ACT Government

MINISTERIAL BRIEF

Environment, Planning and Sustainable Development Directorate

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To:	Minister for the Environment and Heritage	**Tracking No.:** 20/27302
Date:	28th May 2020	
Subject:	Findings of the 2019 Catchment Health Indicator Report	
Critical Date:	29 May 2020	
Critical Reason:	A media release has been prepapred to coincide with the return of volunteer sampling, which occurred as of the weekend 16/17 May	

Recommendations
That you:

1. Note the information contained in this brief;

He findings of the Waterwatch 2019 Catchment Health Indicator Program (CHIP) Report at Attachment A; and

Noted / Please Discuss

2. **Agree** to the Media Release at Attachment B.

Agreed / Not Agreed / Please Discuss

Mick Gentleman MLA 3/6/2020

Minister's Office Feedback

Background

1. ACT Waterwatch has been operational since 1995 and is a regional water quality program including monitoring sites from above Tantangara Dam to Burrinjuck Dam, an area more than 11,000km^2.
2. The ACT Government has been the main funder (approximately $480,000 per annum) since 2014 and announced ongoing funding for the program earlier this year.
3. Waterwatch comprises community-based coordinators hosted by the Molonglo,

Southern ACT and Ginninderra catchment groups. There is also a coordinator at Cooma, funded by Icon Water, who is supported by the Regional Waterwatch Facilitator in the Environment, Planning and Sustainable Development Directorate (EPSDD).

4. Please note that the 2019 Catchment Health Indicator (CHIP) report does not reflect any data attributed to the recent bushfires of late 2019/early 2020. This will be reflected in the next CHIP report.

Issues

5. The 2019 CHIP report at Attachment A, is the fifth CHIP report which brings together data collected by more than 200 volunteers from across the region who collectively undertook 2,040 water quality surveys, 184 water bug surveys and 211 riparian condition surveys.

6. Of the 98 reaches presented in this report, three were scored as in *excellent* condition: one reach in the Cooma catchment, and two in Southern ACT. This was two fewer than 2018. A further 37 reaches were scored as being in *good* condition, which is the same as last year, and 53 reaches were in *fair* condition, four more than 2018. Four reaches received a *poor*, one more than last year, and no reaches received a *degraded* score. These findings are summarised in the table below:

CHIP Result	Cooma	Ginninderra	Molonglo	Southern ACT	Yass	Total
Excellent (A)	1	0	0	2	0	3
Good (B)	12	1	14	10	0	37
Fair (C)	10	12	11	14	6	53
Poor (D)	0	2	1	1	0	4
Degraded (E)	0	0	0	0	0	0

7. Overall, 59% of reaches fell into the *fair/poor* range which is an increase from 55% last year and from 47% the year before that. The continued downward trend in 2019 can once again be likely attributed to the upper Murrumbidgee catchment receiving 40% below annual average rainfall. This is following the already extreme dry experienced in 2018 that adversely affected the CHIP parameters.

8. Platypus numbers also continued to stay down in 2019 with 11 individuals detected during Platypus Month which was the same amount as 2018. The results this year, however, were more mixed with the Murrumbidgee River sites appearing to support higher numbers.

9. While the fires occurred too late in the year to be captured in CHIP 2019, volunteers were out viewing the aftermath and collecting data in January and February to help better understand the impacts of this devastating event. Sampling was temporarily put on hold due to the onset of COVID-19, however volunteers have returned to monitoring as of the weekend 16 and 17 May 2020.

Financial Implications

10. Costs associated with compilation and publication of the CHIP report are met from the ACT Government's Waterwatch budget.

11. At the 2019/20 Mid-year Budget review the Waterwatch program was given ongoing funding.

Consultation

Internal

12. The Media Release (Attachment B) was developed in consultation with the EPSDD Communications team.

13. The 2019 CHIP report was developed in consultation with the Natural Resource Management team and the Water Science Officer within the Environment Division of EPSDD.

Cross-Directorate

14. N/A

External

15. The 2019 CHIP report was developed in consultation with the four Waterwatch coordinators and Icon Water who part fund the Waterwatch program.

Benefits/Sensitivities

16. The downward trend in catchment health in 2019 can mostly be attributed to the upper Murrumbidgee catchment receiving 40% below annual average rainfall as a result of the continued dry conditions experienced throughout the year.

17. The fires mostly occurred in 2020 and there is no fire-affected data featured in the report.

Communications, media and engagement implications

18. A media release has been prepared at Attachment B. The return of volunteer sampling has coincided with the release of the CHIP and is a theme of the media release.

19. At the request of the EPSDD Communications team, the Regional Waterwatch Facilitator has arranged for a volunteer to be available to talk to media at their site at Umbagong District Park, should this be requested.

Signatory Name:	Ian Walker	Phone:	62059027
Action Officer:	Woo O'Reilly	Phone:	62072246

Attachments

Attachment	Title
Attachment A	2019 Catchment Health Indicator Report
Attachment B	Media Release

WATERWATCH
Upper Murrumbidgee

Catchment Health Indicator Program

2019

Supported by:

ACT Government

icon WATER

In Partnership with:

Molonglo Catchment Group

Southern ACT Catchment Group

Ginninderra Catchment Group

This report was written using data collected by over 200 Waterwatch volunteers. Many thanks to them.

Written and produced by the following:

Woo O'Reilly – Waterwatch Regional Facilitator

Antia Brademann – Cooma Region Waterwatch Coordinator

Martin Lind – Southern ACT Waterwatch Coordinator

Bruno Ferronato – Ginninderra and Yass Region Waterwatch Coordinator

Deb Kellock – Molonglo Waterwatch Coordinator

Anke Maria Hoefer – Frogwatch Coordinator

Danswell Starrs – Data Management

Angela Cumming – Design and Maps

For more information on the Upper Murrumbidgee Waterwatch program go to: http://www.act.waterwatch.org.au

The Atlas of Living Australia provides database support to the Waterwatch program. Find all the local Waterwatch data at: https://biocollect.ala.org.au/actwaterwatch

Cover photo of tram at Flemington Pond: M.Burton.

Photo of volunteer Wendy on page 6: A.l'ons.

Contents

Executive Summary

Upper Murrumbidgee Waterwatch (Waterwatch) works with the community to monitor, raise awareness, educate, restore and protect our local waterways. Waterwatch has been running in the ACT region since 1995 and covers the Murrumbidgee catchment upstream of Burrinjuck Dam (with the exception of the Goodradigbee catchment). The total area monitored by Waterwatch is more than 11,400km^2.

Two primary functions of the Waterwatch program are to facilitate community engagement through the monitoring and care of local waterways, and to use the data (water quality, macroinvertebrate [waterbug] and riparian condition) as an early warning system for aquatic ecosystem health issues. A key output of this program is the annual Catchment Health Indicator Program (CHIP) report, which provides a numerical score of catchment health, displayed in individual reach report cards, using data collected by Waterwatch volunteers.

The 2019 CHIP report is based upon 2,040 water quality surveys, 184 waterbug surveys and 211 riparian condition surveys conducted by over 200 volunteers. The total number of sites surveyed was 232 with a total of 98 reach report cards produced. For the second year in a row we have included the important addition of the number of 'dry' surveys conducted in the overall survey tally (ie. when a volunteer has visited their site but it is completely dry). While these do not contribute to the CHIP score, they are an important factor in the condition of the catchment and highlight survey effort. A total of 193 water quality surveys were 'dry' in 2019 (up from 118 in 2018), taking the number of surveys that contributed to the CHIP score down to 1,847.

There were two additional reaches created this year. MOL7 includes the most downstream section of the Molonglo River and splits MOL6 to better represent the influences of the Lower Molonglo Water Quality Control Centre (MOL7) from the upstream rural and urban areas (MOL6). A low rural reach has also been created on Guises Creek west of Royalla which runs directly into the Murrumbidgee River. All these refinements and additions help to ensure that the reaches outlined in this report best represent the condition of the catchment.

Of the 98 reaches presented in this report (Table 1), three were scored as in *excellent* condition. One reach in the Cooma catchment plus two in Southern ACT. This was two less than 2018. A further 37 reaches were scored as being in *good* condition, which is the same as last year, and 53 reaches were in *fair* condition, four more than 2018. Four reaches received a *poor*, one more than last year, and no reaches received a *degraded* score. Overall, 59% of reaches fell into the fair/poor range which is a rise from 55% last year and from 47% the year before that. One reach, Scabbing Flat Creek, has a report card but didn't receive scores as it was data deficient due to being dry for most of the year. This was despite the volunteer visiting the creek every month.

Table 1: CHIP results for 2019.

CHIP Result	Cooma	Ginninderra	Molonglo	Southern ACT	Yass	Total
Excellent (A)	1	0	0	2	0	3
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Degraded (E)	0	0	0	0	0	0

The continued downward trend in 2019 can once again be likely attributed to the upper Murrumbidgee catchment receiving 40% below annual average rainfall. This is following the already extreme dry experienced in 2018 that saw all three main CHIP parameters adversely affected to varying degrees. Interestingly, not all the sub-catchments this year fared as badly with the Molonglo receiving an increase in *good* scores. These inprovements appear to be mostly driven by water quality parameters with one theory being that the reduction in rainfall is simply not washing sediments and nutrients into the system. Five of the six urban Molonglo reaches showed improvements in water quality which would further support this theory. Southern ACT on the other hand showed a strong downward trend with most of the Murrumbidgee River reaches receiving lower scores. The river showed signs of stress after such an extended dry and by December, flows were measured at a mere 0.09ML/day at Tharwa. Continued and future pressures on the Murrumbidgee River such as feral horses, climate change and Snowy 2.0 will all have impacts on water quality and quantity and Waterwatch will monitor these issues closely.

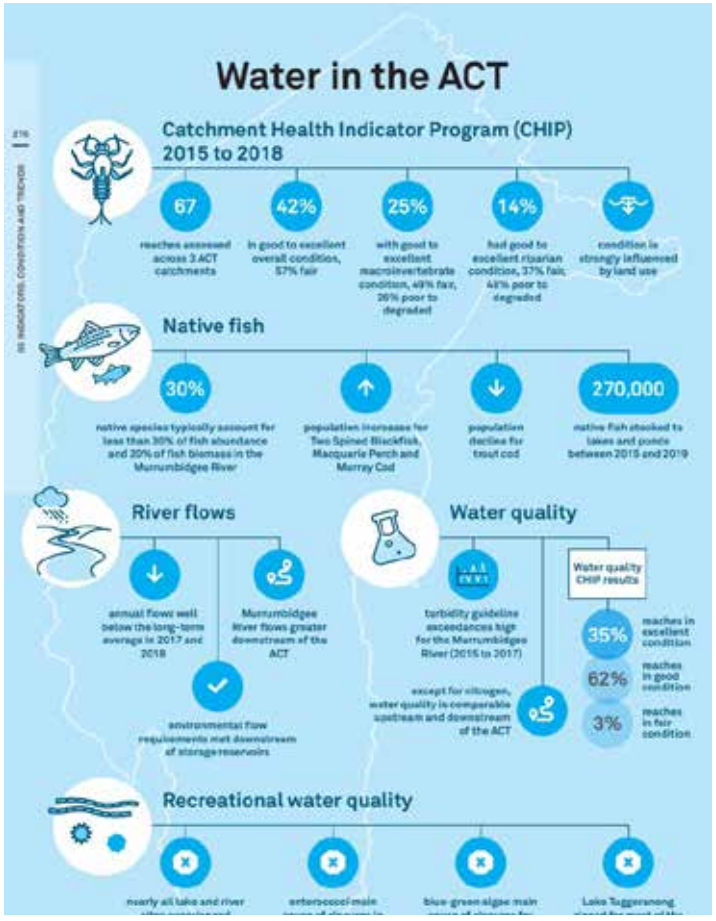
Platypus numbers also continued to stay down in 2019 with 11 individuals detected during Platypus Month which was the same amount as 2018. The results this year, however, were more mixed with the Murrumbidgee River sites appearing to support higher numbers: Point Hut Crossing surveys detected three individuals (possibly four) and Scottsdale conservatively estimating five individuals (possibly as many as seven). In contrast, Cooma and Jerrabomberra Creeks detected low numbers with just one and two individuals respectively.

The pressures on the catchment ramped up in the second half of 2019. Only a third of the average rainfall was recorded in winter and just half in Spring. By December 2019 a mere 1.2mm of rainfall was recorded. This, combined with the extreme heat, saw trees such as Eucalypts become stressed and go brown. It was at this vulnerable time that the bushfires started in the upper Murrumbidgee catchment.

Nearly the entire Badja River catchment and much of the Bredbo and Cowra Creek catchments were burnt due to one or a combination of the Badja Forest and Good Good fires which started in December 2019. Bushfires continued throughout January and February 2020 with 80% of Namadgi and over a third of Kosciuszko National Park burned as well as impacting communities surrounding Tharwa, Bredbo and Numeralla. The fires were followed by heavy rain that washed ash and debris into the catchment, turning rivers such as the Numeralla, Gudgenby and Murrumbidgee, black. Turbidity and phosphorus levels went beyond what most Waterwatch kits are capable of measuring.

While the fires occurred too late in the year to be captured in CHIP 2019, at the time of writing this report, volunteers have already been out viewing the aftermath and collecting data to help us all better understand the impacts of this devestating event. It has been agreed that long term monitoring will play a critical role in the recovery process and Waterwatch is well placed to work with volunteers and land managers to help. There is an estimated 20 CHIP reaches that have been impacted by fires and Waterwatch may consider a special fire report concentrating specifically on these areas.

Waterwatch continues to work hard to promote the CHIP to government and community organisations involved in managing our waterways. An prime example is the 2019 ACT State of Environment report which prominently features data from the past four CHIP reports. It's with great pride that we highlight the prominence of the CHIP in the water section of both the Summary Report and in Chapter Five on Indicators, Condition and Trends. Frogwatch and Waterwatch are also well featured in Chapter Three on Community Leadership. There would be many a citizen science program that could only hope for such an acknowledgement and acceptance of their work.



The 2019 CHIP report would not have been possible without the generous financial support from ACT Government and from Icon Water. A further three years of funding has recently been announced by the ACT Government, meaning the Waterwatch program can continue its important work.

Thank you, as always, to the volunteers. This report would not be possible without their continued efforts to collect this important data on the health of our waterways. Long-term monitoring will be more important than ever as we turn to 2020 and what we can do to help restore our fire-affected catchments. The continued collection of large amounts of high quality data is a real credit to the dedication of the volunteers who have demonstrated that, with support, they can make a significant contribution to the improvement of our waterways.

LEFT: The 2019 ACT State of Environment report prominently features data from the past four CHIP reports.

Introduction

Upper Murrumbidgee Waterwatch

Upper Murrumbidgee Waterwatch (Waterwatch) engages with the community to monitor, raise awareness, educate, restore and protect our local waterways. Waterwatch has been running in the ACT region since 1995 and covers the Murrumbidgee catchment upstream of Burrinjuck Dam, with the exception of the Goodradigbee catchment. The total area monitored by Waterwatch is more than 11,400km^2.

Four Waterwatch coordinators support volunteers in the major sub-catchments of Cooma, Molonglo, Southern ACT, Ginninderra and Yass (see Figure 1). Each of these sub-catchments make up sections I – V of this report.

As at 31 December 2019, Waterwatch had 232 active sites being monitored by over 200 volunteers. Waterwatch thanks the generous funding from the ACT Government as well as funding for the Cooma Region through Icon Water. The Atlas of Living Australia also provides support through the maintenance of the database used by the Waterwatch program. At the time of writing this report, the database houses over 23,500 Waterwatch records.

The purpose of the CHIP

The Waterwatch annual report card is called the Catchment Health Indicator Program (CHIP), based upon the data collected by volunteers throughout the preceding year. The purpose of the report is to give the community a better understanding of water quality and riparian health issues in the catchment as well as providing an ongoing baseline assessment of catchment health, to assist natural resource managers and policy-makers in addressing some of these issues. The CHIP is recognised in the ACT Water Strategy 2014-44 as a way to *'enhance knowledge and spatial planning for water and catchment management'*.

How does the CHIP work?

Waterwatch volunteers and coordinators collect data relating to water quality, waterbugs (macroinvertebrates), and riverbank (riparian) vegetation. The frequency of this data collection is outlined in Table 2. These data sources provide the basis for a composite CHIP score that encompasses physico-chemical properties of water, in-stream waterbug diversity and abundance, and riparian vegetation condition. When combined for an individual stretch of waterway (a reach), the data gives us a score that indicates the overall health of that reach. This CHIP score is linked with a colour to produce maps of reaches at both an individual and sub-catchment scale. Importantly, each individual reach map is accompanied by a report card written by the local coordinator. This provides further insight into the state of that reach and possible issues influencing the score. Data from other Waterwatch initiatives such as Platypus Month and Carp Love 20°C, as well as from our colleagues at Frogwatch, are also used in these report cards to provide greater context.

Technical details regarding the computation of CHIP scores is provided in Appendix II.

Table 2. Summary of data collected to produce the CHIP.

