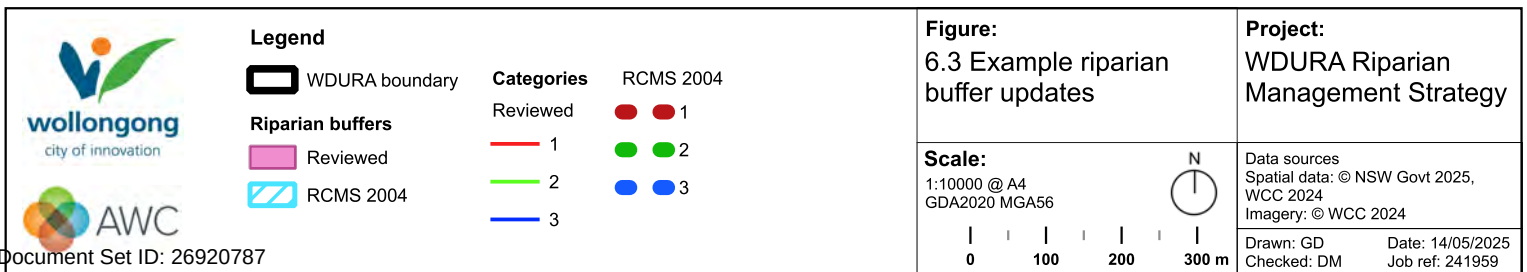
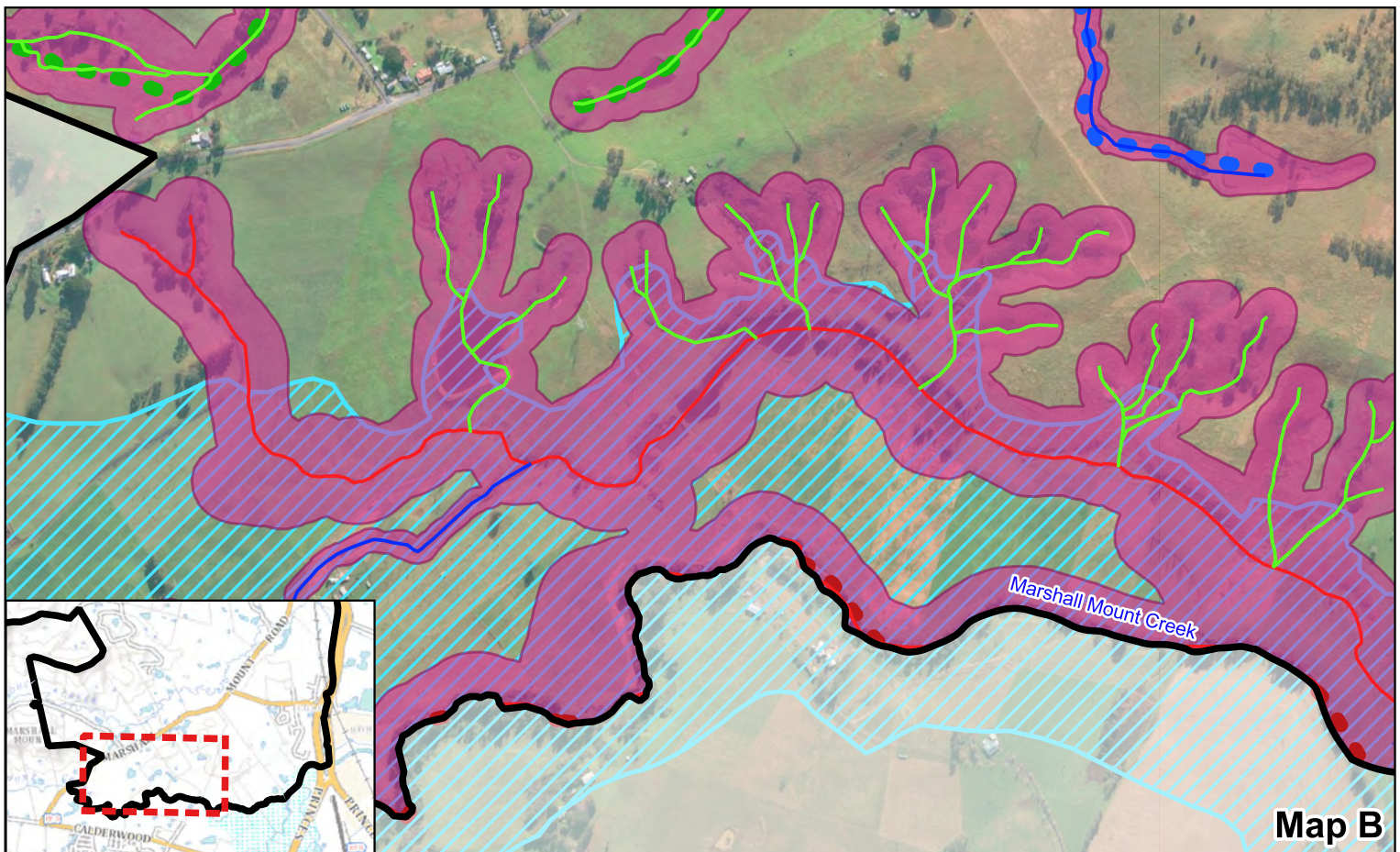
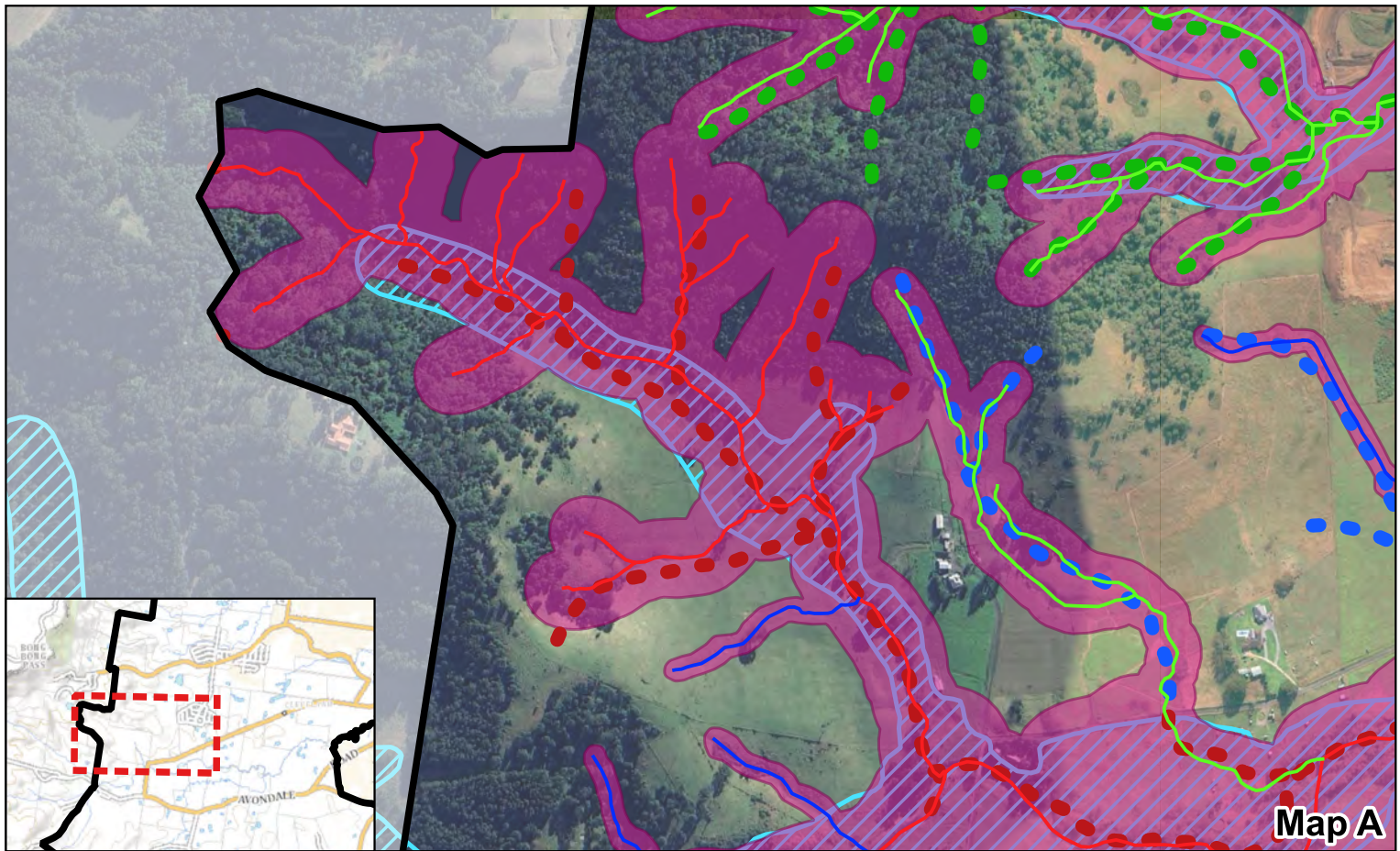
Minimal changes have been made to stream categories. Such changes have primarily occurred in locations where hydrolines were not mapped by the RCMS. Due to the passage of time between mapping substantial developments have occurred within the WDURA. Riparian mapping have necessarily been updated to reflect the

on-ground works including stream realignments and incursions into the RCMS-mapped riparian corridors. Updated riparian corridor mapping has reflected the current landuses as evidenced by current aerial imagery.

Despite the examples highlighted above the authors of this review have noted updated mapping has led to very few large scale changes indicating the original mapping deserves to be viewed with high levels of confidence.

6.4.2 Applicant Review

Mapping results are considered a baseline, with any contentions to the baseline mapping to be further investigated by applicants as part of future Planning Proposals, Neighbourhood Plans, Concept Development Applications etc. It is important to note that additional assessment is only required where an applicant believes there is a discrepancy with the Strategy objectives. Where published mapping is not contended by a developer or proponent the approval process is straightforward.



7 Strategy and Implementation

7.1 Riparian Corridor Management Strategy

7.1.1 Vision for Waterways within West Dapto Urban Release Area

More than 150 years of human settlement within West Dapto has brought with it significant changes to waterways and future urban development place fundamental limits on what can be achieved in restoring these areas. Restoration in this context then needs to be articulated and agreed upon to ensure a common vision of healthy and functioning riparian corridors.

From a geomorphic perspective, streams are considered to have a trajectory based on past and future land use in combination with stream and catchment character. Restoration can be viewed as a spectrum of options which can guide this trajectory to where the stream behaves within a range of natural variability that is appropriate for the stream type and landscape setting (Brierley & Fryirs, 2009). The most appropriate outcome for a subcatchment, stream or reach will be guided by local context and planning objectives and create working parameters for ecological/riparian restoration.

In designing a stream restoration outcome, consideration must be given to the functional attributes missing or impaired and which processes can be (or must be) reinstated. When thinking about a typical stream and riparian zone, there are physical, biological, chemical and hydrological processes to identify and understand at the site and catchment level, then to determine and clearly explain appropriate rehabilitation goals which are achievable in the specific context and with consideration to relevant planning objectives. Various report figures highlight these key stream components schematically compared to a typical section of degraded stream within the WDURA, the purpose being to highlight the extent to which features have been impaired, altered, or lost.

In developing management responses, spatial and temporal scales should be sufficient to include the full range of hydrological and biophysical processes and linkages which can support priority fauna species and habitat assemblages (CRC for Water Sensitive Cities, 2018). This requires a broader perspective than simply setting riparian zone widths by Strahler stream order and then using this categorisation as justification for reduced protection or modifying or removing a stream section. Management responses should consider the stream type, its geomorphic condition and trajectory, and address biodiversity values and ecological context. Specifically, when applying this approach to current section 10.6.2 of Chapter E23 of the Wollongong DCP, it is important that guidance on stream types and associated watercourse crossing requirements is included to clarify the design process. Typically, the larger the buffer between the stream and adjoining land uses, the greater latitude for the stream to recover of its own accord and timeframes (Fryirs and Brierley, 2021). However, the role of catchment conditions must also be considered when determining stream character and future condition. Buffers on their own will not protect a stream when there are significant changes in catchment hydrology, hydraulics, sediment loads, and nutrient export associated with the transition from rural to urban land uses. Stream types present in the WDURA have adapted to rural land uses prevalent for the past 100+ years.

Urbanisation will initiate a new phase of changes and adjustments in stream behaviour and condition. Riparian zones and vegetated buffers will allow for this adjustment by providing space for lateral movement, bank overtopping to reduce flow energy and permit initiatives such as bed control structures and log jams which can be used to halt/prevent incision and bed lowering. These measures also increase stream roughness and maintain or reinstate floodplain connectivity which will be critical for mitigating flood impacts downstream. Floodplain re-engagement allows for various bio-physical and chemical processes that are fundamental to function of a riparian zone and associated biodiversity (Greet *et al.*, 2022; Fisher *et al.*, 2021).

The existing RCMS in combination with provisions in Chapter E23 of the Wollongong DCP, make explicit the management objectives and minimum outcomes required in decision making.

The new riparian management strategy remains consistent with the objectives of Chapter E23, while providing clear guidance for future land use planning decision, urban design and management of waterways and biodiversity values. Riparian Corridor Width Requirements are clearly defined within Section 10.2 of the Chapter E23, along with the definition of the riparian corridor. As stated, any development must achieve the minimum width requirements for each watercourse category as detailed within Table 7.1 of this chapter. These minimum criteria can and may often exceed minimum width requirements stipulated in General Terms of Approval from the Department of Planning and Environment for Controlled Activity Approvals.

Table 7.1 Stream categories and associated riparian buffer widths, adopted from Wollongong DCP Ch E23

Watercourse Category	Name	Min. Core Riparian Zone (each side of channel)	Min. Vegetated Buffer (each side of channel)	Min. Total Riparian Corridor Width
Category 1	Environmental Corridor	40m	10m	100m + channel width
Category 2	Terrestrial & Aquatic Habitat	20m	10m	60m + channel width
Category 3	Bank Stability & Water Quality	10m	–	20m + channel width

7.2 Managing Floodplain Risk

The NSW Flood Risk Management Guideline outlines approaches to floodplain risk from planning through to adaptation phases. Principle 8 of this guide is to maintain natural flood functions. Flooding impacts typically arise from changes in catchment land use, increased areas of impervious surfaces creating runoff, choke points at existing infrastructure (e.g. bridges and culverts) vegetation clearing and development/filling on the floodplain.

Development on floodplains can have adverse impacts on riparian lands and riparian processes. Recognising that flood events which engage with floodplains are integral to the health and function of riparian zones, flood planning and mitigation works should to the greatest extent practical facilitate natural geomorphic and riparian processes rather than inhibit them. This requires:

- Managing flood detention requirements at source – i.e. within the development footprint and outside the riparian zone prescribed by the stream category
- Within flood assessments, allowing for a roughness within streams consistent with a fully structured riparian zone
- Where feasible, allow streams to overtop onto the floodplain in a regime approximating natural conditions. In a natural state a creek will fill and overtop in storm events with an average recurrence interval between 1 and 5 years (Gordon et al., 2008). Acknowledging that streams within the WDURA have changed considerably since pre-European times, generally enlarging, the frequency of overtopping has likely reduced in many streams, but as anticipated in the Mullet Creek Floodplain Risk Management Study and Plan (recommendation P11, page 95), rehabilitation of streams will often increase flood heights and should be accommodated within the interim defined flood event (DFE).

7.3 Stormwater Management

7.3.1 Policy Context

Stormwater management in the WDURA is guided by a suite of Council and broader policy documents, often broadly captured under the term Water Sensitive Urban Design (WSUD). At the time of releasing the RCMS (2004), WSUD as a practice was relatively new and there has been significant research and development of best practice approaches to stormwater management over the past 20 years. WSUD can be defined as: a holistic approach to stormwater management which considers the entire water cycle and draws upon the skills of engineers, scientists, and urban designers to create site sensitive designs based on principles of bioengineering and ecologically sustainable design.

Stormwater management in the WDURA must adhere to prescriptions within Chapter E15 in the Wollongong DCP related Council's goals for water quality and quantity, landscape and urban design and maintenance. With stormwater devices generally required to sit outside the Category 1, 2 and 3 corridors, the principal requirement relevant to this updated strategy is to ensure no adverse impacts on objectives for riparian corridors related to biodiversity, connectivity, water quality, geomorphic processes and erosion.

Stormwater management strategies prepared in support of new urban development, including the siting of devices for enhanced storage within the riparian corridor, should respond to local catchment context and character. This requires a demonstrated understanding of geomorphic condition of a stream, biodiversity values for individual species and ecosystems and linkages within and across catchments and flood behaviour. This type of investigation will necessarily be multi-disciplinary and be guided by a risk-based assessment and design response. This will likely mean that performance requirements within Chapters E14 and E15 of the DCP related to on-site detention and nutrient removal, should be considered as a component of a holistic design response rather than the only part of an assessment.

In practical terms this means that a stormwater management strategy should:

- Be demonstrably responsive to the land use, pollutant types and receiving environment. Noting that certain products and treatment technologies have inherent limitations in their ability to treat dissolved nutrients and may deprive a waterway of sediment and organic matter essential for sustaining geomorphic processes.
- Only use proprietary products certified under the SQIDEP protocol or other schemes recognised by the stormwater industry and Council.
- Maintain pre-development hydrological regimes and/or regimes that facilitate stream rehabilitation.
- Consider sensitive ecological receivers and their specific water quality requirements when setting water quality objectives.
- Use practical treatment measures which mimic and complement streams, wetlands and other ecosystems found within the WDURA.

7.3.2 Current Water Quality

Water quality monitoring is ongoing throughout the WDURA and within Lake Illawarra providing a measurable understanding of the range and variability of water quality as it relates to land use. Council managed water quality monitoring between 2021-2024 included 21 monitoring locations in the Lake Illawarra catchment including 7 within the WDURA (Habitat Innovation & Management, 2024). The data shows clear spatial trends in water quality, with highest water quality in well-vegetated headwater streams beneath the escarpment, deteriorating downstream as the rural and then urban and industrial land uses are introduced. Elevated nutrients, faecal coliforms are associated with agricultural lands, while heavy metals, hydrocarbons and sediment are associated with urban, industrial and commercial areas in the lower catchment. Lake Illawarra is known to

display significant temporal and spatial variability in water quality and as a shallow estuary has periods of anoxia and algal blooms driven by poor mixing and sediment laden with nutrients exported from West Dapto.

The spatial trends in water quality throughout the catchment is synonymous with ‘urban stream syndrome’ used to describe the multiple environmental problems which typify the degradation of urban streams (Walsh et al., 2004). These symptoms include increased intensity of flow after rainfall, erosion, sedimentation, stream bed and bank scouring, and degraded water quality; all of which apply to waterways within the WDURA. Increased hard surfaces, increasing surface run-off volumes and velocity, in concert with removal of natural riparian buffers are strong drivers of urban stream syndrome. Traditional concrete stormwater infrastructure focused on ‘efficient drainage’ without consideration of replicating natural stream functions are typically associated with degraded water quality and aquatic ecosystems. These points are well-established with multiple studies correlating impervious surfaces across 5% of a catchment with the onset of stream degradation (Walsh et al., 2006; Tippler et al., 2012; Belmer et al., 2015; 2016; 2019).

Setting water quality targets for land use must acknowledge that the assimilative capacity of Lake Illawarra has largely been exceeded (DCCEEW, 2024) and therefore (as stated in section 7.3.1 above) stormwater management must focus on provided water quality which protects and enhances aquatic ecosystems. Water quality objectives (WQO’s) for Lake Illawarra are detailed within the Lake Illawarra CZMP and provide a guide on targets suitable for stormwater management in the lower reaches of creek catchments. It is recommended that these WQO’s are explicitly acknowledged in stormwater strategies prepared in the WDURA.

Regarding water quality objectives for Lake Illawarra, the Risk-Based Framework has determined through pollutant export modelling that existing pollutant removal targets within Chapter E15 of the DCP are not sufficient to ensure a no worsening in water quality within Lake Illawarra. The assessment notes that stormwater device size required under the DCP scenario are “25% to 50% of the footprint of the corresponding no net increase scenario” (DCCEEW, 2024, page 134). Fifteen scenarios were investigated in the risk based framework to achieve a no net increase in pollutant loading in Lake Illawarra, with comparison of options finding that a combination of strategies are required to achieve no net increase in pollutant loading including:

- Increased volume of rainwater tanks to intercept flows and reduce potable water demand
- Large bioretention filters and or constructed wetlands within floodplains
- potential to locate centralised ephemeral parks, biofiltration basins or constructed wetlands within flood planning areas (but outside floodway areas and riparian corridors) to reduce the loss of otherwise potentially developable land
- Allowing offset stormwater treatment areas for existing urban development to allow smaller devices within development areas while still achieving water quality outcomes at a catchment scale.

The recommended stormwater pollutant removal targets are provided in Table 40 of the Risk-based framework with a recommendation that Council’s DCP is updated with the following targets:

Table 7.2 Stormwater pollution reduction targets (source: Table 40; DCCEEW, 2024)

Parameter	Pollutant Load Reduction
Gross pollutants (anthropogenic litter >5 mm and coarse sediment >1 mm)	90%
Total Suspended Solids (TSS)	82%
Total Phosphorous (TP)	78%
Total Nitrogen (TN)	67%

7.4 Recommendations

The updated riparian corridor management strategy has responded to numerous factors including:

- Changes in regional legislation and local policy since RCMS (2004) was released
- Advances in urban design and catchment management, notably the adoption of WSUD as a practice
- Acceptance that climate change impacts are underway and the implications for new urban areas
- Updated flood modelling approaches and reporting
- Growing recognition of the role of waterways in managing urban heat

As part of the updated strategy, all streams and their assigned stream category have been reviewed. The results of internal and external workshops have provided an understanding of experiences and challenges in implementing the existing strategy. In particular, the misconception that riparian buffers in the strategy are interchangeable with vegetated riparian zones (VRZs) associated with controlled activity applications prescribed under the *Water Management Act 2000* has been addressed.

Updating the strategy allows Council to reassert their policy position on the management of waterways within the WDURA while also creating a more accessible and unambiguous document. This report does not recommend a retrospective view, that is, riparian corridor mapping within this Strategy does not apply to prior Council or State Government decisions made on riparian outcomes as part of approved Neighbourhood Plans, Concept Development Applications and Development Applications. In addition, this strategy does not apply to current Planning Proposal, Neighbourhood Plan, Concept Development Applications or Development Application Assessments submitted prior to the adoption of this strategy and does not apply to the Calderwood Urban Development Project, approved by the NSW State Government in 2010.

The recommendations provided herein have considered feedback received during the Public Exhibition phase of the document. The recommendations precede Table 7.4 which translates these recommendations into prioritised actions. It is acknowledged there will be challenges in implementing some of these actions and many/most should be supported by ongoing training and awareness raising to reinforce the purpose of the strategy - namely to create resilient and biodiversity rich riparian zones, which contribute to improved ecological connectivity and function, consistent with regional and local policy and strategies for natural capital.

The following recommendations are the result of a review of latest information related to the WDURA, current best practice in urban development, biodiversity management, WSUD and current legislation and policy. The recommendations also draw upon feedback obtained from stakeholders during consultation phases. The recommendations have been categorised into themes for ease of referencing, acknowledging that some recommendations touch on more than one theme.

