Darling Baaka River Health Project 2023 to 2025

Chapter 2 River Condition Index summary

**Department of Climate Change,
Energy, the Environment and Water**

NSW GOVERNMENT

Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

Artist and designer Nikita Ridgeway from Aboriginal design agency Boss Lady Creative Designs created the People and Community symbol.

Cover photo: Sampling the lower Darling Baaka River at Pooncarie, Lake Wetherell. Kathryn Korbel/DCCEEW

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2.1 The 2025 Darling Baaka River Condition Index

This chapter gives an overview of the river health for the entire study area. It serves as a summary of the 6 individual river condition indexes (see also Chapter 1) but also provides a more detailed analysis of the sub-indicators, and metrics which make up the 6 indexes. The 6 indexes are:

- Geomorphic Condition Index
- Water Quality Index
- Riparian Vegetation Condition Index
- Biodiversity Condition Index
- Hydrological Stress Index
- Landscape Disturbance Index (renamed from Catchment Disturbance Index).

The river between Wilcannia and Wentworth, including the Great Darling Anabranch, was divided into 28 subcatchments. These subcatchments are consistent with the *River Condition Index: method report* (DPE 2023a), referred to as the 2023 RCI. Most subcatchments contain numerous sites that were sampled for this project (see Chapter 1), some indicators relied on remotely sensed spatial analysis instead of field sampling (see Chapters 3 to 8 for details), and others used a modelling approach.

The River Condition Index (RCI) scores for each of the 6 indexes (details given in Chapters 3 to 8) were calculated for each subcatchment as illustrated in Figure 1. When multiple sampling sites existed in a subcatchment, indicator scores were averaged into one 'score' for each indicator per subcatchment. This occurred for the Water Quality Index, Riparian Vegetation Condition Index and the Biodiversity Condition Index. This method takes into account the variability within each subcatchment. The numerical index scores for each of the 6 indexes were combined using Equation 1 (adapted from 2023 RCI) (DPE 2023a) and then classified into a letter 'grade' (A to E) to represent overall river condition in that subcatchment (Table 1).

Equation 1: $$RCI = 1 - \left(\frac{\sqrt{(1-RvCI)^2+(1-GCI)^2+(1-HSI)^2+(1-BCI)^2+(1-WQI)^2+(1-LDI)^2}}{\sqrt{6}}\right)$$

Where RvCI = Riparian Vegetation Condition Index, GCI = Geomorphic Condition Index, HSI = Hydrological Stress Index, BCI = Biodiversity Condition Index, WQI = Water Quality Index, LDI = Landscape Disturbance Index.

Due to the nature of the study area, several subcatchments do not have stretches of the river passing through them or contained dry water bodies. Access was also an ongoing issue in several areas, with wet weather and lack of access to private land preventing access to other subcatchments. Thus not all indicators could be calculated for some

subcatchments. For these instances ‘no data’ has been recorded for impacted indicators within a subcatchment. When no data was available, the average water quality and biodiversity condition indicator scores for upstream, adjacent subcatchments were used as indicative RCI grades. This only occurred in subcatchments Coonalhugga Creek (1481), Murray–Darling Confluence (1507), Anabranch Offtake (1516) and Popio (1522). Additionally, pesticides and metals were not sampled at every site (see Chapter 4).

This chapter provides the index scores and grades and a summary assessment for the 28 subcatchments within the lower Darling Baaka study area. Subcatchments have been grouped into 6 river reach zones, based on delineation by waterbody (that is, Great Darling Anabranch vs lower Darling Baaka River) and further by logical separation of reaches by major weirs (Figure 2).

The 6 river reach zones are:

- Wilcannia to Lake Wetherell
- Menindee weir pool
- Pooncarie North
- Pooncarie South
- Great Darling Anabranch
- Talyawalka Creek.

This project has had resources which have allowed an intensive sampling campaign to better characterise river health at the time of the study. The more intensive sampling and analysis account for the differences between the 2025 Darling Barka RCI scores presented in this report and the 2023 RCI assessments (see Chapter 9).

Table 1 River Condition Index grades

Combined RCI scores	RCI grade	RCI category
0.0 to <0.2	E	Very poor condition
0.2 to <0.4	D	Poor condition
0.4 to <0.6	C	Moderate condition
0.6 to <0.8	B	Good condition
0.8 to 1.0	A	Very good condition

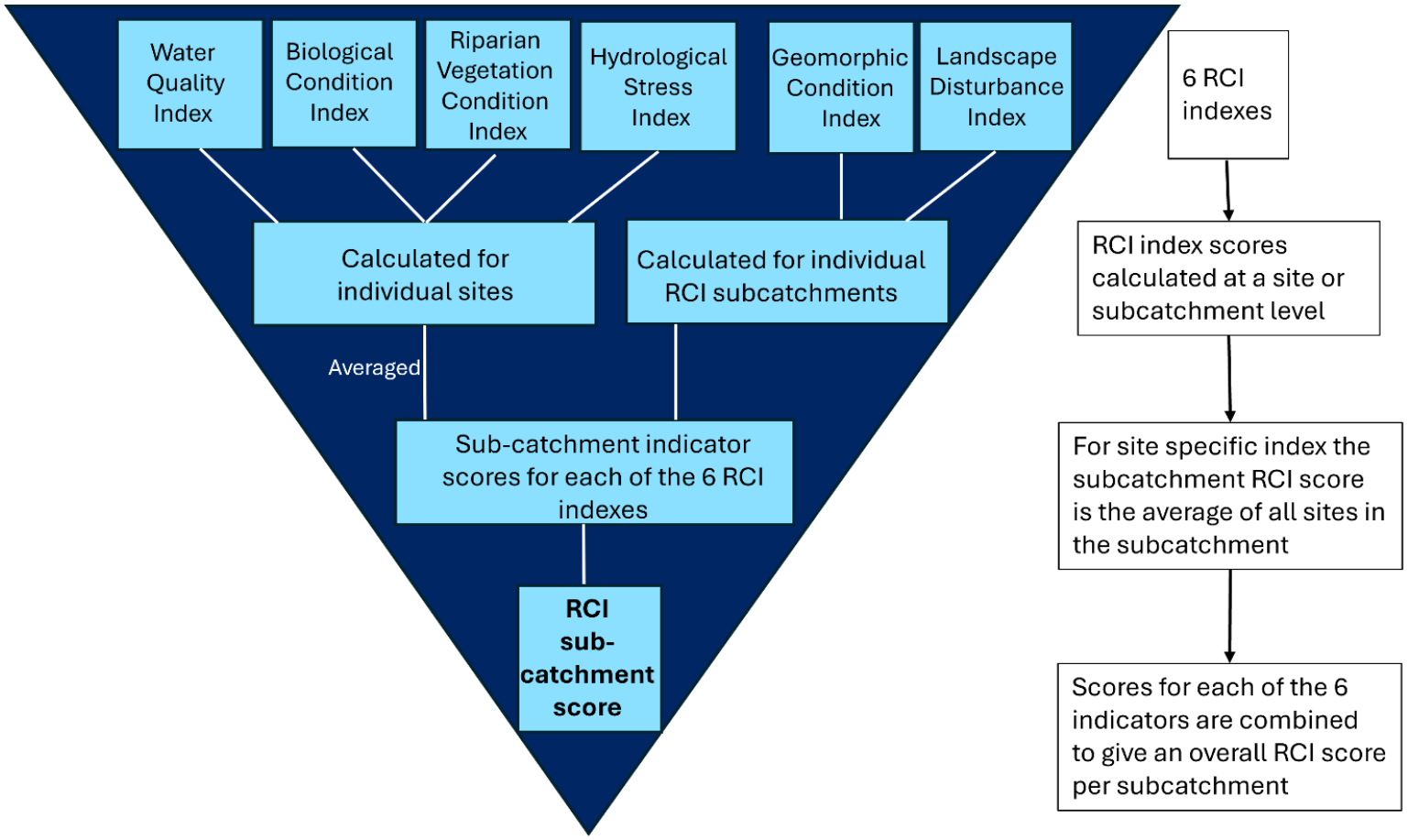

Figure 1 **Calculation of overall River Condition Index scores**

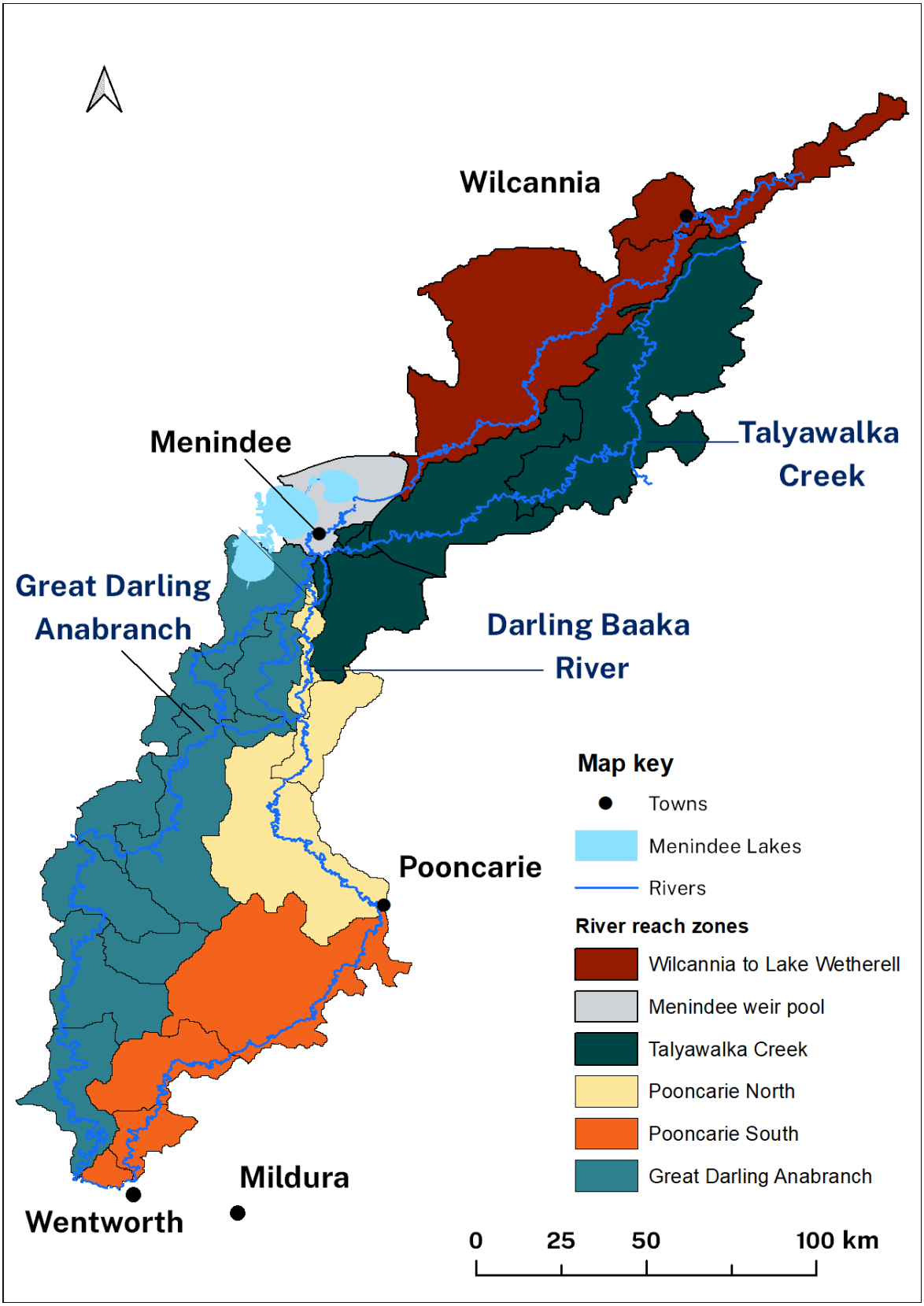

Figure 2 River reach zones, used for reporting purposes

2.2 Overall river health of the lower Darling Baaka

2.2.1 River Condition Index scores and catchment-wide issues

The majority of subcatchments in the study area are assessed as being in moderate condition, indicating that the river is under stress (see Figure 3 and Table 2).