	Parameter	Frequency	Number of sites
Water Quality	pH	Monthly	All sites
	Electrical Conductivity	Monthly	All sites
	Turbidity	Monthly	All sites
	Phosphorus	Monthly	All sites
	Nitrate	Monthly	All sites
	Dissolved Oxygen	Monthly	All sites
	Temperature	Monthly	All sites
Macro-invertebrates	SIGNAL 2.0	Biannual (Spring & autumn)	Key sites (min 1/reach)
Riparian Condition	RARC	Biennial	All sites

Figure 1. Overview of the upper Murrumbidgee River catchment, outlining the five major sub-catchment areas represented in this report as well as the border of the ACT. The Goodradigbee catchment is not included in this report.

2019 CHIP

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WATERWATCH

Cooma Region Catchment Facts

The 'Cooma Region' catchment includes the upper Murrumbidgee River south of the ACT, plus the Bredbo, Numeralla, Kybeyan and Badja River sub-catchments. These sub-catchments provide the majority of inflows for the upper Murrumbidgee River upstream of the ACT as 95% of its headwaters are diverted at Tantangara Dam as part of the Snowy Hydro Scheme.

Landuse in the Cooma Region includes urban, rural residential, rural (grazing and cropping) and conservation. The lower lying, more fertile areas of the catchment are generally cleared and modified with more intensive landuse and limited native riparian vegetation. The headwaters of catchments are generally less modified and are in better condition. Protection of in-stream and riparian (riverbank) habitat needs to be prioritised in these areas.

The Actions for Clean Water (ACWA) Plan sets out a strategy for improving water quality (targeting turbidity) in the upper Murrumbidgee catchment. It identifies the Numeralla and Bredbo River catchments as areas where erosion risk is very high. Addressing erosion goes hand in hand with maintaining native vegetation and groundcover while reducing the impact of invasive weeds. These issues are the focus of Landcare groups and regional catchment organisations in the Cooma region.

The upper Murrumbidgee has areas of high-quality aquatic habitat where species such as Murray cod, Trout cod, Macquarie perch, Murray River crayfish, Platypus, Rakali (Water rats) and Eastern long-necked turtles are found. Protecting and improving these habitats and species is the focus of the Upper Murrumbidgee Demonstration Reach (UMDR) initiative. The UMDR works with many partners, including Waterwatch, and focusses on the upper Murrumbidgee River between Tantangara and Burrinjuck Dams.

Waterwatch volunteers have been monitoring river health in the Cooma Region since 2010.

Cooma Catchment Health Summary

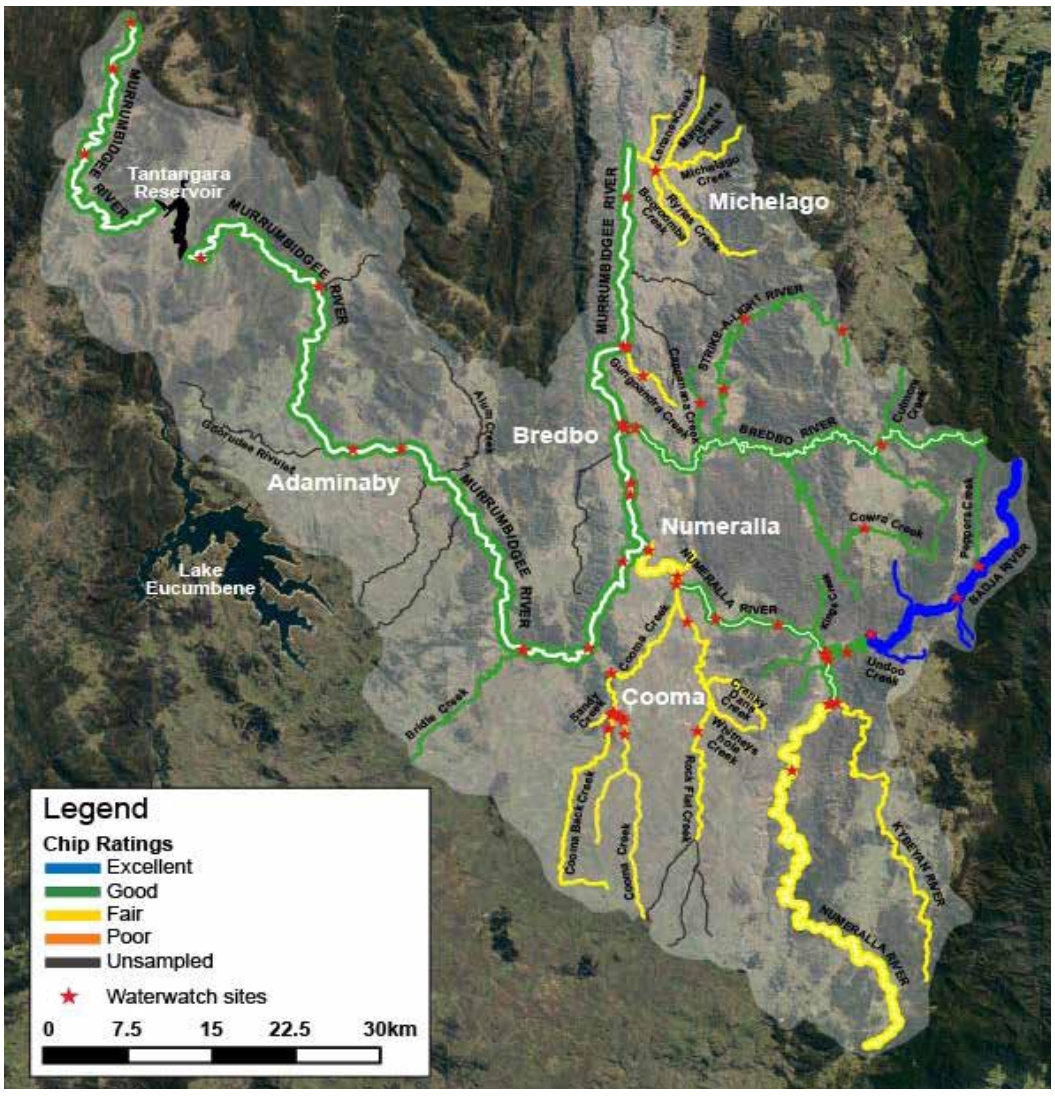
The predominant factor affecting waterways across the Cooma Region in 2019 was the continuing dry conditions. River levels were low to very low with some streams forming isolated pools and large sections drying up altogether toward the end of 2019. The year ended with a very hot summer, which saw leaves of in-stream vegetation such as Ti-tree 'brown-off' (dry out) and this phenomenon was also seen on a broader scale in Eucalypt trees across the catchment.

Groundcover was also significantly reduced, with riparian (river side) zones providing the only green in the landscape and in turn being heavily grazed. Grazing pressure in-stream was also noted, including grazed reeds beds and damage from pigs.

Overall condition scores in the Cooma Region declined slightly compared to 2018, with the more impacted and modified streams showing the most stress and decline. Areas with intact native catchment vegetation such as the headwaters of the Bredbo and Badja River, the Gungoandra Creek and sections of the Murrumbidgee River retained excellent water quality, despite lower flows.

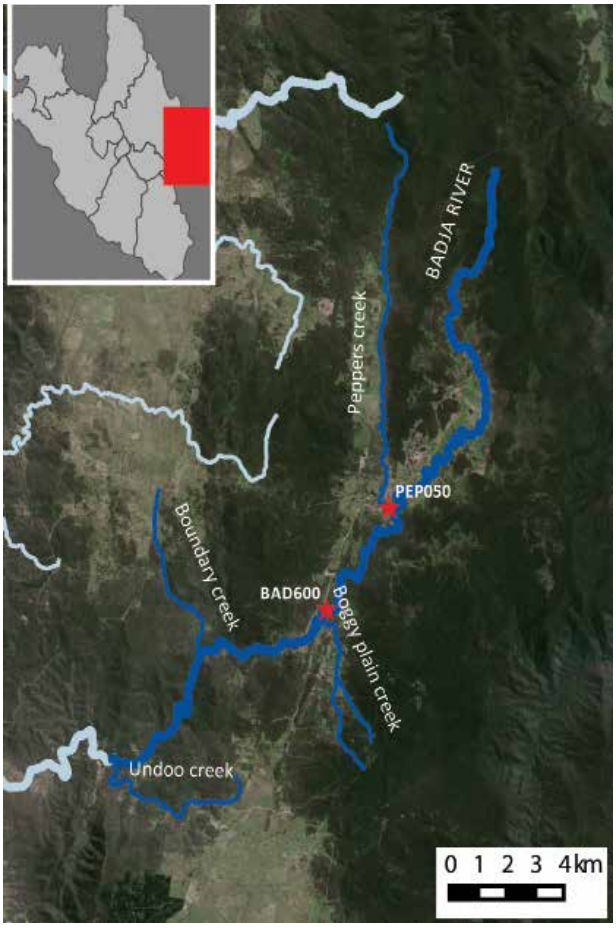
Of note was the severity of storms when rain did fall. In January 2019 there was a localised storm in the Numeralla catchment where it is estimated up to 120mm of rain fell within several hours. The storm resulted in a lot of overland surface flow stripping the ground of organic matter and washing away sediment. A peak discharge of 7,500ML/day and turbidity of approximately 1,000NTU was recorded in the Numeralla River as a result. This turbidity plume reached the ACT border a number of days later and bacterial counts also became high. Another storm upstream of the Cooma pumping station early in the year also spiked turbidity, putting a lot of pressure on the water treatment plant.

Waterwatch continued its monitoring activity in the headwaters of the upper Murrumbidgee River where feral horse impact on in-stream habitat has been increasing over the last years of drought. This year extensive pugging (trampling of stream banks) was observed, correlating with a rise in turbidity at the worst affected sites.



Badja River BAD1
Headwaters to Undoo Creek

2019 CHIP Result A- (Excellent)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**25**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Good**	**2**



Reach Facts

Reach network length: approx. 51km
Dominant land uses: Rural and conservation

This reach includes the headwaters of the Badja River down to and including Undoo Creek. The Badja River rises in the Badja Swamps Nature Reserve which includes the nationally-listed Big Badja Swamp. The top of the reach flows through open, historically cleared country then on through steeper, uncleared country with good native vegetation cover.

This reach is one of the most healthy streams in the Cooma Region. This is due to intact in-stream and riverside (riparian) habitat found along the river and the high level of native vegetation and groundcover within the catchment. Grazing is the dominant landuse.

Water quality in this reach reflects what you would expect of a healthy upland stream- very low electrical conductivity, very clear water (low turbidity) and low nutrient levels. Waterbug surveys are always interesting with high numbers and diversity found, including many sensitive types which require good water quality such as stoneflies, caddisflies, mayflies and dobsonflies.

In 2019 the extremely dry conditions saw the river reduced to isolated pools. The Ti-trees in the river corridor started to 'brown-off' (die back) due to the heat and dry. Despite this, water quality and waterbug scores remained high and this reflects the high level of native vegetation in the catchment.

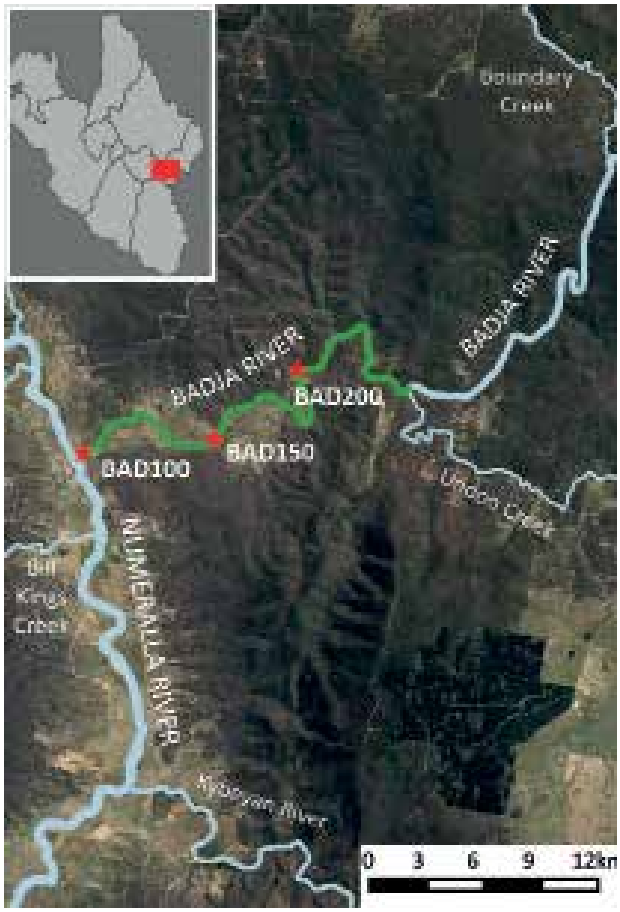
Nearly the entire Badja River catchment was burnt due to the Badja Forest and Good Good fires which started in December 2019. The impacts of this are not captured in the data for this year.

Upper Badja River after fire impact (d/str BAD600).

Badja River BAD2

Undoo Creek to Numeralla River

2019 CHIP Result B+ (Good)		
2018 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**34**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**1**
Riparian condition	**Fair**	**3**



Reach Facts

Reach network length: approx. 8.6km
Dominant land uses: Rural and rural residential

This reach includes the lower section of the Badja River from Undoo Creek to the Numeralla River confluence. It flows through open, cleared country used predominantly for grazing and some dryland cropping. Continuous native vegetation is found on both sides of the river along the entire reach.

The cumulative impact of increased rural residential activities and historic landuse change can be noticed in this reach, compared to its upstream section. For example the river is known to become very turbid during high run-off events and there is an increase in Carp as well as woody weeds such as Willows and Blackberries. Recreational gold fossicking activities are increasingly impacting the riparian zone near BAD200. Platypus and Rakali (Water rat) sightings are often reported near BAD100.

Despite some adverse impacts, the health of this reach remains high thanks to the ongoing efforts of the Numeralla Landcare Group and local landholders. They have worked to fence the river off from stock, control blackberries and willows, increase native plantings and control erosion on tributary gullies.

In 2019 the extremely dry conditions saw the river reduced to isolated pools. The Ti-trees in the river corridor started to 'brown-off' (die back) due to the heat and dry. Despite this, water quality and waterbug scores remained high and this reflects the high level of native vegetation in the catchment.

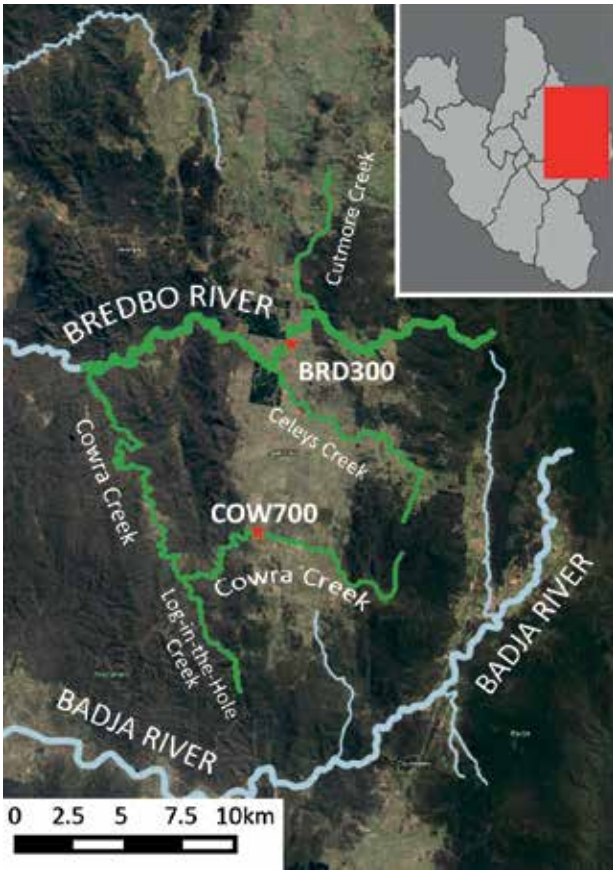
Nearly the entire Badja River catchment was burnt due to the Badja Forest and Good Good fires which started in December 2019. The impacts of this are not captured in the data for this year.

The Badja River at BAD100 was very low by December 2019.

Bredbo River BRD1

Headwaters to Cowra Creek confluence

2019 CHIP Result B (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**15**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**1**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 33km
Dominant land uses: Rural

This reach includes the headwaters of the Bredbo River down to and including Cowra Creek. It runs through a mix of unmodified and cleared, grazing country.

Generally good groundcover levels are retained throughout the catchment which in turn protects water quality, however some gully erosion is found in the middle of the Cowra Creek catchment. This is related to gold mining and historical landuse activities such as clearing and grazing. Our Waterwatch sites are upstream of this area.

Sampling shows consistently *excellent* water quality - even after heavy runoff events. The extremely dry conditions saw much of this reach reduced to isolated pools towards the end of 2019. Waterbug surveys show a good diversity and abundance of sensitive bug types. This demonstrates the positive effects of a well vegetated catchment and the presence of good instream habitat.