Table 7.3 Recommendations schedule

No.	Recommendation	Comment
Urban Development and Planning		
1	Recommendations and mapping within this updated Riparian Strategy to inform future revision and amendments of the Wollongong LEP & DCP.	A key outcome of stakeholder consultation. Will aid in asserting the requirements to the same level as other planning overlays including Fisheries and Coastal Wetland buffers
2	Early engagement with applicants of subdivisions to ensure Council's needs and expectations are incorporated into the subdivision design.	On-going point of discussion in the stakeholder engagement – Council involvement sooner in the planning phase.
3	Explore incentives for applicants to exceed the provisions of this strategy	
4	Investigate the feasibility of developer contributions to Council via	Would provide greater control to Council

No.	Recommendation	Comment
	planning agreements or other acceptable mechanisms to avoid deferment of rehabilitation and maintenance responsibilities.	over the strategic management of riparian corridors.
5	Council to develop a risk-based assessment framework in urban design to provide clearer guidance to developers and separately, the delivery of essential public infrastructure by ensuring site specific issues are being addressed by consultants with demonstrated expertise in relevant issues.	Planning proposals, Neighbourhood Plans and development applications should be clearly informed by specific site characteristics (biodiversity, hydrology, geomorphology, water quality) and relevant strategies developed.
6	Advocate for and implement supportive policies and regulations that protect riparian corridors, including zoning laws, conservation easements, and incentives for landowners who maintain or restore these areas.	
7	Where riparian ownership is taken on by Council a funding mechanism is established, accounting for project risk, based on expected costs required for vegetation to reach a resilient status sustainably providing benefits with minimal further intervention	Allows a strategic and sustainable manner for achieving objectives
8	Urban development recommended to 'front on' to riparian corridors or use public infrastructure (eg. roads, parks etc) to act as the interface	Further limits flood risk to private assets. Provides open sight lines and greater use/value of riparian environments by community
9	Objectives in Section 2.6 of this report are considered core criteria to guide assessment of any development impacting riparian corridors.	Objectives supported by further detail in this report and 2004 RCMS
10	Foster community awareness, value and ownership of riparian corridors and waterways through access and engagement (eg. open space design, cultural and educational actions)	Community value aids in creating support and demand for achievement of objectives
Water Quality		
11	Holistic management of the water cycle to ensure stormwater management is sympathetic and responsive to receiving environments. This includes ensuring appropriate hydraulic and hydrological regimes and water quality objectives are met.	Recommendation aligned with and which supports Council policy.
12	Reconcile the difference between DCP 2009 stormwater pollution reduction targets and those prescribed in the Lake Illawarra Risk-Based Framework (2024).	The DCP should be updated in response to latest catchment investigations.
Geomorphology		
13	Waterways within the study area have specific geomorphic characteristics which must be considered in urban subdivision design. Works in and around waterways must be supported by assessments from appropriately qualified practitioners.	Should be clearly communicated in training sessions, pre-lodgement meetings and consent conditions.
14	Development and implementation of rehabilitation measures should be prepared or reviewed by practitioners with demonstrated expertise and experience in geomorphology and waterway restoration	On-going point of discussion in the stakeholder engagement – involvement of experienced professionals.
15	Complete a geomorphic condition assessment across the entire WDURA and use these results to inform recommendations made by Council when reviewing development applications.	Outcome from stakeholder engagement
16	Training and awareness raising for Council staff and consultants around the principles of geomorphology and stream restoration.	To place Council in a defensible position, equipped with the tools for communication with industry.
Biodiversity		
17	WCC to attach a premium to any environmental bonds where land is rehabilitated by WCC.	Raised in stakeholder engagement. Certainty in results delivery, reduced financial risk to WCC, developer released from 5yr+ obligations
18	Works in riparian zones are often below the standard conditioned by Council. Continue to carry out periodic audits of riparian zones to ensure Council's expectations are being met. Circulate findings as part of ongoing training and awareness raising.	Approach similar to other land development / land use auditing protocols.
19	Council continue clear stipulation of development approval conditions as the criteria for handover of assets to Council which	On-going point of discussion in the stakeholder engagement – Council

No.	Recommendation	Comment
	allows Council input to the arrangement and components within the corridors as well the criteria via which successful rehabilitation is defined.	involvement sooner in the planning phase.
20	Rehabilitating riparian corridors as early as possible in the development process to maximise rehabilitation time. Ideally rehabilitation works should be initiated as the first stage of the development prior to civil works commencing, acknowledging that some sequential works following civil works will be required.	Rehabilitation criteria published in section 3.5.4 (Regeneration/revegetation) of Council's VMP guidelines (WCC 2024) should be emphasised in communication with developers.
21	Ecological and geomorphic characteristics are often overlooked or not understood. Training and awareness raising for Council staff and consultants would assist in developing a clear understanding of success	To place Council in a defensible position, equipped with the tools for communication with industry.
Education, Community and Land Managers		
22	Passive recreational infrastructure (eg. boardwalks, bike paths) should be sympathetically designed if co-located within the riparian buffer	Provides community co-benefits for use and engagement with natural environment and cool recreational spaces in a warming climate
23	Educational materials (Factsheets, FAQ's links to NSW Local Land Services etc) produced and compiled for engagement with landowners and the community on the environmental and heritage value of riparian corridors and how to manage existing riparian corridors	Increase community value of riparian areas
24	Council to encourage private landholders to manage and show-off these assets by providing public access	Increase community value of riparian areas
Flood Risk Management		
25	Publish examples of desirable stream and riparian rehabilitation outcomes and associated instream roughness including planting types and densities in different locations and riparian environments.	Provides consistency and clear expectations for industry.
26	Consider the flood risk management implications of the final updated riparian corridor extents for the WDURA. This should include a review of the Floodplain Risk Management Study and Plans for the Mullet Creek and Duck Creek catchments, and specifically, the implications to planning requirements such as flood planning levels.	Provides confidence in impacts of the updated RCMS to flood risk management in the catchments
General		
27	Council to undertake works as a best practice case study in a location with competing values and constraints	Provides real world example of what is achievable and expected
28	Strategic level riparian management should account for the following factors in prioritising actions: - Stream category - Timing of locations to be developed - Alignment of the watercourse with reference to large centres in the WDURA - Linking of existing habitats	Takes a WDURA-wide view to focus and achieve actions effectively
29	Evaluation of successful delivery of this RCMS should occur at regular intervals to ensure RCMS remains current and valuable in guiding sustainable development in the WDURA	Without evaluation successful implementation cannot be ensured.
30	Projects may be initiated by Council, Landcare groups or landowners, in addition to new development and outside of the development process, subject to permission from affected landowners	Provides additional community benefits and may be used as a benchmark for local riparian restoration works.

7.5 Implementation Plan

The overarching priorities within the existing RCMS are to generally protect and enhance:

- Biodiversity
- Water quality
- Geomorphic function
- Human use
- Floodplain risk management

These priorities remain appropriate and relevant to the updated Strategy and have informed the following implementation plan and associated recommendations. Feedback obtained through stakeholder engagement tasks have also reaffirmed a range of issues arising from the implementation of the RCMS (2004), in developing this implementation plan these issues have been taken into consideration. Specific issues with implementing the 2004 RCMS include:

- Inconsistent application and enforcement of the Stream Categories and riparian buffers
- Failure to consider the RCMS early in the urban development planning phases
- A lack of understanding of ecological and geomorphic context
- Use of inappropriate rehabilitation and stormwater management approaches
- Poor outcomes within rehabilitation areas, increasing Council's maintenance burden

A key point to emphasise is that stream categories and related riparian buffers are not based on Strahler Stream Order, which is associated with the *Water Management Act 2000* and controlled activities guidelines. The categories, within the highly modified WDURA, are also not guided purely by the current condition of the stream and the adjoining riparian zone. The intention of the Stream Categories is to inform land use planning decisions and to:

- Protect and enhance stream health and allow for natural geomorphic processes (erosion, accretion, bank migration, accumulation of woody debris) to operate unimpeded
- Create and enhance biodiversity corridors using riparian zones as key ecological habitat patches and connectivity linkages
- Create and enhance habitat for native flora and fauna in green spaces which are of a sufficient scale that they are self-sustaining and resilient to edge impacts from adjoining urban land use
- Improve stream bank stability by increasing riparian vegetation cover along watercourses
- Maintain water quality through natural processes, for example the filtering of pollutant and sediments, shading and carbon formation
- Provide substantial areas of green space, shade and urban cooling for future residents
- Limit development within floodplains, which otherwise puts residents and public assets at risk and requires significant investment in engineering infrastructure

Table 7.4 Implementation plan is guided by these Stream Category objectives and provides a schedule for actions and recommendations. As the authority responsible for development assessment in the WDURA Wollongong City Council holds primary responsibility for progress, implementation and evaluation of the success of the 2025 RCMS and its objectives. Actions reflect recommendations and take account of experiences implementing the 2004 RCMS as identified in stakeholder consultation.

Table 7.4 Implementation plan

No.	Action	Timing	Priority	Comment
Urban Development and Planning				
1	Update Wollongong LEP with: - Stream category objectives - Minimum riparian core riparian zone + buffer widths - Requirement for no-net loss and to meet obligations as a minimum	TBC	High	This would increase Council's ability to enforce strategy actions.
2	Review and update DCP Chapters E23 (Riparian management) and D16 (West Dapto Release Area) based on the 2025 RCMS	Late 2026	High	Further align Council policies and increase ability to enforce strategy actions.
3	Investigate the feasibility of providing incentives for applicants who exceed the provisions of this strategy	Late 2026	Moderate	Raise awareness of projects using best practice methods and encourage broader strategic and regulatory uptake.
4	Develop a community - waterway engagement strategy for the entire WDURA to develop ways and means for community awareness, respect and enjoyment of waterways including the provision of public access	Early 2027	Moderate	In time the corridors will be the most significant green space within the WDURA – use requires careful and holistic planning.
5	Updated mapping to be included in Council online mapping portal and used as a decision making tool for assessment of planning applications in the WDURA including: rezoning, neighbourhood plans, Concept Development Applications and Development Applications	End of 2025	Very high	Publishing in online portal enables uptake by external stakeholders
6	Development of a risk-based assessment framework in urban design to provide clearer guidance to developers and delivery of essential public infrastructure by ensuring site specific issues are addressed by consultants with relevant expertise	Late 2026	Very high	Planning proposals, Neighbourhood Plans and development applications should be clearly informed by specific site characteristics (biodiversity, hydrology, geomorphology, water quality) and relevant strategies developed.
7	Funding mechanism and standards established for transfer of riparian zone management obligations from developers to Council	Late 2026	High	Enables strategic and sustainable management of riparian corridors
Geomorphology				
8	Complete a geomorphic characterisation and health assessment for the WDURA.	Late 2026	Moderate	Task would assist Council's to provide more specific direction on stream categorisation during land use assessment processes .
Biodiversity				
9	Create an internal audit plan to guide inspections of rehabilitation works. The audit plan should define required outcomes for these works. Use audit results for ongoing training and awareness raising.	June 2027	High	A response to Council's feedback that rehabilitation works on new developments is often unsatisfactory.
Flood Risk Management				
10	Ensure Council's latest flood results are included in all waterway investigations.	Ongoing	Moderate	Raise awareness of the human and asset risks associated with flood impacts.
11	Create worked examples outlining desirable stream and riparian rehabilitation outcomes and associated instream roughness.	Late-2026	High	Would assist in providing consistency in stream rehabilitation responses and provide clear expectations for industry.

No.	Action	Timing	Priority	Comment
12	Review of the Floodplain Risk Management Study and Plans for the Mullet Creek and Duck Creek catchments, and specifically, the implications to planning requirements such as flood planning levels	Next scheduled review of catchments	High	Provides confidence in impacts of the updated RCMS to flood risk management in the catchments
Education, Community and Land Managers				
13	Roll out a series of information and training sessions for developers and land managers in support of the updated strategy being adopted.	Late-2026	Very high	Proactively seek to place higher value on the role of riparian zones.
14	Schedule periodic information sessions and field days to raise awareness of desirable case studies for developers and land managers.	Six monthly, from mid-2026	High	Proactively seek to place higher value on the role of riparian zones.
Evaluation and Adaptive Management				
15	Evaluation of the successful implementation of the 2025 RCMS. Council and external stakeholders to provide input with particular focus on: - Clarity of obligations - Currency of mapping - Delivery of objectives 'on the ground' - Progress in delivering Recommendations and Implementation Plan - Recommendations for improvement	Yearly for 3 years then once every five years	High	Success in implementation cannot be ensured without evaluation and adaptive management (where required). Initial annual evaluations allow issues to be addressed early in the life of the RCMS
General				
16	Council to identify suitable site and undertake works or collaborate with landowners or community environmental groups (eg. Landcare) as a best practice case study in a location with competing values and constraints	Initiate works by late 2026	Moderate	Provides real world example of what is achievable and expected

7.6 Funding Pathways

Sustainable funding of maintenance in riparian corridors is a key challenge for Council. Management costs can vary significantly depending on the specific management activities involved. Within naturalised and public open space incorporating passive recreation, stormwater management and natural rehabilitation, the scope of maintenance will be broad and likely require a range of skills and knowledge related to management of parkland, stormwater assets and conservation areas. Riparian lands dedicated to Council within the WDURA will eventually exceed 1,762 hectares, meaning significant planning and allocation of resources will be required.

A significant burden to Council is to receive assets (parkland, stormwater and natural areas) which are substandard with regard to design, construction and maintenance and subsequently place significant demand on Council resources. The criteria (and funding) required to be met for handover of assets to Council should be clearly stipulated in development approval conditions which allow Council input to the arrangement and components within the corridors as well the criteria via which successful rehabilitation is defined. This proactive input will help to ensure Council does not receive assets which are a maintenance burden.

The primary source of funding for riparian corridors in the WDURA typically comes from developer contributions, with developers responsible for constructing these assets and maintaining them during the defects liability

period. Council may also receive contributions under Section 7.11 of the EP&A Act 1979 to fund local infrastructure. However, Section 7.11 contributions are limited to “essential works,” including formal open space, land for community facilities, stormwater management, and transport infrastructure — and cannot be used to fund natural area management such as riparian corridors. As such, Council has very limited funding sources for managing these areas outside of general rates revenue and development-specific contributions negotiated through the planning process. The Act does provide for Voluntary Planning Agreements (VPAs), which allow developers to contribute to public benefits such as natural area management where agreed with Council.

Beyond developer contributions and environmental levies secondary sources of funding include state and federally funded grants, volunteer programs and public-private partnerships. While these sources can be important, they have limitations in that, time and effort is required to apply for grants with no guarantee of success, volunteers must be coordinated and extension officers are required to coordinate public-private partnerships which are likely to be voluntary and non-binding.

Increasingly, Council is deciding to not accept dedication of certain assets since they don’t fit within a Council’s strategic management of a locality. In these instances, a reserve area will remain attached to a single lot of body corporate, an applicant must devise alternative funding arrangements. This arrangement has positives – namely Council is not burdened with additional reserves to maintain and the owners enjoy a private reserve. The negative can be that the burden of maintenance may be beyond those private landowners over time the reserve is neglected. Regardless of land tenure Council will receive the complaints from land holders without the resources or ownership rights to respond. There is also a question as to whether natural areas should be in public ownership to ensure access to the entire community. Access was highlighted in community consultation with the Strategy seen as an opportunity for Council to encourage landholders to manage and exhibit these assets by providing a degree of public access.

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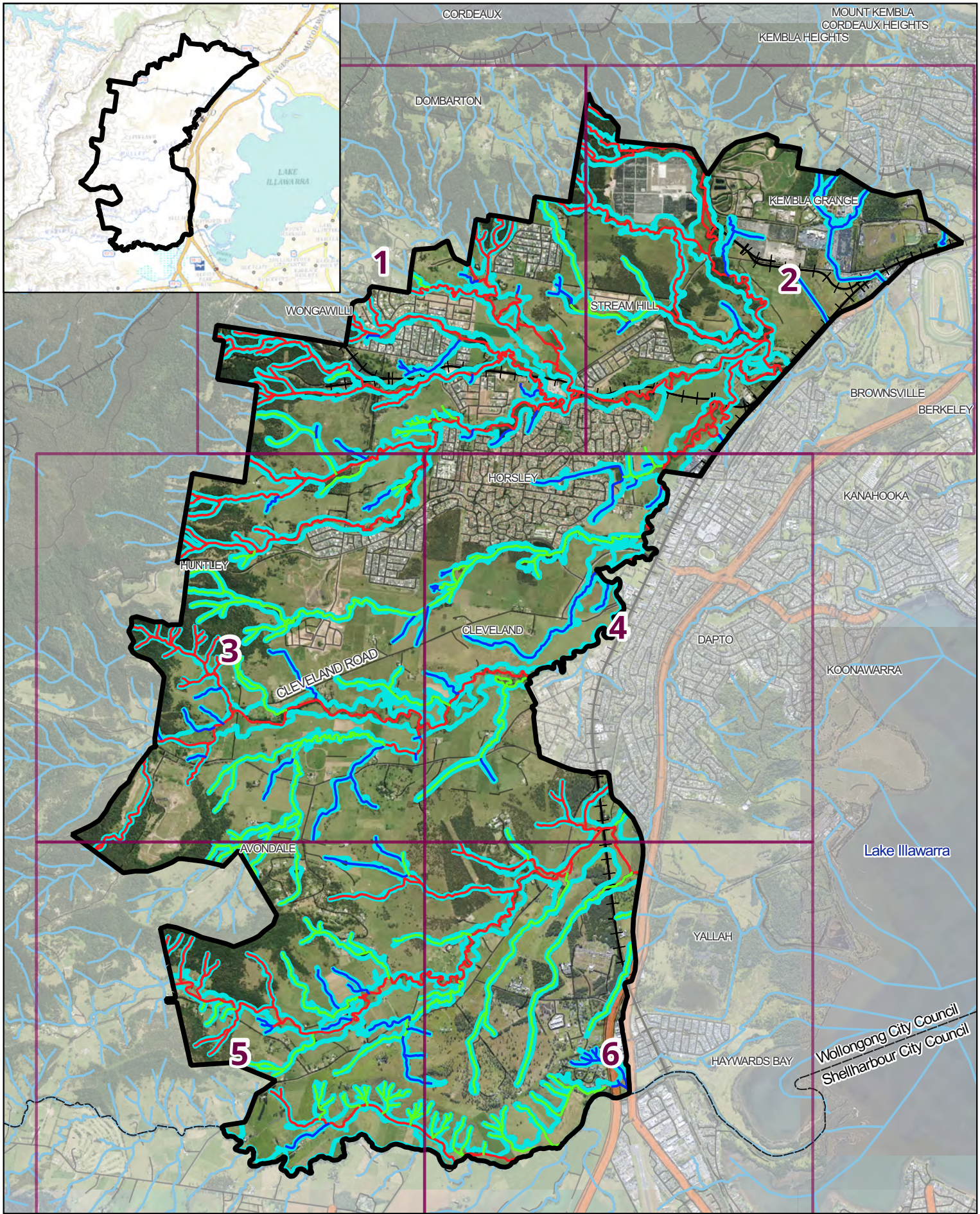
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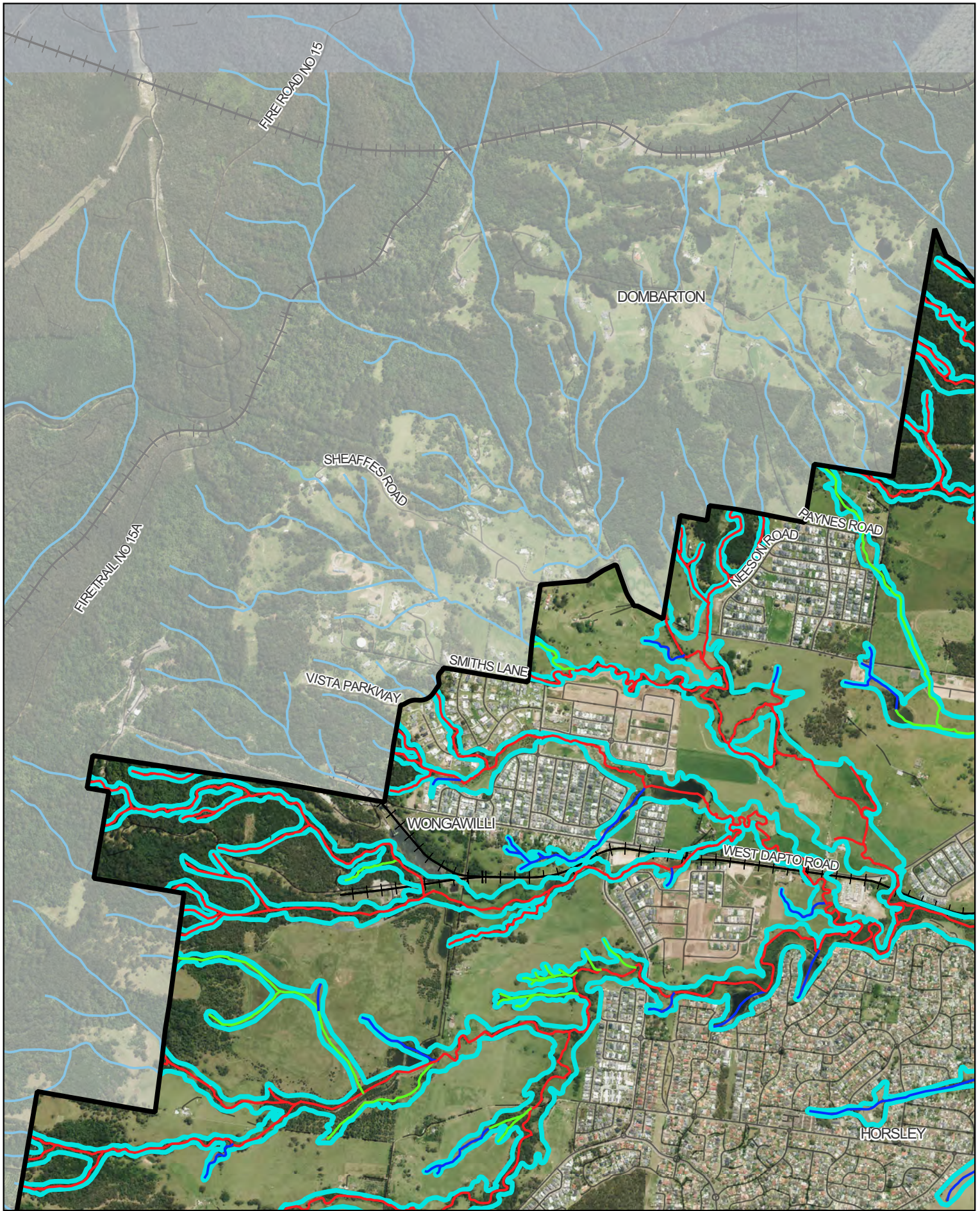
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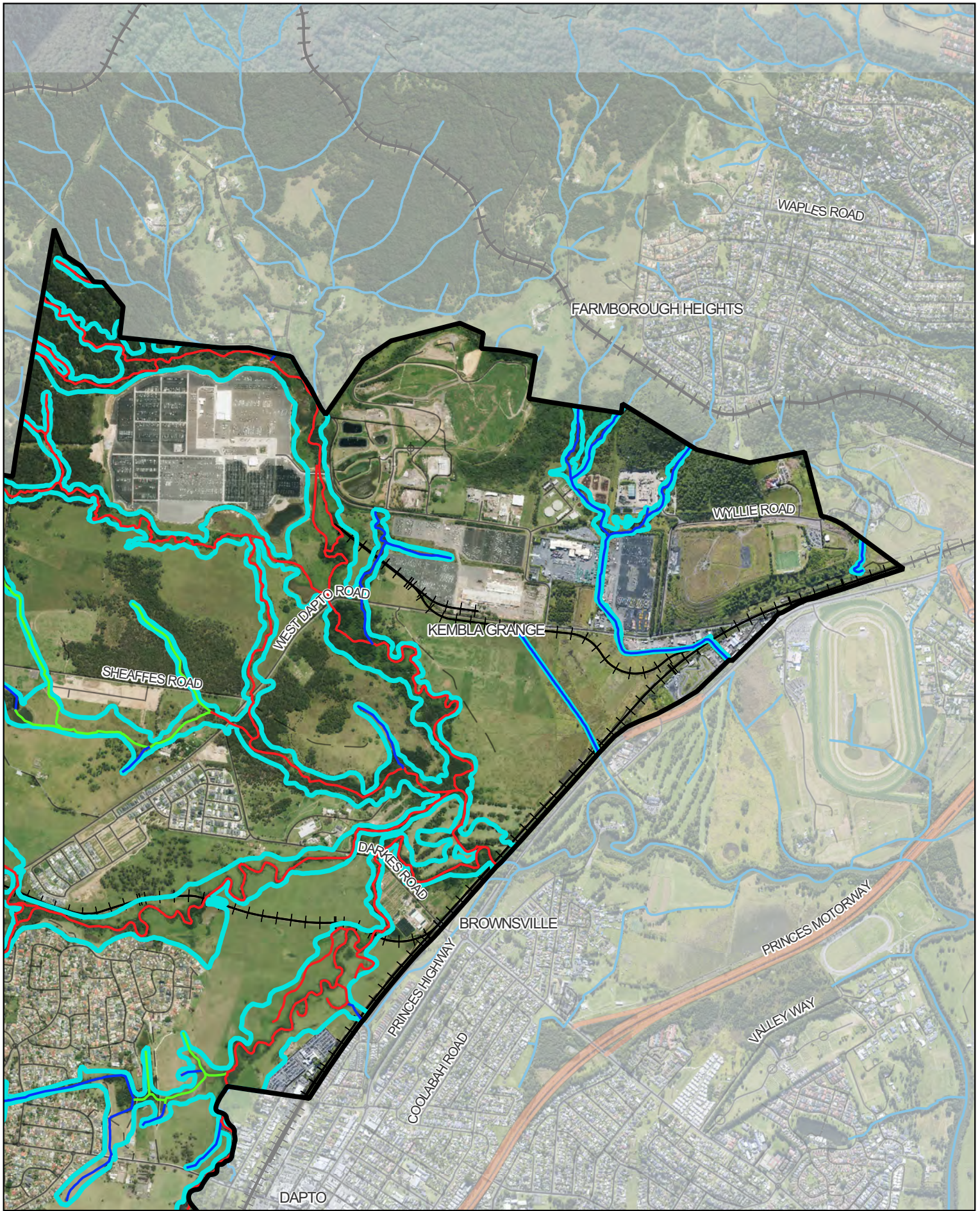
Appendix A – Riparian Management Objectives Maps