Some individual index results suggest areas of the lower Darling Baaka River and the Great Darling Anabranch are in a degraded state. The prevalence of significant hydrological stress throughout the system has contributed to poor to very poor water quality in some subcatchments, with associated ecological communities across all trophic levels under stress. Much of this is attributed to several decades of altered hydrological regimes due to river regulation and extensive water extraction.

There are several issues which are presented across all subcatchments. Water quality was consistently poor, with high nutrient, turbidity and algal concentrations. Biodiversity condition was also moderate to poor across the study area, with fish condition classified as very poor in the majority of subcatchments. The prevalence of European carp (*Cyprinus carpio*) (70% of total biomass in the study area) is of particular concern for the biodiversity of the region, as were the low number of pollution-sensitive macroinvertebrates. Of the fish species, Murray cod (*Maccullochella peelii*) was predominantly found downstream of main weir (1 found in Lake Weatherell), however, bony herring (*Nematalosa erebi*) and golden perch (*Macquaria ambigua*) were located at almost every site.

The combination of spatially and temporally consistent poor water quality and biodiversity condition indicates stress on the entire system. It was also noted that recruitment of canopy riparian vegetation was poor throughout the study area, indicating that the long-term viability of important species, such as the river red gum (*Eucalyptus camaldulensis*), may be at risk. It is likely that all of these factors are a result of hydrological stress, and highly turbid, nutrient-rich waters entering the study area from the upper Darling Baaka river system. When combined with river regulation associated with the Menindee Lakes Storage Scheme, this places the entire river under considerable duress.

The zone around Menindee weir pool (subcatchment number 1483) received consistently poor grades across almost all indicators, highlighting a known area of concern on the lower Darling Baaka. River regulation structures and water management operations associated with the Menindee Lakes Storage Scheme, in conjunction with catchment-scale historical impacts and water extraction, exacerbate poor river condition outcomes in this area. The results for individual RCI indexes are discussed in section 2.3, and data for each of the indexes are presented in relevant chapters throughout this report (Chapters 3 to 8).

2.2.2 Value of the River Condition Index framework

The RCI framework is valuable for river managers and communities as it can highlight areas of specific concern. It is a method which has combined 152 individual measurements of river health into one overall grade, thus has produced an extensive

database over an 18-month period. This dataset alone provides the basis for a long-term dataset, whereby with ongoing and future monitoring, the overall health of the river can be assessed, and trends in river condition improvement or degradation can be identified. This approach provides early warning of potential issues.

However, when using a single indicator for something as complex as river health, fine details and important findings can be obscured, and results can often be misinterpreted as indicating better river condition than is reflected in field samples. The averaging effect of combining multiple condition indexes into one score can mute key areas of concern. So, while the 2025 Darling Baaka RCI has indicated that the majority of the study area is in moderate condition, there are data associated with several indicators which identify or signal issues of concern which require further investigation.

Many important results of the 2025 Darling Baaka RCI assessment are discussed in the following sections of this summary chapter. The individual RCI index results are discussed in relation to the lower Darling Baaka study area as a whole, and section 2.4 details river health in the 6 lower Darling Baaka river reach zones identified above (Figure 2), with a focus on the numerous sub-indicators which are combined to create the water quality and biodiversity condition indexes.

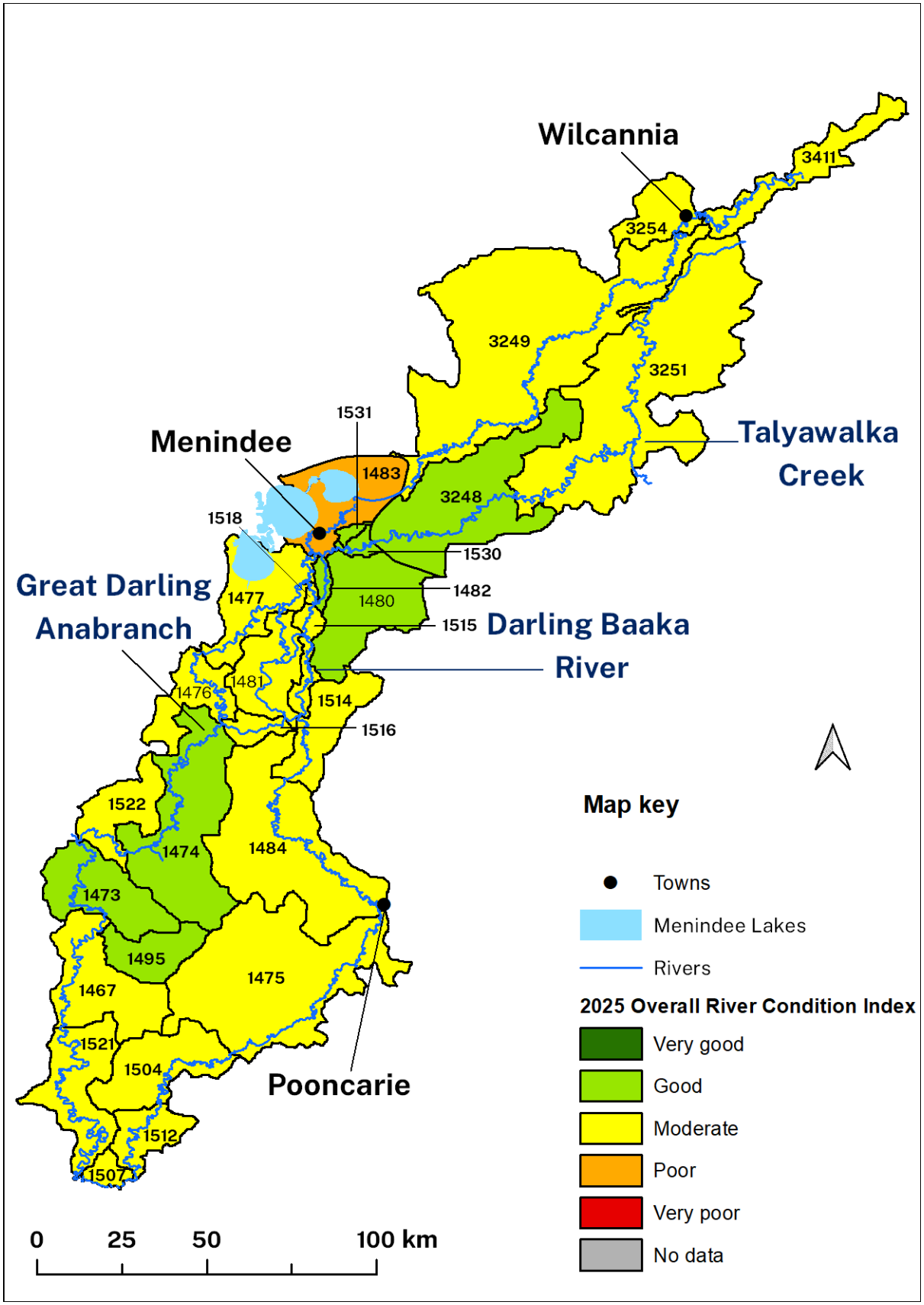

Figure 3 Overall 2025 River Condition Index grades for the Darling Baaka. Numbers refer to subcatchments (see Table 2)

Table 2 Summary of 2025 Darling Baaka River Condition Index (RCI) grades

Sub-catchment name	Sub-catchment number	Water Quality Index	Geomorphic Condition Index	Hydrological Stress Index	Biodiversity Condition Index	Landscape Disturbance Index	Riparian Vegetation Condition Index	Subcatchment overall RCI grade
Darling Baaka River subcatchments								
Lower Paroo	3411	C	C	B	D	A	B	C
Lake Woytchugga	3254	D	C	B	D	B	C	C
Wilcannia downstream	3249	D	C	C	D	A	C	C
Lake Wetherell	1483	D	D	D	D	D	C	D
Downstream Weir 32	1518	D	B	D	D	A	B	C
Lower Yampoola Creek	1515	D	B	D	D	A	D	C
Cuthero Creek	1514	D	B	D	D	B	D	C
Upstream Pooncarie	1484	D	B	C	D	C	C	C
Downstream Pooncarie	1475	D	B	C	D	D	C	C
Palinyewah	1504	D	B	D	D	C	C	C
Lower Darling	1512	D	B	D	D	B	C	C
Murray–Darling Confluence	1507	D^	B	C	D^	A	C	C^
Great Darling Anabranch subcatchments								
Cawndilla	1477	D	B	D	D	B	B	C
Lower Redbank Creek	1476	C	A	D	C	B	B	C
Anabranch North Lakes	1474	D	A	C	C	A	A	B

Sub-catchment name	Sub-catchment number	Water Quality Index	Geomorphic Condition Index	Hydrological Stress Index	Biodiversity Condition Index	Landscape Disturbance Index	Riparian Vegetation Condition Index	Subcatchment overall RCI grade
Coonalhugga Creek	1481	D^	A	n.d.	D^	B	C	C^*
Popio	1522	D^	A	C	C^	A	C	C^
Anabranch Offtake	1516	C^	A	D	C^	A	C	C^
Anabranch North	1473	C	A	C	B	A	C	B
Lake Milkengay	1495	n.d.	A	A	n.d.	B	C	B*
Warrawenia Lake	1467	D	A	C	C	B	C	C
Lower Anabranch	1521	D	A	C	C	A	B	C
Talyawalka Creek subcatchments								
Upper Talyawalka Creek	3251	n.d.	A	E	n.d.	A	D	C*
Middle Talyawalka Creek	3248	n.d.	A	C	n.d.	A	C	B*
Lower 3 Mile Creek	1531	n.d.	A	C	n.d.	A	C	B*
Lower Talyawalka Creek	1530	n.d.	A	C	n.d.	A	C	B*
Yampoola Creek	1480	n.d.	A	n.d.	n.d.	A	C	B*
Charlie Stones Creek	1482	n.d.	A	n.d.	n.d.	A	B	B*

Table notes: *Not all RCI indexes available to calculate the final overall RCI grade, ^ indicates water quality and biodiversity subcatchment index scores are inferred from upstream adjacent subcatchment results, n.d. = no data.

2.3 Individual River Condition Index results

2.3.1 Geomorphic Condition Index

Geomorphic condition refers to the degree of departure from the expected physical form of a river, given the environmental and landscape setting in which it is found.

Geomorphic condition varies depending on the alteration to geomorphic processes generally associated with in-channel structures and river regulation. Two key factors contribute to the geomorphic condition index: geomorphic condition and recovery potential (see Chapter 3).

Geomorphic condition varied in the study area, with grades from poor to very good. The mainstem of the lower Darling Baaka River has a higher level of disturbances to the river's geomorphology than the major anabranches. Most of the subcatchments along the lower Darling Baaka River had a moderate to low potential for recovery (Figure 4). These subcatchments are characterised by features which contribute to the decline of the river's health, such as elevated rates of erosion and associated inputs of sediment by alluvial gullies.

There have been significant changes to the lower Darling Baaka River hydrology due to river regulation, both upstream and within the study area (for example the flooding of Lake Wetherell). Flow along the Great Darling Anabranch is regulated by the Menindee Lakes Storage Scheme and currently flows far more frequently than under natural conditions. Its natural hydrology would likely reflect that of Talyawalka Creek which flows approximately every 5 years, only during very large floods (WaterNSW 2025a). These differences have implications for geomorphology, ecosystem functioning, food webs and drought refugia in the study area. Geomorphic assessments of the lower Darling Baaka River indicate the following persistent geomorphic threats to the river.