There are Trout in the Bredbo River and Platypus have been recorded in the Bredbo River and Cowra Creek. Carp are found lower down in the Cowra Creek. They were introduced into the catchment via a landholder putting Carp in his dams in the 1980's.

A large section of the upper Bredbo and part of the Cowra Creek catchment were burnt in the Good Good fire which started right at the end of the year. The impacts of this are not captured in the data for 2019.

The upper Bredbo River was reduced to pools at the end of the year.

Bredbo River BRD2

Cowra Creek to Murrumbidgee River

2019 CHIP Result B- (Good)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**22**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**1**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 25km
Dominant land uses: Rural including dryland cropping and grazing

This reach includes the Bredbo River from below Cowra Creek to the Murrumbidgee River and includes a site on Cappanana Creek. The lower end of this reach has wide alluvial floodplains which are used for dryland cropping and grazing. This reach is a high priority ACWA catchment with five key erosion sites. The Bredbo Landcare Group is working in the lower parts of this reach to control riparian weeds and improve native vegetation.

Historic and current landuse activities have resulted in large amounts of sand and sediment washing down from upstream catchments and is now smothering available aquatic habitat. During high flow events, turbidity can become very high. Exotic species including African lovegrass, Blackberry, Willow and Poplars dominate the riparian (riverside) vegetation. In some areas stock are allowed to graze the river corridor. Electrical conductivity (salt and mineral levels) in the river are elevated due to natural groundwater sources. At the bottom of this reach native reed beds are stabilising sand bars and allowing the re-establishment of a defined river channel. The reed beds are also increasing the diversity of in-stream habitat which in turn is improving the diversity and abundance of waterbugs found there.

The extremely dry conditions saw the lower Bredbo River dry to shallow pools at the end of the year. As the water warmed there was an increase in algae and electrical conductivity was elevated due to evaporation. Where Carp were present in pools the water became increasingly turbid.

Water levels became very low throughout 2019 reducing the lower Bredbo River to isolated pools.

Cooma Creek COO1

Headwaters to Banksia Lane

2019 CHIP Result C (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**12**
pH	Good	
Turbidity	Fair	
Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

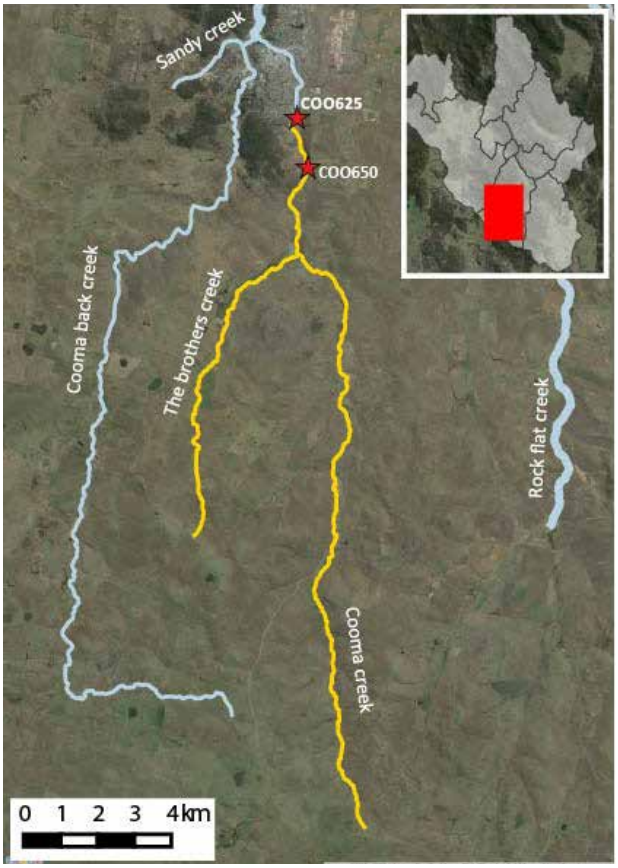
Reach network length: approx. 22km
Dominant land uses: Rural and urban

The headwaters of Cooma Creek rise south of Cooma and flow through open, basalt country. The fertile floodplains in this reach are used for dryland cropping and grazing agriculture. Native vegetation has been historically modified and in-stream vegetation such as reeds/sedges which are beneficial for stability and nutrient retention, are largely absent in the creek. This lack of in-stream habitat at our waterbug site contributed to the *fair* waterbug score for this reach.

Much of this section of Cooma Creek is unfenced which results in unregulated stock access that can further reduce ground cover and increase erosion. Cropping activities can also mean that floodplain groundcover is laid bare and vulnerable to wash off during high intensity storm events. Thus, turbidity can become elevated after rain events. Natural factors such as the geology of the catchment also contribute, in part, to the elevated levels of electrical conductivity, pH and phosphorus. The heightened phosphorus levels may also contribute to the high levels of algae that can be seen in the creek from time to time, especially when combined with low flows and warmer conditions.

Improving the habitat and health of Cooma's creeks is a focus of the Cooma Landcare Group in partnership with Snowy Monaro Regional Council and Cooma Waterwatch. This work has been assisted by a NSW Environmental Trust grant in the last few years.

The extremely dry conditions saw this reach dry to isolated pools during the latter half of the year.



The Cooma Creek upstream of Cooma at COO650 where good groundcover is maintained.

Cooma Creek COO2

Banksia Lane to Cooma Back Creek confluence

2019 CHIP Result C (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**18**
pH	Good	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 3km
Dominant land uses: Urban

This section of Cooma Creek flows through the township of Cooma. Flood mitigation levees have been constructed to protect houses from flooding and there is a popular walking path along the length of this reach. Stormwater from the town is discharged into the creek untreated and litter from stormwater drains is an ongoing problem.

The Cooma Creek environment is greatly modified and little native vegetation remains along its corridor. This means the small amount of in-stream habitat which remains such as reeds and long grass, is highly important to support biodiversity inhabiting the creek including ducks, frogs, Galaxias, Rakali (native Water rat) and Platypus.

Improving the habitat and health of Cooma's creeks is a focus of the Cooma Landcare Group in partnership with Snowy Monaro Regional Council and Cooma Waterwatch. These groups, along with staff and students of Monaro High School have been doing regular litter clean-ups along this reach. Litter surveys show plastic bags, soft drink bottles, drink cans, fast food and snack food packaging have been the most common items found over the years. Now that the single use plastic bag ban and the NSW container deposit scheme have been put in place the number of plastic bags, bottles and drink cans are much reduced.

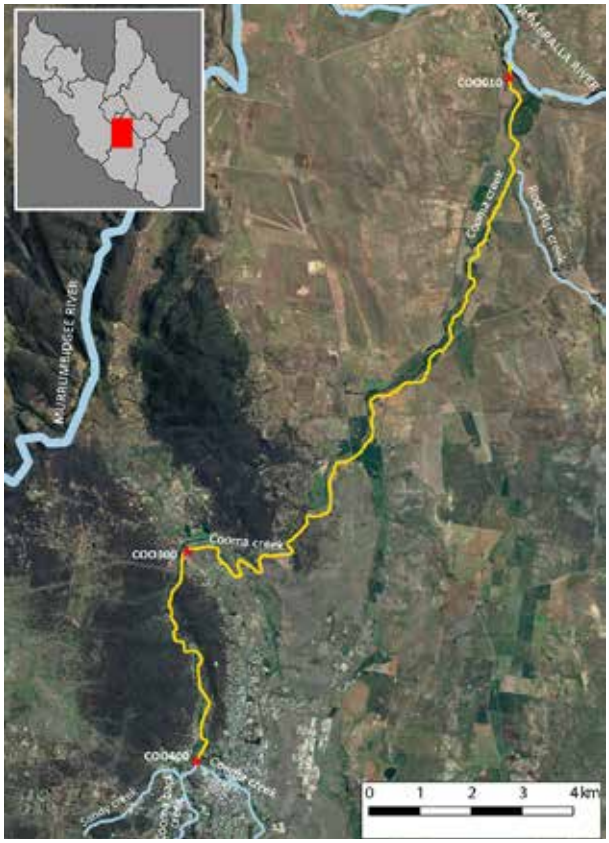
The dry conditions resulted in very low water levels during the year. At the end of 2019, in-flows from the upstream catchment stopped completely and the only inflows occurring was run-off from town, through the stormwater system. This poses challenges for water quality.

The Cooma Creek at COO405.

Cooma Creek COO3

Cooma Back Creek confluence to Numeralla River

2019 CHIP Result C- (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**28 (4 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**No data**	**2 (2 dry)**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 18km
Dominant land uses: Conservation, rural residential and rural

This reach includes the Cooma Creek downstream of Cooma to its confluence with the Numeralla River. The creek is flanked by the North Ridge Nature Reserve at its upper end, then flows through more open, rural residential holdings in the Mittagang Road area and finally through Bunyan/Chakola where river flats are used for irrigated cropping. Cooma's sewage treatment plant is located near the top of this reach above the Waterwatch site at Mittagang Road (COO300). Nitrate levels can be as high as 10mg/L at this Waterwatch site.

We have a Platypus Month monitoring site at the top of this reach and surveys have been carried out for the last six years. At least one Platypus has been recorded each year, including a juvenile in 2019. Incidental sightings at other locations in Cooma show that Platypus are utilising many parts of Cooma's creeks especially during the dry times. Riparian vegetation is being improved along the creek to help protect Platypus habitat as part of the NSW Environmental Trust funded 'Improving Cooma's creeks' project. This project is a partnership between Cooma Landcare, Cooma Waterwatch and the Snowy Monaro Regional Council.

The lower part of this reach flows through highly modified farming country and riparian vegetation is very reduced. High amounts of sand are found in-stream and Carp are also present.

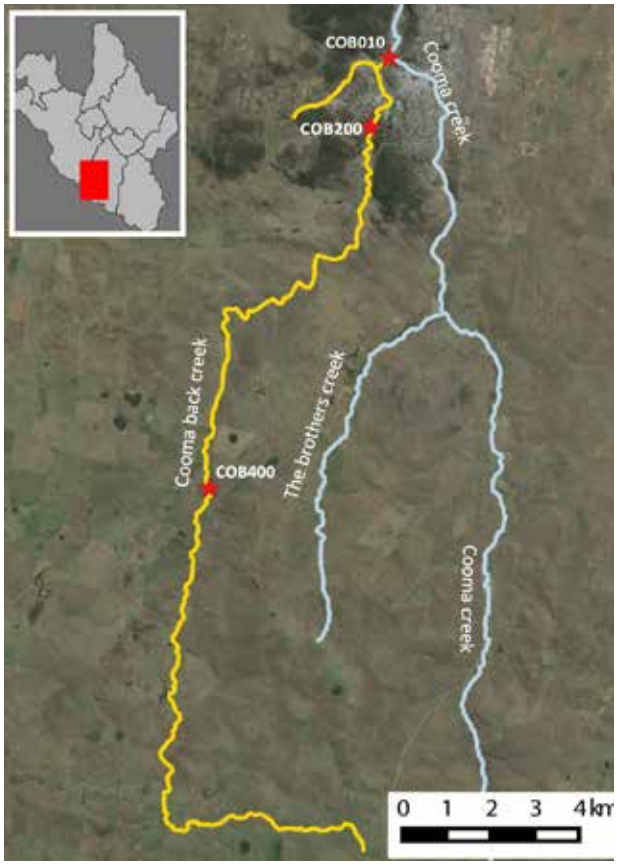
The dry conditions of 2019 saw the lower end of the Cooma Creek dry up completely, especially towards the end of the year.

The Cooma Creek at COO0010 was often dry in 2019.

Cooma Back Creek COB1

Headwaters to Cooma Creek

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**36 (1 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: approx. 30km
Dominant land uses: Conservation, urban, rural residential and rural

This reach includes the entire Cooma Back Creek and tributaries. The upper sections of the reach flow through open, cleared basalt country used for grazing and dryland cropping. The lower, urban section of the reach includes the Lambie Gorge which is a site of Aboriginal cultural significance.

Electrical conductivity is always high in this reach due to catchment geology and urban in-flows. Our monitoring shows that electrical conductivity goes up in dry periods as the salts and minerals become more concentrated in the water column due to evaporation. This reach has had consistently low flows throughout the last few years which have been drier than normal. Observations from our volunteers noted heavy algal growth, in-stream weeds and Azolla (a native floating fern) increasing as flows have reduced. Native reed beds have expanded in recent years taking advantage of the dry conditions. These reeds are beneficial for the creek, providing filtering and stabilising effects as well as improving habitat.

Our Frogwatch surveys found that the bottom end of Lambie Gorge had the highest frog diversity of sites surveyed within the Cooma township, with five species being recorded.

Riparian plantings are being carried out below the Gorge as part of the NSW Environmental Trust funded 'Improving Cooma's creeks' project to help enhance habitat for frogs and bank stability. This project is being carried out by the Snowy Monaro Regional Council, Cooma Waterwatch and Cooma Landcare Group to improve the health of Cooma's creeks.

Low flows has resulted in filtering beds of reeds establishing at COB010.

Gungoandra Creek GUD1

Headwaters to Murrumbidgee River

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16 (3 dry)**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 9km
Dominant land uses: Rural and conservation

This reach includes the entire Gungoandra Creek which flows into the Murrumbidgee River downstream of Bredbo Gorge. The upper section of the creek has been cleared and grazed. The lower section has been managed for conservation by Bush Heritage Australia as part of their Scottsdale Reserve since 2006. The Waterwatch sites are located within the Scottsdale Reserve.

Bush Heritage Australia has been working to improve the health of the creek by planting native vegetation in the riparian corridor as well as within the catchment. They have carried out in-stream erosion works as well as feral animal control, targeting pigs which dig up the creek. Removal of stock has seen stands of native reeds establishing along the length of Gungoandra Creek which provide positive benefits such as filtering the water, settling sediment, in-stream habitat and stabilising the stream channel. Recovery works have been supported by funding from Local Land Services and the Rivers of Carbon program as part of the Upper Murrumbidgee Demonstration Reach partnership.

Galaxias (a small native fish), Rakali (native Water rats), Platypus and Lathams Snipe have all been sighted along the creek. The creek is fed from groundwater further up in the catchment. Over the last couple of years, it has formed isolated pools during summer due to the extended dry conditions. Our waterbug surveys in spring 2019 surveyed the creek when it had dried to a large pool at GUD100 with high algal growth. Despite the low levels, good diversity and abundance of waterbugs was found and this reflects the integrity of the catchment.

Revegetation and recovery of instream habitat is improving the Gungoandra Creek at GUD100.

Kybeyan River KYB1

Headwaters to Numeralla River

2019 CHIP Result C+ (Fair)

2018 CHIP Result B- (Good)

Parameter	Rating	No. Survey
Water quality	**Good**	**8**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

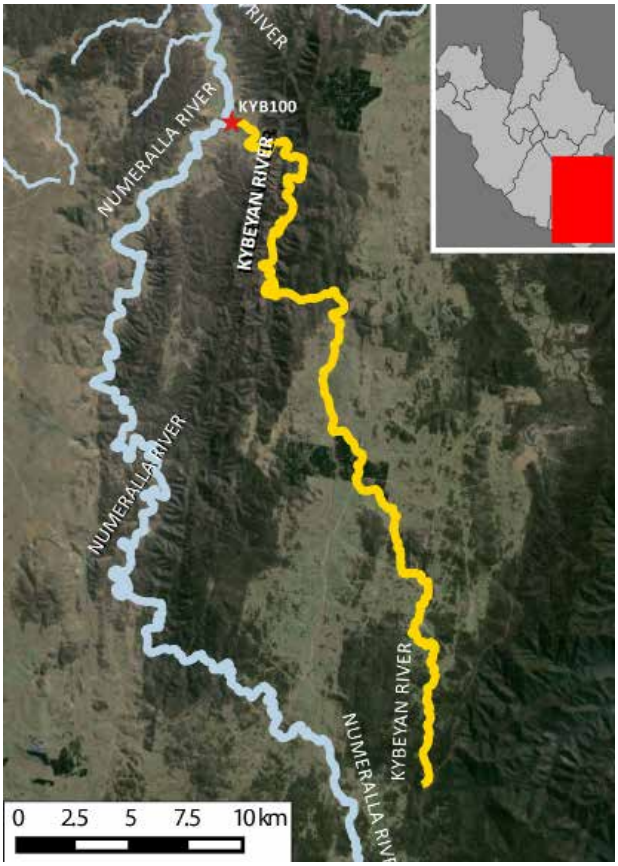
Reach network length: approx. 49km
Dominant land uses: Rural and conservation

This reach includes the entire Kybeyan River catchment. The reach has cleared grazing country around the river's headwaters, from where it flows through steep, unmodified country (including through the Kybeyan State Conservation Area) and then on to join the Numeralla River. The lower floodplains of the reach are utilised for both grazing and cropping purposes. There is an ACWA site on a tributary gully at the bottom end of this reach.

Nutrient levels are always very low in this reach and the water appears clear most of the time. This is a reflection of the intact habitat and vegetation in the catchment upstream of the Waterwatch site. That said, turbidity can become elevated after high runoff events. Riparian condition at the bottom of the reach is influenced by historic clearing, the planting of long rows of Poplars to stabilise river banks and grazing landuse leaving only a narrow strip of vegetation adjoining the river.