A.1 – Top of Bank Mapping

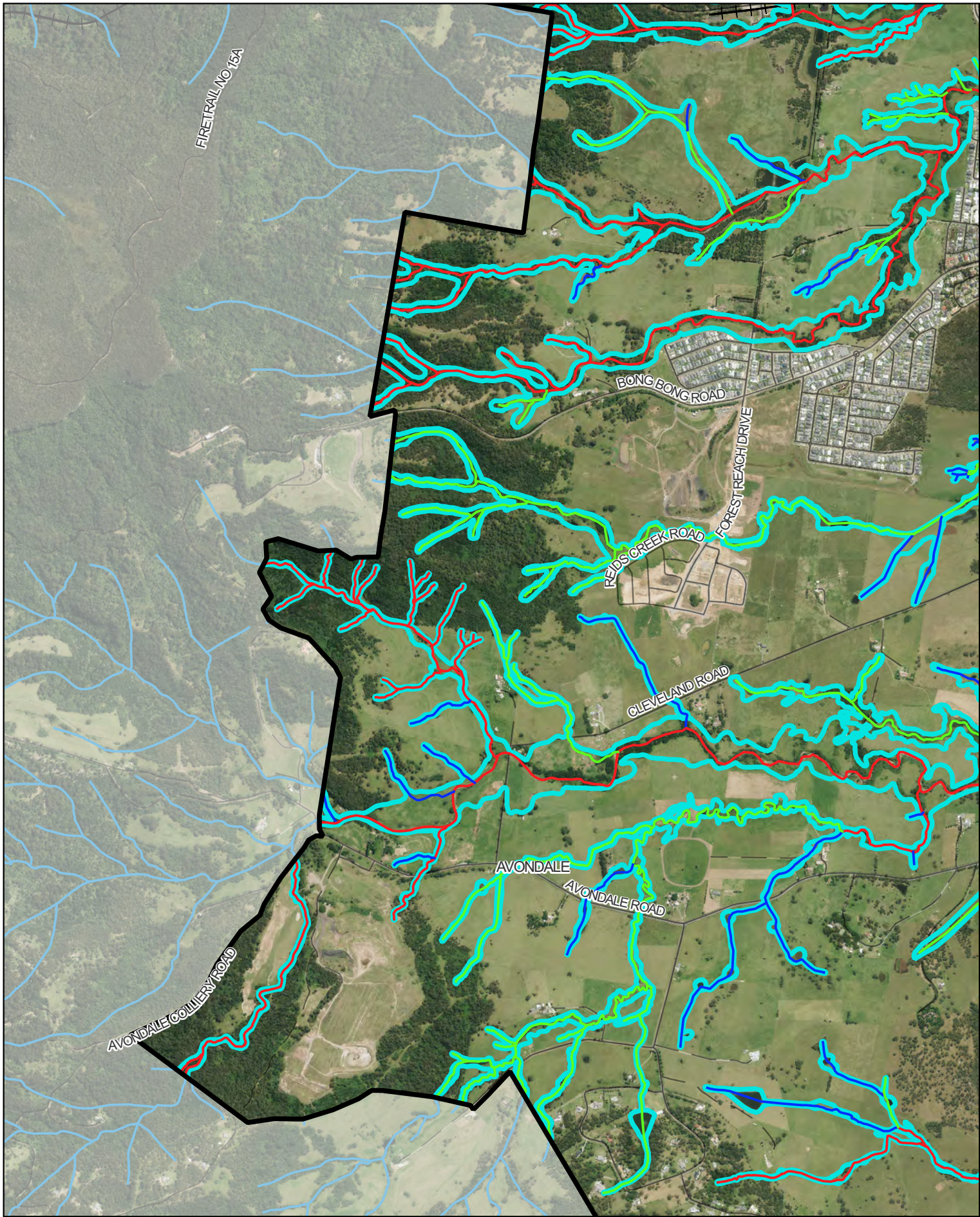




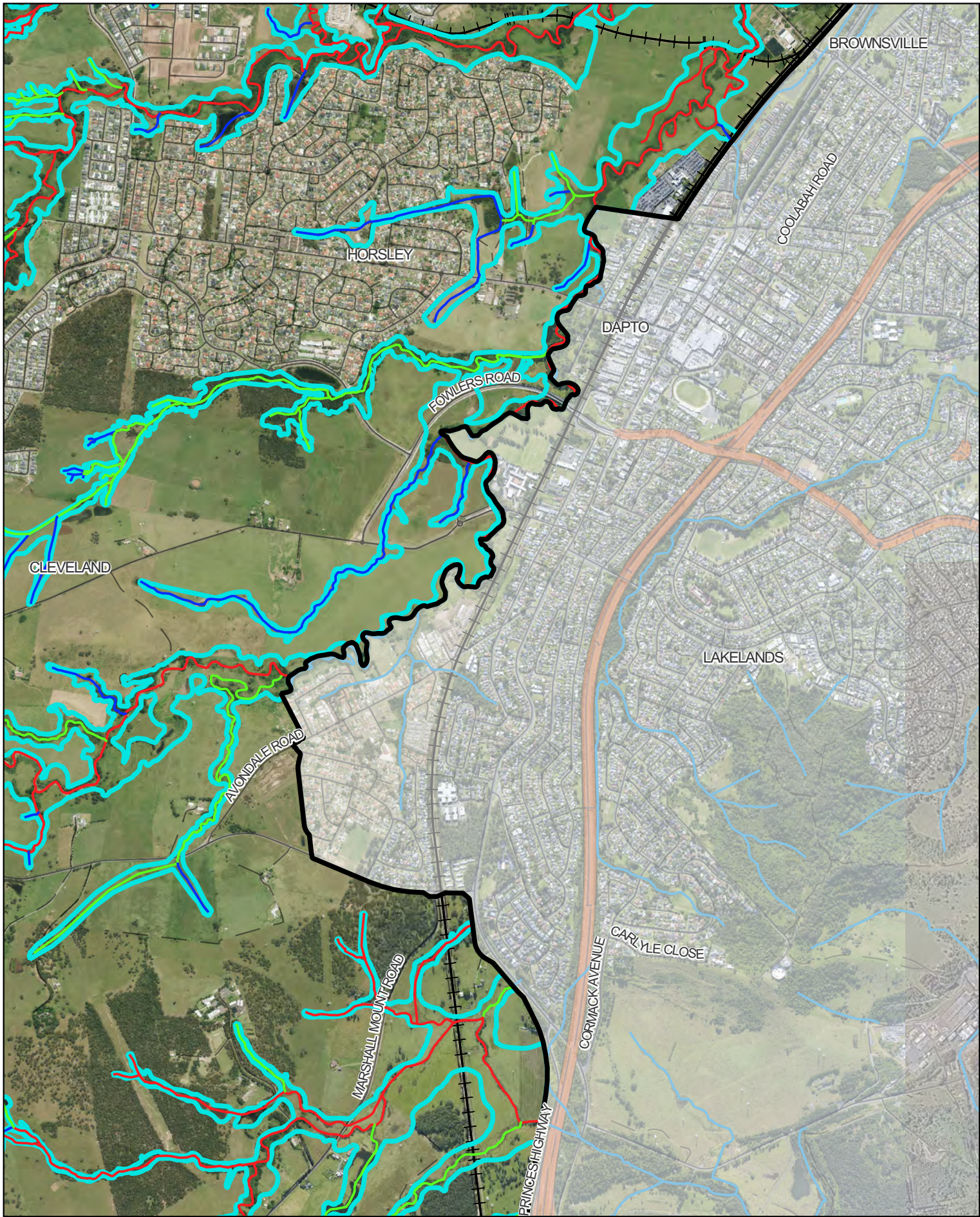
 	Legend - WDURA boundary - Top of Bank - Hydroline Category 1 - Hydroline Category 2 - Hydroline Category 3 - LGA boundary - Railway - Road / Track	Figure: A.1.1 Top of bank mapping Scale: 1:22,000 @ A4 GDA2020 MGA56 0 250 500 750 m N	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/09/2025 Job ref: 241959
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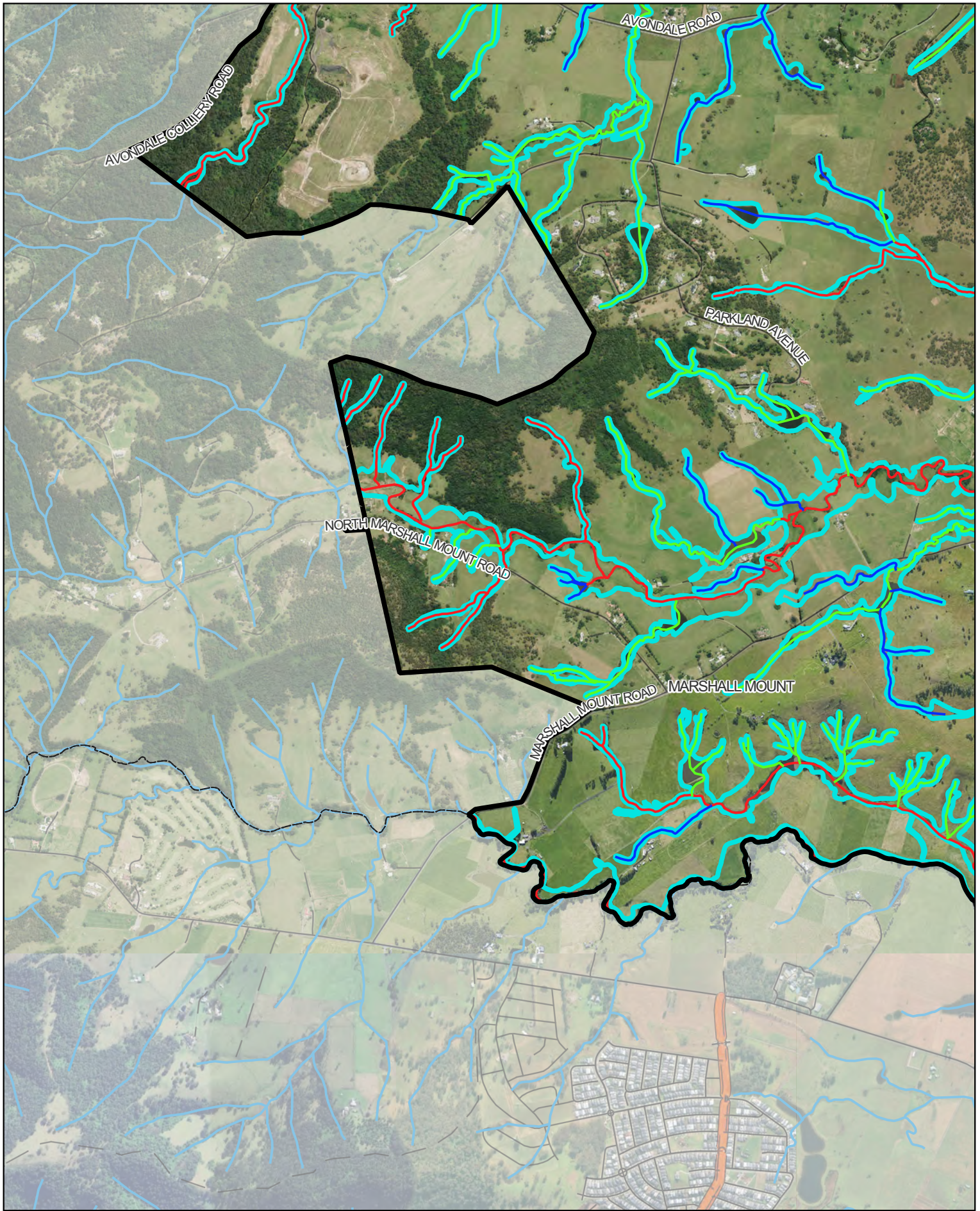
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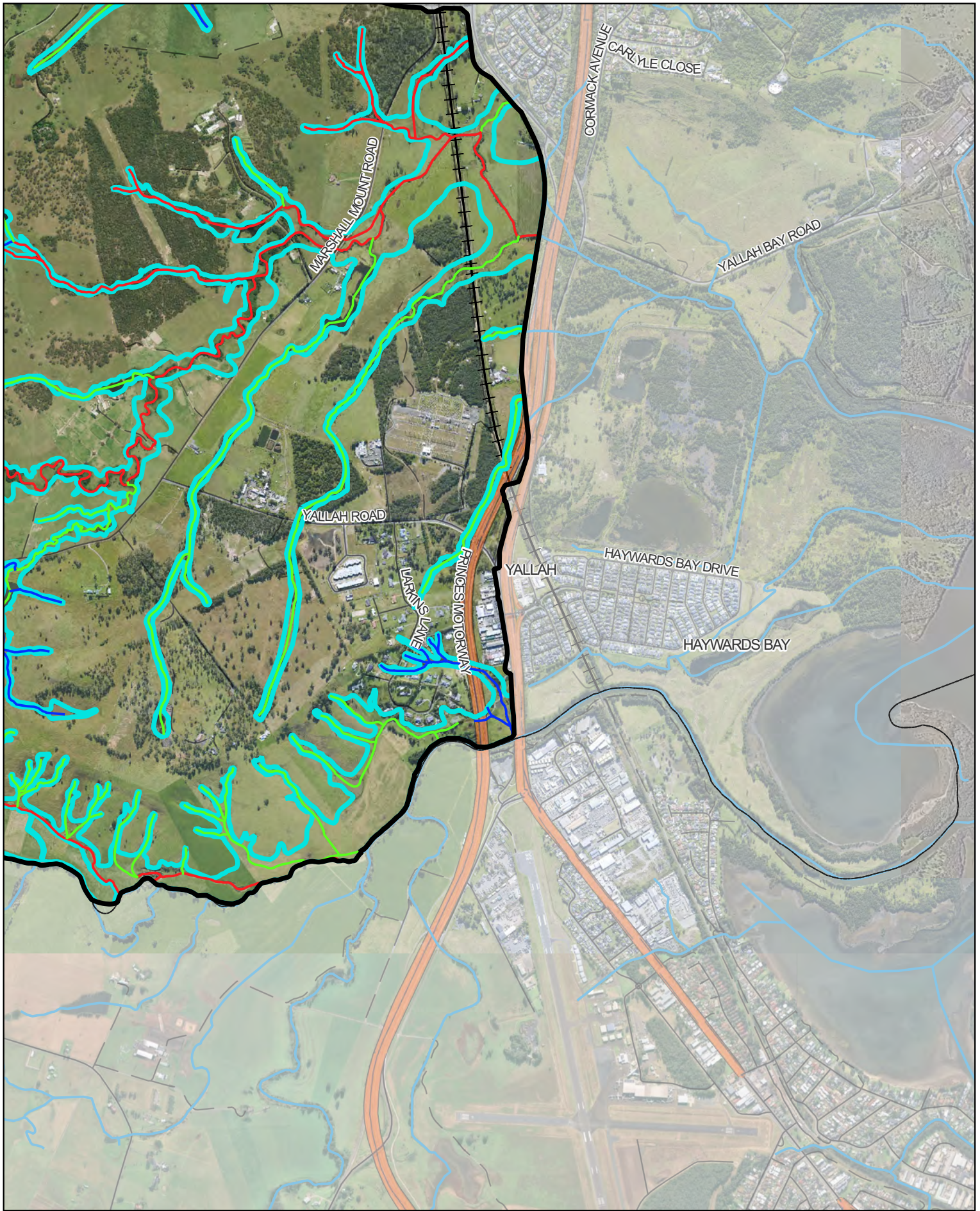
 	Legend  WDURA boundary  Top of Bank Hydroline  Category 1  Category 2  Category 3  LGA boundary  Road / Track	Figure: A.1.3 Top of bank mapping Scale: 1:22,000 @ A4 GDA2020 MGA56  	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/09/2025 Job ref: 241959
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 	Legend  WDURA boundary  Top of Bank - Hydroline  Category 1  Category 2  Category 3  LGA boundary  Railway  Major road  Road / Track	Figure: A.1.4 Top of bank mapping Scale: 1:22,000 @ A4 GDA2020 MGA56 0 250 500 750 m N 	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/09/2025 Job ref: 241959
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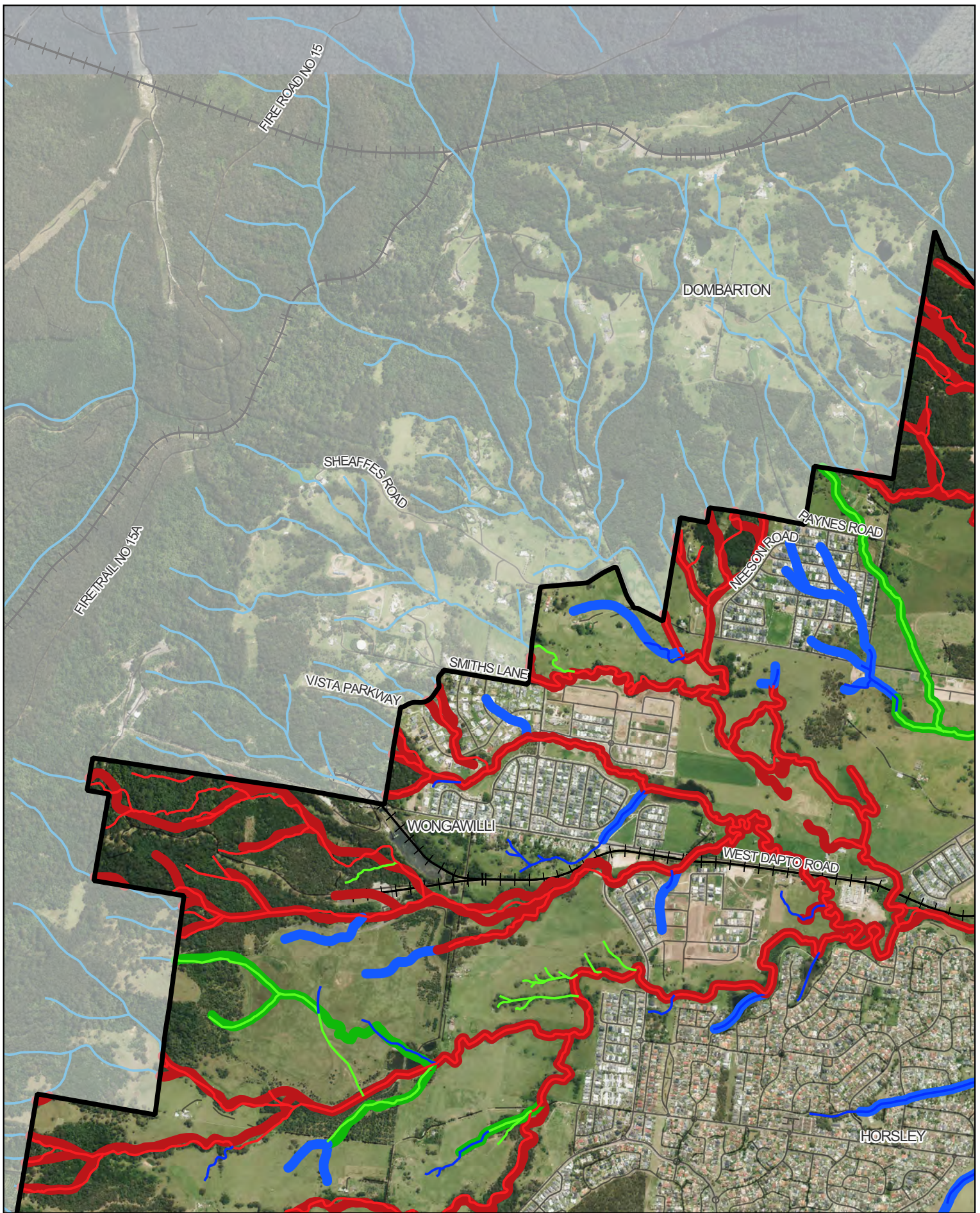