Increased local sediment supply from alluvial floodplain gullies

Gullies have a distinct impact on sediment transport and river condition (Wethered et al. 2015). Observations on the lower Darling Baaka River highlighted numerous gully formations that extended into coarser-grained aeolian red soil, which results in localised inputs of fine-medium grained sand into the river. Erosion of gullies during the waning stages of floods may also be associated with the discharge of 'black water' to the main river as overland flows with high organic matter return to the channel. Gullies in red soil tend to transport coarser sediment to the river but will not always be associated with widescale riverine flooding.

Lack of river red gum recruitment in some riparian areas

While there are well-established river red gums along the lower Darling Baaka River and the Great Darling Anabranch, many areas lack significant recruitment of saplings and juveniles (see Chapter 5). This lack of recruitment presents a long-term geomorphic

threat given the importance of river red gums in stabilising banks and providing large woody debris to the river.

River regulation

The compounding impacts of catchment-scale water extractions and weirs on river geomorphology can be difficult to quantify. During drought, the extraction and storage of small flows throughout the Darling Baaka catchment increases the likelihood of extended cease-to-flow events in the lower Darling Baaka River (Mallen-Cooper and Zampatti 2020). This flow disruption causes a dominance of lentic (slack water) pools behind weirs, significantly altering the river's hydraulic characteristics, and impacts water quality and aquatic ecology. The shift from flowing (lotic) to still (lentic) water conditions can also elevate sedimentation rates in waterholes, particularly when combined with increased sediment loads associated with catchment disturbances and localised inputs of sediment from alluvial floodplain gullies (Pearson et al. 2024).

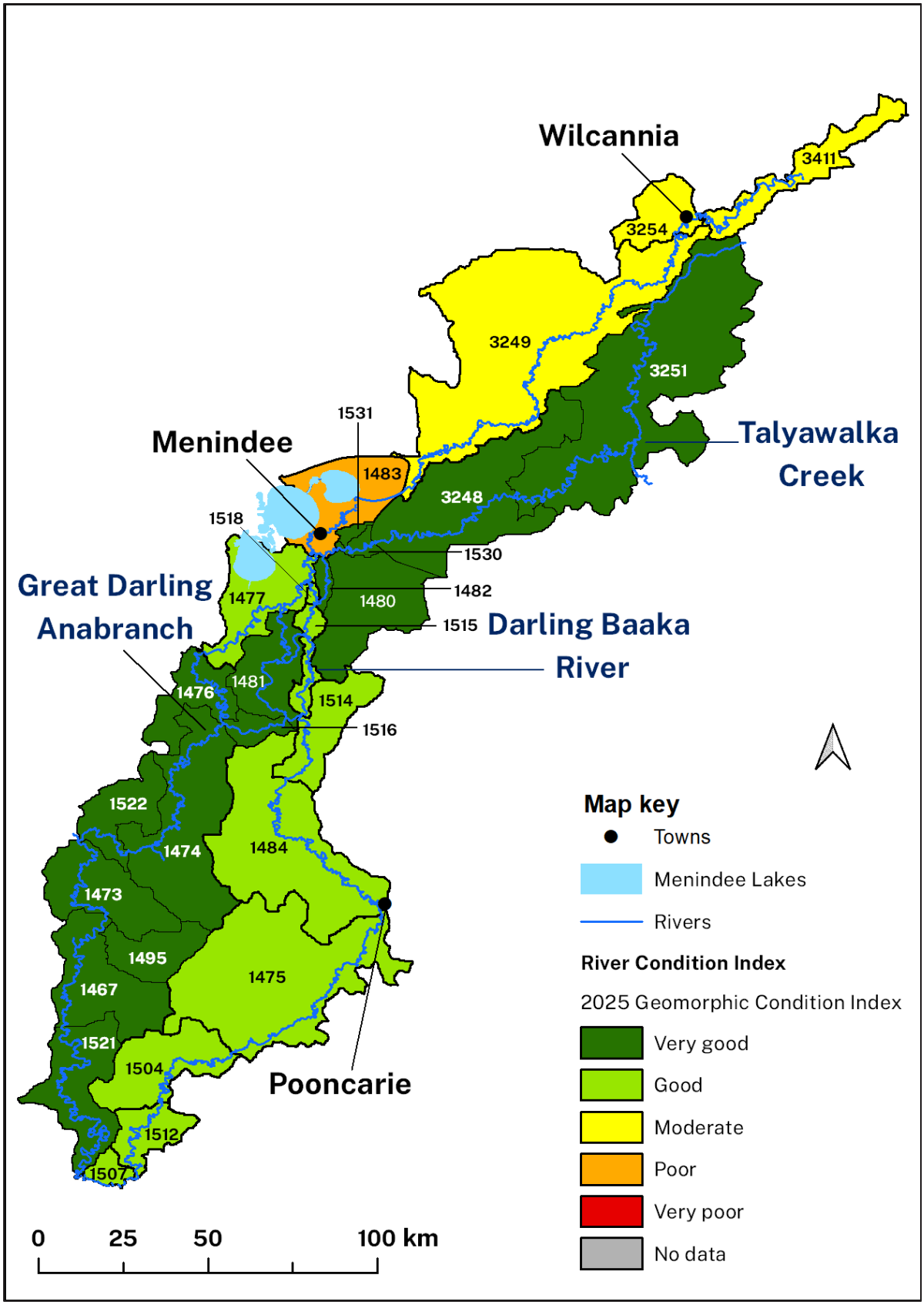

Figure 4 **2025 Geomorphic Condition Index grades for the lower Darling Baaka. Numbers refer to subcatchments (see Table 2)**

2.3.2 Water Quality Index

The Water Quality Index is a measure of the number and magnitude of exceedances of guideline values for a variety of metrics, including nutrients, turbidity, chlorophyll-a, pesticides, metals, and dissolved oxygen.

Poor water quality was recorded across the entire study area and throughout the duration of the sampling period (Figure 5). The contribution of groundwater to the study area was modelled (Chapter 8), indicating groundwater flows into the river in the sections below Menindee and on the Great Darling Anabranch. The groundwaters here demonstrated elevated nutrient levels, which warrants further investigation on the contribution of groundwater to river water quality.

Subcatchments in Talyawalka Creek were not sampled due to the intermittent nature of this ephemeral waterway. The subcatchment of Lake Milkengay (1495), on the Anabranch, does not have any waterway in its subcatchment boundary, so was not sampled.

The results indicate that water quality in the lower Darling Baaka River is poor due to high nutrient concentrations, excessive algae growth and reduced oxygen levels. Total nitrogen and total phosphorus concentrations exceed guideline values at most sites, most of the time. The high nutrient concentrations are likely contributing to elevated rates of algal growth. The process of eutrophication is a major concern and has the potential to make ecosystems more vulnerable and susceptible to other contaminants of concern, further exacerbating ecosystem degradation and risks to aquatic species. The algal blooms associated with eutrophication, which is reflected in high chlorophyll-a concentrations, lead to the exceedance of chlorophyll-a guideline values in almost all samples collected from all sites.

Turbidity was a major driver of the poor water quality grades, with inputs of highly turbid water from the upper Darling Baaka River basin occurring during several high-flow events throughout the study period. These contributions, combined with the high background turbidity, resulted in regular exceedances of guideline values. It is likely that high turbidity is, to some degree, a natural characteristic given the dominant fine-grained sediment of the Darling Baaka River floodplain. However, significantly elevated and persistently high turbidity likely represents degradation of the riverbanks and elevated sediment input throughout the catchment in this stressed system. Pesticides and heavy metals found to be present in some subcatchments did at times exceed guideline values, but concentrations were generally below 95% species protection guidelines.

The assessments of the lower Darling Baaka River indicate the following major drivers of poor water quality:

Poor inflow water quality from the upper Darling Baaka River

Significant inflows from rainfall events in the upper Darling Baaka were reflected in inflows received at Wilcannia. These inflows brought with them very high turbidity and

nutrient levels. Changes in turbidity, whether from inflows or sediment resuspension, have implications for light penetration and primary production, as well as for the mobility of sediment-bound contaminants. Significant algal blooms were associated with elevated nutrients in the study period, including toxin-producing cyanobacteria. The interaction between turbidity, dissolved oxygen and biogeochemical processes plays a critical role in mediating internal nutrient and metal fluxes, influencing water quality (see Chapter 4).

River regulation and altered hydrology (associated with the Menindee Lakes Storage Scheme)

Water regulation activities have a major impact on the water quality within the river and on the Anabranch. Weirs have created artificially deep reaches along the river (for example Lake Wetherell) which reduce flow velocities and promote stratification. The routing of water via Lake Pamamaroo and the controlled releases to the Menindee weir pool and downstream from Weir 32 have a range of implications for water quality. This includes the reduction of turbidity due to increased water residence times, which allows settling, in certain reaches. Impacts of regulation activities on nutrient and dissolved carbon concentrations was observed in outlet water on several occasion (see Chapter 4).

Periods of stratification and hypoxia were particularly evident in deeper reaches created due to the permanent inundation of Lake Wetherell and the Menindee weir pool. Such stratification can drive poor water quality. Stratification of both temperature and dissolved oxygen were noted throughout the study period, with deep zones sometimes experiencing prolonged stratification with little to no overnight mixing. This resulted in several sites with dissolved oxygen concentrations below guideline values, with concentrations <4 milligrams per litre (mg/L) being a threat to fish survival. This stratification can also promote redox-driven release of phosphorus, ammonium and metals (such as iron, manganese, aluminium) from sediments. These anoxic conditions facilitate the breakdown of organic matter and enhance concentrations of nutrients, particularly during periods of low flow when stratification persists.

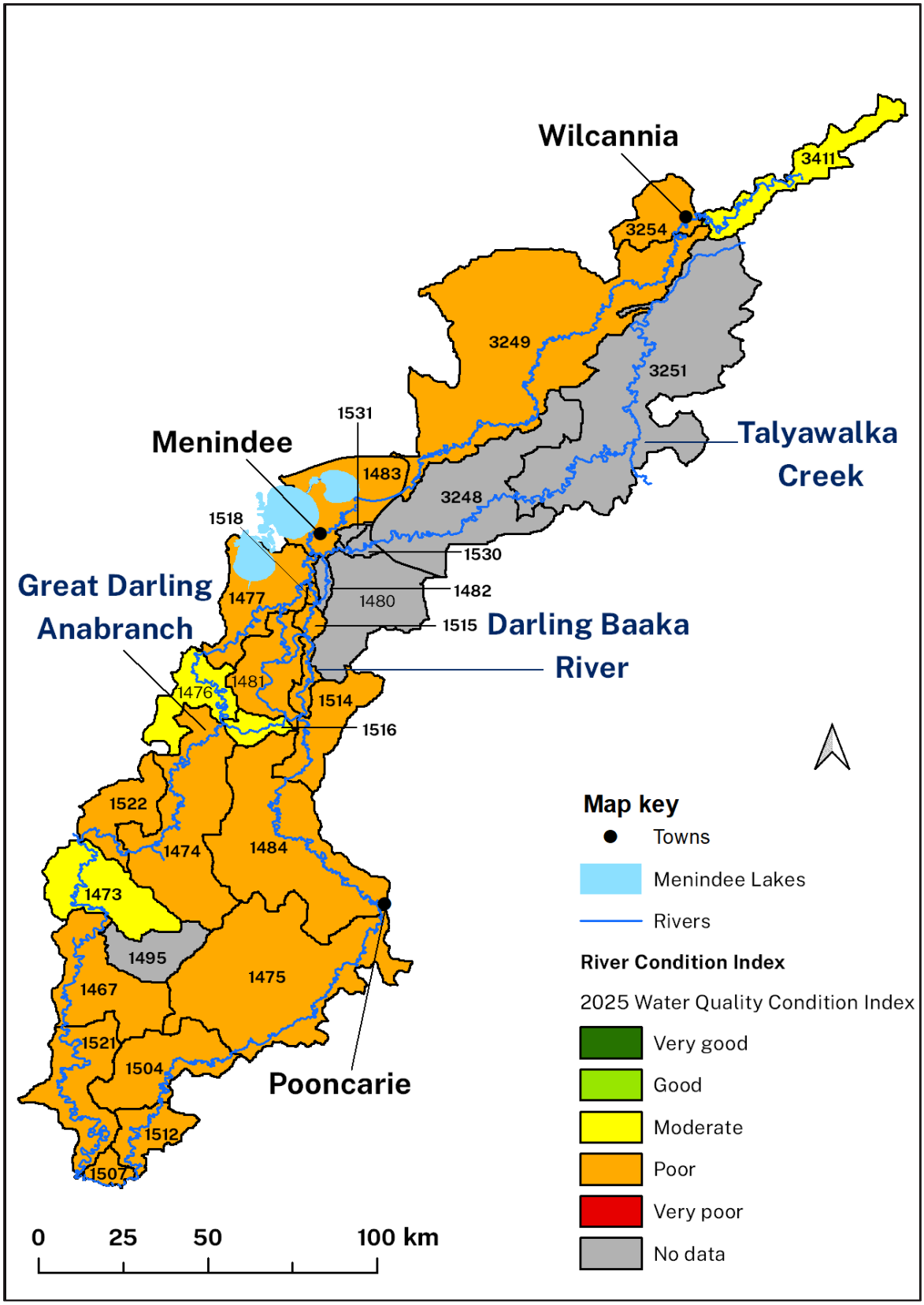

Figure 5 **2025 Water Quality Index grades for the lower Darling Baaka. Numbers refer to subcatchments (see Table 2)**