The adjoining landholder has noted how much the river has changed over the last 20 years, with Trout once being plentiful and Platypus sightings common every time you visited the river. Now Carp are more often sighted, Eastern gambusia (a small pest fish) are also present in large numbers and Platypus are sighted only very occasionally. The river experienced very low flows during the year due to the extended dry conditions.

This reach is monitored at only one site and another volunteer to monitor an additional site further upstream would greatly enhance our knowledge of this catchment.

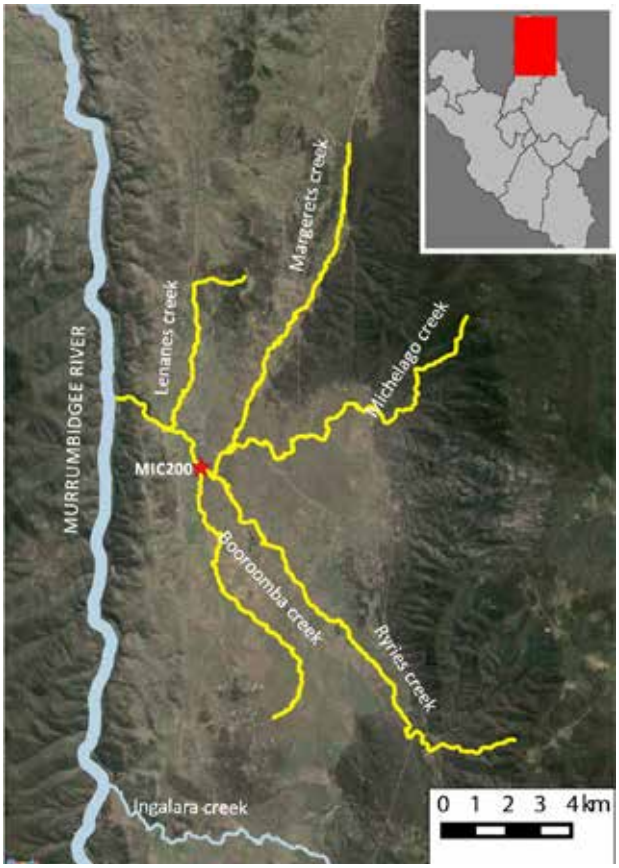


The Kybeyan River had very low flows in 2019 with much of the instream habitat exposed.

Michelago Creek MIC1

Headwaters to Murrumbidgee River

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**13**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**1**
Riparian condition	**Poor**	**1**



Reach Facts

Reach network length: approx. 55km
Dominant land uses: Rural, rural residential and conservation

This reach includes the entire Michelago Creek catchment including the Margerets and Ryries Creeks. The upper sections of these creeks retain native, unmodified vegetation where they rise in the Tinderry Range. The lower sections flow through open, historically cleared country used for grazing and rural residential purposes (in and around the village of Michelago).

Landuse and past clearing in the catchment has resulted in a *poor* riparian condition with very limited native vegetation remaining having been replaced by exotic species such as Poplars and Willows. Grazing and cultivation upstream of the Waterwatch site may be contributing to the organic matter build up and algal rafts often seen at the site. It may also be contributing to the *fair* waterbug survey results. The geology of the catchment contributes to the consistently elevated electrical conductivity levels recorded. Carp are absent from the reach, but Eastern gambusia (a small pest fish) are regularly seen in the warmer months.

Michelago Landcare have been working along the creek replanting native riparian vegetation and installing rock gabions to stabilise streambanks. Large stands of native reeds are establishing in the lower part of the reach which is having a stabilising effect and improving in-stream habitat. 2019 saw very low water levels due to the dry conditions.

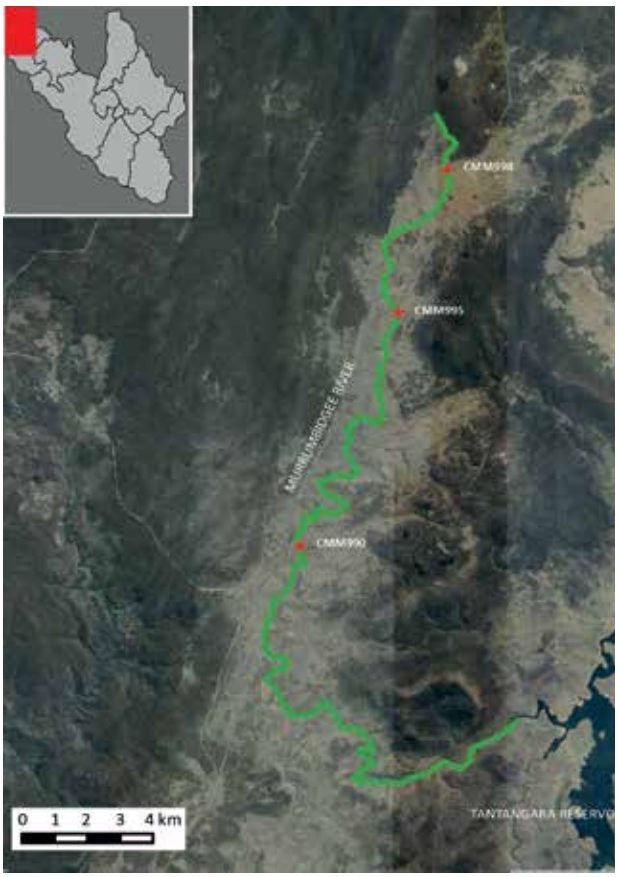
This reach is monitored at only one site and another volunteer to monitor an additional site upstream would greatly enhance our knowledge of this reach.

Michelago Creek - upstream of Michelago village.

Murrumbidgee River CMM1

Headwaters to Tantangara Dam

2019 CHIP Result B+ (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**13**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
Waterbug	**Good**	**3**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 53km
Dominant land uses: Conservation

This reach is the Murrumbidgee River from its headwaters to Tantangara Dam and is entirely within Kosciuszko National Park. The vegetation in the catchment includes heaths, grasslands, bogs and subalpine woodlands typical of the Australian Alps bioregion. The area is used for camping, fishing and touring. It is closed between the June and October long weekends and is not monitored during this time.

In the past, water quality and waterbug surveys have shown consistently high scores. Surveys showed the river at the Waterwatch sites had crystal clear water, no nutrients, neutral pH and very low electrical conductivity. Waterbug surveys had a very high diversity of species including many of the most sensitive bug types.

Over the last years sampling shows that banks are being increasingly pugged (impacted from hard-hoofed animals), the water has become regularly turbid and nutrients have increased. An increase in fine sediment on the river bed is being observed and waterbug surveys show the most sensitive waterbug species reducing in number and sediment tolerant species increasing. As the dry conditions of 2018 and 2019 continued, the increasingly higher impact of horses using the riparian zones could be observed. This year for the first time ever, the Waterwatch sites were observed to have consistently turbid water towards the end of the year.

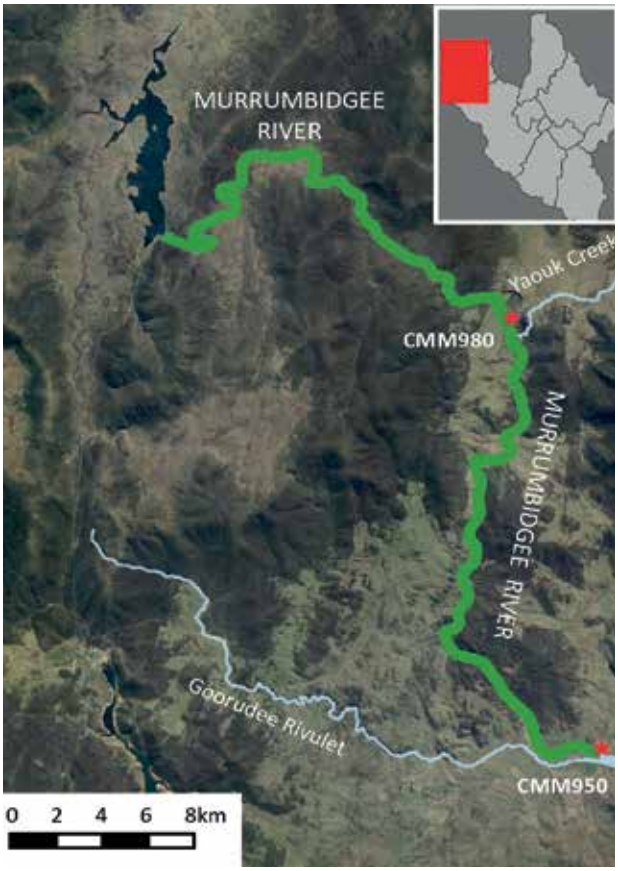
Riparian vegetation only scores as *fair* as the lack of canopy layer in natural tussock grasslands is not accounted for by the riparian survey method used by the CHIP. Reviews to the methodology will look to remedy this in the future.

Heavily pugged edges were seen after snowmelt at CMM998 in spring 2019.

Murrumbidgee River CMM2

Tantangara Dam to Goorudee Rivulet confluence

2019 CHIP Result B (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**18**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
Waterbug	**Good**	**3**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: approx. 55km
Dominant land uses: Rural

This reach includes the Murrumbidgee River and its tributaries immediately downstream of Tantangara Dam. The catchment comprises of open valley floors (which would historically have contained tracts of swampy meadows/tussock grasslands) with a backdrop of steep unmodified country.

Tantangara Dam diverts 95% of river flows to Eucumbene Dam as part of the Snowy Hydro scheme and so the natural flows are greatly reduced. The impact of flow regulation is very evident with in-stream habitat and aquatic species of this reach exhibiting the characteristics of slower flowing ecosystems rather than a fast flowing upland stream. For example, water lillies are growing at the edges and there is fine sediment build-up in-stream. This benefits more tolerant waterbugs which thrive on higher levels of organic matter such as segmented worms and freshwater snails. Water quality scores reflect the high quality water released from the dam, which maintains a base flow in the reach throughout the year.

Riparian vegetation only scores as *fair* as the lack of canopy layer in natural tussock grasslands is not accounted for by the riparian survey method used by the CHIP. Grazing occurs along the edge of the river and this also impacts the quality of riparian vegetation in the reach.

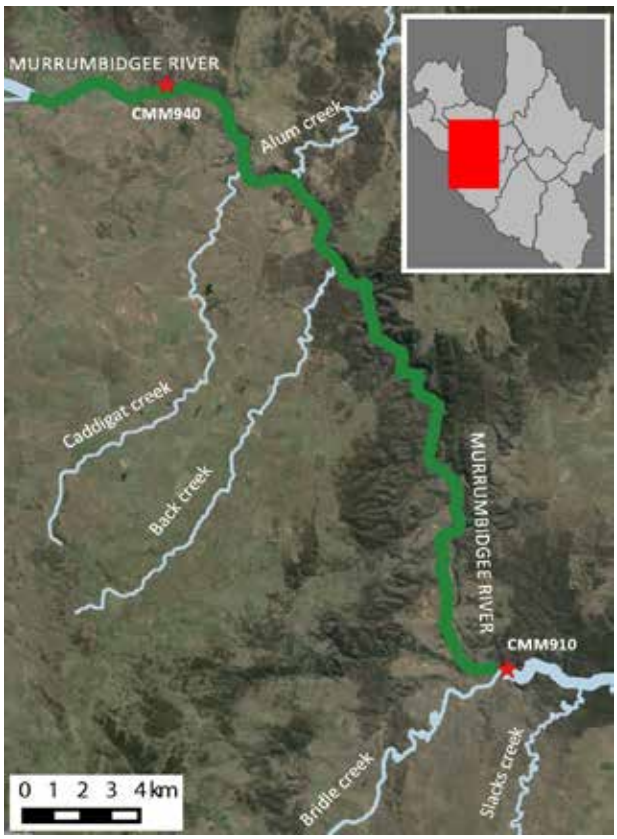
Native Macquarie perch occur in this reach and are part of a nationally significant population which occurs in the upper Murrumbidgee River. Carp are not recorded in this reach and any sightings would be of interest to us.

The Murrumbidgee River at CMM950 displays characteristics of a slow flowing river system.

Murrumbidgee River CMM3

Goorudee Rivulet to Bridle Creek confluence

2019 CHIP Result B+ (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**13**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**1**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 43km
Dominant land uses: Rural and conservation

This reach includes the Murrumbidgee River from Goorudee Rivulet down to the area known as Dry Plains. Within this reach the river first flows through more open, undulating country which is used predominantly for grazing purposes and then through steeper gorge country dominated by woodland vegetation cover which remains largely unmodified. This contributes to the good water quality and waterbug scores recorded for this reach.

Waterbug surveys at downstream sites, however, show a lower abundance of sensitive bug types, when compared to sites upstream. This is due to the fine and gross sediment which is accumulating on the bottom of the river, contributed by streambank erosion and catchment erosion more broadly. High numbers of feral goats and increasing number of deer are also contributing to the problem. The dry conditions throughout the year resulted in higher grazing pressure in riparian zones as the surrounding landscape became increasingly dry and groundcover levels decreased, further adding to the erosion risk. An increasing number of woody weeds (Willows and Box elder) are evident as you move downstream.

Macquarie perch occur in this reach and are part of a nationally significant population in the upper Murrumbidgee River. Carp are also present and the upstream end of their distribution in the upper Murrumbidgee River occurs in this reach.

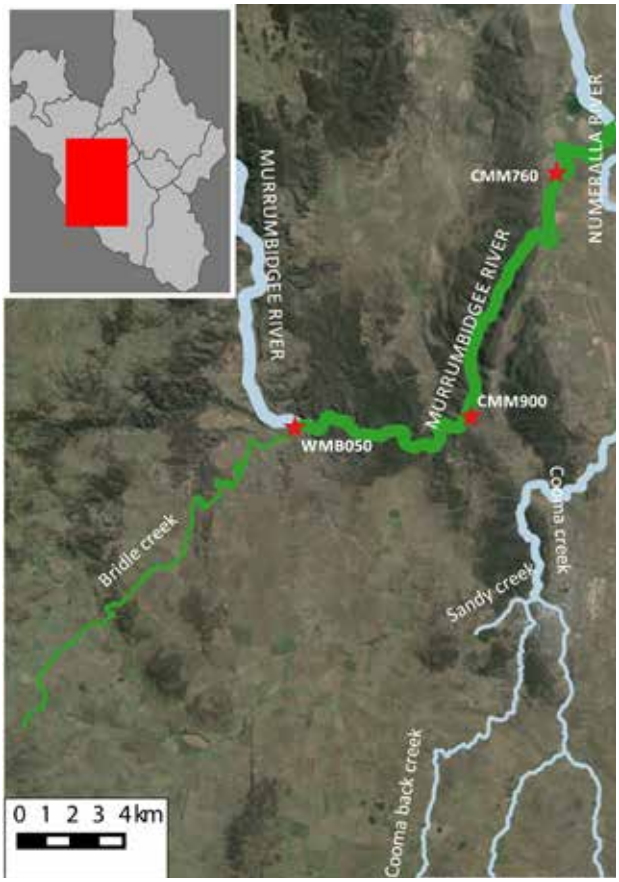
A Platypus survey was carried out at the top of this reach in 2018, where one Platypus and one Rakali (Water rat) were recorded, despite anecdotal reports that multiple individuals are often spotted downstream of the survey area.

The upper Murrumbidgee River at CMM940.

Murrumbidgee River CMM4

Bridle Creek to Numeralla River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**22**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**3**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: approx. 31km
Dominant land uses: Rural and conservation

This reach includes the Murrumbidgee River from Bridle Creek to the Numeralla River confluence. The upper section includes the Binjura Nature Reserve, where the 'Cooma Gorge' is located. In this area there is good quality riparian and aquatic habitat and Macquarie perch are known to breed there. These threatened native fish are part of a nationally significant population which occurs in the upper Murrumbidgee River. Platypus and Rakali (Water rats) have been sighted and two feral fish species, Carp and Eastern gambusia, are also present.

Water quality in this reach is influenced by inflow from upstream catchments including (naturally) high electrical conductivity found in Wambrook and Bridle creeks. Turbidity and nutrient levels can be elevated during high flow events due to gully erosion in the tributaries and cultivation of floodplains at the lower end of the reach. The dry conditions in 2019 saw riparian and catchment groundcover greatly reduced increasing erosion risk throughout the reach. This risk was realised in early 2019 when a localised storm greatly elevated turbidity in the Murrumbidgee River, putting a high strain on Cooma's water treatment plant.

The lower section of this reach has open, cleared country used predominantly for grazing and cropping purposes. Riparian vegetation has been largely modified and dominated by exotic species including Willows as well as small patches of Blackberry.