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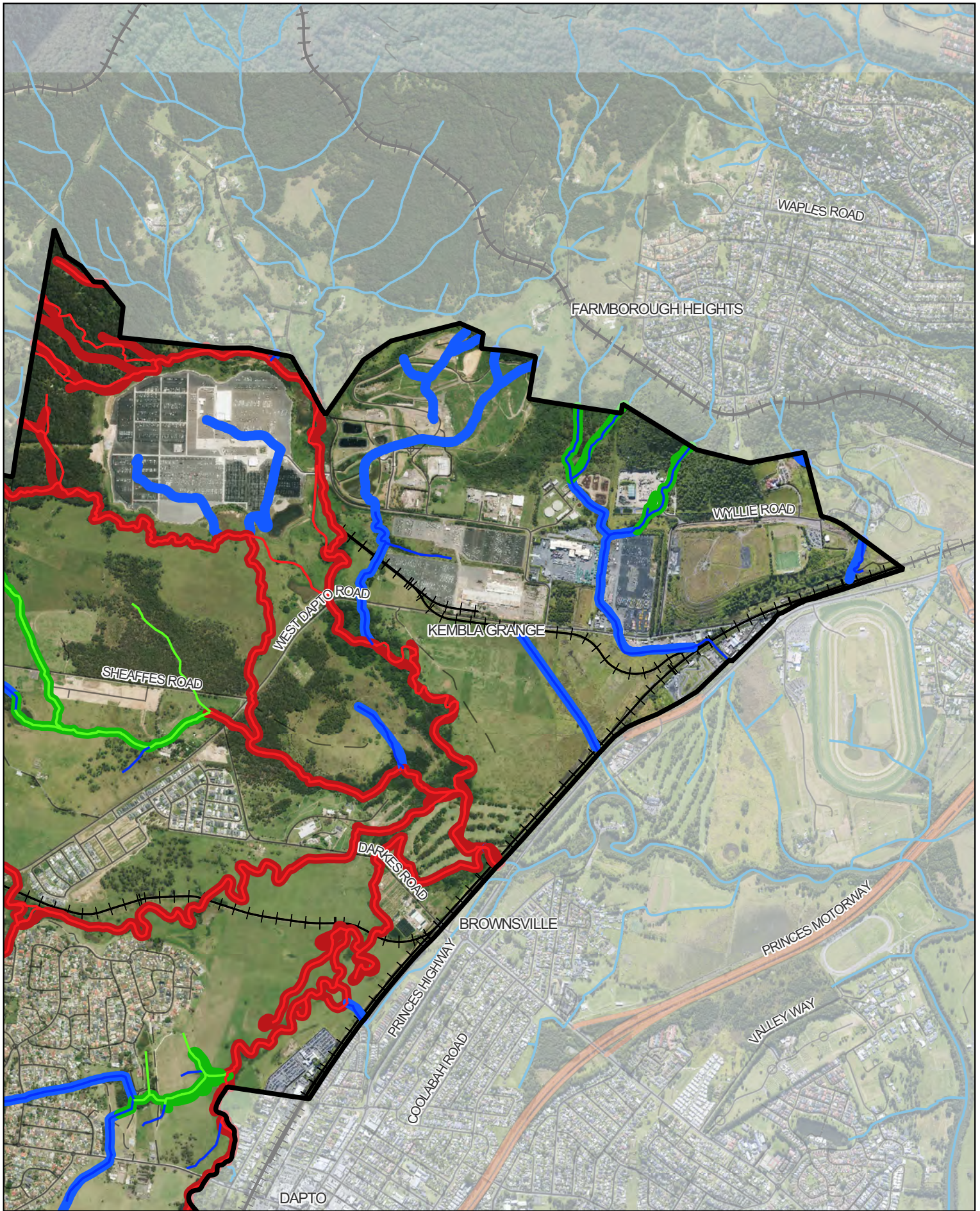


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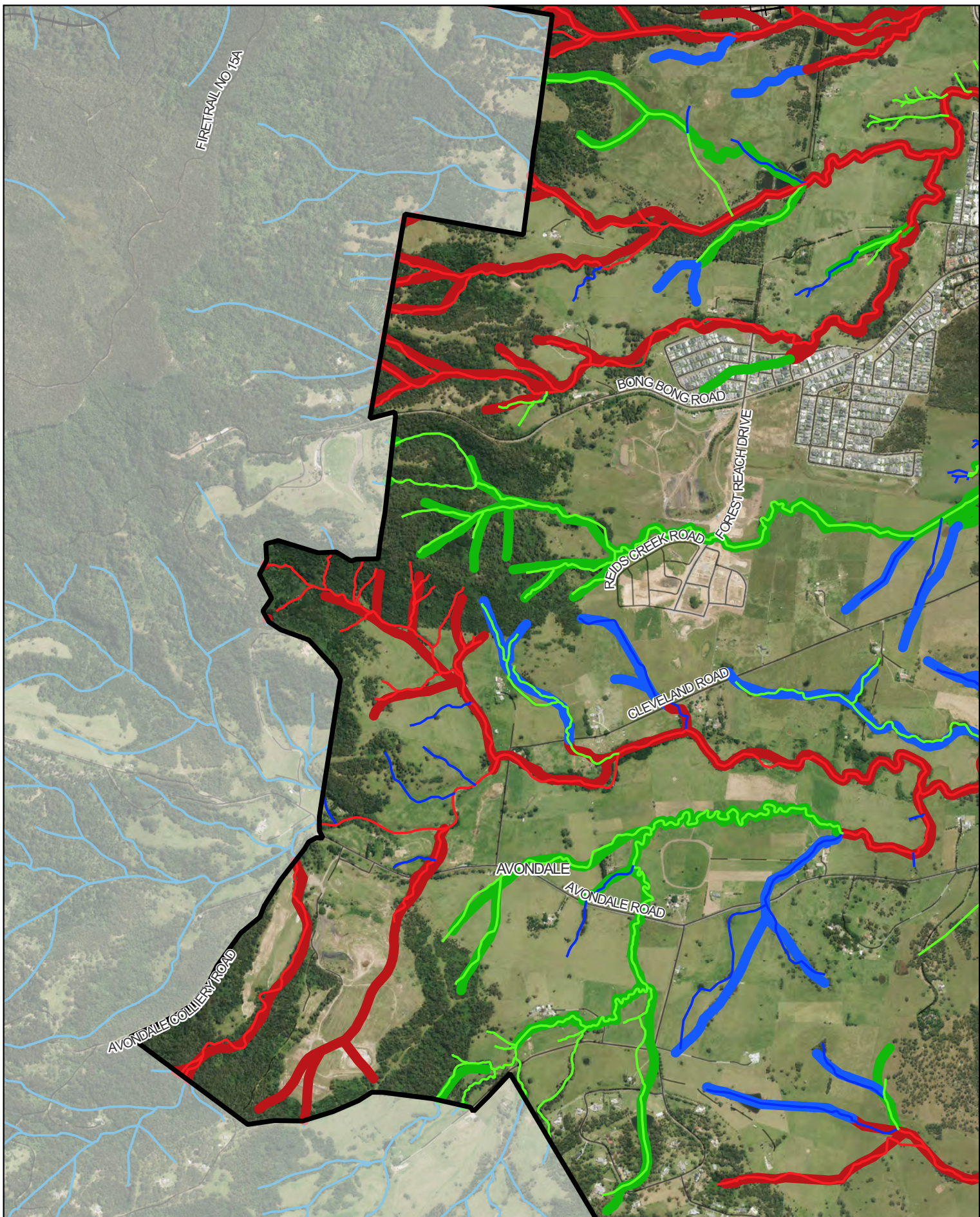
A.2 – Stream Categories



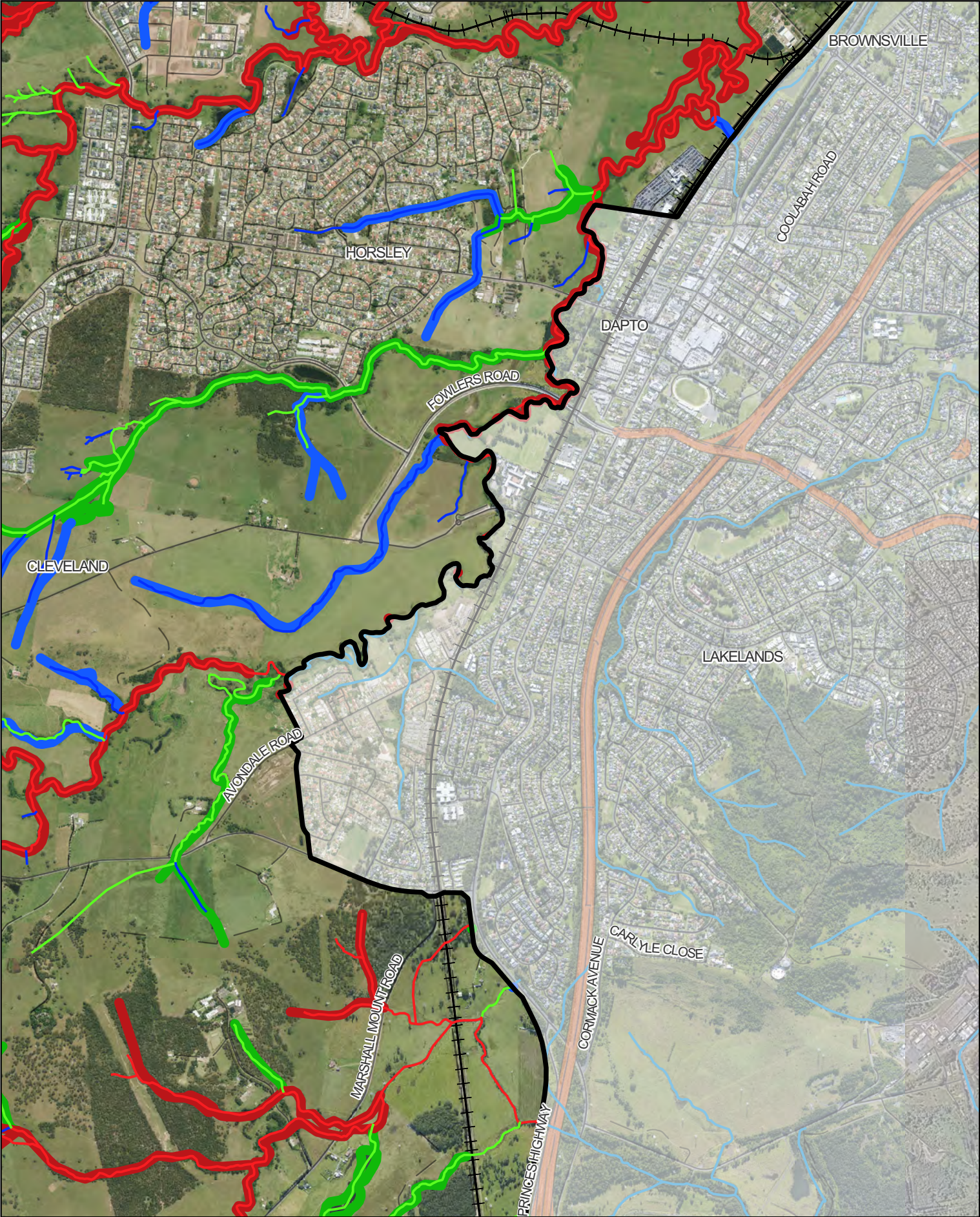
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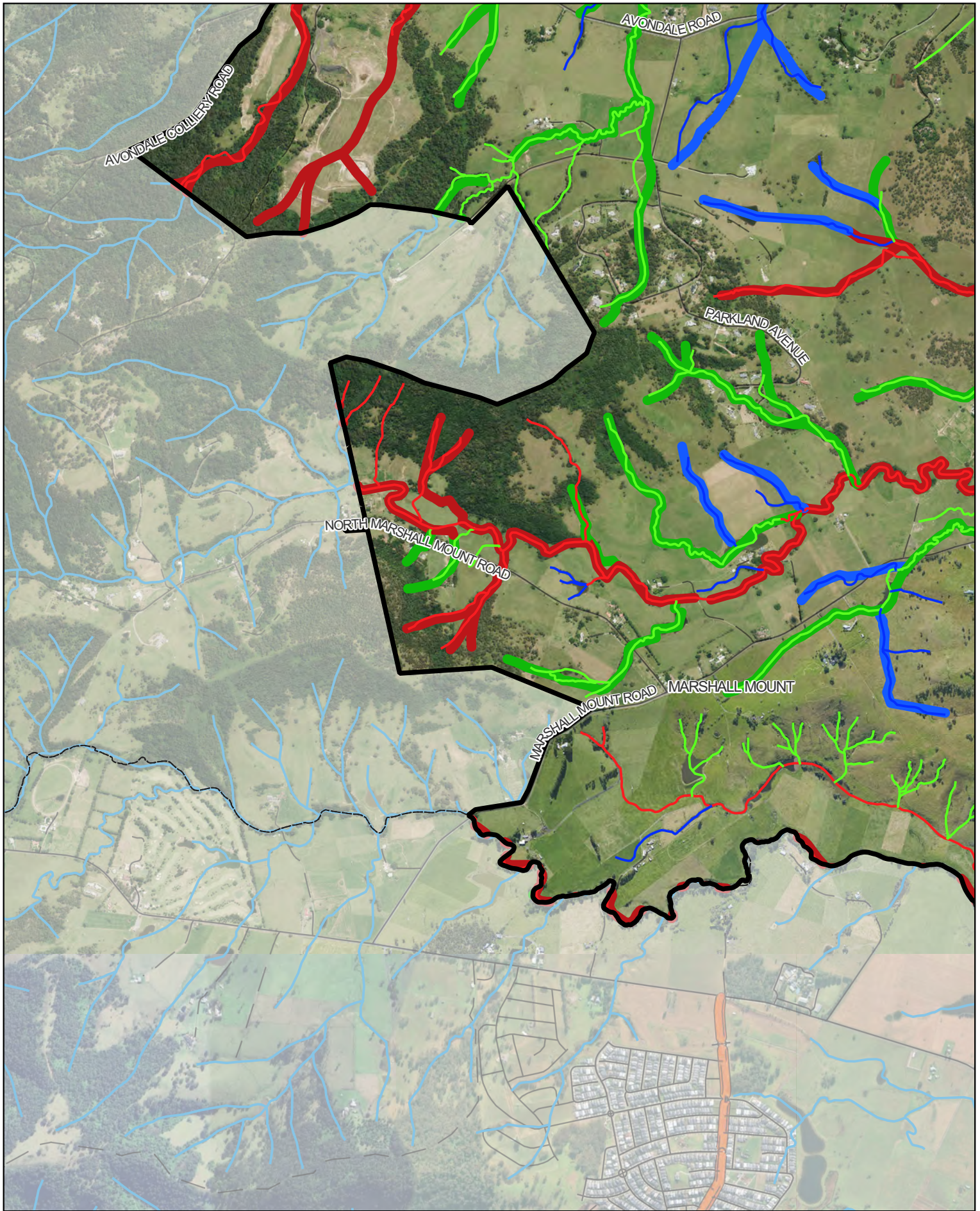
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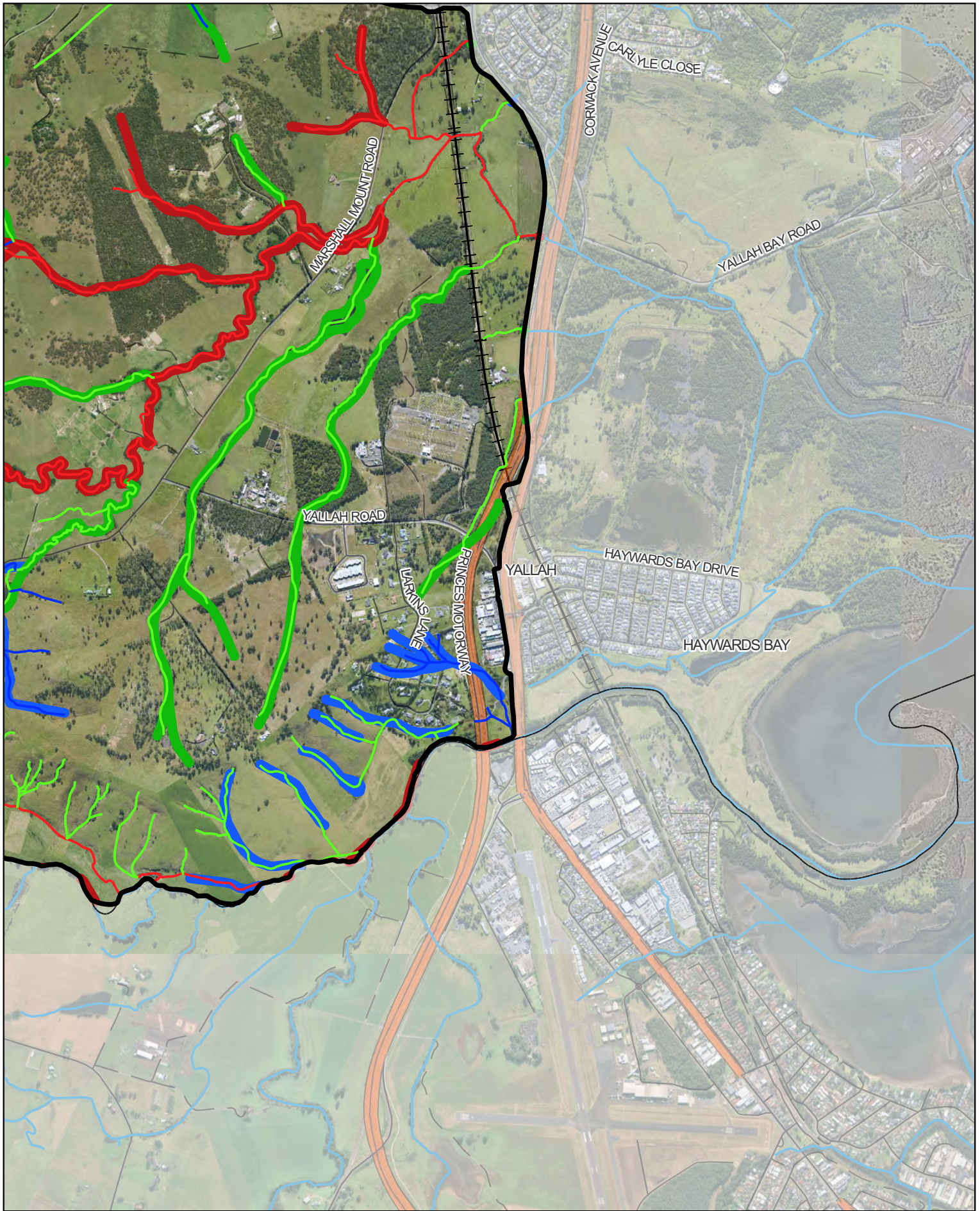
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 	Legend  WDURA boundary  Hydroline (Realigned)  Category 1  Category 2  Category 3  RCMS 2004 (for comparison) Category 1  RCMS 2004 (for comparison) Category 2  RCMS 2004 (for comparison) Category 3  LGA boundary  Major road  Road / Track  Railway	Figure: A.2.4 Stream Categories Scale: 1:22,000 @ A4 GDA2020 MGA56  0 250 500 750 m 	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 14/08/2025 Job ref: 241959
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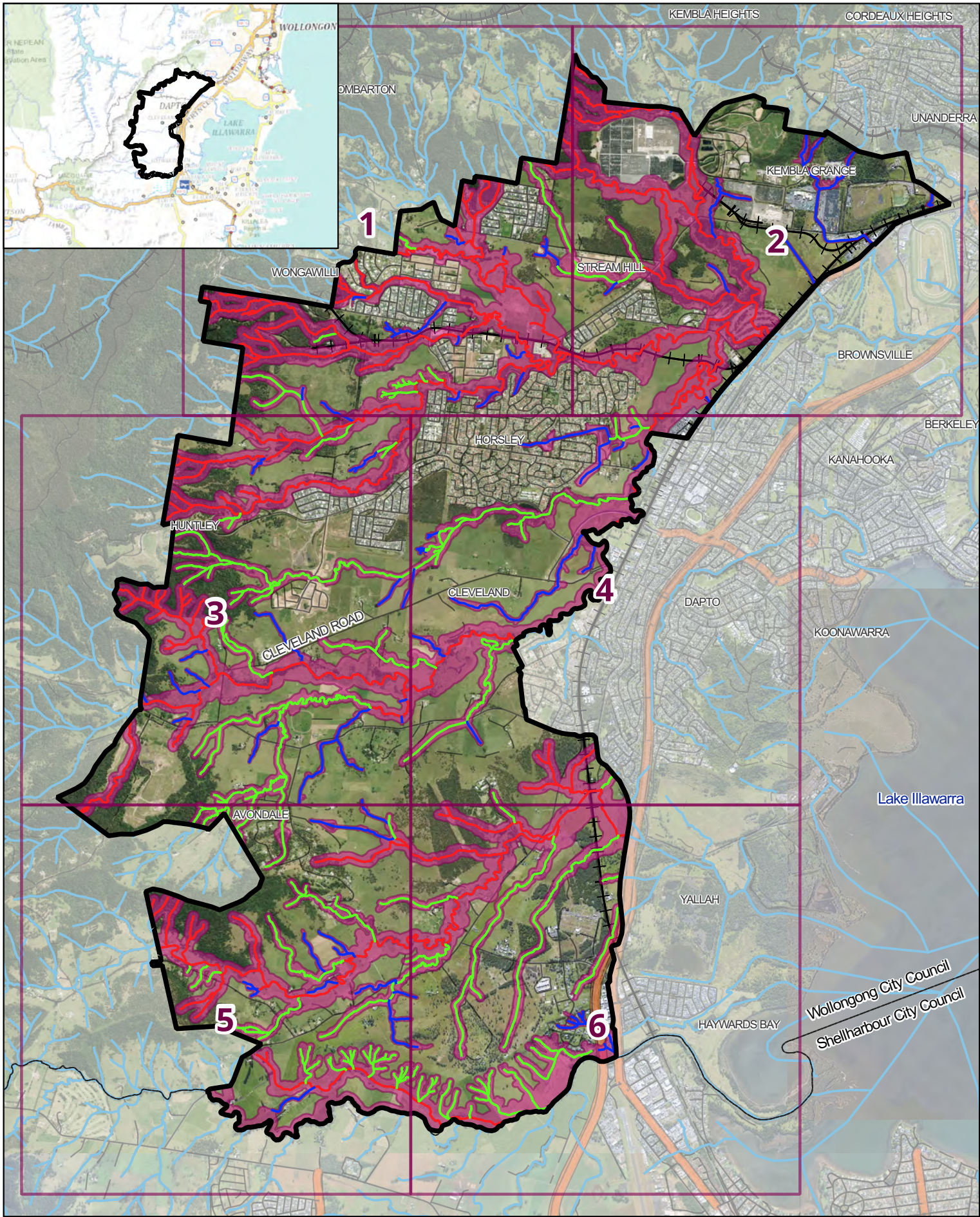