Note: The RCI grades for subcatchments 1481, 1507, 1516, 1522 are an average of the sites in the adjacent upstream catchment.

2.3.3 Riparian Vegetation Condition Index

Riparian vegetation is the vegetation that exists along the rivers bank and floodplains. It is important for habitat, bank stability and reducing sediment loads into the waterway.

The riparian vegetation in the majority of subcatchments has been assessed as being in moderate condition (Figure 6). These results have been formulated using 3 vegetation condition assessment methods:

- spatial modelling of vegetation health
- tree health and community condition assessments using full-floristic plot data
- rapid appraisal of riparian condition.

Overall, riparian vegetation in 19 of the subcatchments in the study area is assessed as in a moderate condition, 3 subcatchments are in poor condition, and 6 range from good to very good condition (Figure 6). However, concerns regarding the recruitment of trees and long-term viability of populations are noted.

Field sampling showed that mature river red gums are widespread throughout the area. However, field assessments for both the riparian vegetation condition and geomorphic condition indexes indicated many of the subcatchments are lacking in juvenile and sapling river red gums, indicating a lack of successful recruitment.

It is assumed that mature trees have extensive root systems that are accessing groundwater during times of limited supply. Wet conditions over recent years have allowed some sites to support recruitment (that is, the growth of saplings is evident). There are, however, a very small number of trees estimated to be between 5 and 20 years old which may indicate that the saplings are not surviving long enough for their roots to be accessing groundwater supplies. Long-term viability and stability of canopy tree populations within the study area appears limited and unreliable, with on-ground surveys showing low numbers of river red gum and black box (*Eucalyptus largiflorens*) recruits across each of the plant community types. This needs to be further investigated.

The major threats to the riparian vegetation are:

Changes to hydrology

Riparian vegetation is an ecotone between aquatic and terrestrial ecosystems, therefore can be impacted by a range of factors. Hydrological stresses, including variations and long-term changes to water flows and changes to inundation regimes, significantly impact riparian vegetation in the lower Darling Baaka study area. Frequent changes to the amount of water released inhibits the growth of groundcover and understorey vegetation and the recruitment of canopy trees.

Historic vegetation clearing and grazing

Landscape disturbances, particularly historic vegetation clearing and grazing, impact riparian condition and threaten the viability of riparian zones of the lower Darling Baaka River system. Human impacts have caused the degradation of riparian vegetation condition in the study area. The grazing pressures were ranked as high in many of the subcatchments, with cattle (*Bos taurus*) and goats (*Capra aegagrus hircus*) observed trampling and eating riparian vegetation. The highest floristic condition scores were recorded where land-use pressures (such as grazing) were minimal (see Chapter 5).

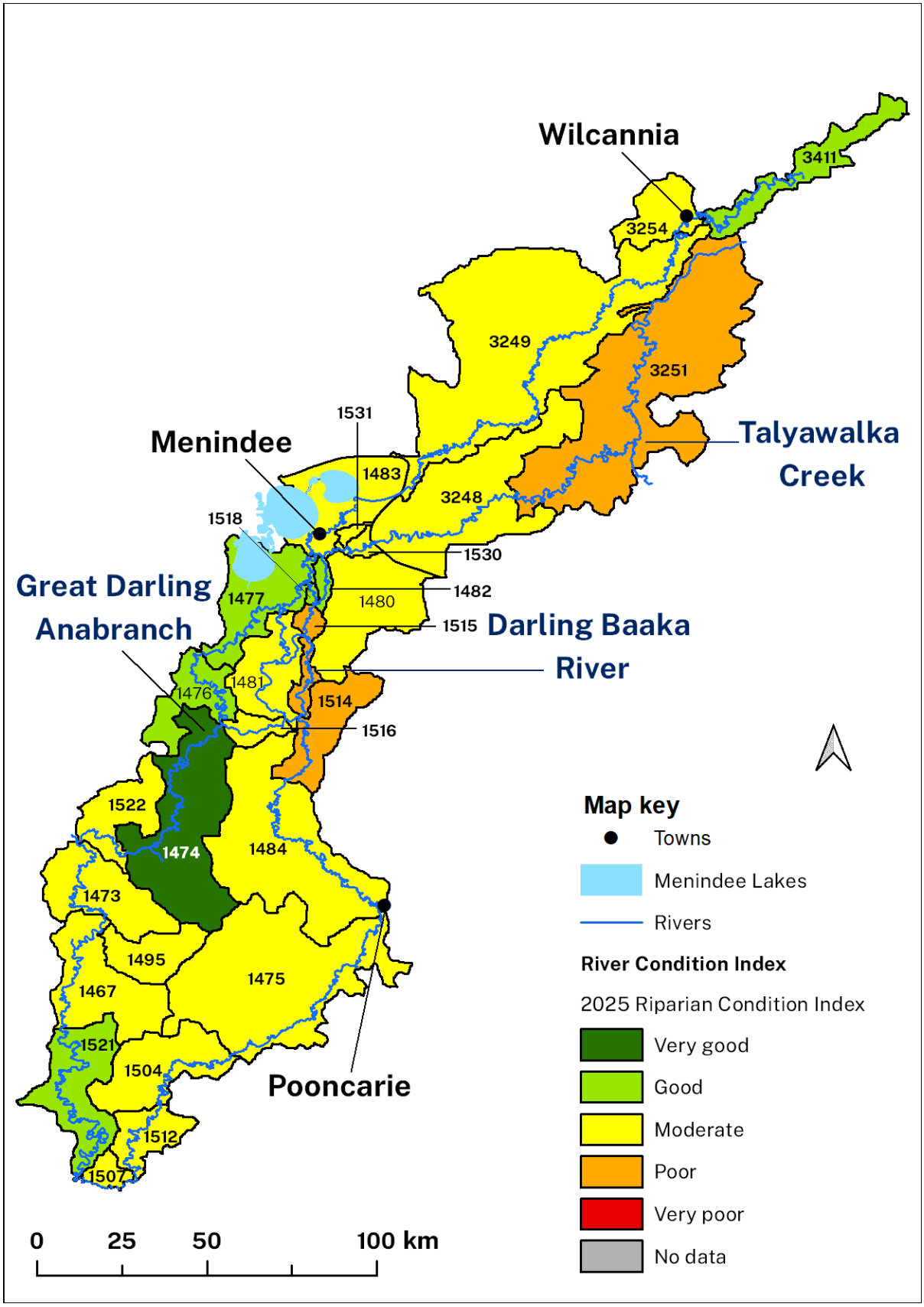

Figure 6 **2025 Riparian Vegetation Condition Index grades for the lower Darling Baaka. Numbers refer to subcatchments (see Table 2)**

2.3.4 Biodiversity Condition Index

Biodiversity is a broad term referring to the variety of living organisms in a region. It is the variety of life on Earth and can be thought of in terms of genetic diversity, species diversity and ecosystem diversity.

In general, biodiversity condition in most subcatchments was assessed as poor (Figure 7). This reflects the impacts of decades of alteration to the river. Overall, the Great Darling Anabranch has a slightly better biodiversity condition than the lower Darling Baaka River, primarily due to relatively high macroinvertebrate and zooplankton scores. The Great Darling Anabranch river reach zone is still below the benchmark for a healthy biological community.

Several catchments had no biological data collected in the study period. These catchments had no water flowing at the time of the surveys, with catchments Lake Milkengay (1495), Yampoola Creek (1480) and Lower 3 Mile Creek (1531) having no waterways within their boundaries. Talyawalka Creek subcatchments (a total of 7) were not surveyed in this study.

The 2025 Darling Baaka RCI grades likely reflect several issues throughout the study area, including disruptions to natural flow and drying regimes (see Chapter 7), poor water quality, particularly dissolved oxygen concentrations (see Chapter 4), and degradation of riparian and macrophyte communities (see Chapter 5). These factors combined have a cumulative impact on the long-term ability of the river to sustain a healthy biotic community. Some of the key threats are changes due to river regulation and introduced species.

Changes to natural hydrology, water quality and geomorphology through river regulation

The entire Darling Baaka River has been subjected to years of disturbance to flow and geomorphic degradation owing to river regulation, removal of vegetation and snags within the channel, stock access and associated declines in water quality. These impacts appear to have had long-term effects on the macroinvertebrate communities present in the lower Darling Baaka system. The long-term composition shift of macroinvertebrates towards smaller-bodied species with broad tolerances for water quality and hydrological disturbances has been recorded in the Murray River (Paul et al. 2013). It is likely that the highly regulated lower Darling Baaka system has experienced similar trends, which is demonstrated by a macroinvertebrate community which was dominated by species tolerant to disturbances. Zooplankton around Wilcannia, Pooncarie and Menindee were also dominated by small protozoans, and combined with macroinvertebrates and fish surveys, the biological data are indicating a stressed ecosystem.

The other major issue with river regulation is the impacts on fish migration and community dynamics. Weirs provide a major barrier to natural movements of fish along

the river. This was identified by the Office of the Chief Scientist and Engineer's report (OCSE 2023) as a major contributing factor to the mass fish deaths in early 2023.

Introduced species

Fish communities in the region are dominated by European carp, which contributed to over 70% of the total biomass of fish surveyed. The presence of carp is known to have a detrimental effect on native fish species and on water quality. The feeding habits of carp cause an increase in turbidity and water column nutrients and have been linked to the occurrence of algal blooms, contributing to the moderate to very poor values seen for turbidity, nutrients and chlorophyll-a. The increased turbidity resulting from carp activity reduces aquatic visibility and damages habitats, negatively impacting other aquatic biological communities. Carp can survive the high algal content and periodic very low oxygen concentrations which are prevalent in the lower Darling Baaka (see Chapter 4). This has a cascading effect on smaller native fish, as not only do the carp outcompete these species and contribute to increases in turbidity, but they can survive and breed in oxygen-depleted waters where native fish become highly stressed.