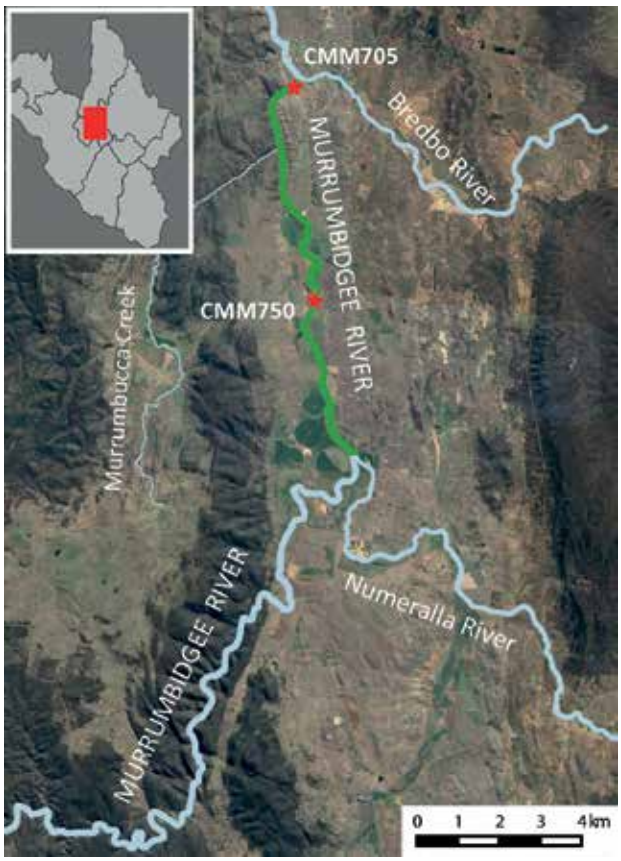
The UMDR and Local Land Services are working with landholders to reduce woody weeds and enhance riparian vegetation in and below the Cooma Gorge to benefit river health and improve aquatic habitat connectivity.

Murrumbidgee River looking upstream of the weir at Cooma Pumping Station (Photo: M. Mannile).

Murrumbidgee River CMM5

Numeralla River confluence to Bredbo River confluence

2019 CHIP Result B (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**14**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**2**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: approx. 12km
Dominant land uses: Rural

This reach includes the Murrumbidgee River from the Numeralla River to the Bredbo River confluence. The wide alluvial floodplain areas which flank the river are used for dryland and irrigated cropping as well as grazing. Very limited native riparian vegetation remains due to historic clearing in this reach and this has adversely affected the riparian condition score. This reach is in a priority ACWA catchment and there are two ACWA erosion sites present.

Water quality in this reach is influenced by inflow from upstream catchments including the Numeralla River which itself has a sizable catchment. The Numeralla is also a priority ACWA catchment where erosion risk is high and as a result turbidity levels can become elevated after high run-off events. The Numeralla River is also a source of gross sediment (sand) which has washed in from historic erosion and now is moving downstream through this reach. These 'sand slugs' have clogged up the river channel, smothered in-stream habitat and provided an ideal seed bed for Willows to take hold and spread.

Feral fish such as Carp and Eastern gambusia (a small pest fish) are regularly sighted in this reach. Platypus have been observed only occasionally although landholders report them being more common prior to the 'Millenium drought'. A native Galaxias fish has also been observed during the waterbug surveys.

The ongoing dry conditions saw water levels drop especially towards the end of the year. Extraction for irrigation in this reach put additional pressure on the water resource and significantly reduced water levels downstream.

The Waterwatch team undertaking a waterbug survey at Billilingara Road Bridge (CMM750).

Murrumbidgee River CMM6

Bredbo River confluence to Michelago Creek confluence

2019 CHIP Result B+ (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**19**
pH	Good	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**2**
Riparian condition	**Fair**	**2**

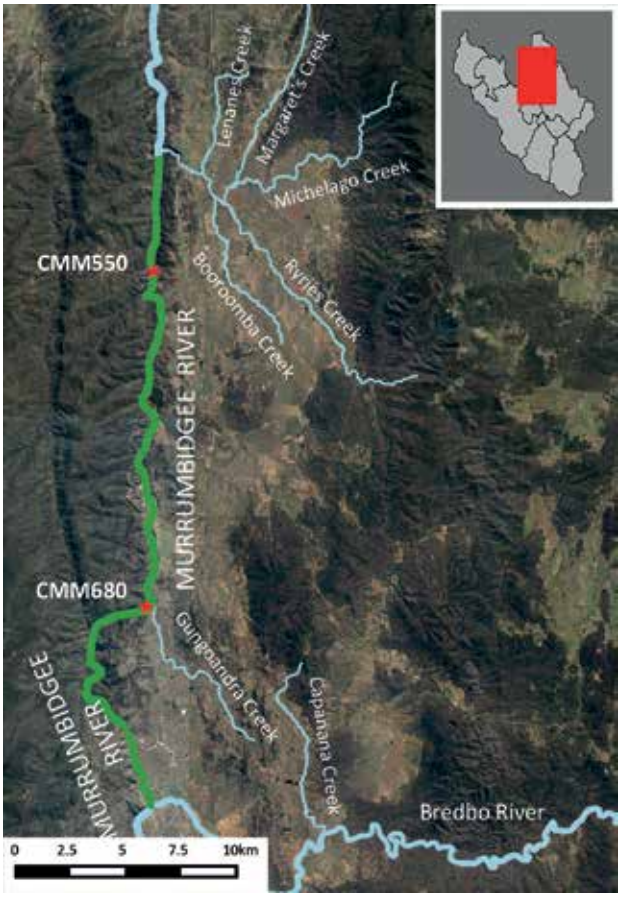
Reach Facts

Reach network length: approx. 35km
Dominant land uses: Rural and conservation

This reach includes the Murrumbidgee River from the Bredbo River to the Michelago Creek confluence. It flows through the Bredbo and Colinton Gorges which form the upper and lower sections of the reach. These gorge areas contain good quality riparian and aquatic habitat. The middle section flows through the Bumbalong Valley which has more open, cleared country.

This reach demonstrates the importance of high quality riverine habitats on overall river health. For example, intact riparian and in-stream habitats capture sediments entering the water and absorb nutrients out of the system, resulting in more stable oxygen levels and clearer water. Macquarie perch, Murray cod, Trout cod and Murray River crayfish, all of which are protected species, are present and further highlight the importance of this reach. Bush Heritage Australia's Scottsdale Reserve flanks the lower Bredbo Gorge where BHA carries out our annual Platypus Month surveys. In 2019 this survey site recorded the highest Platypus count in the region indicating it may be an important drought refuge. Carp are also present.

There is much work occurring to protect and improve the river in this reach including fencing off the river corridor, improving fish habitat, woody weed control and native plantings as part of the UMDR's Rivers of Carbon program in partnership with local landholders and on Scottsdale Reserve. In 2019 works included installing erosion flumes, building fish hotels to improve fish habitat and woody weed control throughout the reach, assisted by the UMDR adventurous volunteers program. Fish and Waterwatch monitoring is helping to track progress.

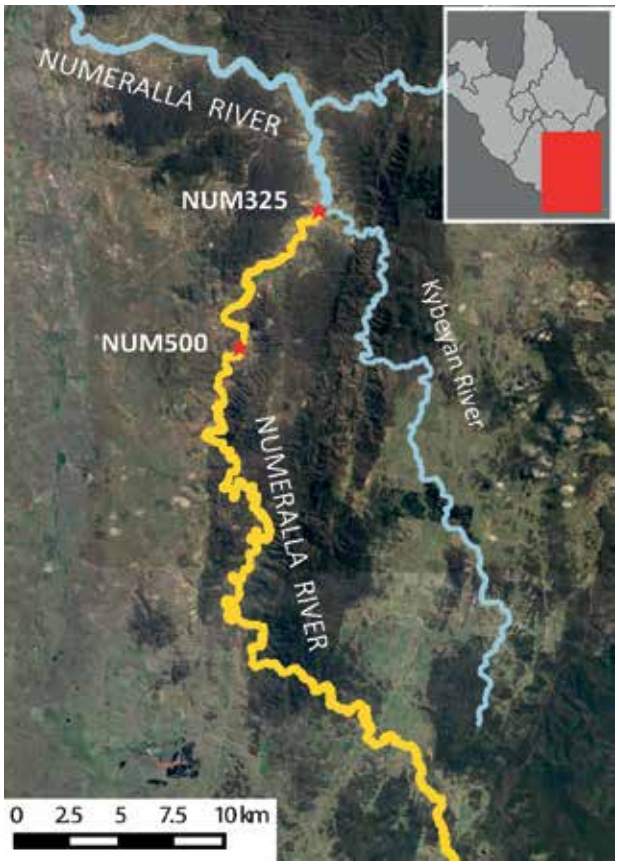


The Murrumbidgee experienced very low water levels in spring and summer of 2019 .

Numeralla River NUM1

Headwaters to Kybeyan River confluence

2019 CHIP Result C (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**14**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: approx. 38km
Dominant land uses: Rural and conservation

This reach includes the Numeralla River upstream of the Kybeyan River confluence. Land use includes dryland cropping and grazing agriculture in the mid to lower sections. In these areas native vegetation has been cleared and historic erosion has contributed large amounts of sand and fine sediment to the river. Sections of the upper reaches retain native vegetation including in the Dangelong Nature Reserve.

The large areas of cultivated and grazed agricultural land present affects water quality through elevated electrical conductivity and nutrient levels. The river corridor has been historically cleared and this has had a negative impact on riparian condition scores as well as streambank stability.

Hence it is not surprising that this reach is a high priority ACWA catchment where erosion risk was assessed as very high. The Numeralla Landcare Group, Numeralla Fishing Club, landholders and catchment organisations have worked since the 1990s to stabilise the river bed and address streambank erosion. As a result streambanks have stabilised, stock access has been reduced and in-stream vegetation (including Ti-tree and reeds) has regenerated along the river. This in turn continues to further stabilise the river channel and improve habitat. Native plantings have been carried out to re-establish riparian trees along the river.

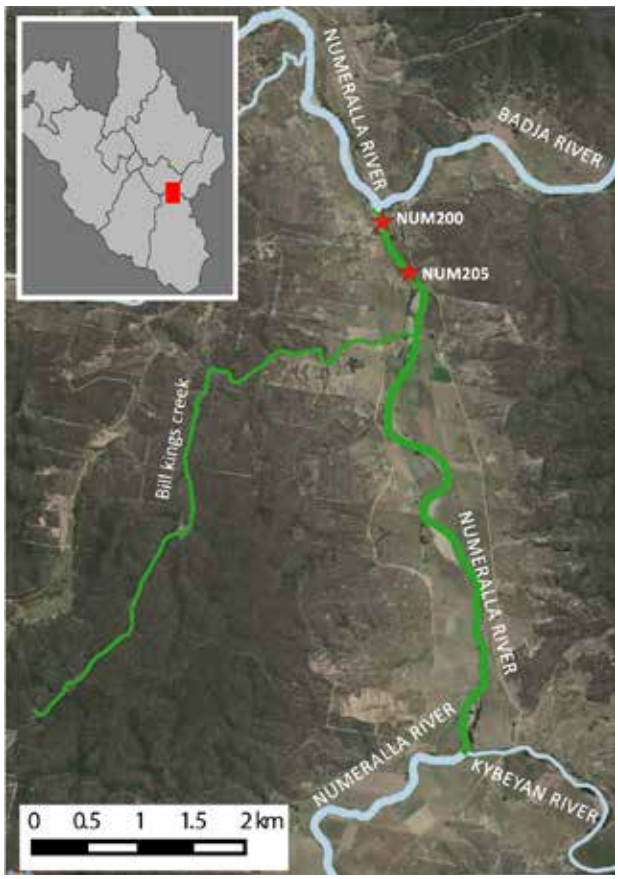
In 2019 the extremely dry conditions saw the river reduced to isolated pools. The Ti-trees in the river corridor started to 'brown-off' (die back) due to the heat and dry.

Low levels were seen on the Numeralla River at NUM500 during the latter half of 2019.

Numeralla River NUM2

Kybeyan River confluence to Badja River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**13**
pH	Excellent	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
Waterbug	**Fair**	**2**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 40km
Dominant land uses: Rural and conservation

This reach includes the Numeralla River from the Kybeyan River to the Badja River confluence. It is flanked by wide alluvial floodplains used for dryland cropping and grazing. The Numeralla village is at the bottom end of the reach. Past landuse has resulted in loss of native vegetation and erosion has contributed large amounts of sand to the river channel and this sediment continues to move downstream. This reach is a high priority ACWA catchment where erosion risk was assessed as very high.

The length of the reach has been fenced to exclude grazing thanks to over two decades of work by Numeralla Landcare, the Numeralla Fishing Club, landholders and catchment organisations. Native plantings have replaced exotic trees in the riparian zone at various sites. Native reed-beds and Ti-tree continue to establish along the river which continues to improve in-stream habitat and stabilise banks. Fish habitat has been improved via re-snagging (adding large, woody debris to the river). These factors all contribute to a better CHIP score in this section of the Numeralla River than in the reach upstream (NUM1).

Platypus and Rakali (Water rats) are occasionally sighted in this reach. Carp can be regularly seen and Eastern gambusia are also present. The Numeralla Fishing Club undertakes annual 'Carp-outs' to reduce feral fish numbers.

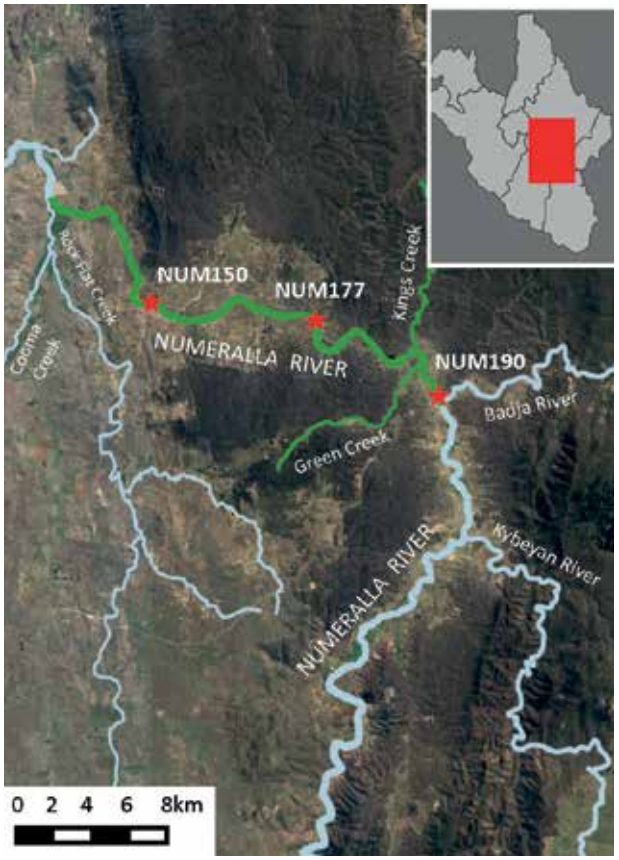
In 2019 the extremely dry conditions saw the river reduced to isolated pools. Carp trapped in the shrinking pools raised turbidity levels.

The Numeralla River at Deepwater (NUM205).

Numeralla River NUM3

Badja River confluence to Cooma Creek confluence

2019 CHIP Result B (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**23**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**1**
Riparian condition	**Fair**	**3**



Reach Facts

Reach network length: approx. 14km
Dominant land uses: Rural and rural residential

This reach includes the Numeralla River from the Badja River to the Cooma Creek confluence. The top half of this reach is flanked with good native vegetation. This includes tall stands of Ribbon gums, fringing Ti-trees and Bottlebrushes, beds of in-stream reeds and swathes of Water milfoil submerged in the river. Platypus were once common but are now only occasionally sighted. The clear waters of the Badja River flow in at the top of this reach. These factors contribute to the reach score being slightly better than the score of NUM2 upstream.

The lower parts of the reach have wide floodplains used for dryland cropping and grazing. In this area native vegetation has been cleared and historic erosion has contributed large amounts of sand and fine sediment to the river. This reach is in a high priority ACWA catchment where erosion risk was assessed to be very high.

Upstream of NUM150 there is a known Carp spawning hot spot, where large numbers of Carp gather every spring. The river in this area has an open channel with large stands of reeds. Smaller numbers of Carp (groups of five) have also been seen spawning in a shallow, water milfoil covered riffle section below NUM150. This highlights that in the upper Murrumbidgee catchment, Carp spawn opportunistically in a range of habitats. Eastern gambusia are also regularly sighted in this reach.

In 2019 the extremely dry conditions saw the river reduced to isolated pools. Ti-trees in the river corridor 'browned-off' (died back) due to the heat and dry especially where canopy shade was lacking.

Good stands of Ribbon gum and Ti-tree are present along this section of the Numeralla River.

Numeralla River NUM4

Cooma Creek confluence to Murrumbidgee River

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**15**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 17km
Dominant land uses: Rural

This reach includes the Numeralla River from the Cooma Creek to its confluence with the Murrumbidgee River. It runs through wide floodplains which are used for grazing and dryland and irrigated cropping. Stock are allowed to access the river in some areas.

Overall, there is very little native vegetation remaining along this section of the Numeralla River due to historic clearing. Hence riparian (riverside) vegetation is made up of invasive exotic species such as Willows, Box elder, Poplars and Blackberry. Over time in-stream reeds and native Ti-tree have been increasing, providing beneficial stabilising and channel forming functions for the river.