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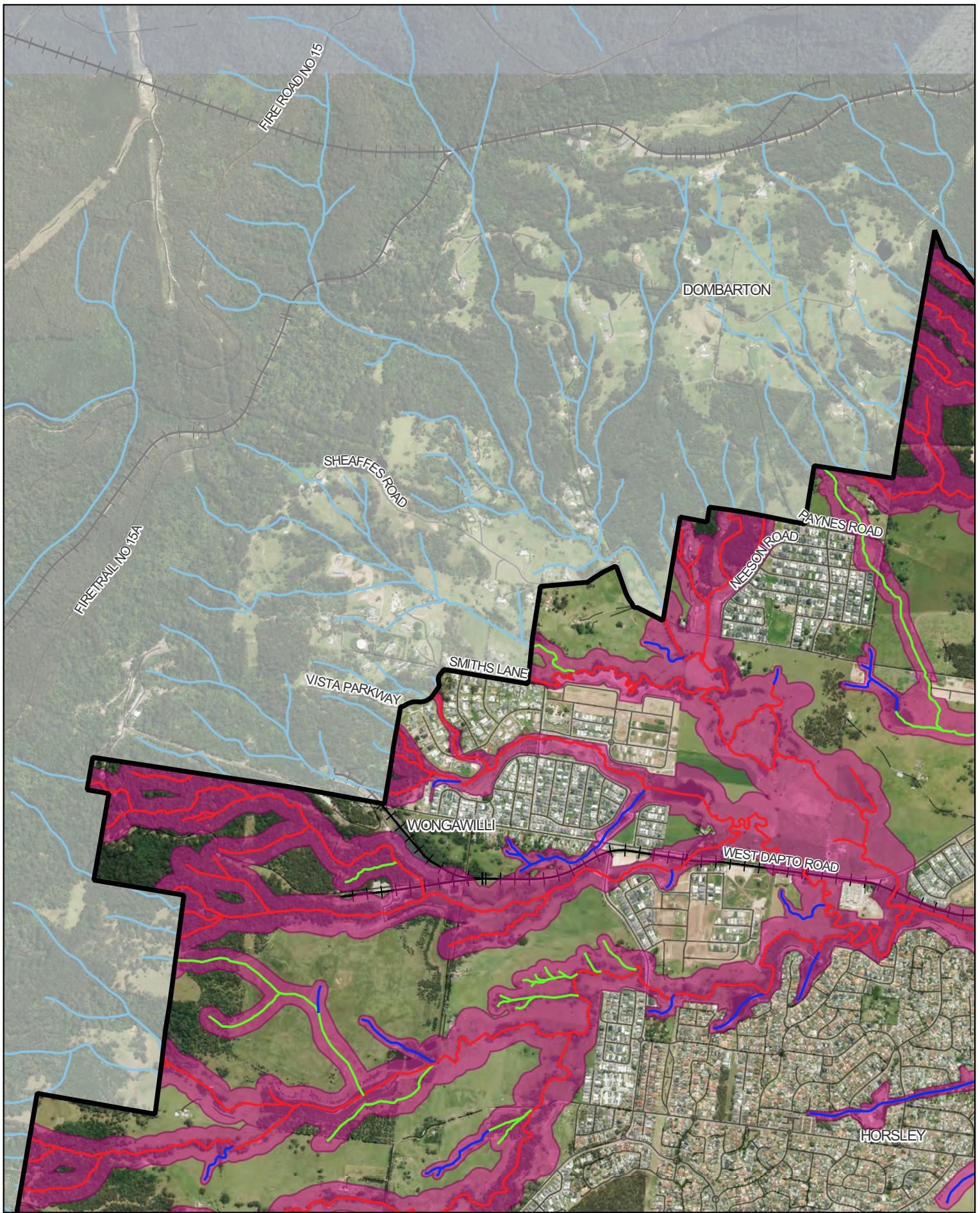


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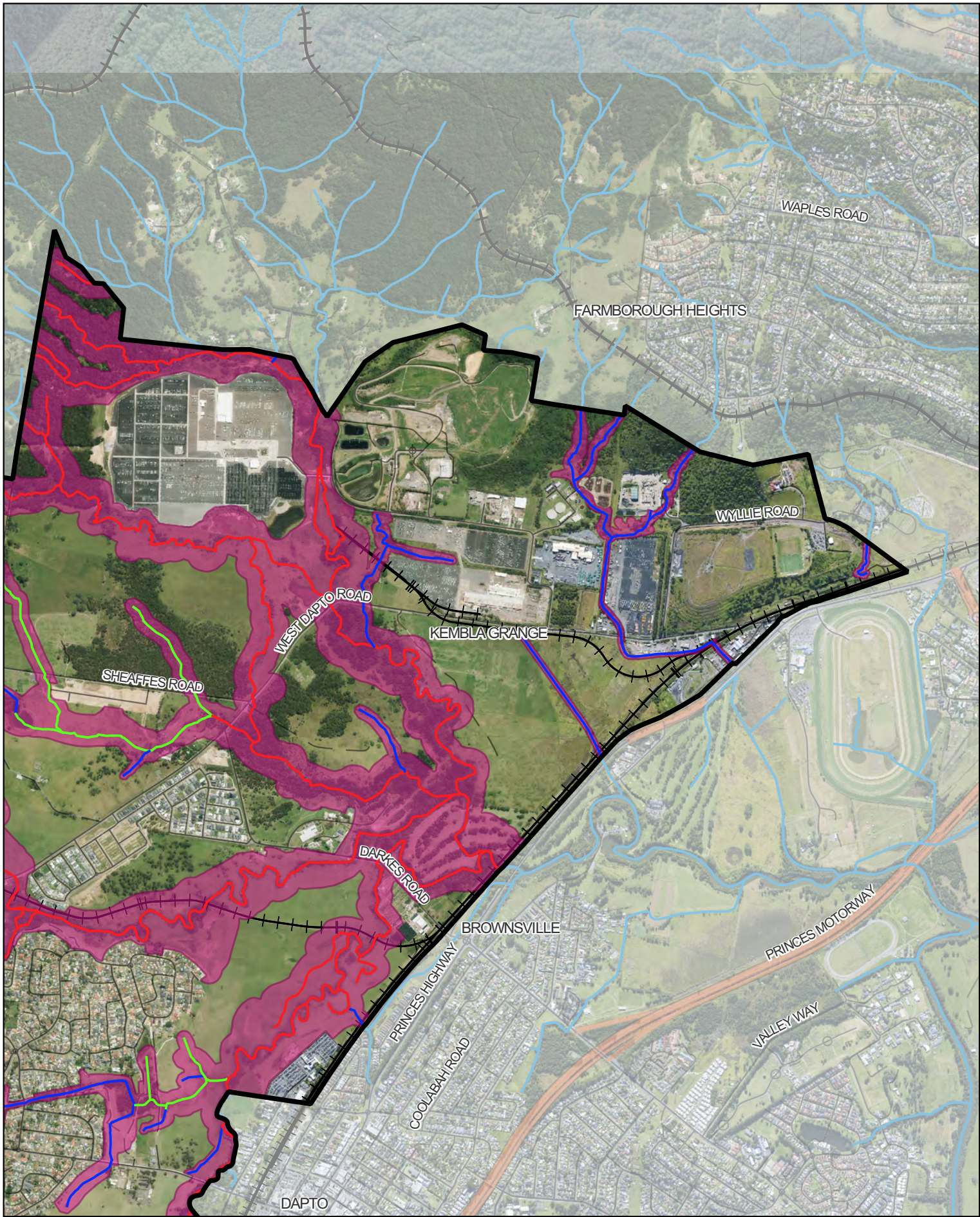
A.3 – Stream Buffers



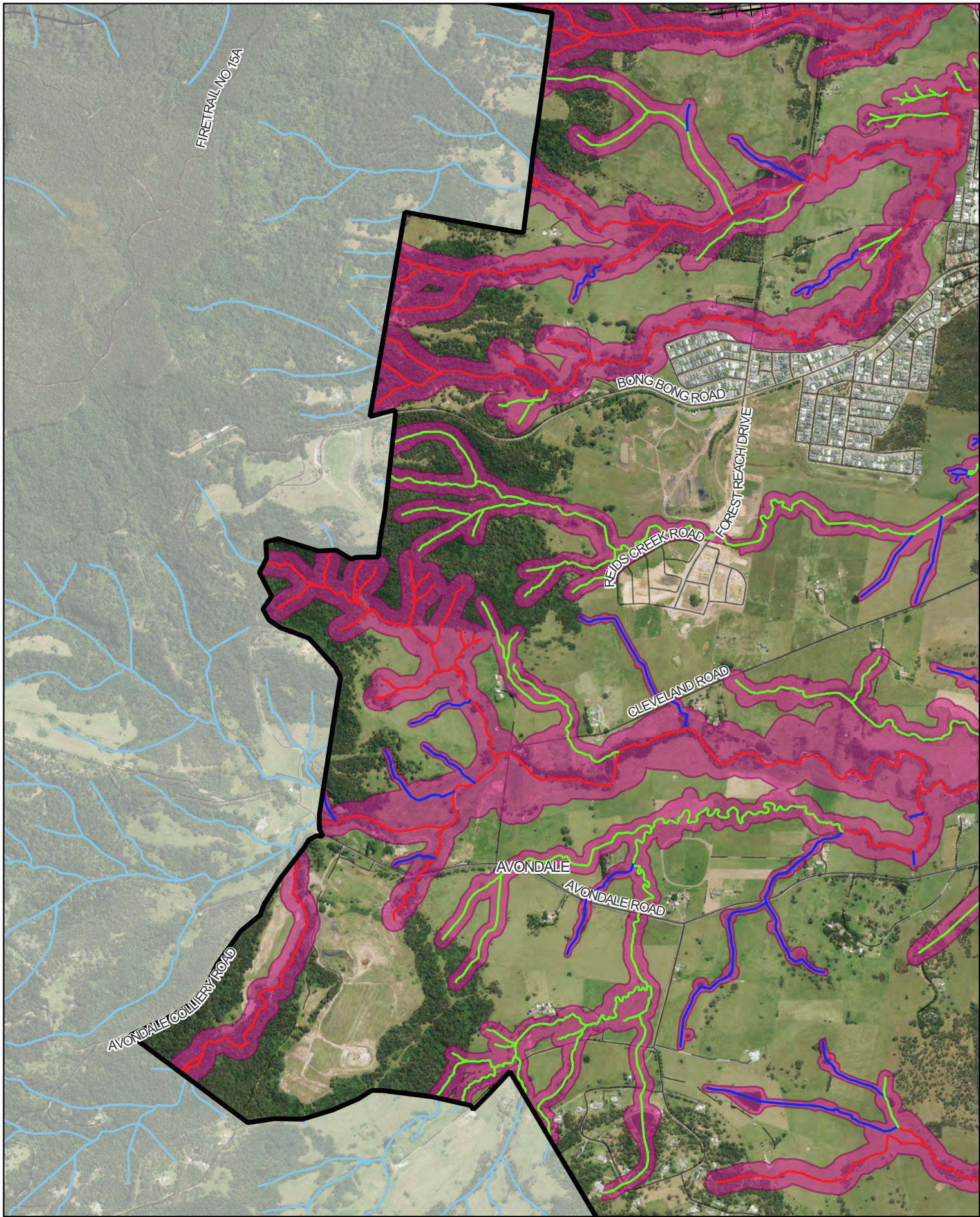
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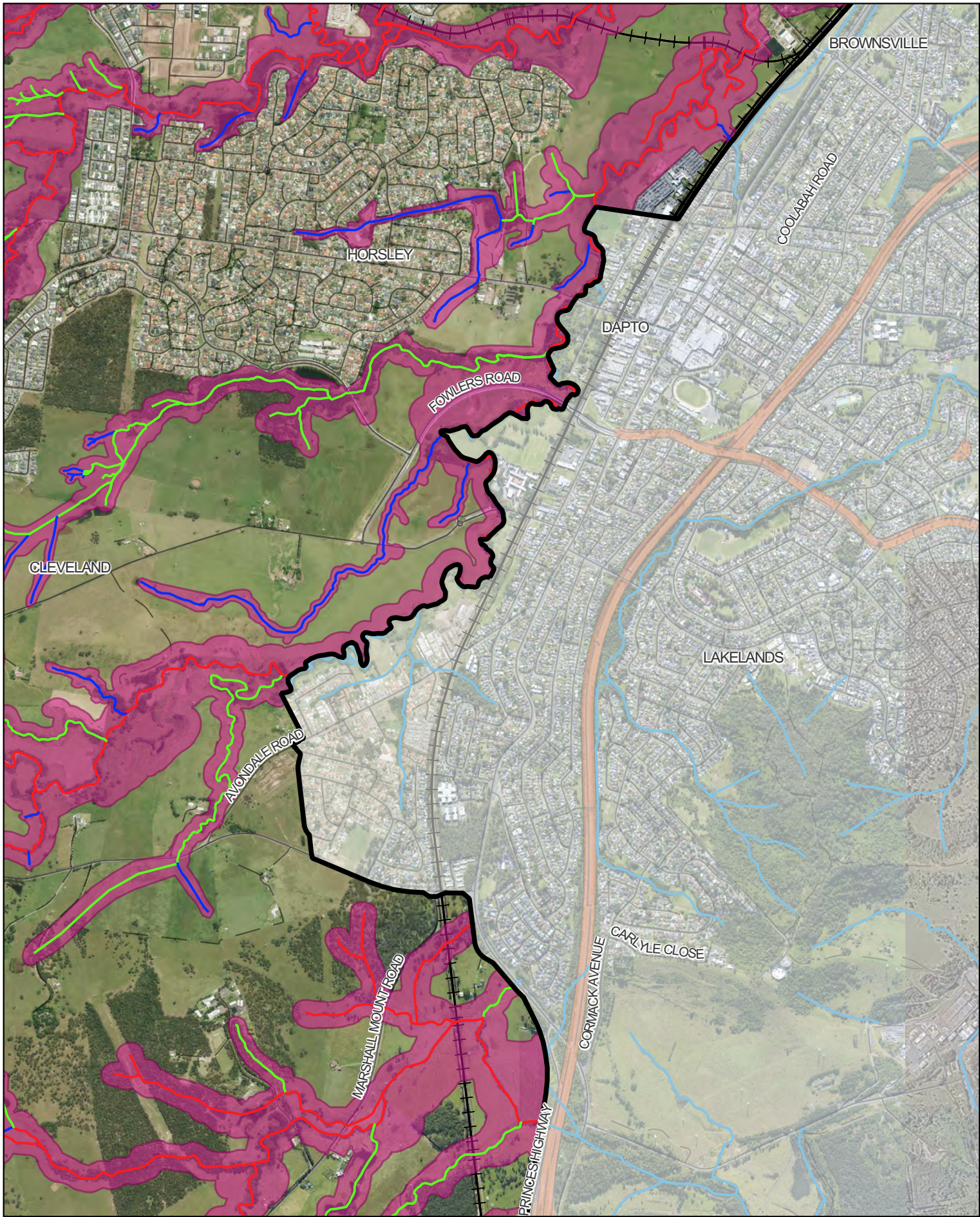
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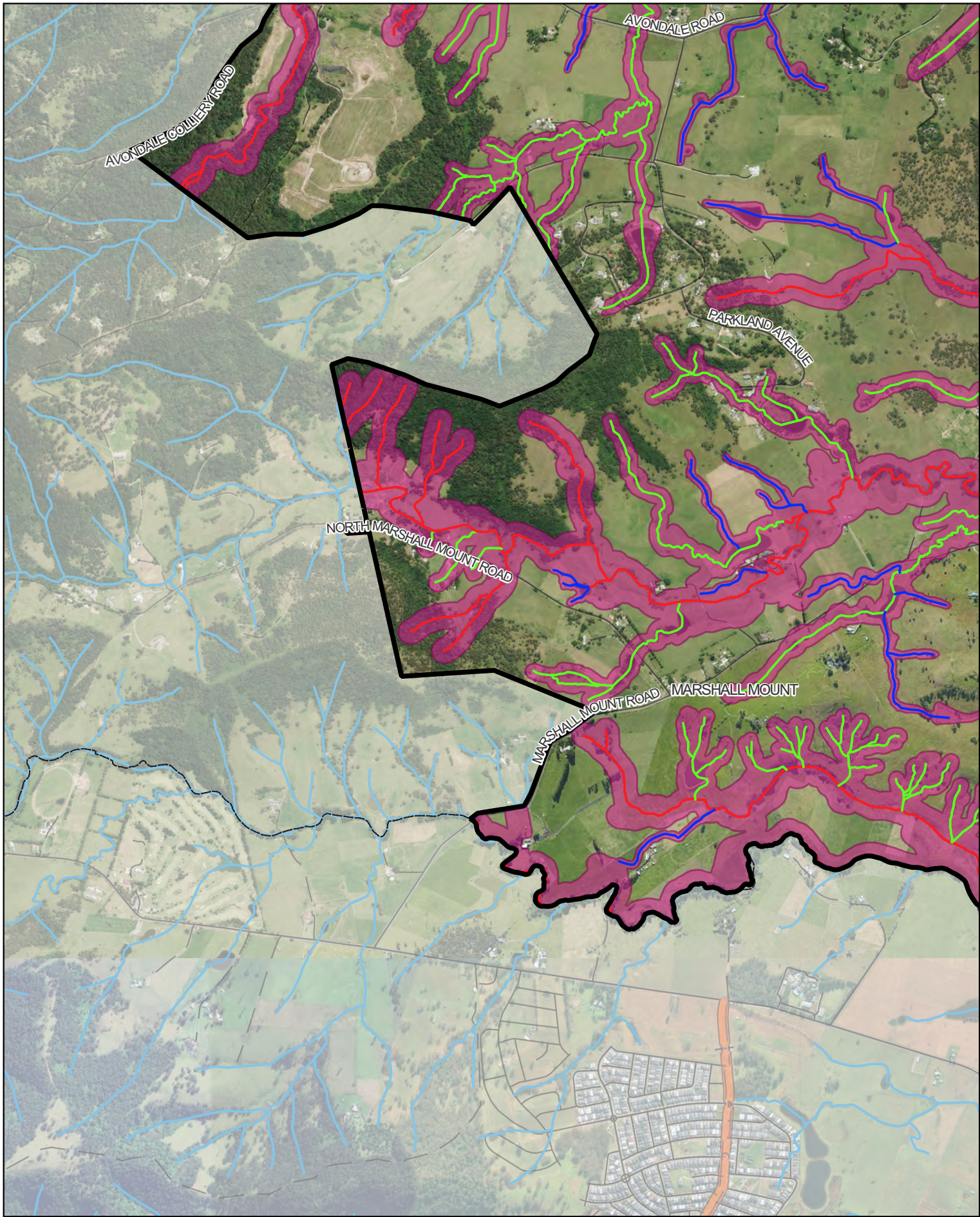
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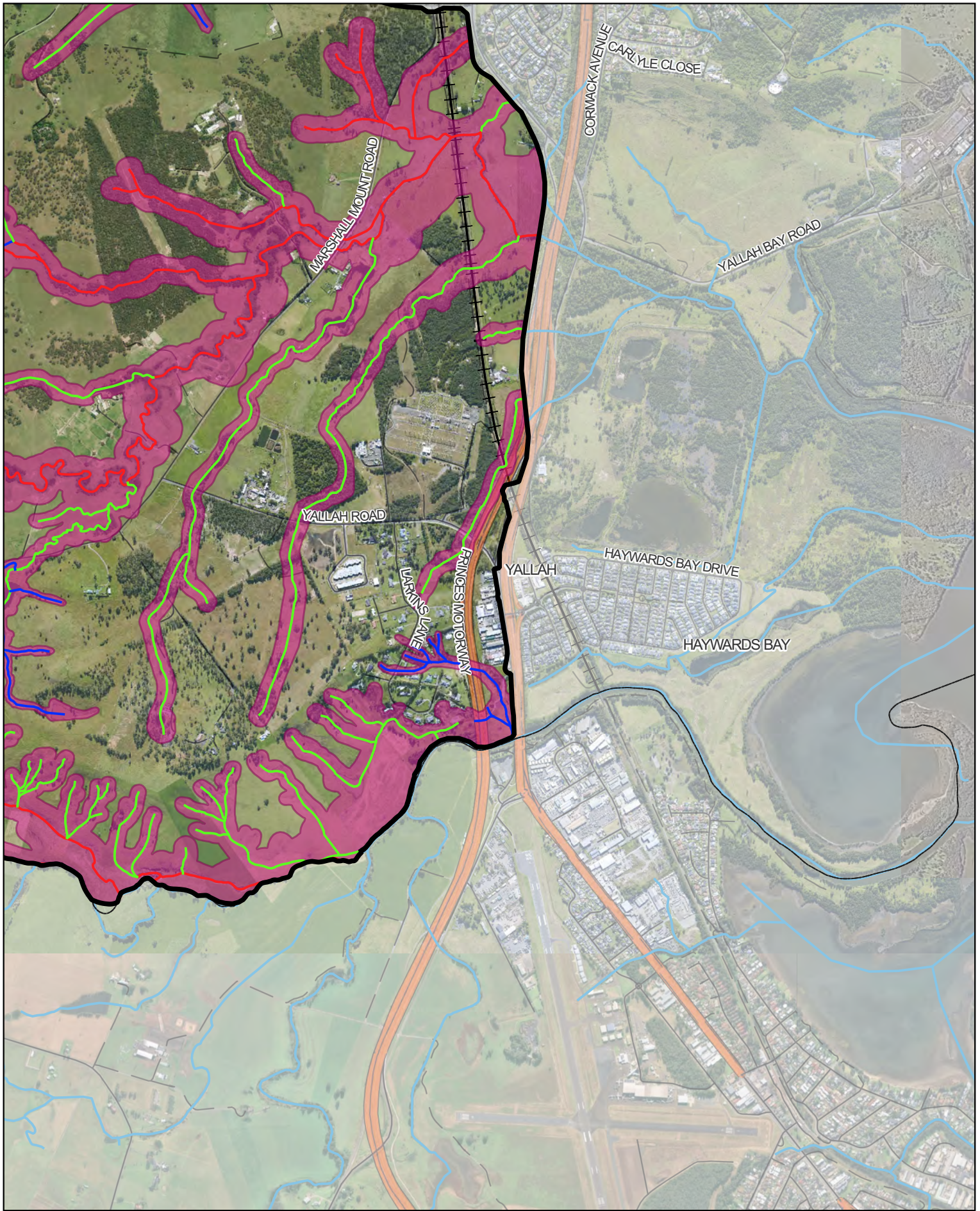
 Document Set ID: 26920787 Version: 1, Version Date: 02/10/2025	Legend  WDURA boundary  Riparian buffer  Hydroline (Realigned - AWC)  Category 1  Category 2  Category 3  LGA boundary  Road / Track	Figure: A.3.3 Stream Buffers Scale: 1:22,000 @ A4 GDA2020 MGA56  	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/09/2025 Job ref: 241959
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 	Legend - WDURA boundary - Riparian buffer - Hydroline (Realigned - AWC) Category 1 - Category 2 - Category 3 - LGA boundary - Major road - Road / Track - Railway	Figure: A.3.4 Stream Buffers Scale: 1:22,000 @ A4 GDA2020 MGA56 0 250 500 750 m	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/09/2025 Job ref: 241959
	Document Set ID: 26920787 Version: 1, Version Date: 02/10/2025		