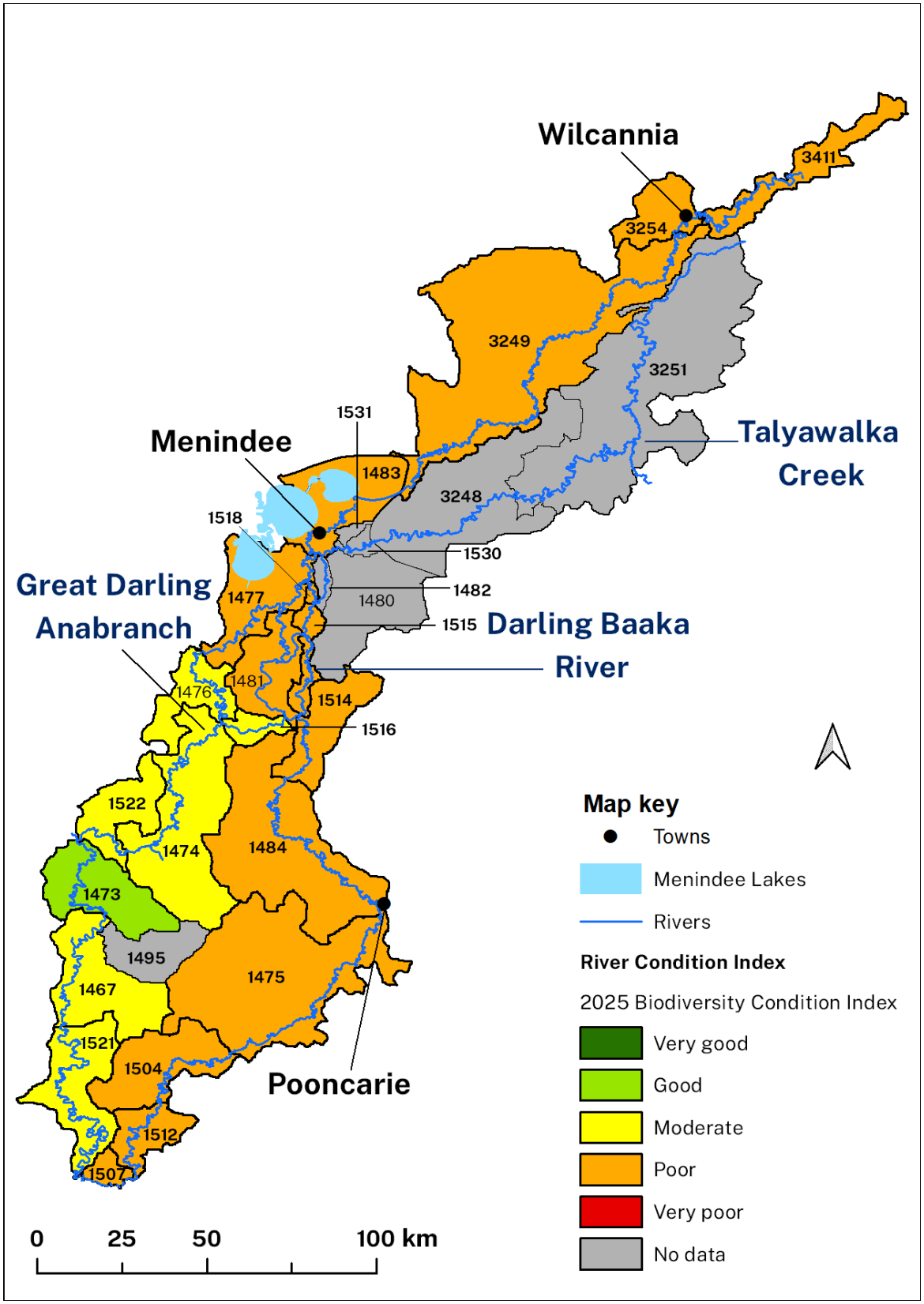

Figure 7 **2025 Biodiversity Condition Index grades for the lower Darling Baaka. Numbers refer to subcatchments (see Table 2)**

Note: The RCI grades for subcatchments 1481, 1507, 1516, 1522 is an average of the sites in the adjacent upstream catchment.

2.3.5 Hydrological Stress Index

Hydrological stress is a measure of the degree of alteration to natural river flows (DPE 2023a). It is a way to assess the pressure placed on water resources due to human influences such as river regulation, water extraction and the installation of dams and weirs.

Hydrological condition in the lower Darling Baaka River is characterised by significant flow deviations, damming and extraction along the river length. Comparing modelled undisturbed flow with current conditions, nearly 95% of the lower Darling Baaka (by area) is in moderate or poor hydrological condition (Figure 8). No data were available for 2 of the subcatchments, primarily as there were no records of gauged waterways in these areas. One of the subcatchments did not have any mapped waterways within its boundaries.

Several catchments with a grade of poor for hydrological stress are located near major weirs and outlets (Lake Wetherell [1483] and Cawndilla [1477]). These subcatchments have some of the largest land disturbances and river flow regulation in the region, due mainly to weirs and permanent inundation of floodplains associated with the Menindee Lakes Storage Scheme. Hydrological stress immediately downstream of Main Weir and Cawndilla is high, demonstrating the impacts of water management actions on natural flow regimes.

The results indicate that river health is being placed under significant stress due to alteration of natural flow regimes, with the main stress being river regulation and the reduced frequency of flow events.

River regulation and frequency of flow events

The key drivers of the poor hydrological conditions within the study area are changes to the frequency and duration of zero-flow events. However, the model does not consider the impacts of river regulation and extractions upstream of the study area. These impacts need to be considered as the cumulative impacts of damming, extraction and modification of flow paths in the upper Darling Baaka basin are likely driving the levels of hydrological stress experienced in the study area. Due to this, the scores and grades provided in this report are inherently conservative in terms of the degree of hydrological stress that the lower Darling Baaka experiences.

To a lesser extent, the deviations in the frequency and duration of freshes also contributed to the impacted subcatchments. Finally, the influence of the groundwater as a function of the subcatchments was delineated, showing a loss to groundwater storages in the upstream river reach zones and gains into the river flow downstream of the Main Weir. The potential for groundwater to add to the hydrological stress needs further investigation.

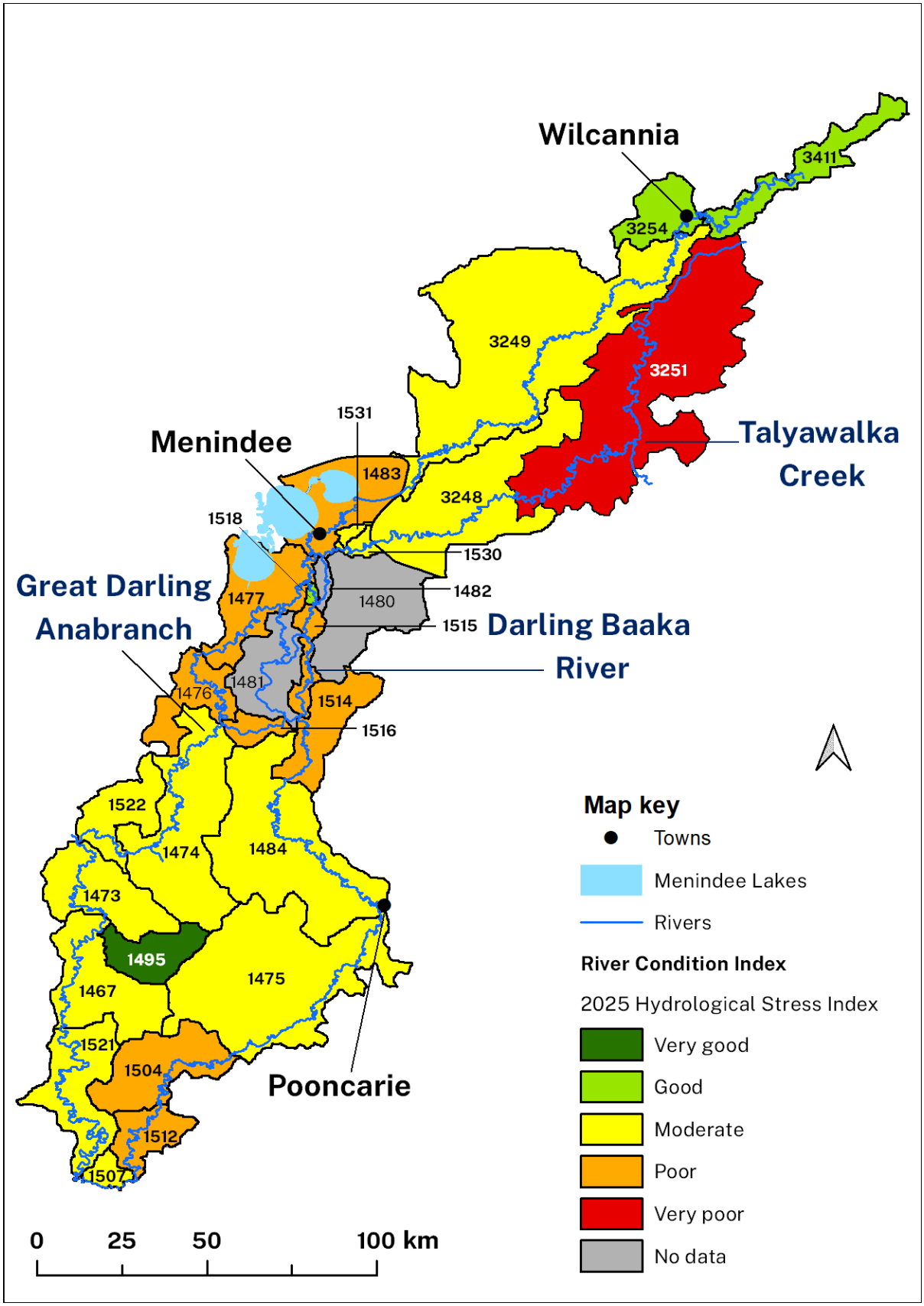

Figure 8 **2025 Hydrological Stress Index grades for the lower Darling Baaka. Numbers refer to subcatchments (see Table 2)**

2.3.6 Landscape Disturbance Index

Landscape disturbance is a measure of activities like road building, irrigated and dryland cropping, mining, grazing and land clearing; all of which influence river functions across a range of spatial and temporal scales.

The majority of subcatchments have been identified as being in good or very good condition, in terms of landscape disturbances (Figure 9). Except for farm dams and weirs, there is relatively minimal infrastructure influencing river health in the catchments, with low levels of roads, tracks and powerlines throughout the study area. Land use in the region is dominated by grazing, with minimal urban regions and mining, thus land use is not seen as a major contributor to landscape disturbances.

These results somewhat conflict with on-ground observations that grazing, large feral goat populations and historic vegetation clearing in the study area appear to be contributing to riverbank destabilisation and the formation of gullies. This may be due to the methods being used to assess land cover change, as historic clearing (in the 19th and 20th centuries) is not captured in the land cover change indicator.

There is evidence of long-term elevated sedimentation rates in Murray–Darling Basin waterholes which is associated with historical land clearing. This reduces waterhole depth and therefore their persistence duration during drought (Tibby et al. 2023). Combined with the semi-arid nature of the region and the flat ancient landscape, calculating land cover change over short periods may not truly reflect the long-term pressure that land use clearing continues to exert on the river.