This reach is in a priority ACWA catchment where erosion risk was assessed to be very high. Increased turbidity has been observed after high run-off events. Sediment deposition from past and current erosion is widespread in the river and continues to be mobilised downstream. The above factors affect the CHIP score for this reach which is lower than for the two reaches (NUM2 and NUM3) directly upstream in the Numeralla catchment.

Platypus are reported to have been very common in the past, in the deep holes which are found lower down in the reach. Now Platypus sightings are less common. Carp are reported in large numbers, including 'spawning runs' up the river past Chakola.

In 2019 the extremely dry conditions saw the river reduced to isolated pools.

Looking downstream at Chakola causeway (NUM100).

Rock Flat Creek ROC1

Headwaters to Cooma Creek

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**15 (1 dry)**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**1**
Riparian condition	**Degraded**	**2**

Reach Facts

Reach network length: approx. 42km
Dominant land uses: Rural

This reach includes the entire Rock Flat Creek catchment. The creek flows through predominantly open basalt country, which is used for grazing and cropping agriculture. This reach includes a high priority ACWA site just downstream of the Cottage Hill Road crossing.

Riparian vegetation along the creek is highly modified with the canopy and shrub layers largely absent, with the exception of some scattered Willows. Similarly, there is a lack of in-stream vegetation along this reach, especially where the creek is accessed by stock. Sections of the creek have unstable streambanks causing increased turbidity and sediment inputs during high runoff events which in turn reduces water quality and smothers available habitat. These factors influence the waterbug community found in this reach which usually consists of very tolerant species such as segmented worms, flatworms, fly larvae and beetle larvae.

Water levels have been very low during the last few years and the creek has been reduced to a series of pools during the summer months in both 2018 and 2019. At these times grazing pressure increases as stock can access more of the creek bed. Increased streambank pugging (trampling) and grazing of in-stream vegetation was observed where stock had gained access.

This reach was at one time a renowned Trout stream but now Carp are more commonly seen. Platypus are now only occasionally sighted, but are reported to have been plentiful in the past.

Rock Flat Creek formed a series of pools in 2019 due to the extended dry conditions in 2019.

Strike-A-Light River STR1

Headwaters to Bredbo River

2019 CHIP Result B- (Good)		
2018 CHIP Result C+ Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**9**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 38km
Dominant land uses: Rural

This reach includes the entire Strike-A-Light River catchment. The catchment includes cleared open country, utilised predominantly for grazing agriculture at the top and bottom ends of the reach. In these areas riparian vegetation has been cleared. The middle of the reach is largely native vegetation with intact riparian areas and good in-stream habitat.

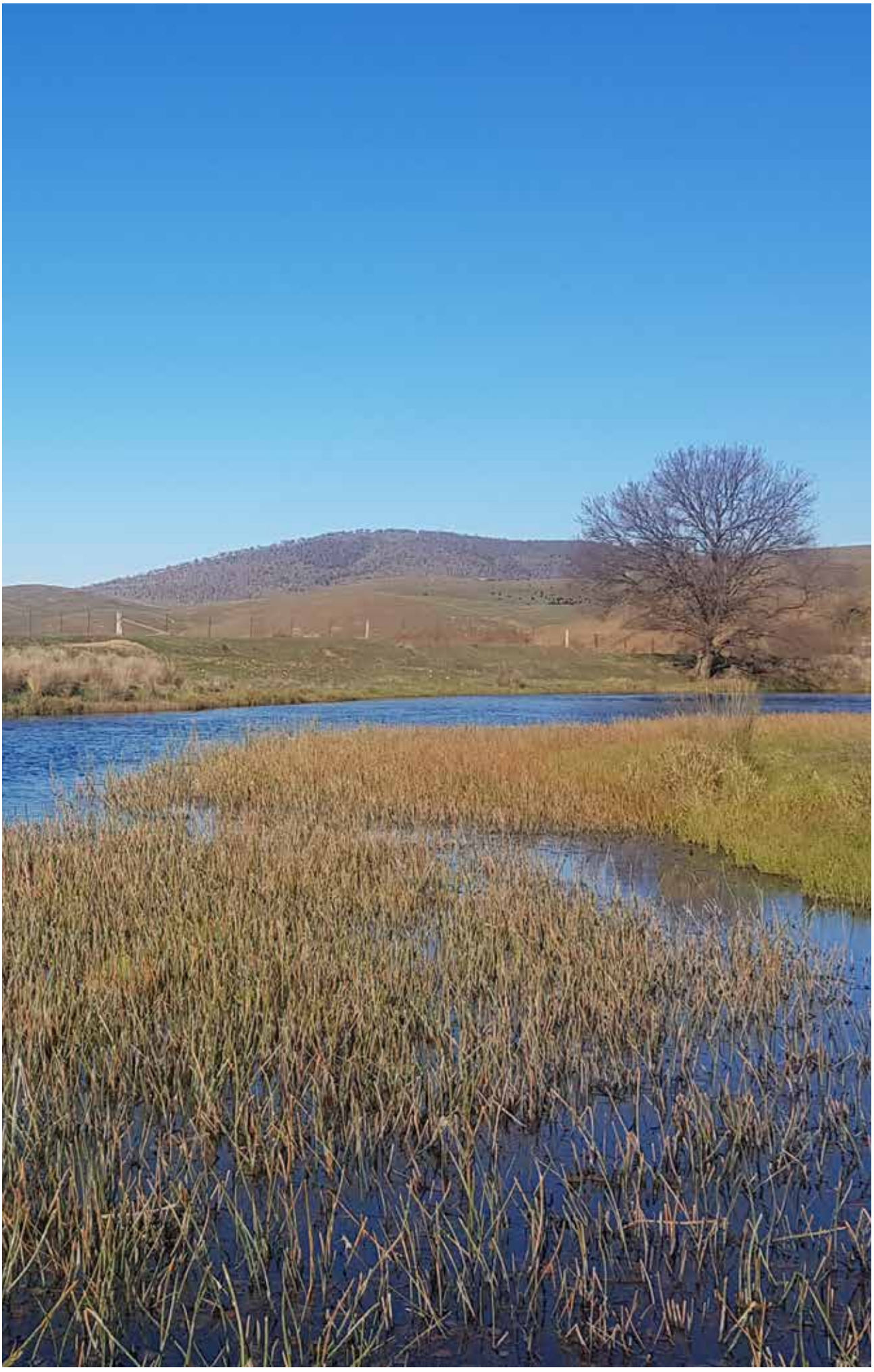
Dry conditions over the last years has seen the Strike-A-Light River reduced to a series of pools during 2019. Despite this, the water remained largely clear and free of algae. This is most likely due to the highly vegetated catchment upstream of the Waterwatch site having a positive impact on river health. Low water levels most likely influenced electrical conductivity and dissolved oxygen scores, which have declined during the drought in comparison to previous years.

The river can become turbid during high run-off events indicating streambank erosion further up in the catchment. Large deposits of in-stream sand in the lower end of the reach indicate large scale erosion events have occurred in the past.

Carp are present in the lower sections of the river, however they have not been seen up as far as STR200. Rakali (Water rats) and Eastern water dragons have been seen swimming in the river near the Waterwatch site.

This reach is monitored at only one site and another volunteer to monitor upstream would greatly enhance our knowledge of this catchment.

The Strike-A-Light River was a series of pools thoughout 2019 due to the ongoing dry.



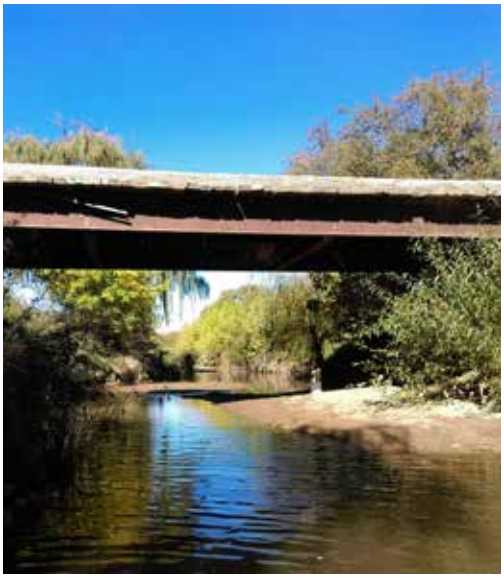
Ginninderra Catchment Facts

Over 42% of ACT residents live in Ginninderra Creek catchment making it the most urbanised in the ACT. It carries substantial urban water runoff, from both established and newly developing suburbs, directly into the Murrumbidgee River.

Ginninderra Creek itself begins in the upper reaches of Gungahlin, within the Mulligans Flat Nature Reserve, and enters the Murrumbidgee after passing through the catchment's most significant and best-preserved remnant ecosystem: the Ginninderra Gorge, including the spectacular upper and lower falls. Gooromon Ponds Creek joins Ginninderra Creek near Dunlop and captures run off from much of the NSW land around Wallaroo, including Halls Creek.

Steady development in Canberra's north has impacted significantly over the past 30 years, with sediment from development sites and weeds the two most significant issues. The riparian zone for most of the creek is dominated by exotic grasses with a mix of native and exotic mid-storey and canopy. Some notable exceptions are areas where Landcare groups have been working for many years. This includes Evatt, Umbagong District Park, Macgregor and Dunlop.

Ginninderra Waterwatch Volunteers have been monitoring this catchment since 1997.



Ginninderra Catchment Health Summary

The prolonged dry conditions continued to affect the Ginninderra Creek catchment in 2019, where our volunteers observed 'isolated pools' or 'dry' waterways 23% of the time, 'low' water levels (39%), 'medium' levels (29%), and 'high' levels for only 8% of the year.

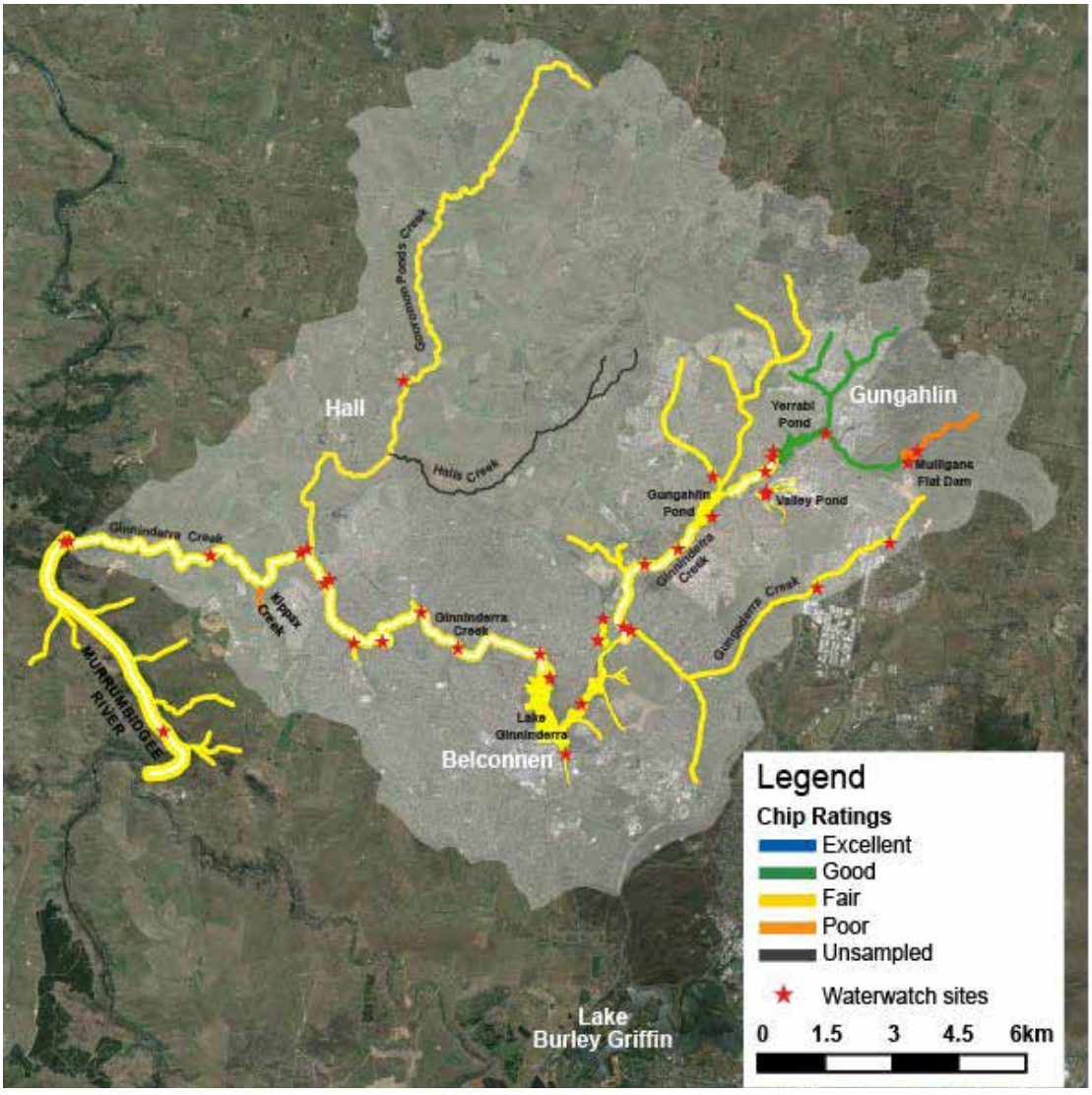
Overall, one reach had a *good* score, twelve had *fair* scores and the remaining two reaches scored *poor*. Compared to last year's CHIP results, scores are not much different, with the vast majority of reaches in this highly urbanised catchment sitting in the *fair* range. Twelve reaches had similar scores to the previous year, eleven continued as *fair* and one as *good* , while three presented worse scores; Kippax Creek, McKellar Wetlands and Mulligan's Flat Dam. No reach showed improved results this year. From the three reaches that received worse scores, it was evident that the deterioration in water bugs in Kippax Creek, from *fair* to *degraded*, and the water quality in Mulligans Flat Dam, from *good* to *poor* played a significant role.

The dramatic reduction in water levels and quality at Mulligan's Flat Dam resulted in this reach going from one of the best in the Ginninderra catchment , to the worst in 2019. This reach was completely dry by December and only abundant and regular rain will reverse the trend.

High nitrate readings continue to be a problem in the Murrumbidgee River (CMM11), with records up to 40mg/L. Regular sampling above and below the Lower Molonglo Water Quality Control Centre (LMWQCC) indicates the likely source of these elevated nitrate readings is outputs from the LMWQCC.

On a good note, Yerabi Pond (YER1) maintained its water level and had the best overall score in the region. This seems to reinforce the idea that urban wetlands can serve as a refuge for wildlife during drier periods.

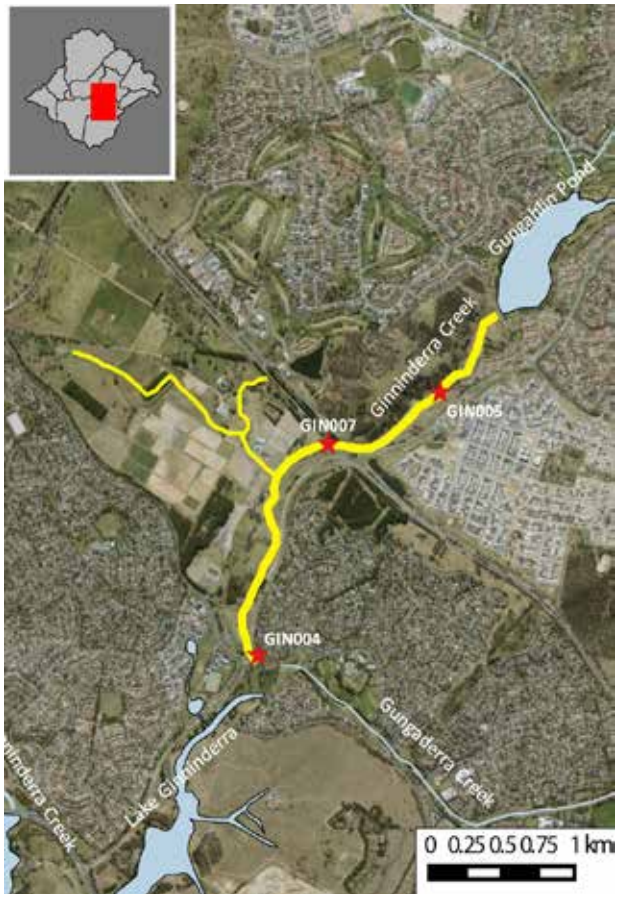
From 2019 the Upper Murrumbidgee Demonstration Reach (UMDR) partnership, which works to protect and improve river health in the Murrumbidgee River, has expanded its region to include the area encompassing CMM11. We look forward to working with UMDR to improve the health of the Murrumbidgee.