 Document Set ID: 26920787 Version: 1, Version Date: 02/10/2025	Legend  WDURA boundary  Riparian buffer  Hydroline (Realigned - AWC) Category 1  Category 2  Category 3  LGA boundary  Road / Track	Figure: A.3.5 Stream Buffers Scale: 1:22,000 @ A4 GDA2020 MGA56  0 250 500 750 m	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/09/2025 Job ref: 241959
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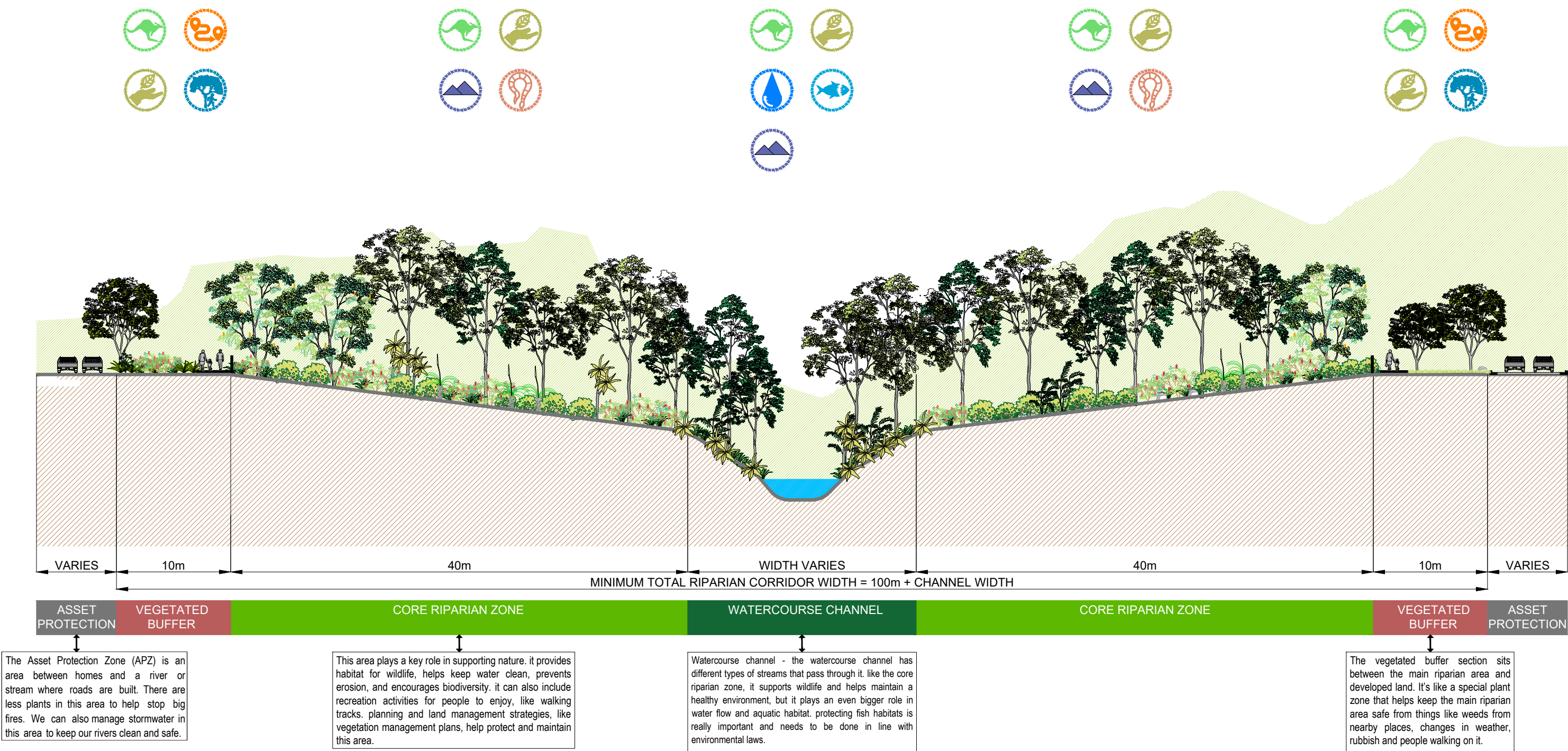


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	Document Set ID: 26920787 Version: 1, Version Date: 02/10/2025		

Appendix B - Stream Types

CATEGORY 1
ENVIRONMENTAL CORRIDOR

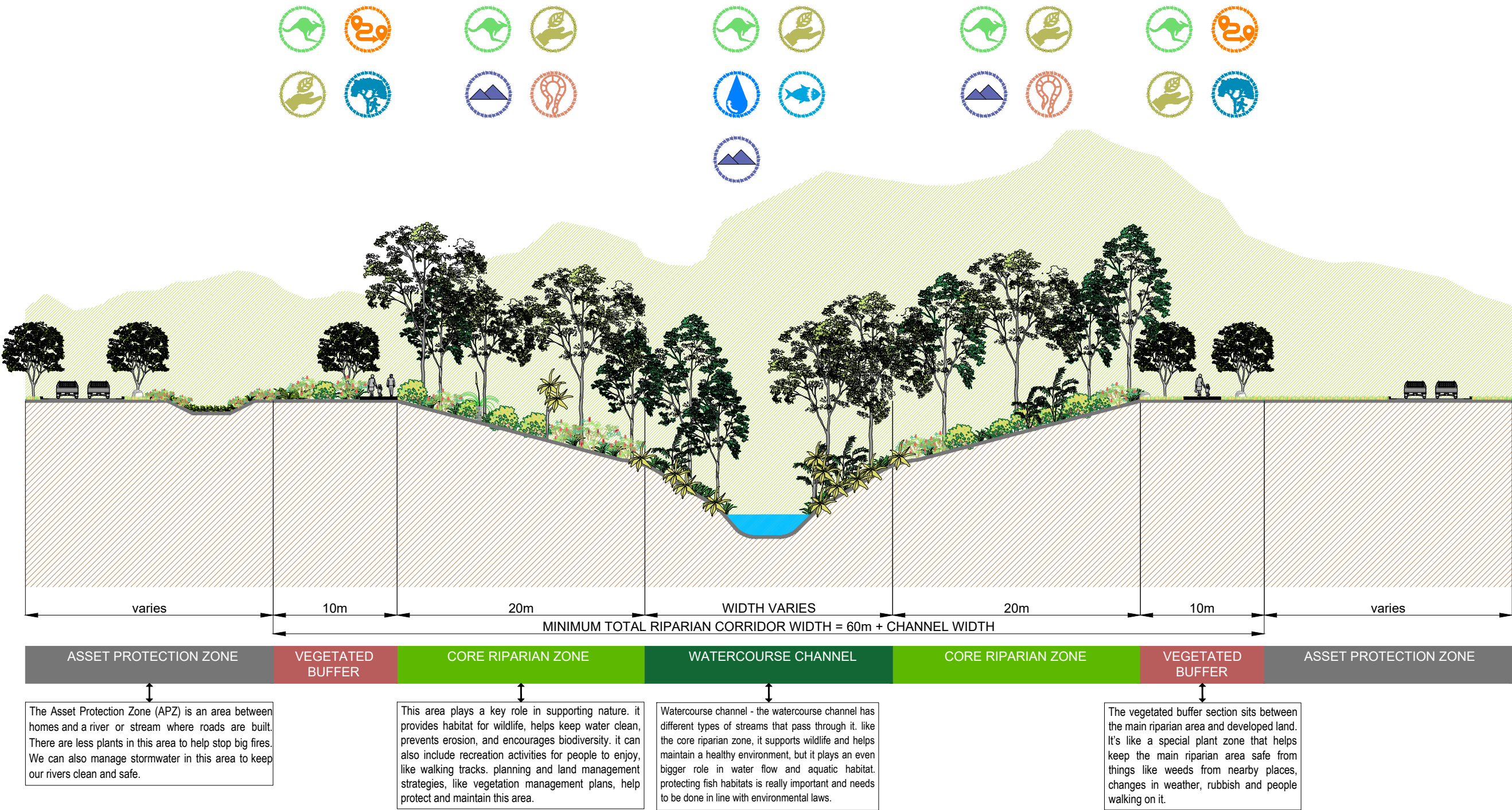
- These play an important role in providing the best possible protection for both land and water habitats, by:
- Making sure there's a continuous stretch of land for plants to grow and wildlife to move through.
 - Creating large, linked-up habitats for animals that live both on land and in the water.
 - Keeping native plants in waterway areas strong and thriving.
 - Managing the impact of nearby urban areas on these natural spaces.
 - Helping stabilise creek banks to prevent erosion.
 - Keeping water clean.
 - Reducing the risk of disturbing cultural heritage and artefacts in these areas.



CATEGORY 2

TERRESTRIAL AND AQUATIC HABITAT

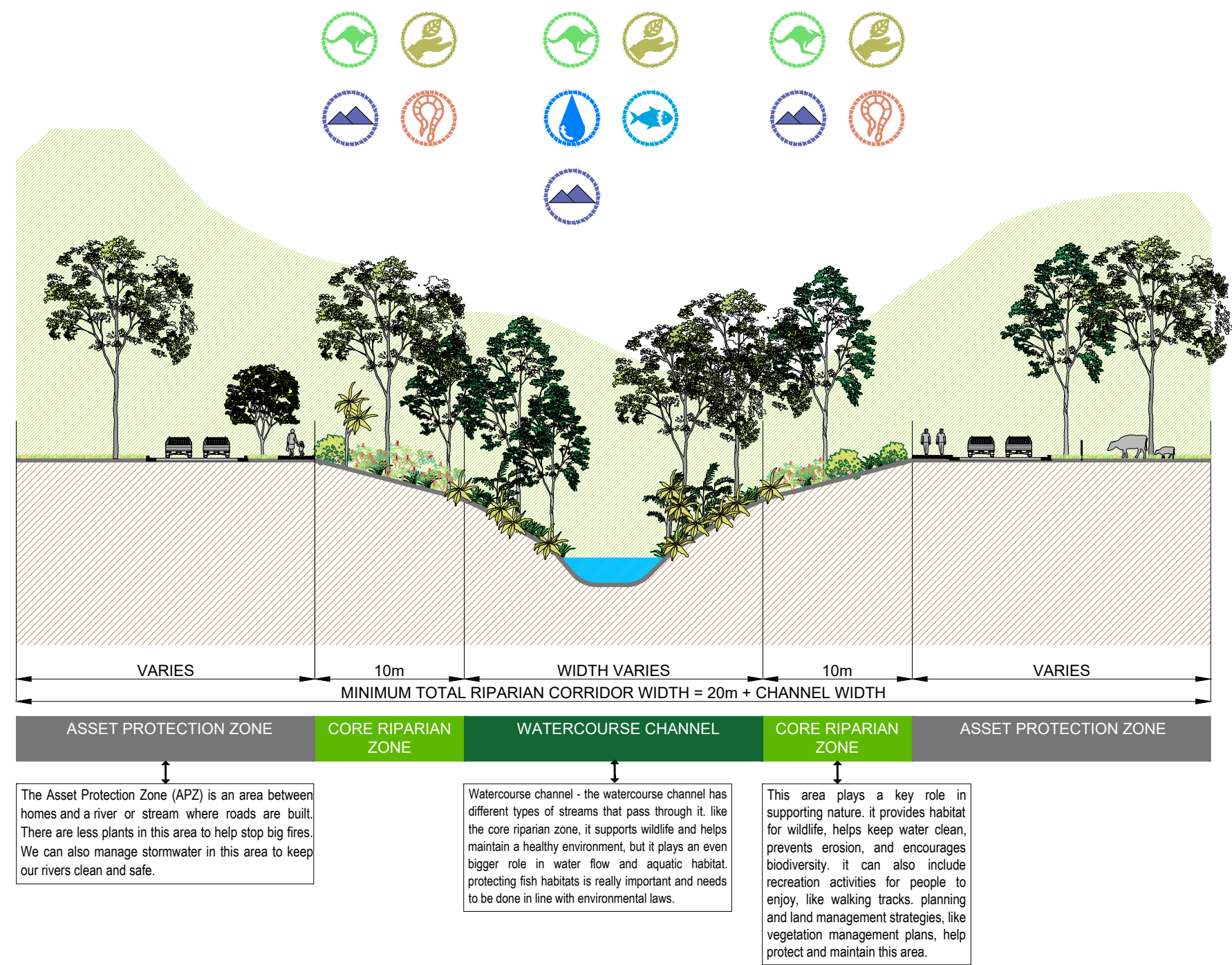
- The main goal is to keep the creek working like it should and help it get better by:
- Creating good habitats for animals that live both on land and in the water.
 - Keeping native plants in waterway areas strong and thriving.
 - Helping stabilise creek banks to prevent erosion,
 - Keeping water clean, and
 - Reducing the risk of disturbing cultural heritage and artefacts in these areas.



CATEGORY 3

BANK STABILITY & WATER QUALITY

- The main goal is to reduce dirt build-up and food for plants that moves around in the water by:
- Helping stabilise creek banks to prevent erosion.
 - Keeping water clean, and
 - Keeping our local plants safe, and
 - Reducing the risk of disturbing cultural heritage and artefacts in these areas.



Appendix C – Consultation

C.1 – Stakeholder Engagement Summary

Targeted consultation with a variety of stakeholders has occurred in stages and comprised the following interest groups identified in Table C.1. Key comments raised are provided in Table C.2. Broader public engagement was conducted by the WCC Engagement Team with the Engagement report provided below.

The information contained within Appendix C is based on preliminary discussions with a selection of stakeholders and is not a comprehensive record of all relevant views or issues. It is intended as an initial summary to inform the early stages of the project. This appendix has been updated and expanded following further engagement with the broader community and key stakeholders as part of the public exhibition phase of the draft report (refer Appendix C.2).

Table C.1 Interest groups

Interest Group	Representatives
Internal project stakeholders	WCC Planning team Biodiversity team Stormwater team WCC Community Engagement Team
Industry	Developer project manager Flood engineers Ecological consultants Development engineers
State government agencies	Sydney Water DPI Fisheries DCCEEW Coast & Flooding
Community & Indigenous* (Conducted internally by WCC)	

Table C.2 Stakeholder engagement themes

Group	Perspective	Comments
Industry	Developer	• Clarity on weight of RCMS vs DCP • Frustration/confusion at inconsistency with jurisdictions across NSW using Waterfront land guidelines (ie. Strahler-based buffer zones for riparian corridors) • Guidance required for streams with no top of bank
	Development engineer	• How is averaging employed, guidance for when and how it is suitable
	Ecology	• Flexibility makes assessments and solutions more streamlined • Multiple policies may overlap with varied and guidelines and buffers distances eg.: - o Coastal Wetlands - o RCMS stream categories - o Fisheries buffers • Coastal Wetland buffers should be included in stream category mapping • WCC online mapping tool hard to use including scale dependant

Group	Perspective	Comments
		visibilities • Drainage lines aren't included in NSW Hydroline mapping • Earthworks well outside of a designated riparian corridor can modify local drainage patterns such that streams with small catchments (eg. 1st order streams) may not act as waterways post development • Guidance required for when realign waterways is acceptable? • Waterways are mapped that do not exist or are highly ephemeral
	Flood engineer	• WDURA and Illawarra region typically subject to higher erosive forces than other regions due to landscape and topography
	General	• Creek reconstruction examples helpful in achieving positive outcomes • Category 3 objectives could be achieved through management measures instead of buffers • Stream category review required • Option to revise categories (ie. merit review). • Guidance required for appropriate site assessments • Changing landforms will lead to stream changes.
WCC	Stormwater/ Flood/ Ecology	• Flashy, high-velocity catchments • Mullet Creek Flood Study highlights concurrence of flood management with vegetated streams • Increased roughness does not equate to increased flood extent • Detention basin within floodplain must not impact riparian functions • Detention basins able to be vegetated • Objectives and examples of devices valuable • Acknowledge lack of industry understanding: • Significance of waterway assessed on future rehabilitated condition not current degraded nature • Biodiversity is top priority for categorisations • Category buffers are minimums
	Natural Area team	• 10m buffer required for maintenance access around corridors
	Planning	• Other policies supporting riparian corridor retention/restoration: • Climate change • Re-greening • Lake Illawarra CMP • Funding of works • Bonds not generally used • Developers required to undertake restoration prior to handover • Financial risk to WCC could be managed by: • Ring-fencing bonds for sole use on riparian corridors • Additional margin on costs to cover financial risk where WCC takes un-restored land • Allows developers to avoid ongoing management post construction • Allows land management at a coordinated catchment level
	General	• Lack of clarity as to whether RCMS mapping is flexible • Acceptance that mapping needs updating due to age and development of

Group	Perspective	Comments
		remote sensing tools/data • Top of banks mapping needs clarity ie. main channel vs paleo channels vs floodplain extent • Industry feedback: ○ Frustrations at not using simple Strahler method ○ Category 1 streams the focus of pushback ○ Seek clarity of reasoning for certain Category 1 streams ○ DCP failing to fully explain and reflect RCMS detail
State Agencies	Water team	• Other LGAs have incorporated RCMS into LEP • Greater authority than DCP • Increased stormwater quantity as important as quality • CAA stricter on greenfield sites than brownfield • RCMS and NSW Riparian Management guidelines are minimum guidelines • Expect greenfield developments to exceed minimums • Watercourses consistent with State guidelines still failing, requiring substantial rectification works • Category 3 streams critical to water quality & bank stability downstream
	RCMS authors	• Strahler classification not used as it is not merit based • RCMS a strategic plan guiding landscape activities compared to NSW Riparian Management guidelines which guide Controlled Activities approvals (CAA) • RCMS followed large floods and Commission of Inquiry • Commission recognised corridor widths needed for strategic planning based on scientific understanding • Category 1 vs 2: • Establish streams with less corridor potential but significant ecology value • Category 2 buffers for conservation of important habitat patches non-corridor streams • Confounding cat 1 v 2 assignment due to upfront compromise allowing greater development opportunities • Brisbane City Council Rehabilitation Guidelines considered best practice • Category 1 upstream valuable as final corridor connectors
	Coast and Flood team	• WCC flood models incorporate vegetated riparian zones (VRZs). While increased roughness generally increase flood levels, VRZs allow attenuation downstream due to increased storage potential upstream • NSW Flood Prone Land Policy – ecological solutions to be used wherever possible to increase flood resilience • Macro channels largely cover extent of large floods • DCCEEW science surveys of communities across NSW identified values and objectives for waterways – RCMS a plan to meet long terms needs of the community
	NSW Fisheries	• Transition to urbanisation (ie. increased hardstand) is the biggest impact on water quality and marine environments • Marine Estate Management Policy considers catchments. Management best at strategic level

C.2 – Community Engagement Report



**Let's
Talk**

Riparian Corridor Management Strategy – West Dapto Urban Release Area

Engagement Report

July 2025



Wollongong City Council

Visit 41 Burelli Street, Wollongong

Phone 4227 7111

Email engagement@wollongong.nsw.gov.au

Web our.wollongong.nsw.gov.au



Table of Contents

Table of Contents2

Executive Summary3

Background5

Stakeholders6

Methods.....6

Results9

Next steps14

The information in this report is based on data collected from community members who chose to be involved in engagement activities and therefore should not be considered representative.

This report is intended to provide a high-level analysis of the most prominent themes and issues. While it's not possible to include all the details of feedback we received, feedback that was relevant to the project has been provided to technical experts for review and consideration.

The analysis of engagement results was assisted by AI technology using de-identified data.

Executive Summary

Wollongong City Council is updating the 2004 Riparian Corridor Management Strategy for the West Dapto Urban Release Area to reflect current development, environmental conditions, and best practice. This will ensure that waterways and surrounding land (riparian corridors) are appropriately managed and protected as West Dapto continues to grow. The update will provide clearer guidelines for development, improve watercourse mapping, and address environmental and planning challenges that have emerged since the original strategy was adopted.

This report outlines how we engaged with landowners, developers, Aboriginal community members, and technical experts to inform a practical and balanced approach to managing waterways as the area develops.

Engagement details

Engagement activities were conducted from 22 April to 19 June 2025. Engagement with Aboriginal stakeholders began on 22 April and engagement with the broader community began on 22 May. We posted letters to 60 residents and property owners within the West Dapto Urban Release Area. The draft Strategy report and associated materials were made available on the project webpage. Meetings were held so people could speak to the project team about the draft Strategy. The engagement was promoted on social media, in targeted e-newsletters, and a media release was issued on 27 May 2025. People could also access the information from Council's Customer Service Centre and Dapto Library.

Engagement participation

Council received 51 submissions. We received seven surveys (one hardcopy, six online), 25 emails, and one verbal submission via phone. Two people asked questions in the online Q&A tool. We spoke to 16 people in meetings. The project webpage had 530 unique views. Feedback came from a broad cross-section of stakeholders including landowners, community members, developers, NSW Government agencies, environmental consultants, landscape architects, and advocacy bodies.

What we heard

Most submissions were detailed and technical. All have been shared in full with the team responsible for finalising the Strategy. The feedback reflected a range of perspectives, with strong community support for riparian protection, alongside practical concerns about how the Strategy will be applied. Key themes across all feedback included the need for clearer rules, better enforcement, stronger upstream protections, improved maintenance, protecting existing development approvals, and shared responsibility between Council and landowners to support long-term riparian health. Following is a high-level summary of the main issues raised:

Cultural and environmental values

Traditional Custodians highlighted the cultural, spiritual, and ecological importance of waterways in the West Dapto area. They called for stronger protection of riparian corridors, joint management approaches, and formal recognition of Aboriginal cultural heritage. Environmental stakeholders supported wider buffers, habitat protection, and stronger legal enforcement through planning controls. Respondents advocated for protecting species such as platypus and wombats, and for improving ecological literacy and public land management knowledge.

Mapping, clarity, and enforcement

While many supported the Strategy's intent, concerns were raised about mapping accuracy, including perceived reliance on desktop methods and incorrect classification of streams. Respondents asked for clearer definitions (e.g. top of bank), consistent enforcement, and a formal process for updating mapping with verified data.

Development and planning integration

Some developers supported riparian management in principle but opposed retrospective application of new rules to previously approved plans. There were concerns about reduced housing yields, financial viability, and conflicts with bushfire planning and asset protection requirements. Several called for provisions to protect existing approvals and greater clarity on who is responsible for long-term corridor maintenance.

Flooding, water quality, and maintenance

Respondents shared experiences of erosion, flooding, and poor water quality, particularly around Mullet and Robins Creeks. Concerns were raised about coal wash runoff, loss of land, and lack of coordinated care across properties. Suggestions included improved maintenance, creation of a “Creek Carers” team, fencing, weed control, and better upstream protections. Some questioned Council’s ability to enforce compliance and called for independent ecological assessments.

Public access and community involvement

There was support for low-impact public access in appropriate areas and stronger education to build community skills and knowledge. Good examples of corridor management were linked to active Bushcare and Landcare programs, committed landowners, and minimal development disturbance. However, others noted urban pressures have led to poor management outcomes in some areas.

Feedback via the online Q&A tool and social media

Questions submitted through the Q&A tool asked about stormwater drain repairs in Horsley and whether the Strategy would affect primary producers. Council confirmed the Strategy focuses on new development and is not intended to restrict ongoing primary production. A social media comment called for Council to take more responsibility for riparian maintenance where consent is required for private land management.

Next steps

Council will consider the feedback received and update the draft Strategy where appropriate. A final version of the Riparian Corridor Management Strategy will be presented to Council for adoption. Community members and stakeholders who made submissions will be notified when the report goes to Council.

Background

West Dapto is growing rapidly, with around 56,000 new residents expected to move into the area over the coming decades. As new homes, roads, parks and town centres are built, it's important to protect the creeks and rivers - and the land around them - known as riparian corridors.

These areas help keep water clean, reduce flooding and erosion, support plants and animals, and connect habitats across the landscape. The current Riparian Corridor Management Strategy was written in 2004 but planning rules and environmental knowledge have changed since then.

Council is now reviewing and updating the strategy to reflect current development needs, better environmental practices, and recent studies about flood risk and waterway health. This update focuses specifically on the West Dapto Urban Release Area and aims to make the strategy easier to understand and use for landowners, developers and planners. It will help guide how riparian corridors are managed in future developments to support both community growth and environmental sustainability.