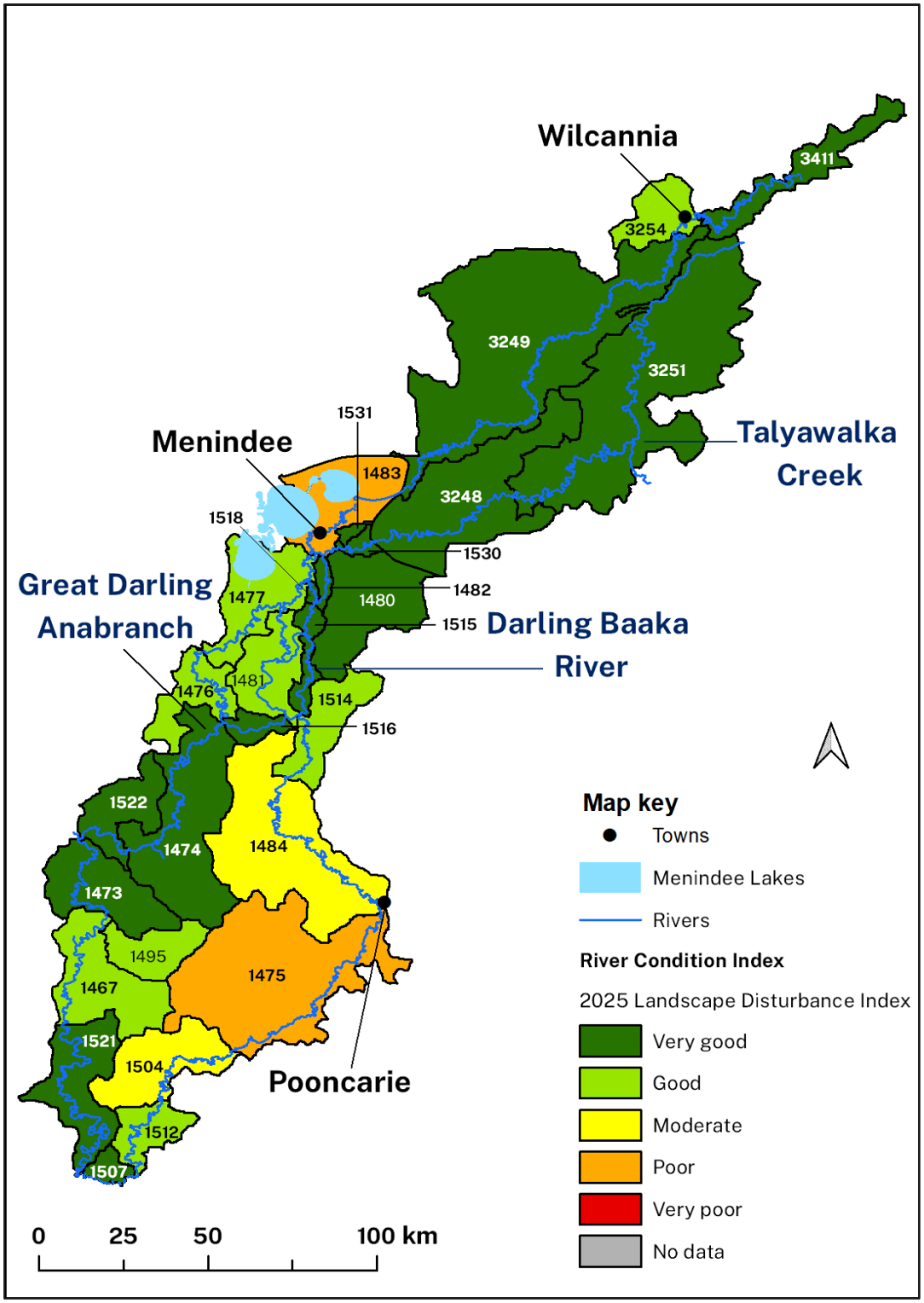

Figure 9 **2025 Landscape Condition Index grades for the lower Darling Baaka. Numbers refer to subcatchments (see Table 2)**

2.4 Detailed river health by river reach zone

For the purposes of reporting, the study area has been divided into 6 river reach zones, based on subcatchment boundaries, river junctions and presence of structures disturbing fish passages and water flows (such as weirs) (see Figure 2). The main findings for each zone are discussed below.

2.4.1 Wilcannia to Lake Wetherell

This zone includes the lower Darling Baaka River between Wilcannia and the upper parts of Lake Wetherell, including the following subcatchments:

- Lower Paroo (3411)
- Lake Woytchugga (3254)
- Wilcannia Downstream (3249).

Overall condition

All subcatchments in this zone were classified as having moderate river health under the RCI framework (Table 3; Figure 3).

The sites in the upper areas of this zone, around Wilcannia, are in moderate geomorphic condition, moderate riparian vegetation condition, and have good to very good landscape disturbance scores. Hydrological stress in the upper zones (Lower Paroo and Lake Woytchugga) is in good condition indicating low stress, with the impacts from weirs resulting in a moderate stress for the Wilcannia Downstream subcatchment. Water quality and biodiversity indexes are in poor condition, with detailed examination provided in the following sections.

Table 3 **Wilcannia to Lake Wetherell zone individual river health index scores and overall River Condition Index scores**

Subcatchment	WQI	GCI	HSI	BCI	LDI	RvCI	Overall RCI
Lower Paroo (3411)	0.45	0.50	0.64	0.31	0.90	0.66	**0.54**
Lake Woytchugga (3254)	0.33	0.57	0.64	0.26	0.70	0.58	**0.49**
Wilcannia Downstream (3249)	0.36	0.53	0.49	0.30	0.82	0.54	**0.48**

Table notes: WQI = Water Quality Index; GCI = Geomorphic Condition Index; HSI = Hydrological Stress Index; BCI = Biodiversity Condition Index; LDI = Landscape Disturbance Index; RvCI = Riparian Vegetation Condition Index; RCI = River Condition Index. Colours: orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition.

Water quality

Water quality in this zone has been assessed as poor to moderate (Table 4). Total nitrogen, oxidised nitrogen, total phosphorus and soluble reactive phosphorus

concentrations generally exceeded default guideline values. However, ammonium concentrations were relatively low, as was the ratio of bioavailable nitrogen to phosphorus.

All sites within this zone exceeded turbidity guidelines, with the highest turbidity levels in the entire study area. These high turbidity levels were attributed to inflows from the upper Darling Baaka River basin. It is likely that high turbidity levels are impacting the biotic assemblages within this zone.

Dissolved oxygen saturation was largely consistent with other sites across the study area and had grades ranging from poor to very good (Table 4). At sites in the Wilcannia Downstream subcatchment (i.e. the upper reaches of Lake Wetherell), dissolved oxygen values were regularly recorded below the lower guideline value of 90% saturation. In contrast, dissolved oxygen exceeded 100% saturation at some sites in the Lower Paroo and Lake Woytchugga subcatchments , indicating high daytime rates of primary productivity.

Chlorophyll-a concentrations were graded very poor within all sites in this zone (Table 4). Chlorophyll-a concentrations persistently exceeded the guideline values for most of the sampling period, with several algae red alerts issued by WaterNSW owing to the presence of blue-green algae in the Wilcannia weir pool. A significant cyanobacteria bloom (genus *Dolichospermum*) occurred around Wilcannia (sites S1–S6) during November 2024. This species can produce toxins and create odour and taste issues for drinking water.

Sites in this zone displayed the highest concentrations of metals including aluminium, copper and zinc, with numerous guideline exceedances recorded (Table 4). The pH and electrical conductivity recorded within this zone fit within the lower and upper guidelines and are categorised from good to very good condition. Pesticide concentrations were generally below 95% species protection guidelines.

Table 4 Wilcannia to Lake Wetherell zone water quality scores

Sub-catchment	Site	Nutrients	Turbidity	Dissolved oxygen	Chl–a	Pesticides	Metals	pH	EC
Lower Paroo (3411)	S1	0.32	0.11	0.71	0.09	0.92	0.60	0.92	0.92
Lake Woytchugga (3254)	S2	0.25	0.12	0.66	0.08	0.92	0.35	0.62	0.92
	S3	0.39	0.18	0.92	0.08	0.92	0.40	0.74	0.92
Wilcannia Downstream (3249)	S4	0.28	0.18	0.40	0.08	0.92	0.65	0.92	0.92
	S5	0.30	0.15	0.40	0.08	0.92	0.40	0.92	0.92
	S6	0.22	0.1	0.22	0.11	0.92	0.38	0.92	0.92
	S7	0.21	0.14	0.31	0.12	0.92	0.38	0.92	0.92
	S8	0.20	0.1	0.22	0.10	0.92	0.39	0.92	0.92

Table notes: Chl-a = chlorophyll-a; EC = electrical conductivity. Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition.

Biodiversity condition

Freshwater turtles were seen at sites S4 and S7, within the Wilcannia Downstream subcatchment, and the vulnerable great crested grebe (*Podiceps cristatus*) was identified at sites S6 and S9. There were no Murray cod or silver perch (*Bidyanus bidyanus*) recorded in this zone, however, spangled perch (*Leiopotherapon unicolor)* were located at almost every site between sites S1 and S8, as were bony herring and golden perch.

The overall biodiversity condition of this zone was assessed as poor (Table 5). Fish species richness and abundance was low, and communities were dominated by invasive species such as European carp. Data collected on macroinvertebrate and zooplankton community health and composition indicate a generally poor to moderate condition in the zone. The identified communities suggest that most sites are indicative of a river in poor health, with few pollution-tolerant macroinvertebrate species, and dominated by smaller zooplankton. Zooplankton form an important part of the food web and indications of stress at this trophic level can have significant impacts throughout other higher trophic level species.

Table 5 Wilcannia to Lake Wetherell zone biodiversity indicator scores

Subcatchment	Site	Fish	Macro-invertebrates	Zooplankton	Overall site score
Lower Paroo (3411)	S1	0.16	0.37	0.41	**0.31**
Lake Woytchugga (3254)	S2	0.16	0.34	0.25	**0.25**
	S3	0.16	0.40	0.25	**0.27**
Wilcannia Downstream (3249)	S4	0.16	0.42	0.50	**0.36**
	S5	0.16	0.37	0.19	**0.24**
	S6	0.16	0.36	0.25	**0.25**
	S7	0.16	0.36	0.32	**0.28**
	S8	0.16	0.36	0.61	**0.38**

Table notes: Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition.

2.4.2 Menindee weir pool

The Menindee weir pool zone was an intensively sampled zone (9 sites) despite only consisting of one subcatchment, Lake Wetherell (1483). Sites B1–B3 are outlets from major water storages, and were assessed for water quality only, and site S9 is at the lower end of Lake Wetherell, upstream of Main Weir.

Overall condition

This zone has been assessed as having poor river health. The subcatchment was assessed as having poor water quality, geomorphology, landscape disturbance,

biodiversity condition and hydrological stress scores (Table 6). Riparian vegetation was the only index with a grade of moderate.

The lowest geomorphic condition grades in the entire study area occurred in this subcatchment. This is likely caused by weirs, embankments and artificial channels associated with the Menindee Lakes Storage Scheme. This zone has experienced significant geomorphic degradation, and has a 'poor' recovery potential, with a very slow rate of recovery (see Chapter 3). This zone may not recover without huge financial costs, bank stabilisation and removal of structures such as embankments and weirs. Geomorphic degradation will likely be ongoing in this subcatchment (see Chapter 3).

Table 6 **Menindee weir pool zone individual river health index grades and overall River Condition Index scores**

Sub-catchment	WQI	GCI	HSI	BCI	LDI	RvCI	Overall RCI
Lake Wetherell (1483)	0.25	0.36	0.30	0.35	0.35	0.57	**0.36**

Table notes: WQI = Water Quality Index; GCI = Geomorphic Condition Index; HSI = Hydrological Stress Index; BCI = Biodiversity Condition Index; LDI = Landscape Disturbance Index; RvCI = Riparian Vegetation Condition Index; RCI = River Condition Index. Colours: orange = poor condition; yellow = moderate condition.

Water quality

The water quality within the Menindee weir pool zone has been assessed as poor (Table 6; Table 7). Nutrients within this zone were classified as very poor and this is a result of persistent and large exceedances of guideline values for total nitrogen, oxidised nitrogen, total phosphorus and soluble reactive phosphorus concentrations.

All sites within this zone exceeded turbidity guidelines. These high turbidity levels were attributed to a combination of managed releases and pulses of highly turbid waters from wet-weather events upstream of Wilcannia. Wind-driven resuspension of fine-grained sediment within the shallow lake storages of the Menindee Lakes Storage Scheme, Lake Pamamaroo and Menindee Lake, can cause higher turbidity waters to be discharged into the Menindee weir pool during releases. Results also indicate the significant impact of wet-weather events in the upper catchment on waters entering Wilcannia (see Chapter 4).