Ginninderra Creek GIN1

Crace to Giralang Pond

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**22**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Good	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 5km
Dominant land uses: Urban

Starting at the outflow of Gungahlin Pond this reach includes the stormwater inflow from Nicholls and Crace. The middle of the reach receives runoff from the CSIRO field test facility while the downstream section flows through the Old Palmerville township historic site 12 and Landcare Forest. The end point for this reach is Giralang Pond which is the only small stream pond present on Ginninderra Creek.

This section of the catchment has been urbanised for many decades, which results in high runoff from the many impermeable surfaces which warms the water and carries lots of urban pollutants with it.

The areas adjacent to Ginninderra Creek in this reach have good ground cover and little signs of erosion, as well as plenty of in-stream reeds. The absence of large trees and shrubs, however, means the creek can be quite exposed in places and tends to receive a poor score for riparian condition.

Feral fish (Carp, Redfin perch and Eastern gambusia) are frequently sighted throughout this reach.

In 2019, murky water was observed several times, at all sites, by our volunteers in this reach, and turbidity as high as 50NTU was noted, even when it had barely rained.

Volunteer James helping with the waterbug survey at Giralang Pond (GIN004).

Ginninderra Creek GIN2

Lake Ginninderra

2019 CHIP Result C (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**28**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

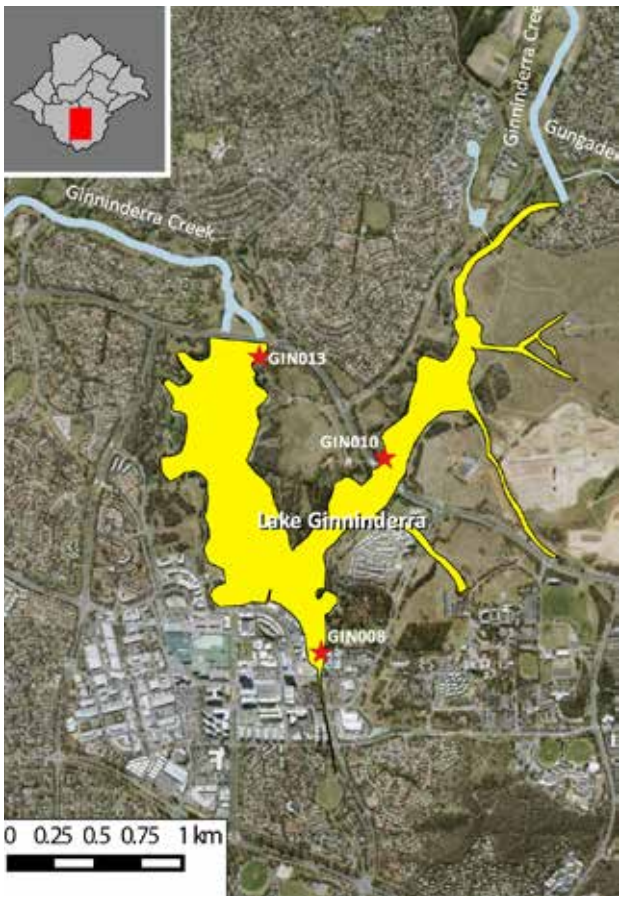
Reach network length: approx. 9km
Dominant land uses: Urban

Starting below Giralang Pond and finishing at the Lake Ginninderra Dam wall, this reach covers the main city centre of Belconnen. The main inflow is from Ginninderra Creek from the north-east, which includes the new suburb of Lawson. The other inflow is at the southern end of the Lake and is mostly urban stormwater that flows into the Eastern Valley Way wetland.

Kayakers and an array of birds species, such as Dusky moorhens, Purple swamphens and White-faced herons, are frequently sighted by volunteers on Lake Ginninderra. Rubbish was also noted as it continues to be a problem throughout this reach.

The riparian zone is this area of Lake Ginninderra is mainly composed of grasses and shrubs, with many being introduced species. There is little available habitat for wildlife along the edges of the Lake. There is scope for improvement in areas that are not required for visitor access and do not need to be maintained in a “neat and tidy” manner.

The prolonged lack of rainfall was observed by the volunteer at GIN008 in December 2019, when electrical conductivity results were twice as much as what is normaly found there (480 µS/cm). This was possibly due to the lower water levels resulting in a higher concentration of salts and minerals in the system.



A higher view of Lake Ginninderra near GIN013.

Ginninderra Creek GIN3

Dam wall to Ginninderra Drive

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**22**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

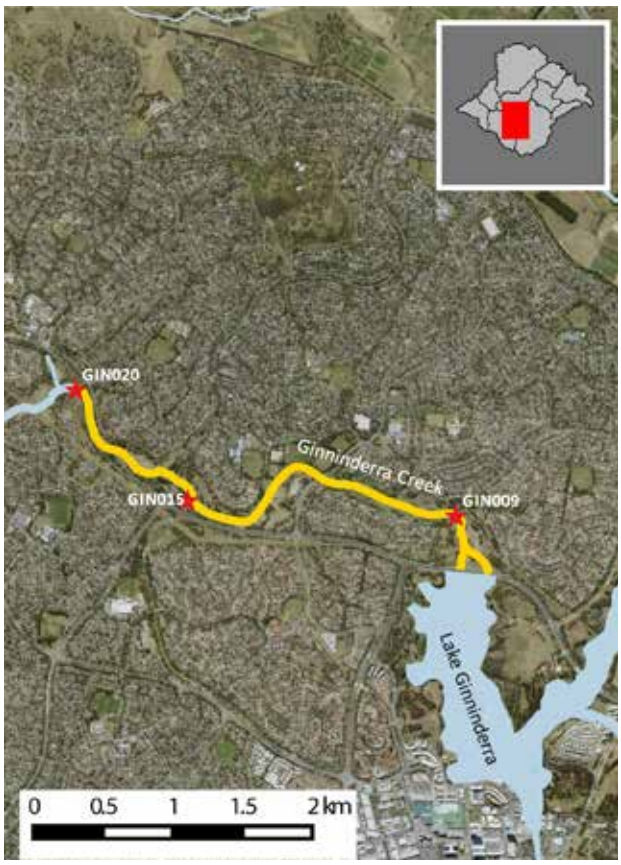
Reach network length: approx. 4km
Dominant land uses: Urban

This reach begins below the Lake Ginninderra spillway and sits entirely within established suburbs with high urban stormwater inflow. The reach has good reed cover and wide, well-grassed buffer zones in most areas. During rain events the water in this section runs very clear and turbidity is only observed when overflow from Lake Ginninderra occurs.

Even though there is a moderate presence of trees along the edge of Ginninderra Creek in this section, the majority are introduced species like Poplars and Willows. These trees drop large amounts of leaf litter into the waterways in autumn causing spikes in nutrients within the system. Some areas of the creek (around GIN009) are choked up with them. There has been great efforts over the years through the Ginninderra Catchment Group and ACT Government tree unit to replace Poplars with native species in this reach. It will take a few years for the benefit of this management strategy to be reflected in the riparian condition scores.

Despite the dry conditions in 2019, waterbug diversity still totalled eight different types in both surveys although the bugs were present in lower numbers.

Two new wetlands that will help improve the water quality of the stormwater were recently built in this reach through the ACT Healthy Waterways program.



Volunteer Ana conducting water testing at GIN009.

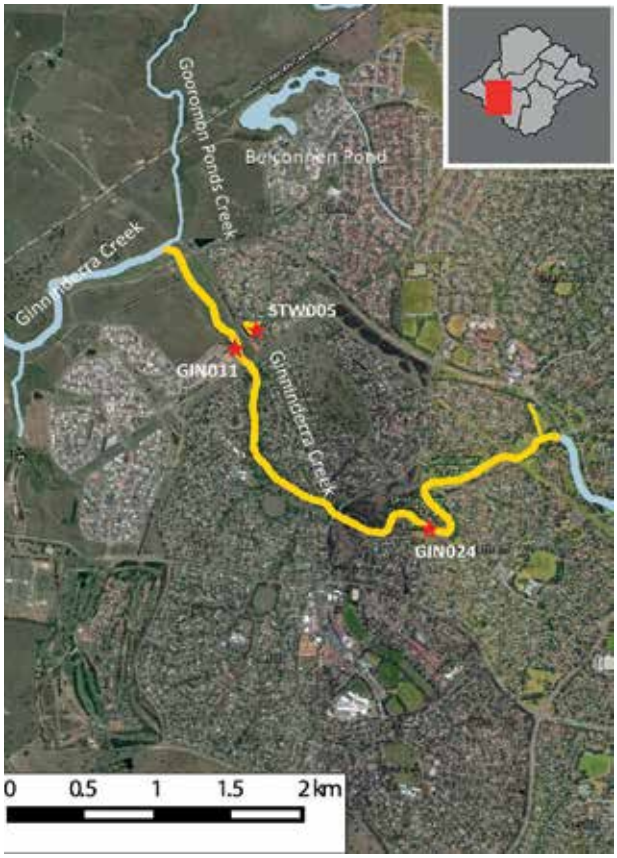
Ginninderra Creek GIN4

Ginninderra Creek at Umbagong District Park

2019 CHIP Result C+ (Fair)

2018 CHIP Result C (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**31 (1 dry)**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**4**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 6km
Dominant land uses: Urban

This reach starts downstream of Ginninderra Drive and flows through the Umbagong District Park, ending at the confluence with Gooromon Ponds Creek. The reach is well vegetated with a good native riparian zone and wide grassland buffers in many sections. Previous creek restoration projects by the Ginninderra Catchment Group and Umbagong and Macgregor Landcare Groups have improved riparian condition and water quality.

Native species commonly recorded is this reach are King parrots, Kookaburras, Reed warblers, Buff-Rumped thornbills, Red-Browned finches and Pobblebonk tadpoles. On the other hand, rubbish is often found in this reach and our volunteers have helped relentlessly to clean this section of Ginninderra Creek.

Dissolved oxygen levels fluctuated dramatically in 2019 (31-135% saturation), with the lowest seen during a dry spell in March that correlated with low flows. Waterbugs sensitive to pollution, such as mayflies, caddisflies and mites, were a common finding in the spring waterbug surveys, while the unique whirligig beetle was found in the autumn sampling. Whirligigs are well adapted to aquatic environments and have lower and upper pairs of eyes which allows them to see what's happening above and below the surface.

A dead yabby after the long dry spell at Umbagong (GIN024) (Photo: J. Fitzgerald).

Ginninderra Creek GIN5

Gooromon Ponds Creek confluence to Ginninderra Falls Gorge

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Good	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 7km
Dominant land uses: Urban/Rural Fringe

This reach runs from the confluence with Gooromon Ponds Creek to the rural properties around Kilby Homestead. The upper section has significant bank erosion and the lower section runs through sheep and cattle farms. Ginninderra Catchment Group, Greening Australia and the Riverview group have undertaken Willow removal and native regeneration work in the mid-section.

It's positive to see the regeneration of native shrubs plus some habitat such as fallen logs, along the edge of Ginninderra Creek at Kilby Homestead. This provides essential refuge for small vertebrates such as frogs and lizards. On the other hand, the lack of in-stream vegetation can be a problem as it is necessary habitat for numerous species of waterbugs and turtles. Carp are also regularly sighted in this reach.

In 2019, strands of green and brown algae were often observed clinging to rocks on the creek's substrate near GIN030. Also, in February an unusually low electrical conductivity result was recorded for GIN030. This was most likely a dilution effect due to the release of water upstream at Jaramlee Pond (STW005) for research purposes as part of the ACT Healthy Waterways program.

At GIN040, due to the ongoing dry conditions, a sandbank formed in the middle of the creek and vegetation began to grow there.

Significant presence of algae at GIN030.

Ginninderra Creek GIN6

Ginninderra Falls Gorge to Murrumbidgee River confluence

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**4**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Waterbug	**Degraded**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 3km
Dominant land uses: Conservation

This reach comprises the high conservation value area of the Ginninderra Falls and Gorge. It is composed of large areas of native woodlands and shrubs. The rough terrain and inaccessible nature of the downstream section contributes to its complex structure. This section has the best riparian habitat in the catchment. Ginninderra Falls also represents an important Ngunnawal cultural and heritage site, known to host significant indigenous ceremonies and male initiations.

Although the riparian vegetation is well represented by mature casuarinas and gum trees, not much regeneration is observed along the creek. Despite the good vegetation cover, the upstream stressors such as urbanisation and farming can still be felt downstream, with elevated electrical conductivity readings. Very little aquatic vegetation has been observed in this section of the creek, which is represented mainly by a rocky bottom.

In 2019, waterbug scores were lower compared to the previous year, yielding seven species in both autumn and spring bug surveys. Tolerant waterbugs were the most abundant, such as water boatmen and fly larvae, with the lower scores in waterbug diversity probably reflecting the lack of in-stream habitat combined with low flows.

On a good note, Eastern water dragons are regularly observed during sampling.

Eastern water dragon by Ginninderra Creek at GIN050.

Gooromon Ponds Creek GOO1

Headwaters to confluence with Ginninderra Creek

2019 CHIP Result C (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20 (1 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Degraded**	**2**

Reach Facts

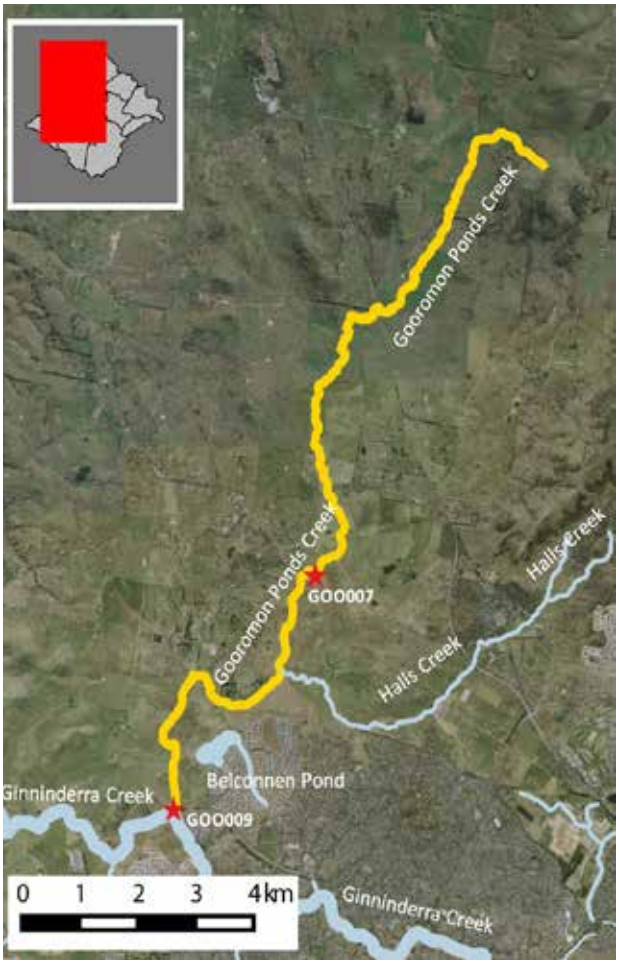
Reach network length: approx. 17km
Dominant land uses: Rural

Flowing through the rural land surrounding Hall and Wallaroo, Gooromon Ponds is a mostly ephemeral creek with intermittent pools. This creek contains sections of moderate erosion and extensive areas with low habitat value.

This reach represents a typically impacted farmland region with low riparian condition scores. Ground cover is relatively intact however exotic pasture grasses dominate, mid-storey and canopy species are scarce and mostly exotic and there is a complete lack of features such as fallen logs and native tussock grasses. The lack of native canopy cover and consequently no leaf litter and native canopy regeneration all contribute to reduced soil stability and can result in erosion.

Electrical conductivity has historically shown elevated levels in this reach and are most likely influenced by the geology of the region and historical land use. During 2019, an unusually low electrical conductivity result was recorded for GOO009 by the Waterwatch volunteer in February. This was most likely a dilution effect due to the release of water directly upstream at Fassifern Pond for research purposes as part of the ACT Healthy Waterways Program.

Illegal dumping is also frequently observed by the volunteer at site GOO007.



Gooroomon Creek at Jaramlee Crossing (GOO009) with an extensive algal presence.

Gungaderra Creek GDC1

Gungahlin to Giralang Pond

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**Survey**
Water quality	**Good**	**21**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**4**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban

This reach starts in the southern suburbs of Gungahlin, flows through the Gungaderra Grassland Reserve and into Ginninderra Creek at Giralang Pond just upstream of Lake Ginninderra. It also includes a stormwater channel from the University of Canberra and Canberra Stadium and has moderate urban stormwater inflow.

This reach displays a marked decrease in water quality parameters from the upstream (GDC010) to the downstream site (STW001), showing the cumulative effects of the water running through the urban landscape, travelling over lots of impermeable surfaces and through concrete drains.

The lack of native canopy and understorey and dominant exotic vegetation, in addition to sections of concrete stormwater drains, account for the poor riparian vegetation assessment. A plan to improve the width of riparian habitat is currently being worked on with the ACT Government wetland staff.

In 2019, 'medium' to 'no flow' in this reach has been regularly noted by the volunteers which has resulted in low dissolved oxygen results (31-73%) on several occasions. Although mites, a sensitive species to pollution, have been recorded in large numbers during the waterbug surveys in this reach, high numbers of tolerant species such as fly larvae and water boatmen have also been observed.