This work links closely with other Council strategies and plans, including:

- West Dapto Vision 2018, which sets out the long-term plan for how the area will grow.
- Development Control Plan (DCP) Chapter E23, which outlines how riparian land should be managed in new developments.
- Development Control Plan (DCP) Chapter D16, which provides guidance for future development within the West Dapto Urban Release Area.
- Flood studies and risk management plans for creeks in the area:
 - Mullet Creek Floodplain Risk Management Study and Plan (2023)
 - Duck Creek Flood Study (2019)
- Lake Illawarra Coastal Management Program (2020).
- Climate Change Adaptation Plan (2022).

These plans aim to create a liveable, resilient, and environmentally responsible future for West Dapto.

Targeted engagement with key technical stakeholders was conducted in December 2024, involving workshops and ongoing discussions. This was followed by engagement with the Aboriginal stakeholders from 22 April to 19 June 2025, followed by broader community engagement from 22 May to 19 June 2025.

Stakeholders

Stakeholders identified prior to the start of the engagement period included:

- Aboriginal stakeholders
- General community
- Schools, TAFE and University
- Development industry
- State Government agencies
- Residents and landowners within the study area
- Neighbourhood Forum 8
- Council's Heritage reference group
- Local environmental groups
- Ecological consultants
- Lord Mayor & Councillors
- Our Wollongong participants; Register of Interest (Environment) + relevant suburbs

Methods

Communication Methods	
Methods	Details of Methods
Aboriginal stakeholder emails	We emailed the information to 10 Aboriginal stakeholders.
Aboriginal stakeholder meetings	We met with four Aboriginal stakeholders to share the information and gather feedback.
Letter	Letters were delivered to 60 landowners in the study area. It included copies of the Frequently Asked Questions and survey.
Email to key stakeholders	An email about the project with FAQ and links to accompanying documents online was sent to 33 key stakeholders.
Register of Interest	An email was sent to 2,821 participants registered on Council's engagement website if they live in a suburb in/around West Dapto or have an interest in the environment.
Engagement website	The project webpage hosted background information and supporting documents: • Draft Strategy report, maps and diagrams • FAQ • Online survey • Q&A tool • Links: - o Riparian Corridor Management Study March 2004 - Department of Infrastructure, Planning and Natural Resources - o Riparian land management at Wollongong City Council - o How can I tell if my property includes a waterway or is next to a riparian path? - o Creek maintenance information for the Wollongong Local Government Area • Related projects: - o Ongoing Council projects in West Dapto - o Biodiversity Certification for West Dapto Urban Release Area

Library information display	The following printed copies were made available at Dapto Library: • Survey and reply-paid envelopes • FAQ • Draft Strategy report
Media	A media release was issued on 27 May 2025 to promote the engagement.
E-newsletters	The engagement was promoted in Council's Sustainable Wollongong e-newsletter on 20 June 2025.

Social media

City of Wollongong's post

What is a Riparian Corridor?

A **Riparian Corridor** is the strip of land alongside a river, creek, or waterway, including the waterway itself.

It also includes the surrounding vegetation (called riparian buffers) that help **stabilise riverbanks** against erosion and slow down flooding.

Riparian Corridors **protect water quality** through filtering pollutants and runoff.

They also **provide habitat** for native plants and wildlife, and produce an urban cooling effect.

In areas undergoing development, it's important to manage Riparian Corridors in a way that allows for **safe and sustainable** development, while ensuring natural environments and waterways are **protected**.

We're **seeking community feedback** on our Riparian Corridor Management Strategy for the West Dapto Urban Release Area.

Head to our website to give your feedback.

and 31 others

1 comment 8 shares

Like Comment Share

All comments

[REDACTED]

If council want to dictate how people manage riparian corridors on their own land including having to obtain consent for vegetation management and erosion control then council should be maintaining these or providing some sort of support to manage these.

Currently wcc does nothing but then want the owners to pay to maintain their own property. The system needs a good shake up

4w Like Reply 3

Engagement Methods

Engagement website	An online survey was used to capture participants' comments. A Q&A tool was available for people to ask the project team questions, with responses published on the site.
Meetings	Online and in-person meetings were held with Aboriginal stakeholders, Council's Heritage Reference Group, and State Government agency representatives.
Email	People emailed in open written submissions and a completed hardcopy survey.
Phone	One person phoned in with their comments.

Results

Residents, landowners and identified stakeholders were invited to provide feedback on the Draft Strategy from 22 April to 19 June 2025.

Engagement Participation

Engagement Activities	Participation
Emails with open submissions	25
Verbal submissions – via phone	1
Meetings:	
• Wollongong Heritage Reference Group	9
• Aboriginal Traditional Custodians	4
• Department of Climate Change, Energy, the Environment and Water	3
Hardcopy surveys (submitted via email)	1
Online Participation	
• Aware – Total number of people who viewed the project webpage.	530
• Informed – Total number of people who clicked a hyperlink, e.g. to download the draft plans.	306
• Engaged – Total number of people who actively contributed to the project, e.g. by submitting comments via the survey or asking a question in the Q&A tool.	8

Submission results

We heard from 51 respondents.

Open submissions

We received 25 emails, one phone submission, and noted comments from 16 people during meetings. Following is a summary of the open feedback we received.

Cultural heritage and traditional knowledge

Traditional Custodians said waterways in the West Dapto Urban Release Area (WDURA) hold profound cultural, spiritual, and ecological importance. These corridors supported traditional life through sustainable fishing, seasonal camps, and travel, and continue to serve as anchors of cultural identity and connection to Country. One Elder shared, “Dapto – or Dabpeto – means ‘place of plenty water’,” while another highlighted Mullet Creek as “a place for gathering, for fishing, and for connection to our ancestors.” Stakeholders called for stronger protection and restoration of riparian areas, recognising their dual ecological and cultural value.

They suggested having formal recognition of Aboriginal heritage in the Strategy, a joint management model that blends cultural knowledge with Council practice, and the requirement for Aboriginal cultural heritage assessments in all waterway-related development. Participants also called for strict enforcement of riparian buffer guidelines, including “fencing to restrict livestock, replanting native vegetation, and better water-sensitive land management.” A broader catchment approach was encouraged to protect connected waterways like Lake Illawarra. Expanding buffers in Category 2 and 3 areas higher in the escarpment was recommended to safeguard habitats for native swamp hens. There

was a clear view that waterways are not just environmental assets but “a source of spiritual wellbeing and intergenerational connection.”

Environmental protection and biodiversity

Numerous stakeholders – including conservationists, ecologists, and landscape professionals – supported the Strategy’s ecological objectives, especially its focus on buffer zones, vegetation restoration, and stream categorisation. Submissions advocated for stronger protections for keystone species such as platypus, frogs, and turtles, and urged adoption of “platypus-friendly design principles” to avoid habitat fragmentation. Several contributors suggested incorporating riparian corridors into the Local Environmental Plan (LEP) and Development Control Plan (DCP) to give the Strategy legal weight.

There was strong support for retaining and restoring existing vegetation, not just replanting. An ecologist spoke about a practice of “misidentifying native vegetation as weeds and clearing under false pretences,” calling for independent ecological assessments and full transparency in the ecological data used during development approvals. Calls were made for wider buffers, preservation of wetlands and floodplains, and a halt to clearing in low-lying, flood-prone areas – particularly below 20 metres elevation. To improve public understanding, some suggested investment in “public education and improved ecological literacy” to promote stewardship and ecological responsibility.

Climate change and long-term planning

Climate resilience was mentioned, with submissions reasoning that the Strategy does not go far enough in addressing climate risk. One urged Council to plan for “sea level rise of up to six metres, not just 0.9m,” in line with their understanding of current scientific projections. They said there is a need to future-proof ecological systems, allowing for upslope migration and planning restrictions in vulnerable low-lying zones. They called for “bolder, science-based decisions that prioritise long-term sustainability over short-term yield.”

Mapping methodology and technical refinement

While the intent of the Strategy was widely supported, concerns were raised about mapping methodology, such as the perceived reliance on desktop analysis. One noted that “macro-channel edges were used instead of active top-of-bank features,” which in some cases produced what they viewed to be overly wide riparian corridors. Stakeholders requested clearly defined, repeatable methods for mapping and categorising streams and corridors. There were calls for site-specific fieldwork to override desktop data where appropriate, and for mapping confidence levels to be included in Council’s spatial layers.

Some submissions on the draft mapping suggested errors or inconsistencies in corridor mapping, including “streams being mapped where none exist,” or “man-made drains being categorised as natural Category 1 waterways.” A clear mechanism was requested to enable updated, expert-verified mapping to formally amend the Strategy in future.

Planning Integration and existing approvals

Some developers and planning consultants expressed concern about the Strategy’s interaction with existing planning instruments. Several supported riparian management in principle but opposed retrospective application of mapping changes to land with existing neighbourhood plans, development applications, or concept plan approvals. One submission argued, “This undermines legally approved planning work and creates significant uncertainty.” Stakeholders requested that protections for prior approvals be embedded in LEP and DCP amendments through clear savings provisions.

Development viability, cost and implementation

Submissions from the development sector speculated that the Strategy, if implemented without adjustment, could reduce housing yields, increase costs, and undermine Council’s housing delivery targets. Buffer widths and stream categorisation were seen by some as excessive or inconsistent with

State guidelines. One submission stated, “If this mapping is applied, we lose 200 lots – that’s not sustainable in the middle of a housing crisis.” Others expressed concern that if there were increased constraints – such as Asset Protection Zones, offset requirements, and stormwater limitations – this may erode financial viability.

Stakeholders also raised concerns about unclear responsibilities for riparian land maintenance. Views varied, with some preferring Council ownership to ensure consistent ecological management, while others warned that “without proper resourcing, this could shift costs to ratepayers or result in degraded assets.”

Flood risk, stormwater, and infrastructure integration

There were conflicting opinions on flood management. One resident said “slowing water from the escarpment won’t work – it needs to move quickly to the lake,” while another supported detention and baseflow systems to slow and filter runoff. A suggestion was made to use “slow-release household rainwater tanks to support creek health and reduce flood risk.” There was a call for stronger integration between riparian strategies and stormwater, nutrient, and pollutant management – especially regarding Lake Illawarra’s long-term water quality.

Bushfire planning and asset protection zones

Concerns were raised about the Strategy’s impact on bushfire mitigation. It was noted that the current approach may prevent the placement of Asset Protection Zones (APZs) within riparian corridors, potentially conflicting with bushfire planning requirements. A fire authority advised that “further consultation would be required if management changes alter site hazard ratings or restrict mitigation measures.”

Public access and community connection

Submissions supported enabling low-impact access in areas where it would not conflict with conservation goals. Suggestions included walking paths through lower conservation value corridors and educational signage to improve community land care knowledge. One group stated, “Public access must be carefully managed – not every green space is suitable for recreation, but people still need to connect with nature.”

Agency and infrastructure stakeholder feedback

Several agencies expressed support for the Strategy’s objectives, commending Council for aligning with best practice in riparian management. However, inconsistencies were flagged in buffer widths (e.g. 10m buffers for areas that should have 30m or 40m under State guidelines) and terminology. An infrastructure provider requested that their assets and operational requirements – including easement access and flood impact mitigation – be fully considered in planning and design. It was noted that “high-voltage electricity infrastructure crosses riparian areas – this must be planned for carefully.”

Online and hardcopy survey feedback

We received six online surveys and one hardcopy survey. Following is a summary of the feedback we received via the survey.

Question: “Are the mapped watercourse categories and buffer zones accurate, or do updates need to be made?”

Several respondents said the mapping was accurate and clear, with one commending Council for providing buffers that support planning. Some confirmed accuracy in specific areas like Cleveland, while a few gave neutral responses.

However, others raised concerns. Some felt the mapping doesn’t consider access needs or existing roads in flood-prone areas. There were suggestions that 1:100 flood mapping underestimates actual risk.

Some view the riparian areas as too extensive, while another believes the buffers didn't go far enough to protect water quality, erosion control, and biodiversity, especially upstream.

Question: "Have you experienced any issues or difficulties managing land near a waterway?"

Several landholders reported serious bank erosion, flooding, and land loss, particularly along Mullet and Robins Creeks. Concerns were also raised about coal wash runoff near Forest Reach, with a request for Council inspection.

Respondents highlighted the need to protect platypus and rakali habitats and maintain water quality, with deer noted as a complicating factor. One environmental group member reported damage to revegetation efforts caused by a running group. There was a call for more bank stabilisation works, like those at William Beach Park, and a view that many issues could be addressed with stronger Council policies and support.

Question: "Are the existing rules for riparian buffers workable in practice for landowners and developers?"

Some respondents said the rules were unclear beyond basic buffer distances. While buffers were generally supported, there is a view current riparian widths are too narrow to protect biodiversity and waterways effectively.

Challenges were noted around installation and early maintenance, especially for landowners managing buffers after development. Concerns were also raised about long-term encroachment and a lack of consistent enforcement, with a perception that Council does not routinely verify compliance, leading to unfair outcomes.

Question: Are the proposed rules for riparian buffers workable in practice for landowners and developers?

Some respondents found the rules unclear beyond buffer distances and wanted more detail on elements like top-of-bank definitions and vegetation requirements.

There was support for stronger protections, including wider buffers and greater developer accountability. Inconsistent enforcement is a concern, with a perception that Council doesn't always verify developer data.

Others raised concerns about long-term maintenance, with riparian areas becoming overgrown or neglected.

The points outlined in Table 5.2 of the draft strategy was seen as reasonable, but practical success depends on better clarity, enforcement, and long-term oversight.

Question: Have you seen any examples of riparian corridors being managed well? What made it work?

Several respondents pointed to positive examples, including Puckey Estate and the Bushcare site at the Kembla Joggers Club. These were credited to active community involvement, minimal developer disturbance, and landowner stewardship through fencing and revegetation. Success factors included strong volunteer programs and long-term commitment to environmental care.

Some respondents said they hadn't seen well-managed examples, citing urban pressures as leading to poor outcomes, particularly in escarpment foothills and lake foreshore areas.

Question: What hasn't worked well, or what needs to change?

Respondents raised concerns about poor maintenance, weak enforcement, and damaging development practices.

Many creeks were described as neglected, with weeds, rubbish, and inconsistent care across properties. Council's long-term maintenance was seen as lacking. Suggestions included establishing a "Creek Carers" team, encouraging private investment, and improving weed removal, fencing, and deer control.

Development too close to creeks, particularly in Wongawilli, was said to disturb wildlife, while poor enforcement and reliance on developer self-reporting was also criticised. One respondent stressed that creeks are "poisonous to drink from" and called for stronger protection of upstream areas.

Better enforcement, independent assessments, and coordinated maintenance are seen as essential to making improvements.

Final comments on the Draft Strategy

Respondents supported increasing vegetation in riparian areas to stabilise creek banks, reduce erosion, improve water retention, enhance habitat, and screen infrastructure. Fencing was requested to prevent deer from accessing these areas due to their environmental impact.

Concern was raised about wombat protection, with a report of active wombat habitat and burrows along Mullet, Forest, and Robins Creeks. It was requested that wombats be recognised as a key species, with mandatory wombat-specific surveys, full buffer retention in known habitat areas, and no development near burrows. A suggestion was also made to develop a community-informed wombat habitat mapping layer.

One respondent criticised the rezoning of flood-prone riparian land, arguing it prioritised development at the expense of environmental protection and was poorly managed.

Q&A tool

Two questions were raised through the Q&A tool regarding the Draft Riparian Corridor Management Strategy.

The first related to the degraded condition of the riparian corridor and stormwater drain between Greenbrook Place and Parkdale Avenue, Horsley. The community member described damage to the concrete base and asked about plans for repair. Council advised that the matter has been referred to the Assets team for investigation and that any repair works would depend on the outcome of that assessment, along with available funding and resources.

The second question asked whether the Strategy would impact primary producers. Council clarified that the Strategy generally applies to land proposed for new urban development and does not affect ongoing primary production activities where these are permitted under current planning and land use laws. The Strategy aims to offer benefits to landholders, such as reduced erosion, improved water quality, and clearer guidance on managing land near waterways. Primary producers were encouraged to review the draft documents and provide feedback to help ensure the Strategy is both practical and supportive of farming activities.

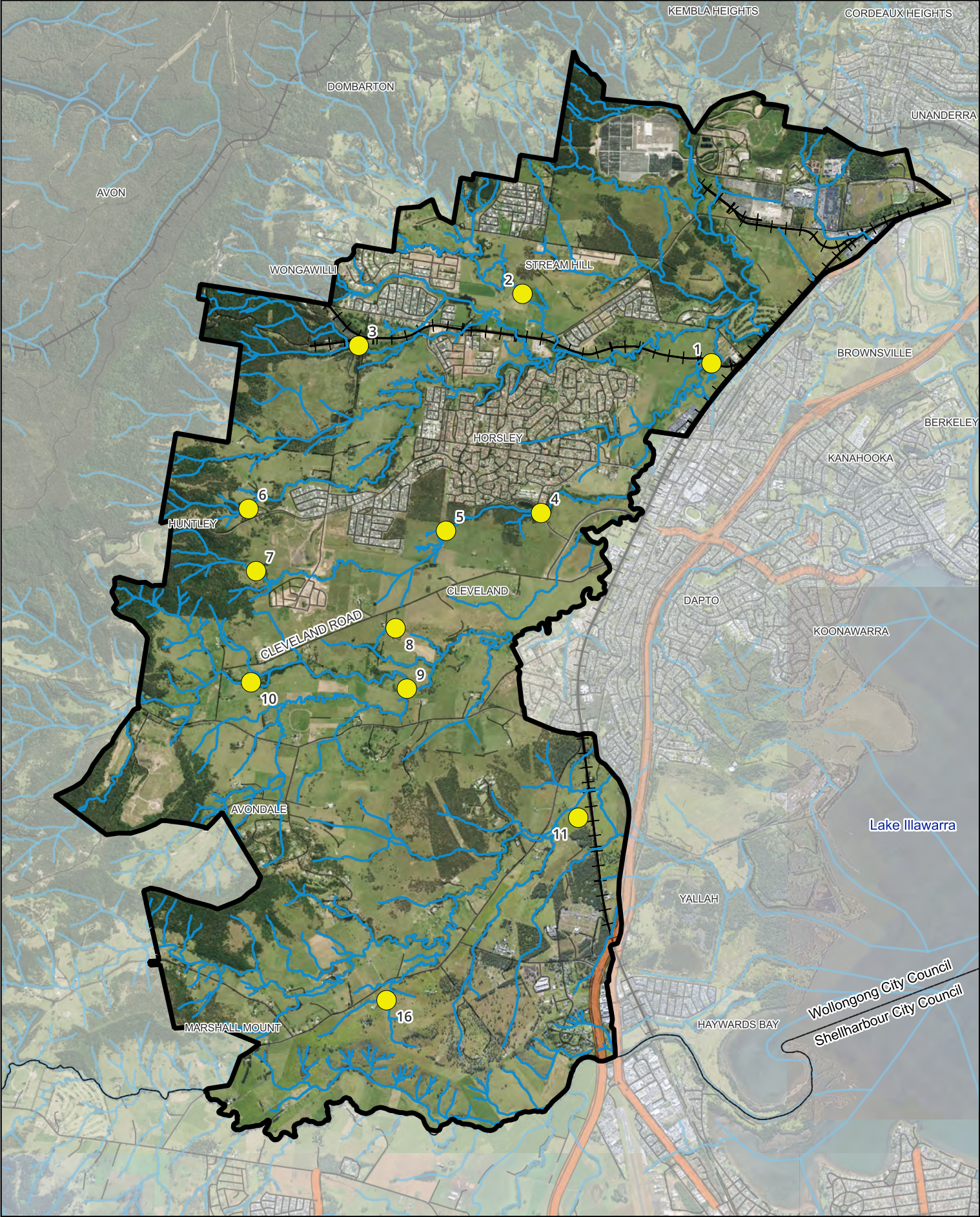
Social media

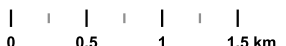
A Facebook comment expressed frustration with the current approach to managing riparian corridors on private land. The commenter felt that if landowners are required to seek Council consent for activities such as vegetation management and erosion control, then Council should also provide support or take responsibility for maintaining these areas. They perceive there to be a lack of assistance from Council and argued that expecting landowners to cover all maintenance costs is unfair. They called for reform to the current system.

Next steps

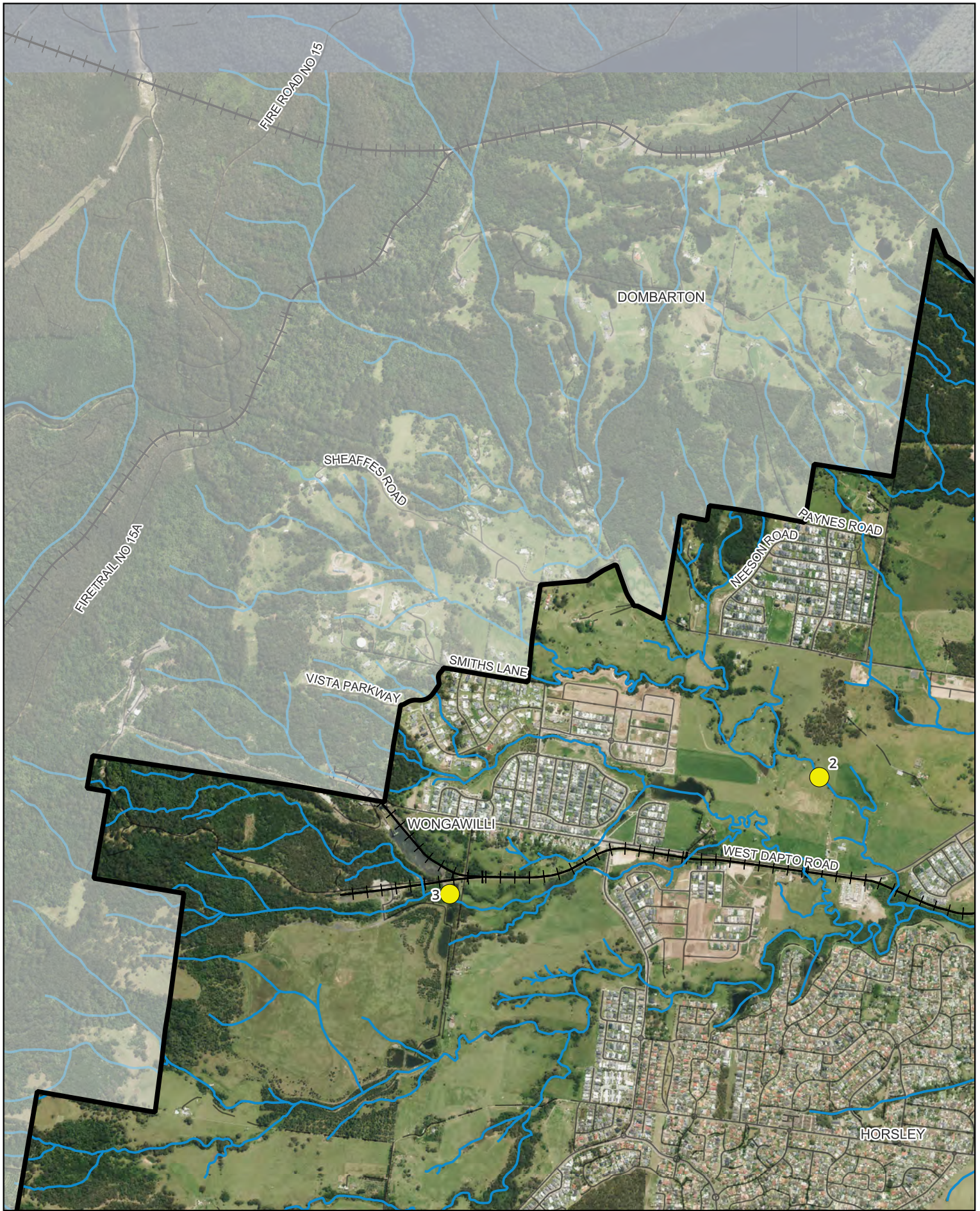
Council will consider the feedback received and update the draft Strategy where appropriate. A final version of the Riparian Corridor Management Strategy will be presented to Council for adoption. Community members and stakeholders who made submissions will be notified when the report goes to Council.