Dissolved oxygen results were variable, with individual site grades ranging from poor to good. This is likely attributed to the frequency of environmental flows being released to combat dissolved oxygen concentrations, when they were below the guideline values. Variability associated with diurnal variation in oxygen concentrations is also a likely contributing factor to concentrations recorded.

Chlorophyll-a levels were graded very poor across this zone, with average concentrations at each site in this zone exceeding the guideline values. Cyanobacteria algal blooms were noted in this area, particularly during May and August 2024.

Pesticides rarely exceeded guideline values, and metals concentrations were also generally below guideline values except for site S9 where exceedances of aluminium, zinc and copper occurred (Table 7).

Table 7 Menindee weir pool zone water quality scores

Subcatchment	Site	Nutrients	Turbidity	Dissolved oxygen	Chl–a	Pesticides	Metals	pH	EC
Lake Wetherell (1483)	S9	0.19	0.1	0.27	0.12	0.87	0.21	0.92	0.92
	S10	0.18	0.17	0.71	0.09	n.d.	n.d.	0.81	0.92
	S11	0.19	0.16	0.45	0.09	0.89	0.65	0.81	0.92
	S12	0.18	0.14	0.3	0.09	0.89	0.63	0.92	0.92
	S13	0.18	0.1	0.37	0.08	n.d.	n.d.	0.92	0.92
	S14	0.22	0.14	0.45	0.08	n.d.	n.d.	0.92	0.92
	B1	0.19	0.09	0.45	0.08	n.d.	n.d.	0.78	0.92
	B2	0.19	0.09	0.66	0.09	n.d.	n.d.	0.92	0.92
	B3	0.17	0.11	0.33	0.09	n.d.	n.d.	0.8	0.92

Table notes: Chl-a = chlorophyll-a, EC = electrical conductivity. Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. n.d.= no data.

Biodiversity condition

The biodiversity condition within the Menindee weir pool zone (assessed at 6 sites) was assessed as in poor condition (Table 8). This likely reflects the poor water quality and high hydrological stress recorded in the same zone.

There were several waterbirds in this zone, including the vulnerable great crested grebe and the endangered eastern great egret (*Ardea alba modesta*). Site S9 (located in Lake Wetherell) had a much higher abundance of waterbirds such as pelicans, and cormorants, when compared to the river reach between sites S10 and S14.Murray cod were located at sites S9, S11, and S14 with records of silver perch, golden perch and spangled perch. Native Rakali (*Hydromys chrysogaster*) were observed at sites S11 and S14.

Fish condition at all sites was assessed as very poor. Carp were recorded at all 6 sites in high numbers, with 96 individuals caught at site S14, the most in the entire study area. The biomass of the exotic species contributed to over 85% of the total biomass at some sites in this zone. Murray cod were found at site S11 and site S14 during late spring/early winter sampling. Fish community health is likely to be heavily influenced by water quality and weirs, which prevent the fish from moving freely.

Macroinvertebrates within this zone are listed as poor to moderate, with zooplankton ranging from moderate to good. Sites S10 and S14 have higher zooplankton scores as more individual specimens were noted to carry eggs.

Table 8 Menindee weir pool zone biodiversity indicator scores

Subcatchment	Site	Fish	Macro-invertebrates	Zooplankton	Overall site score
Lake Wetherell (1483)	S9	0.16	0.34	0.41	**0.30**
	S10	0.16	0.34	0.72	**0.41**
	S11	0.16	0.38	0.50	**0.35**
	S12	0.16	0.38	0.50	**0.35**
	S13	0.16	0.38	0.41	**0.32**
	S14	0.16	0.40	0.61	**0.39**

Table notes: Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition.

2.4.3 Pooncarie North

The Pooncarie North zone incorporates all subcatchments on the lower Darling Baaka River from Weir 32 to Pooncarie (Figure 2). These 4 subcatchments are:

- Downstream Weir 32 (1518)
- Lower Yampoola Creek (1515)
- Cuthero Creek (1514)
- Upstream Pooncarie (1484).

Overall condition

The river health in this zone of the lower Darling River has been assessed to be in moderate condition. The area is under a considerable amount of hydrological stress, with 2 sites assessed in poor hydrological condition. Biota and water quality are also failing benchmarks in this zone. Riparian vegetation condition has considerable variability, with some sites assessed in poor condition and others assessed in good condition.

The high geomorphic and landscape scores in this zone are elevating the overall river health grades in all subcatchments (Figure 8; Figure 9; Table 9).

Table 9 **Pooncarie North zone individual river health index grades and overall River Condition Index scores**

Subcatchment	WQI	GCI	HSI	BCI	LDI	RvCI	Overall RCI
Downstream Weir 32 (1518)	0.27	0.76	0.30	0.27	0.93	0.73	**0.47**
Lower Yampoola Creek (1515)	0.38	0.86	0.40	0.31	0.86	0.39	**0.47**
Cuthero Creek (1514)	0.25	0.79	0.39	0.31	0.75	0.38	**0.44**
Upstream Pooncarie (1484)	0.32	0.79	0.45	0.27	0.42	0.56	**0.44**

Table notes: WQI = Water Quality Index; GCI = Geomorphic Condition Index; HSI = Hydrological Stress Index; BCI = Biodiversity Condition Index; LDI = Landscape Disturbance Index; RvCI = Riparian Vegetation Condition Index; RCI = River Condition Index. Colours: orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition.

Water quality

The average water quality for the subcatchments in this zone is moderate. As with other subcatchments on the lower Darling Baaka River, chlorophyll-a concentrations exceeded guidelines on most sampling occasions.A large algal bloom around Pooncarie was observed in May 2024. The dominant genus of cyanobacteria was *Cyanobium* in this zone. Additionally, a smaller bloom of the non-toxic *Prochlorothrix* occurred in this zone in May 2024.

High nutrient concentrations and turbidity were measured throughout this zone. Elevated nutrients can contribute to excessive algal growth, which are likely to be contributing to the very poor chlorophyll-a grades during the sampling period (Table 10). Pesticide and metal levels range from very good to good within this zone, with no exceedances of pesticide guidelines, and only occasional and minor exceedances for metals.

Table 10 Pooncarie North zone water quality scores

Sub-catchment	Site	Nutrients	Turbidity	Dissolved oxygen	Chl–a	Pesticides	Metals	pH	EC
Downstream Weir 32 (1518)	S16	0.24	0.25	0.77	0.08	n.d.	n.d.	0.77	0.92
Lower Yampoola Creek (1515)	S17	0.22	0.29	0.92	0.08	0.92	0.66	0.92	0.92
Cuthero Creek (1514)	S18	0.24	0.29	0.69	0.08	n.d.	n.d.	0.66	0.92
Upstream Pooncarie (1484)	S19	0.24	0.22	0.52	0.08	n.d.	n.d.	0.81	0.92
	S20	0.25	0.19	0.42	0.08	0.92	0.62	0.92	0.92

Table notes: Chl-a = chlorophyll-a, EC = electrical conductivity. Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. n.d.= no data.

Biodiversity condition

The biodiversity condition of the lower Darling Baaka River between Weir 32 and Pooncarie was assessed as poor (Table 11). The fish communities within this zone are in very poor condition, with high biomass and abundances (194 total individuals) of invasive European carp sampled in this zone. Invasive species like carp can outcompete the native species in the river like the Murray cod and golden perch, which were present in this zone but in much lower abundances than carp.

The poor to moderate condition of macroinvertebrates and zooplankton is relatively consistent with other sections of the lower Darling Baaka. This likely reflects poor water quality in the region, with macroinvertebrate communities dominated by pollution-tolerant species.

Table 11 Pooncarie North biodiversity indicator scores

Subcatchment	Site	Fish	Macro-invertebrates	Zooplankton	Overall site score
Downstream Weir 32 (1518)	S16	0.10	0.40	0.32	**0.27**
Lower Yampoola Creek (1515)	S17	0.10	0.43	0.41	**0.31**
Cuthero Creek (1514)	S18	0.10	0.42	0.41	**0.31**
Upstream Pooncarie (1484)	S19	0.10	0.36	0.41	**0.29**
	S20	0.10	0.39	0.32	**0.27**

Table notes: Colours: red = very poor condition; orange = poor condition; yellow = moderate condition.

2.4.4 Pooncarie South

The zone downstream of Pooncarie (Pooncarie South) incorporates the following 4 subcatchments:

- Downstream Pooncarie (1475)
- Palinyewah (1504)
- Lower Darling (1512)
- Murray–Darling Confluence (1507).

Overall condition

The river health of the Pooncarie South river reach zone has been classified as being in moderate condition.

The geomorphic condition has been assessed in good to very good condition in the subcatchments in this zone. This is due to the 'moderate' geomorphic condition assessment, but 'high' recovery potential (see Chapter 3). Riparian condition in this zone is assessed as moderate. Several subcatchments in this zone have moderate to poor hydrological condition potentially due to the impacts of weirs and extraction. Landscape disturbances were also variable, with grades near Pooncarie impacted by the presence of weirs and sandmining activity (Table 12).

Both water quality and biodiversity condition were graded as poor in each of the sampled subcatchments.

Table 12 **Pooncarie South individual river health index scores and overall River Condition Index scores**

Subcatchment	WQI	GCI	HSI	BCI	LDI	RvCI	Overall RCI
Downstream Pooncarie (1475)	0.32	0.71	0.45	0.32	0.29	0.53	**0.42**
Palinyewah (1504)	0.32	0.71	0.21	0.38	0.42	0.50	**0.40**
Lower Darling (1512)	0.36	0.63	0.31	0.33	0.64	0.52	**0.45**
Murray–Darling Confluence (1507)	0.36*	0.68	0.58	0.33*	0.84	0.54	**0.57**

Table notes: WQI = WQI = Water Quality Index; GCI = Geomorphic Condition Index; HSI = Hydrological Stress Index; BCI = Biodiversity Condition Index; LDI = Landscape Disturbance Index; RvCI = Riparian Vegetation Condition Index; RCI = River Condition Index. Colours: orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. *indicates index score is inferred from upstream adjacent subcatchment results; n.d. = no data.

Water quality

Water quality downstream of Pooncarie was assessed as poor during the sampling period. For this zone, pesticides were categorised as very good, and metals were categorised as good, with neither exceeding guideline values.

Consistent with the rest of the zones on the lower Darling Baaka River, the main areas of concern were nutrients, turbidity and chlorophyll-a concentrations. Most samples exceeded guideline values for these 3 metrics (Table 13).

The chlorophyll-a levels within this zone were assessed as very poor. Cyanobacteria algal blooms were noted in the area, particularly in May and August 2024.

Table 13 Pooncarie South water quality scores

Subcatchment	Site	Nutrients	Turbidity	Dissolved oxygen	Chl–a	Pesticides	Metals	pH	EC
Downstream Pooncarie (1475)	S21	0.19	0.22	0.63	0.08	n.d.	0.78	0.81	0.92
	S22	0.23	0.13	0.69	0.08	0.92	0.65	0.69	0.92
Palinyewah (1504)	S32	0.39	0.21	0.46	0.08	n.d.	0.78	0.66	0.92
Lower Darling (1512)	S23	0.23	0.26	0.38	0.08	0.92	0.63	0.81	0.92

Table notes: Chl-a = chlorophyll-a, EC = electrical conductivity. Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. n.d. = no data.

Biodiversity condition

Overall, fish, macroinvertebrate and zooplankton scores were poor for the zone downstream of Pooncarie (Table 14). Bony herring was the most prevalent fish species in this zone, with carp and golden perch second and third most common, respectively. Ten Murray cod were surveyed in this zone, the same as Pooncarie North. Macroinvertebrate and zooplankton communities indicated moderate to poor condition in this zone, with pollution-sensitive species dominating the surveys.