Appendix D – Assessment Location Sites



 	Legend  WDURA boundary  Assessment sites  Hydroline  LGA boundary  Major road  Road / Track  Railway	Figure: D.1.0 Assessment sites Scale: 1:50,000 @ A4 GDA2020 MGA56  0 0.5 1 1.5 km 	Project: WDURA Riparian Management Strategy Data sources Spatial data: © NSW Govt 2025, WCC 2024 Imagery: © WCC 2024 Drawn: GD Checked: DM Date: 15/05/2025 Job ref: 241959
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Document Set ID: 26920787
Version: 1, Version Date: 02/10/2025



Legend

- WDURA boundary
- LGA boundary
- Assessment sites
- Road / Track
- Hydroline
- Railway

Figure:

D.1.1 Assessment sites

Project:

WDURA Riparian Management Strategy

Scale:

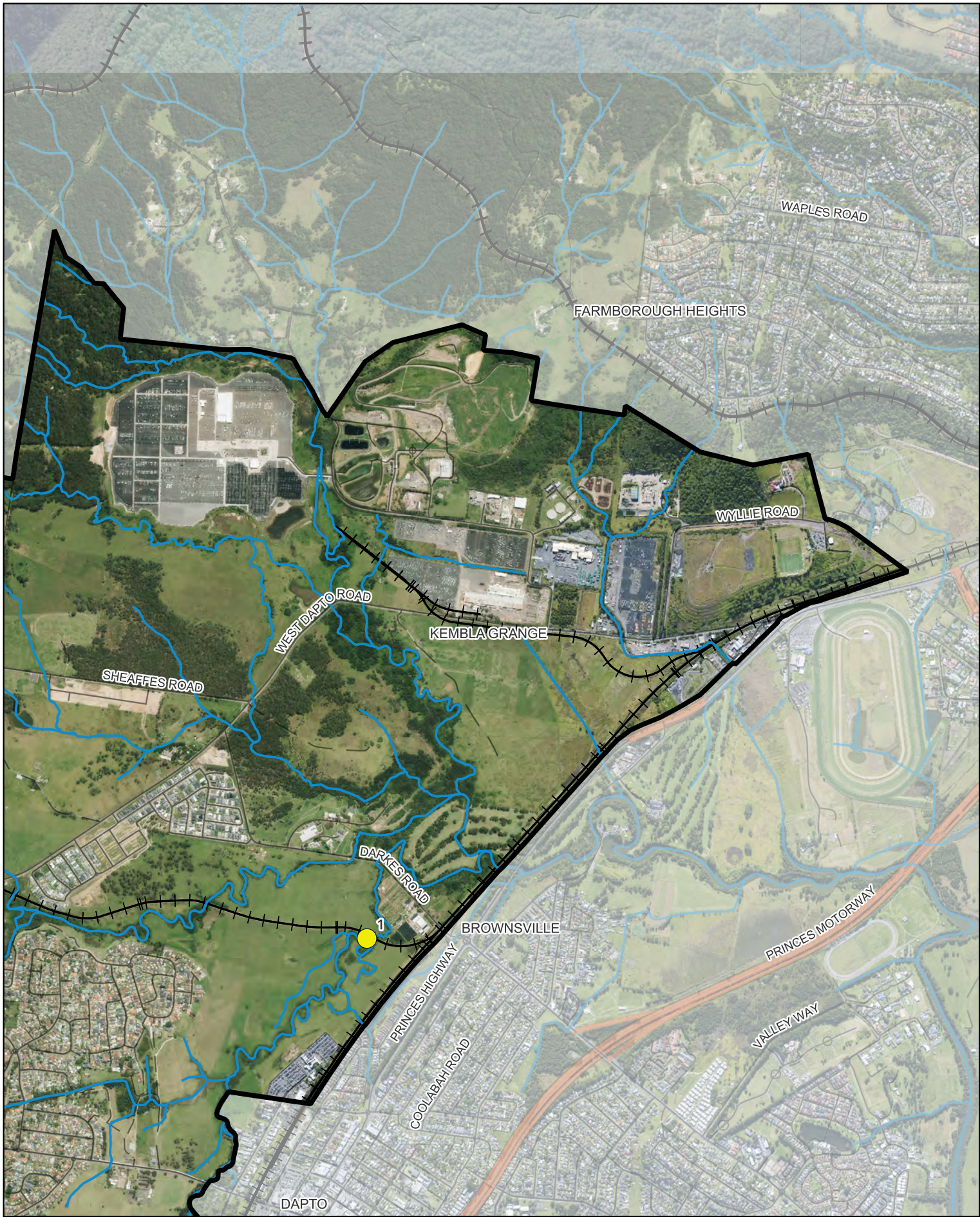
1:22,000 @ A4
GDA2020 MGA56



0 250 500 750 m

Data sources
Spatial data: © NSW Govt 2025,
WCC 2024
Imagery: © WCC 2024

Drawn: GD Date: 16/05/2025
Checked: DM Job ref: 241959



Legend

-  WDURA boundary
-  LGA boundary
-  Assessment sites
-  Major road
-  Hydroline
-  Road / Track
-  Railway

Figure:

D.1.2 Assessment sites

Scale:

1:22,000 @ A4
GDA2020 MGA56



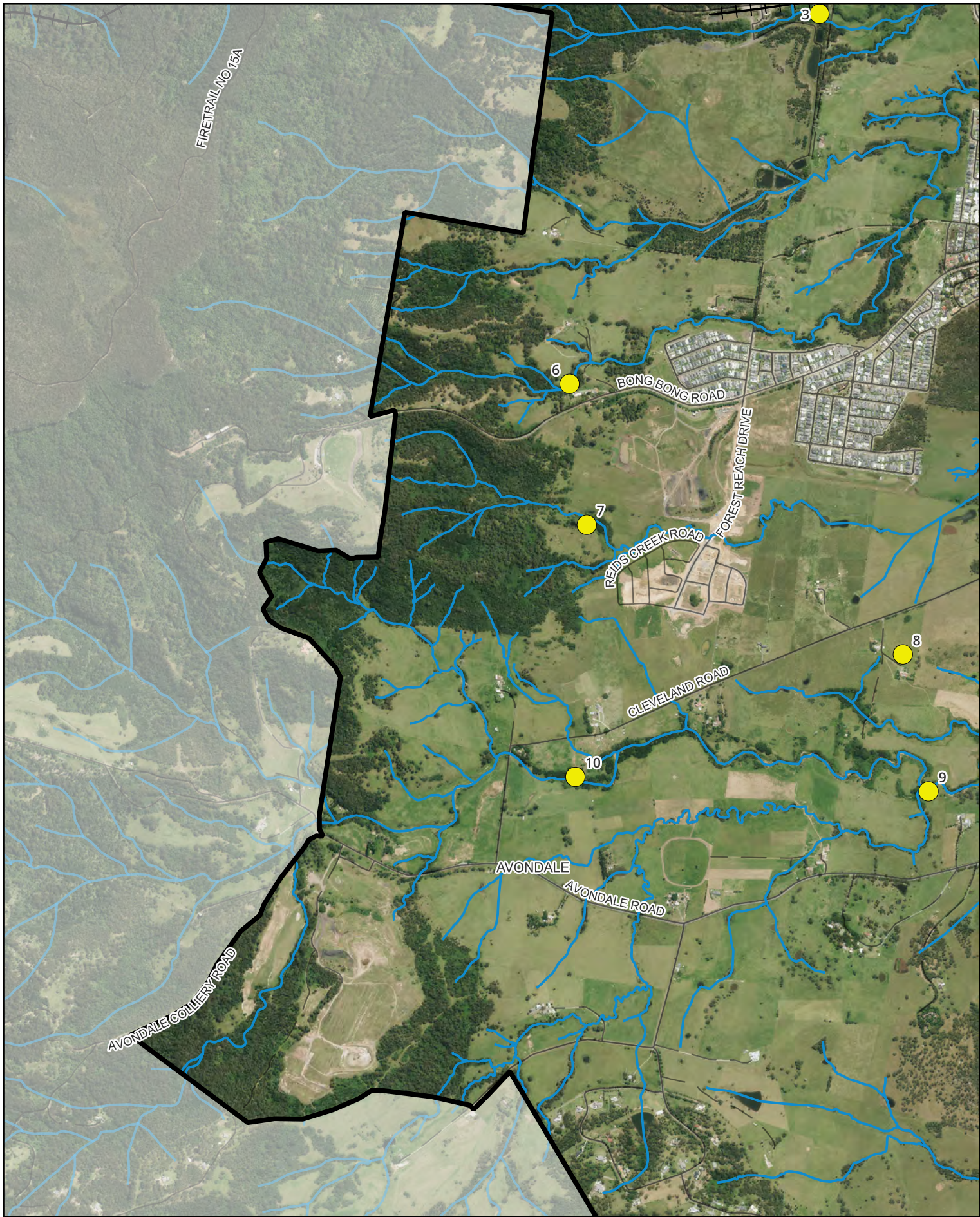
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Project:

WDURA Riparian
Management Strategy

Data sources
Spatial data: © NSW Govt 2025,
WCC 2024
Imagery: © WCC 2024

Drawn: GD Date: 16/05/2025
Checked: DM Job ref: 241959



Legend

- WDURA boundary
- LGA boundary
- Assessment sites
- Road / Track
- Hydroline

Figure:
D.1.3 Assessment sites

Project:
WDURA Riparian
Management Strategy

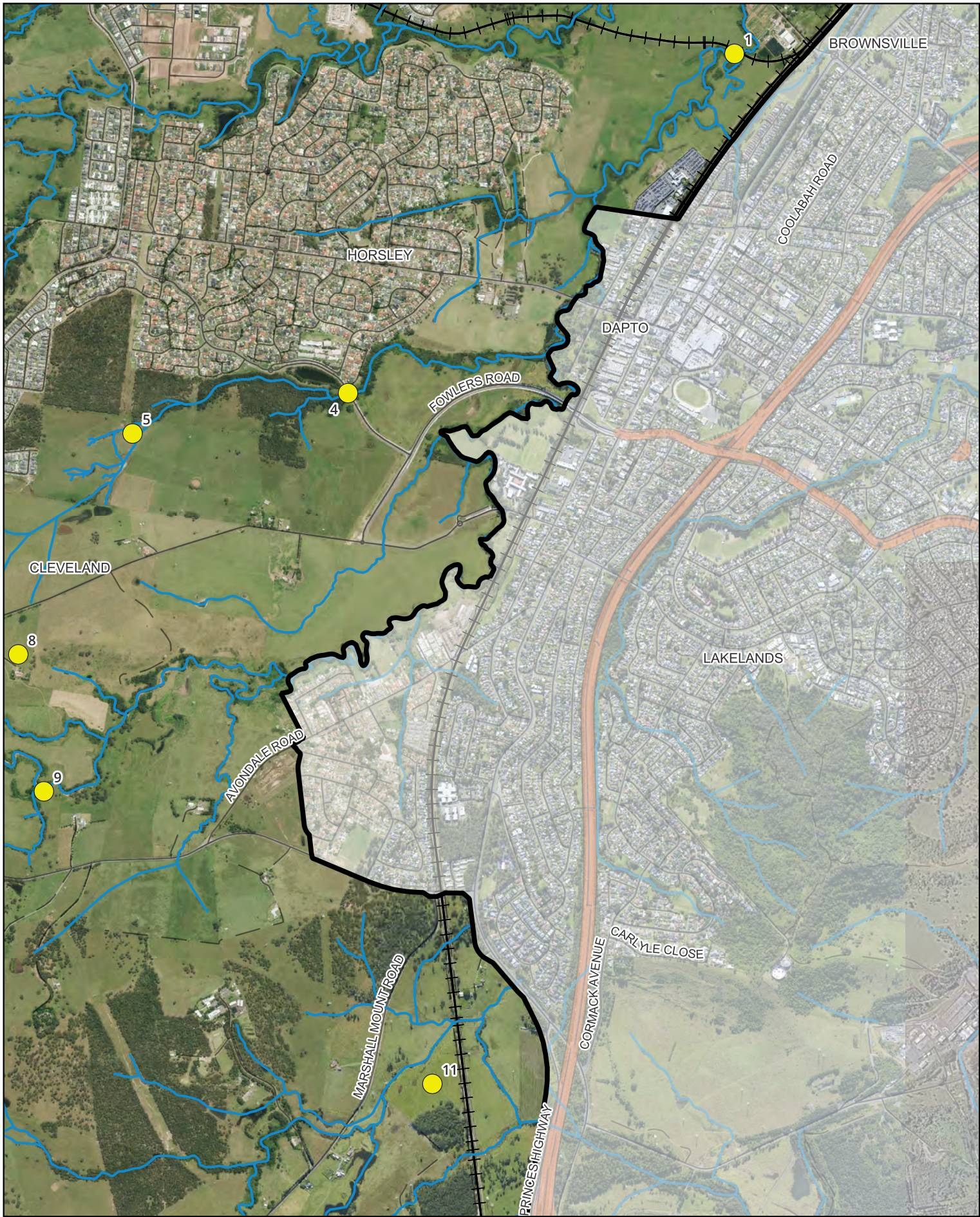
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GDA2020 MGA56



0 250 500 750 m

Data sources
Spatial data: © NSW Govt 2025,
WCC 2024
Imagery: © WCC 2024

Drawn: GD Date: 16/05/2025
Checked: DM Job ref: 241959



Legend

-  WDURA boundary
-  LGA boundary
-  Assessment sites
-  Major road
-  Hydroline
-  Road / Track
-  Railway

Figure:

D.1.4 Assessment sites

Scale:

1:22,000 @ A4
GDA2020 MGA56



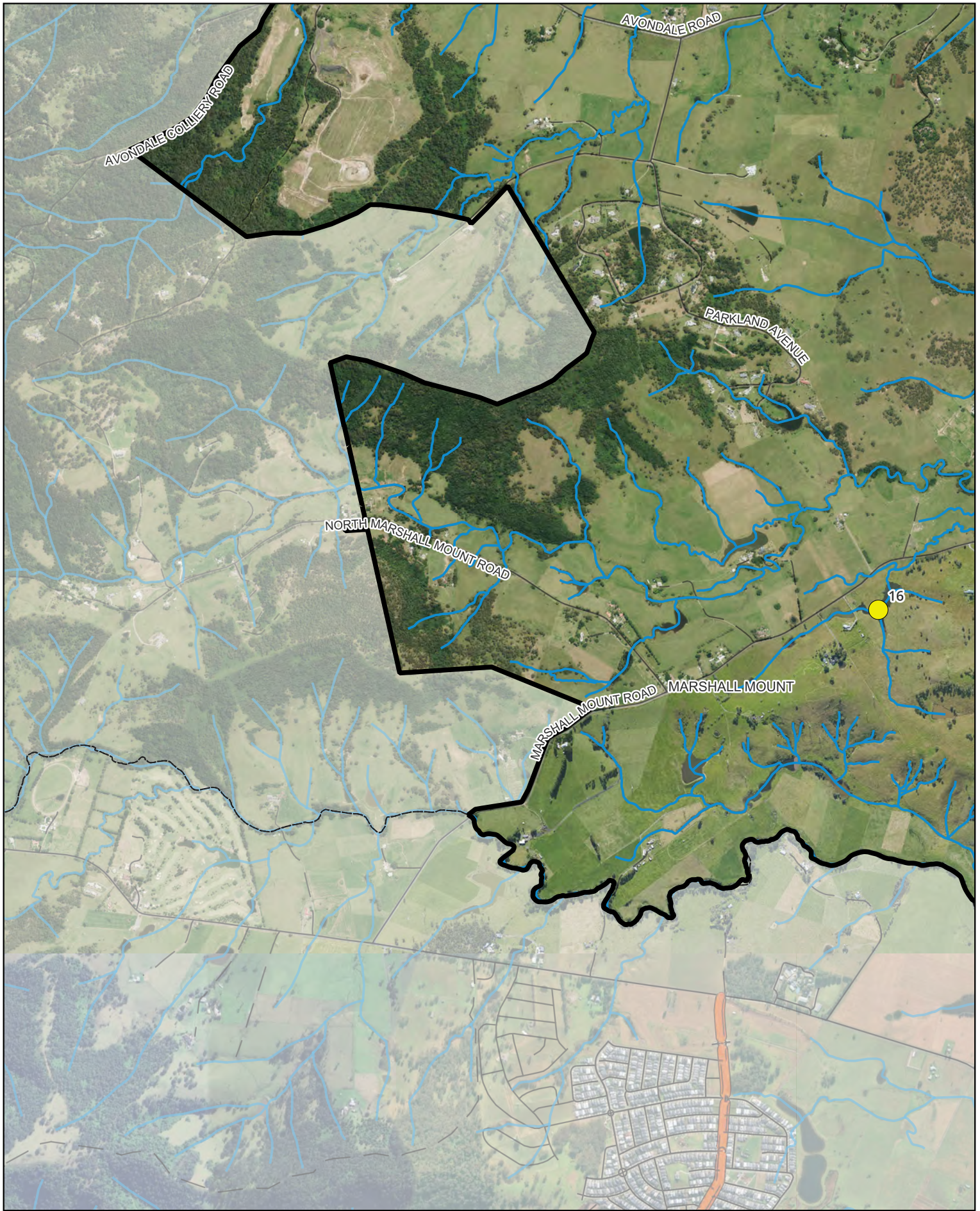
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Project:

WDURA Riparian
Management Strategy

Data sources
Spatial data: © NSW Govt 2025,
WCC 2024
Imagery: © WCC 2024

Drawn: GD Date: 16/05/2025
Checked: DM Job ref: 241959



Legend

-  WDURA boundary
-  LGA boundary
-  Assessment sites
-  Road / Track
-  Hydroline

Figure:
D.1.5 Assessment sites

Project:
WDURA Riparian
Management Strategy

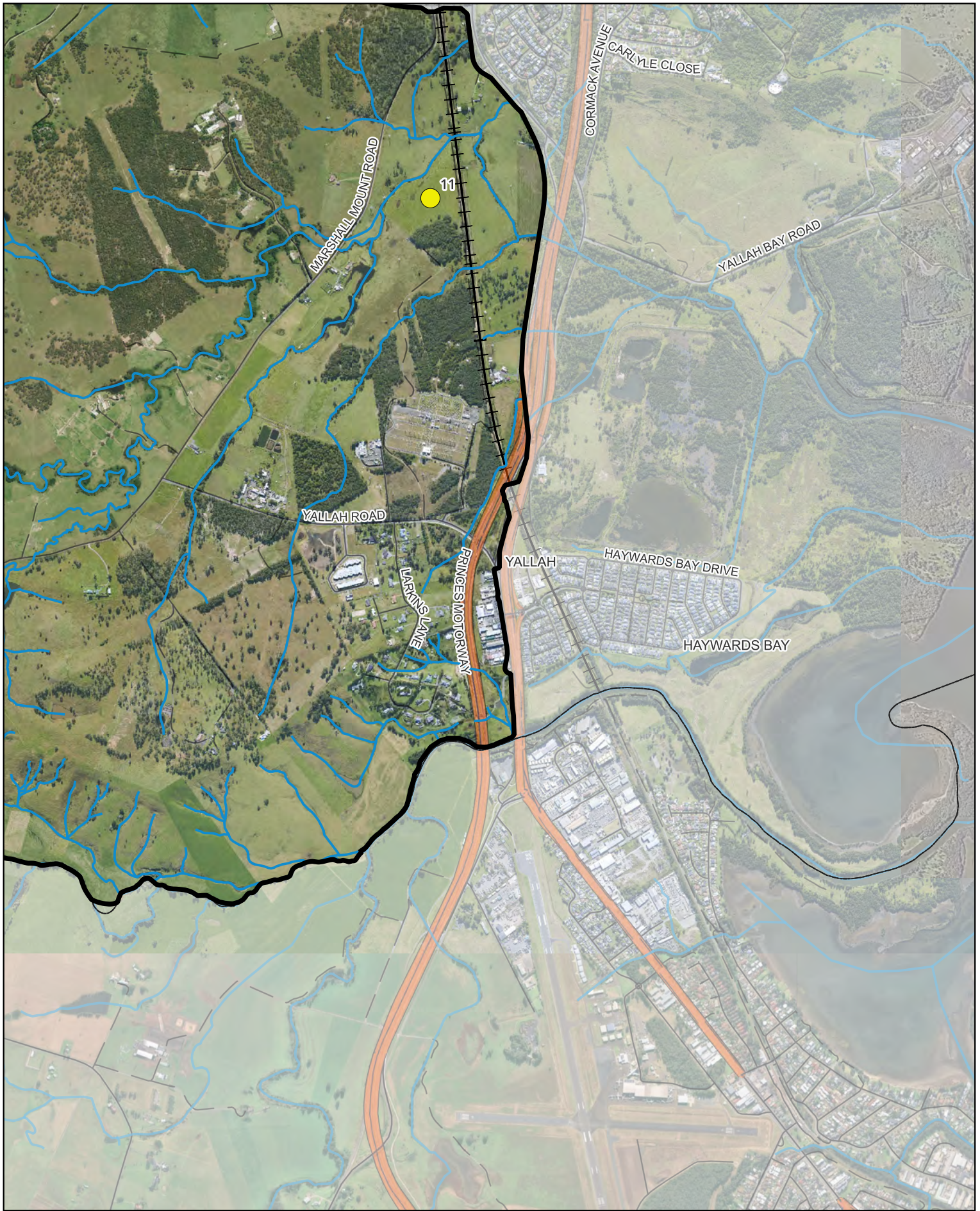
Scale:
1:22,000 @ A4
GDA2020 MGA56



0 250 500 750 m

Data sources
Spatial data: © NSW Govt 2025,
WCC 2024
Imagery: © WCC 2024

Drawn: GD Date: 16/05/2025
Checked: DM Job ref: 241959



Legend

- WDURA boundary
- Assessment sites
- Hydroline
- LGA boundary
- Major road
- Road / Track
- Railway

Figure:

D.1.6 Assessment sites

Scale:

1:22,000 @ A4
GDA2020 MGA56



0 250 500 750 m

Project:

WDURA Riparian
Management Strategy

Data sources
Spatial data: © NSW Govt 2025,
WCC 2024
Imagery: © WCC 2024

Drawn: GD Date: 16/05/2025
Checked: DM Job ref: 241959

Appendix E - Site Assessment Photos



Site 1





Site 2





Site 3





Site 4



Site 5



Site 6





Site 7





Site 8





Site 11





Site 16



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