Table 14 Pooncarie South biodiversity indicator scores

Subcatchment	Site	Fish	Macro-invertebrates	Zooplankton	Overall site score
Downstream Pooncarie (1475)	S21	0.20	0.46	0.32	**0.33**
	S22	0.20	0.42	0.32	**0.32**
Palinyewah (1504)	S32	0.36	0.39	0.41	**0.38**
Lower Darling (1512)	S23	0.20	0.37	0.41	**0.33**

Table notes: Colours: orange = poor condition; yellow = moderate condition.

2.4.5 Talyawalka Creek

Talyawalka Creek, in the northern section of the study area (Figure 2), is characterised by an ephemeral flow regime, meaning it is dry for extended periods and flows intermittently during heavy rainfall or floods. It is located to the east of the Darling Baaka River stretching from roughly 50 km upstream of Wilcannia and rejoining the mainstem of the river in the Menindee zone just downstream of Weir 32. The zone includes Charlie Stones Creek. The 6 subcatchments in this zone are located on an extensive, infrequently flooded floodplain.

This zone includes the following subcatchments:

- Upper Talyawalka Creek (3251)
- Middle Talyawalka Creek (3248)
- Lower 3 Mile Creek (1531)
- Lower Talyawalka Creek (1530)
- Yampoola Creek (1480)
- Charlie Stones Creek (1482).

As Talyawalka Creek and the surrounding smaller creeks are very rarely inundated, only flowing during major flooding events, there are no water quality or biodiversity condition data for these subcatchments.

Overall condition

Talyawalka Creek has been assessed to be in moderate to good condition. On average the zone was assessed to have very good geomorphic condition, with ‘good’ geomorphic condition and ‘intact’ recovery potential (see Chapter 3). There were minimal landscape disturbances and infrastructure in the zone leading to a Landscape Condition Index grade of very good in all subcatchments. Riparian vegetation ranged from poor to good condition, and hydrological stress was very poor in one subcatchment and moderate in others (Table 15).

Table 15 **Talyawalka Creek zone individual river health index scores and overall River Condition Index scores**

Subcatchment	WQI	GCI	HSI	BCI	LDI	RvCI	Overall RCI
Upper Talyawalka Creek (3251)	n.d.	1.00	0.17	n.d.	0.86	0.38	**0.48**
Middle Talyawalka Creek (3248)	n.d.	0.99	0.50	n.d.	0.87	0.54	**0.66**
Lower 3 Mile Creek (1531)	n.d.	0.84	0.56	n.d.	0.87	0.47	**0.64**
Lower Talyawalka Creek (1530)	n.d.	0.93	0.56	n.d.	0.87	0.42	**0.63**
Yampoola Creek (1480)	n.d.	0.99	n.d.	n.d.	0.84	0.59	**0.75**
Charlie Stones Creek (1482)	n.d.	1.00	n.d.	n.d.	0.86	0.68	**0.80**

Table notes: WQI = Water Quality Index; GCI = Geomorphic Condition Index; HSI = Hydrological Stress Index; BCI = Biodiversity Condition Index; LDI = Landscape Disturbance Index; RvCI = Riparian Vegetation Condition Index; RCI = River Condition Index. Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. n.d. = no data.

The Upper Talyawalka Creek subcatchment (3251) had the poorest Hydrological Stress Index score recorded across the entire study area. There were also poor riparian vegetation grades in this subcatchment, with limited recruitment noted. There is a general trend of improving riparian condition in a downstream direction along Talyawalka Creek, with the furthest downstream subcatchment (1482) assessed in good riparian vegetation condition.

The remaining subcatchments in this zone were all shown to have moderate Hydrological Stress Index grading. The factors influencing the changes in condition along Talyawalka Creek have not been clearly identified using current modelling. The consistently very good Landscape Disturbance Index scores can be attributed to minimal built infrastructure such as weirs, roads and powerlines, and very little recorded land cover change in the zone over recent years.

The variability of scores between indexes (with the riparian vegetation and hydrological indexes displaying very poor to moderate health) combined with the high grades for geomorphic and landscape disturbance indexes, indicate that more investigations are required in this zone. In future, and where possible, efforts should be made to collect water and biological data to improve confidence in river health scores in this zone.

2.4.6 Great Darling Anabranch

The Great Darling Anabranch flows to the west of the mainstem of the Darling Baaka River. The Anabranch is heavily regulated, and during the period of this study a cease-

to-flow event occurred between July and late September 2024. This zone includes the following subcatchments:

- Cawndilla (1477)
- Anabranch Offtake (1516)
- Lower Redbank Creek (1476)
- Coonalhugga Creek (1481)
- Popio (1522)
- Anabranch North Lakes (1474)
- Anabranch North (1473)
- Lake Milkengay (1495)
- Warrawenia Lake (1467)
- Lower Anabranch (1521).

The Cawndilla subcatchment (1477) is the northernmost section of this zone and contains a small section of the Darling Baaka River. Site S15 is on the lower Darling Baaka River, and is more reflective of conditions in the Pooncarie North zone. However, due to the RCI 2023a preconceived subcatchment boundaries, results for site S15 have been included in the Cawndilla subcatchment scores. Several subcatchments (1481, 1516, 1522) within this zone were allocated indicative RCI scores reflecting the average of adjacent upstream subcatchment data. This was mainly due to accessibility issues in this zone.

Overall condition

The overall river condition of the Great Darling Anabranch was assessed as moderate. In general, several indexes are graded higher in this zone than the subcatchments on the lower Darling Baaka River. Riparian vegetation condition in this zone was generally good to very good, with some recruitment of canopy trees noted on the Anabranch.

Data from this large zone indicate poor to moderate water quality, moderate to poor hydrological stress grades and good landscape disturbance grades (Table 16). The Geomorphic Condition Index is assessed as good to very good in all subcatchments in the Anabranch. This indicates a ‘good’ geomorphic condition and ‘intact’ recovery potential (see Chapter 3). The geomorphic condition on the Anabranch is in better condition than the subcatchments on the lower Darling Baaka River.

Table 16 **Great Darling Anabranch individual river health index scores and overall River Condition Index scores**

Subcatchment	WQI	GCI	HSI	BCI	LDI	RvCI	Overall RCI
Cawndilla (1477)	0.31	0.62	0.21	0.34	0.79	0.61	**0.44**
Anabranch Offtake (1516)	0.42*	1.00	0.39	0.42*	0.87	0.52	**0.58**
Lower Redbank Creek (1476)	0.42	0.98	0.39	0.42	0.77	0.68	**0.55**
Coonalhugga Creek (1481)	0.31*	1.00	n.d	0.34*	0.87	0.49	**0.57**
Popio (1522)	0.39*	1.00	0.50	0.53*	0.86	0.52	**0.58**
Anabranch North Lakes (1474)	0.39	1.00	0.41	0.53	0.81	0.95	**0.60**
Anabranch North (1473)	0.46	1.00	0.49	0.63	0.86	0.50	**0.60**
Lake Milkengay (1495)	n.d	0.99	0.91	n.d	0.74	0.41	**0.67**
Warrawenia Lake (1467)	0.31	0.97	0.51	0.58	0.65	0.45	**0.53**
Lower Anabranch (1521)	0.38	1.00	0.45	0.55	0.83	0.62	**0.58**

Table notes: WQI = WQI = Water Quality Index; GCI = Geomorphic Condition Index; HSI = Hydrological Stress Index; BCI = Biodiversity Condition Index; LDI = Landscape Disturbance Index; RvCI = Riparian Vegetation Condition Index; RCI = River Condition Index. Colours: orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. *indicates index score is inferred from upstream adjacent subcatchment results n.d. = no data.

Water quality

Water quality index in the Great Darling Anabranch was assessed as poor to moderate. Individual metrics ranged from very poor to very good (Table 17).

There were high concentrations of total nitrogen in several samples in the Great Darling Anabranch. These concentrations may result from the impacts of Packers Weir, wherein water level fluctuations expose the lakes to high rates of organic matter decomposition, a process resulting in high ammonia concentrations.

The very poor scores of chlorophyll-a shown across all sites have been contributed to by a combination of hydrological stress and high nutrient levels. This includes a period in August 2024 when a high abundance of cyanobacteria was detected throughout the Great Darling Anabranch.

Table 17 Great Darling Anabranch water quality scores

Sub-catchment	Site	Nutrients	Turbidity	Dissolved oxygen	Chl–a	Pesticides	Metals	pH	EC
Cawndilla (1477)	S15	0.22	0.21	0.40	0.08	n.d.	0.81	0.69	0.92
	S31	0.46	0.21	0.92	0.10	n.d.	n.d.	0.54	0.92
	S30	0.35	0.11	0.92	0.08	n.d.	n.d.	0.56	0.92
Lower Redbank Creek (1476)	S29	0.31	0.12	0.80	0.08	0.92	0.84	0.66	0.92
Anabranch North Lakes (1474)	S28	0.42	0.20	0.58	0.08	n.d.	0.80	0.74	0.92
Anabranch North (1473)	S27	0.34	0.12	0.71	0.08	0.92	0.87	0.39	0.92
Warrawenia Lake (1467)	S26	0.45	0.16	0.92	0.08	n.d.	0.81	0.46	0.92
Lower Anabranch (1521)	S25	0.43	0.28	0.80	0.08	n.d.	0.81	0.34	0.92
	S24	0.35	0.31	0.69	0.08	0.92	0.74	0.36	0.92

Table notes: Chl-a = chlorophyll-a, EC = electrical conductivity. Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition. n.d.= no data.

Biodiversity condition

The biodiversity condition of the Great Darling Anabranch zone was assessed to be in a generally moderate condition (Table 18). While these results are still below the benchmark of a healthy biological community, the Anabranch received better biodiversity condition scores than other zones of the study area along the mainstem of the lower Darling Baaka River. This is primarily resulting from comparatively higher scores for fish, macroinvertebrates and zooplankton.

The Anabranch North subcatchment (1473) was assessed in overall good biodiversity condition (Table 18). Within this subcatchment, site S27 had high macroinvertebrate diversity and several pollution-sensitive taxa and the highest zooplankton index score due to high densities and the discovery of a new species of cladoceran. Site S28 had the highest macroinvertebrate condition index of any site in the study.

The poor fish community condition grades in the zone are largely due to a low nativeness score, with species like Murray cod absent from the Anabranch entirely. European carp contributed to over 90% of the total biomass of fish at most sites, with site S27 only having 4% native fish by biomass. The very poor fish community condition score at site S15 is reflective of the conditions on the lower Darling Baaka River not the Anabranch.

It should also be noted that site 30, close to the outlet of Lake Cawndilla, recorded the highest waterbird diversity throughout the entire study area. This included species of waterbird seen at few other sites such as Australian shelduck (*Tadorna tadornoides),* Yellow-billed spoonbill *(Platalea flavipes)*, and Little pied cormorant *(Microcarbo melanoleucos)*.

Table 18 Great Darling Anabranch biodiversity indicator scores

Subcatchment	Site	Fish	Macro-invertebrates	Zooplankton	Overall site score
Cawndilla (1477)	S15	0.10	0.42	0.32	0.28
	S31	0.36	0.36	0.50	0.41
	S30	0.36	0.34	0.32	0.34
Lower Redbank Creek (1476)	S29	0.36	0.40	0.50	0.42
Anabranch North Lakes (1474)	S28	0.36	0.51	0.72	0.53
Anabranch North (1473)	S27	0.36	0.47	1.00	0.61
Warrawenia Lake (1467)	S26	0.36	0.38	0.99	0.58
Lower Anabranch (1521)	S25	0.36	0.43	0.99	0.59
	S24	0.36	0.44	0.72	0.51

Table notes: Colours: red = very poor condition; orange = poor condition; yellow = moderate condition; light green = good condition; dark green = very good condition.