Storm water pond on Gungaderra Creek at GDC010.

Gungahlin Pond GUN2

Headwaters of Ginninderra Creek north arm to Gungahlin Ponds

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**25**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 6km
Dominant land uses: Urban/Rural Fringe

The north arm of Ginninderra Creek originates in the rural lands surrounding the northern suburbs of Gungahlin and joins the east arm in Gungahlin Pond. The upper section is mostly ephemeral drainage lines disconnected by stock dams before flowing into the sediment control pond of Gungahlin. This reach receives a high inflow of urban stormwater from surrounding suburbs and new developing suburbs.

Limited sections of the riparian zone score well for their habitat values, with some significant native canopy evident. Exotic species, however, with limited habitat values, dominate the edge of Gungahlin Ponds. These highly urbanised areas are regularly mowed to the water's edge, making the regeneration of native plants difficult. On the other hand, in-stream vegetation in the form of reeds are present throughout the reach, and abundant in some areas, providing good habitat for frogs, turtles and waterbugs. It's also positive to note the regular record of frog calls from the volunteers and several bird species, such as ducks, coots, swans, ibis and swamp hens.

Interesting to note that during the spring waterbug surveys in 2019, the most common species was the Caenid mayfly (110+), which is sensitive to pollution. These particular mayflies are adapted to slow-flowing and standing waters by having covers over their gills to stop suspended particles clogging them up.

Surface film at GIN006 (Photo: M. Bassanelli).

Kippax Creek KIP1

Headwaters to Ginninderra Creek confluence

2019 CHIP Result D+ (Poor)

2018 CHIP Result C+ (Fair)

Parameter	Rating	No. Survey
Water quality	**Fair**	**11**
pH	Excellent	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Poor	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

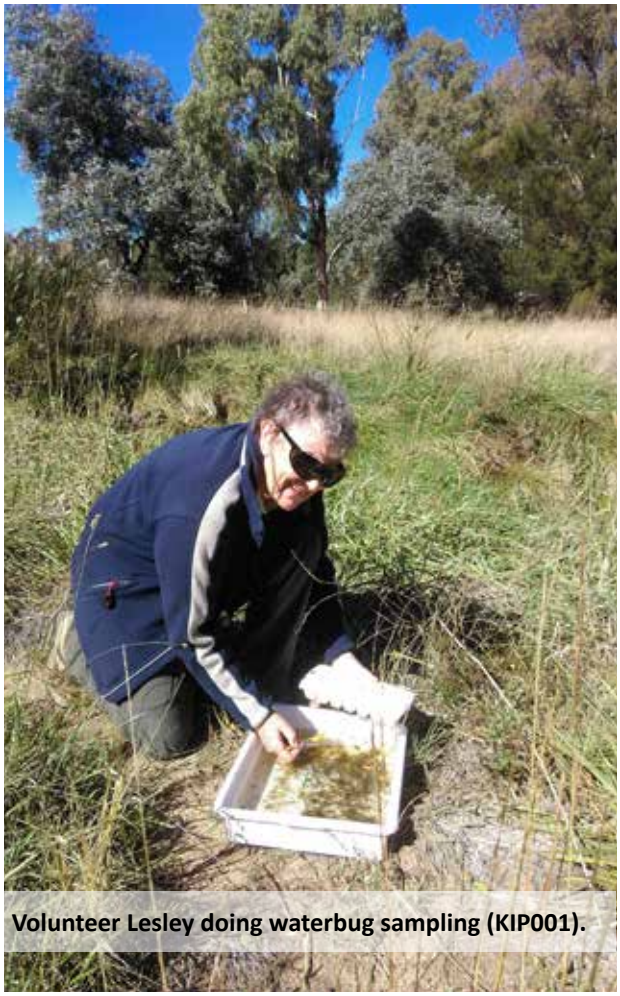
Reach network length: approx. 2km
Dominant land uses: Urban

Kippax Creek is now mostly a system of stormwater drains and drainage lines. The remaining "natural" creek section is only a 400m stretch from the last gross pollutant trap to the confluence with Ginninderra Creek. This reach does offer a great opportunity to study the impacts of a catchment that is heavily urbanised with limited water quality improvement infrastructure. The lower section sits within an important native grassland at the Umbagong District Park.

Although the weed, African lovegrass, is still very common in the area, it is interesting to note the increasing presence of the native Kangaroo grass. Overall the reach lacks native ground cover complexity in structure of layers and habitat features, but it is important to mention some regeneration in the native canopy species and the presence of reeds along this reach.

Our volunteer has been carefully monitoring the erosion in this reach and things have worsened over the last few years following a number of flash floods.

In 2019, the overall score for this reach has worsened as a result of deterioration in both water quality and waterbug scores: with turbidity and nitrates changing from good to poor, and with snails and worms, both tolerant to pollution, the most abundant waterbug types during the spring sampling.



Volunteer Lesley doing waterbug sampling (KIP001).

McKellar Wetlands MCW1

Designed habitat wetland system, McKellar

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Poor	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 500m
Dominant land uses: Urban

The two McKellar wetlands are designed primarily for frog habitat, and secondly for recreation. This is evident in the significant reed growth in both wetlands, and the connecting channel linking them, which is heavily vegetated to facilitate frog movement. It is situated in an established suburb, with nutrient inputs derived from human activity such as gardening, cleaning as well as leaves from deciduous trees.

The *poor* riparian condition score is influenced by the low levels of canopy and understorey cover, although ground cover results are considered good, with a high number of native tussock grasses. The wetlands in this reach are typical of urbanised areas in Canberra, with manicured grasses and low numbers of trees. The riparian assessment does not account for the aforementioned good in-stream habitat.

In 2019, owing to the long dry spell, low water levels and turbidity were an issue on site MCW002, with readings in November reaching 170 NTU. Our volunteer noticed the difficulty in obtaining water samples throughout the year, with the pond in May only about 400mm deep within reach of the sampling pole. Nonetheless, waterbug sampling in MCW001 in autumn and spring showed a total eight and nine types of bugs, respectively. Spring in particular saw fairly good numbers of sensitive bugs such as mayfly, caddisfly and mites, with four different types of caddisfly larvae detected.

Boardwalk view at McKellar Wetlands (MCW002) (Photo: L.Wensing).

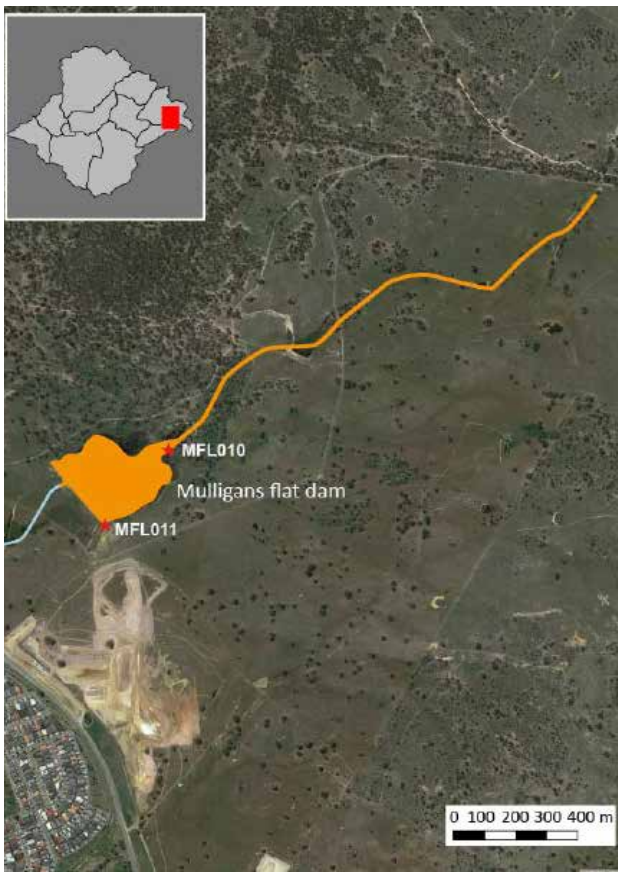
Mulligan's Flat Dam MFL1

Headwaters of Ginninderra Creek to Mulligan's Flat Dam

2019 CHIP Result D+ (Poor)

2018 CHIP Result C- (Fair)

Parameter	Rating	No. Survey
Water quality	**Poor**	**23 (10 dry)**
pH	Excellent	
Turbidity	Poor	
Phosphorus	Degraded	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**2**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 2km
Dominant land uses: Conservation

Mulligan's Flat Dam was originally an old farm dam, now repurposed as an ecological habitat for aquatic life, and native fauna and flora in general. The Mulligan's Flat Nature Reserve was established in 1995 to protect the Box-gum grassy woodlands and associated fauna in the Gungahlin area. The Dam is normally filled with rainwater that is grass-filtered, and is a popular spot for bird watchers. The site plays host to a number of conservation projects and the sanctuary is protected by a predator-proof fence.

Mulligans Flat's main habitat is grasslands and there are high levels of native ground cover vegetation which promote soil stability and provide habitat for small vertebrates, such as frogs, lizards and the New Holland mouse. Most of the 'secondary' grassland communities in Mulligans Flat were created by the early farmers who cleared woodland areas in the region.

In 2019, the effects of the drought have been felt, with site MFL10 being dry all year and MFL11 drying out completely by December.

Waterbugs showed low diversity in autumn and spring sampling, with only four and three species, respectively.

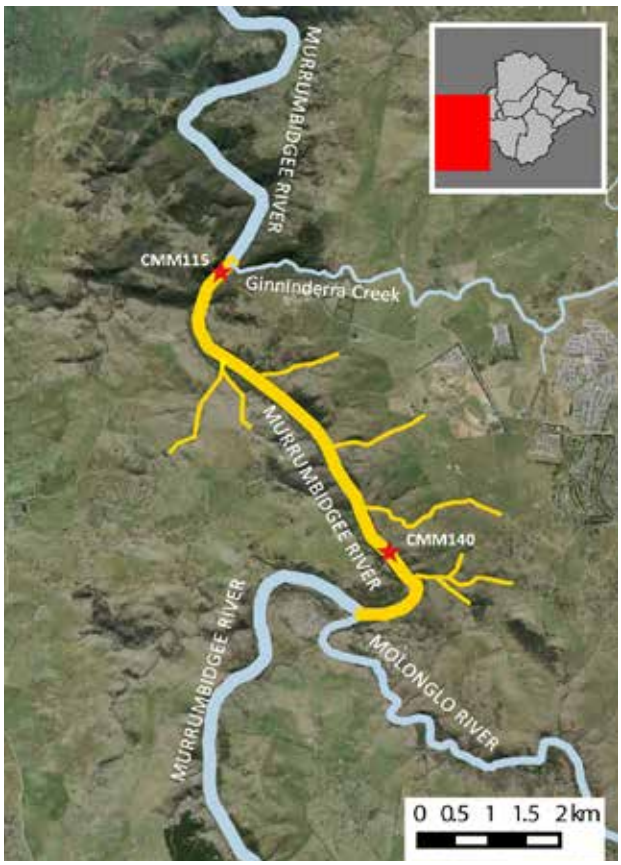
This all resulted in Mulligan's Flat Dam receiving the lowest score in the Ginninderra catchment. Only significant rain will be able to bring it back to its former splendour.

The remnants of the Mulligan's Flat Dam at MFL011.

Murrumbidgee River CMM11

Molonglo River confluence to Ginninderra Creek confluence

2019 CHIP Result C (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**8**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Poor	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 7.1km
Dominant land uses: Conservation, rural

Starting below the confluence of the Molonglo River this reach includes mostly rural land and the Murrumbidgee River Reserve to the confluence with Ginninderra Creek. The reach also includes some sections of gorge country and the upper section of the reach receives the outflow from the Lower Molonglo Water Quality Control Centre (LMWQCC).

A number of high nitrate readings have been recorded in this reach over the past couple of years. This can most likely be attributed to discharges from the LMWQCC as Waterwatch sites on the Murrumbidgee River above the Molonglo River confluence have indicated little to no nitrate present.

In 2019, algal mats were constantly present on the river bed and rocks which may have contributed to the elevated dissolved oxygen readings (121%), well outside the normal range of 88-100% saturation. The high oxygen levels were also a likely contributor to the alkaline pH (8.4).

The shallow and rocky parts of the river have limited potential for macrophytes and other aquatic plants and this reduces the habitat for certain species of waterbugs. Despite recording a higher abundance of waterbug species in spring compared to autumn (nine vs five types), the elevated number of tolerant species in both surveys has delivered a *poor* waterbug score for this reach.

Carp are a common sighting in this reach and occasionally Common eastern froglets *Crinia signifera* are heard.

Volunteer Plaxy measuring turbidity at CMM115.

The Valley Ponds GUN1

Wetland to Gungahlin Town Centre

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**14**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 2km
Dominant land uses: Urban

Originally an old farm dam and artificial seepage grassland, this site was a unique habitat for this catchment. The site has since been redeveloped into urban wetland for the Gungahlin town centre and parts of Palmerston. It is now a high quality education and recreation wetland.

There are low levels of native canopy cover and regeneration in this urban reach and reeds are a common feature in the ponds.

Birralee Scout Group is heavily involved in the sampling in this reach, with Ventures helping in the water testing and Bunyip Cubs and Yowie Pack involved in our autumn and spring waterbug surveys. Our volunteers regularly observe Swamp hens, Black swans and cygnets in the wetland.

In 2019, despite an overall *good* result for water quality, electrical conductivity reached one of the highest values (range: 290-1040 µS/cm) for the urbanised area of Ginninderra Creek. This could be related to the stormwater it receives combined with the effects of the dry conditions, where salts and minerals become more concentrated in the water.

Water boatmen, a waterbug species very tolerant to pollution, was the most common finding in our bug sampling, with more than 500 individuals detected during the autumn survey.

The Valley Ponds.

Yerrabi Pond YER1

Headwaters of Ginninderra Creek to Yerrabi Dam Wall

2019 CHIP Result B- (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban/Rural Fringe

The east arm of Ginninderra Creek originates in the rural lands surrounding the northern suburbs of Gungahlin. It includes the former rural lands, now significant woodland reserve, of Mulligans Flat Sanctuary. The upper section is mostly ephemeral creeks, disconnected by stock dams. It flows into the sediment control pond of Yerrabi. The reach receives a moderate inflow of urban stormwater from surrounding suburbs.

The Riparian vegetation score is largely influenced by the outflow of Yerrabi Pond, which backs onto a concrete channel connected to a main road. The other areas that do contain riparian vegetation are mainly comprised of exotic species, especially in regards to the ground cover. A few scattered trees, with Casuarinas being the most representative native tree, do occur.

Feral fish such as Eastern gambusia and Carp are regularly sighted throughout Yerrabi Pond although it is also stocked with Murray cod and Golden perch fingerlings by the ACT Government's Conservation and Research Unit.

In 2019, this reach had the highest overall score in the Ginninderra catchment and showed a great diversity of waterbugs with nine species in both autumn and spring surveys. It reinforces the importance of urban lakes during drought, serving as a habitat refuge for wildlife such as the Eastern long-necked turtle which migrates to the lake during dry times.

Yerrabi Pond at the dam wall (YER009).

Molonglo Catchment Facts

The Molonglo catchment extends from the Murrumbidgee River, just downstream of Uriarra Crossing, to the headwaters of Molonglo and Queanbeyan Rivers and Jerrabomberra Creek, an area of about 2,000 km^2

This diverse catchment includes the urban areas of Queanbeyan and inner Canberra, villages such as Captains Flat and rural residential areas and farmland including Burra, Royalla and Carwoola. There is new residential development occurring at Googong, south-east of Queanbeyan, and around the lower Molonglo River in the Molonglo Valley. Non-residential areas include native and pine forests, wetlands, national parks and the foreshores of Googong Dam, which supplies some of Canberra's and Queanbeyan's water.

Lake Burley Griffin is on the Molonglo River and collects stormwater and runoff from Queanbeyan, much of north Canberra and Fyshwick industrial area, as well as treated output from the Queanbeyan sewerage treatment plant. Lake Burley Griffin water quality is monitored by the National Capital Authority and information can be found at http://www.nationalcapital.gov.au/WaterQuality/index.php/en/.

The Molonglo catchment has a large population with urban waterways flowing in concrete channels. This is a key issue for urban catchments where there is little riparian vegetation and habitat to slow down flows and capture and absorb nutrients and sediments.

Of the six priority sub-catchments in the ACT Healthy Waterways project, four are in the Molonglo catchment. These sub-catchments are currently the focus of water quality improvement strategies such as wetlands and water-sensitive urban design.

Ten projects that formed part of the ACT Government's Healthy Waterways program have been completed in four sub-catchments of the Molonglo catchment. Water quality improvements are anticipated from these raingardens, wetlands, ponds and waterway restoration projects.

Though water quality across the Molonglo catchment is generally good, when taking account of all our catchment health indicators (water quality, waterbugs and riparian condition), it is the highly urbanised catchments and rural creeks with largely cleared vegetation, that are in the poorest condition.

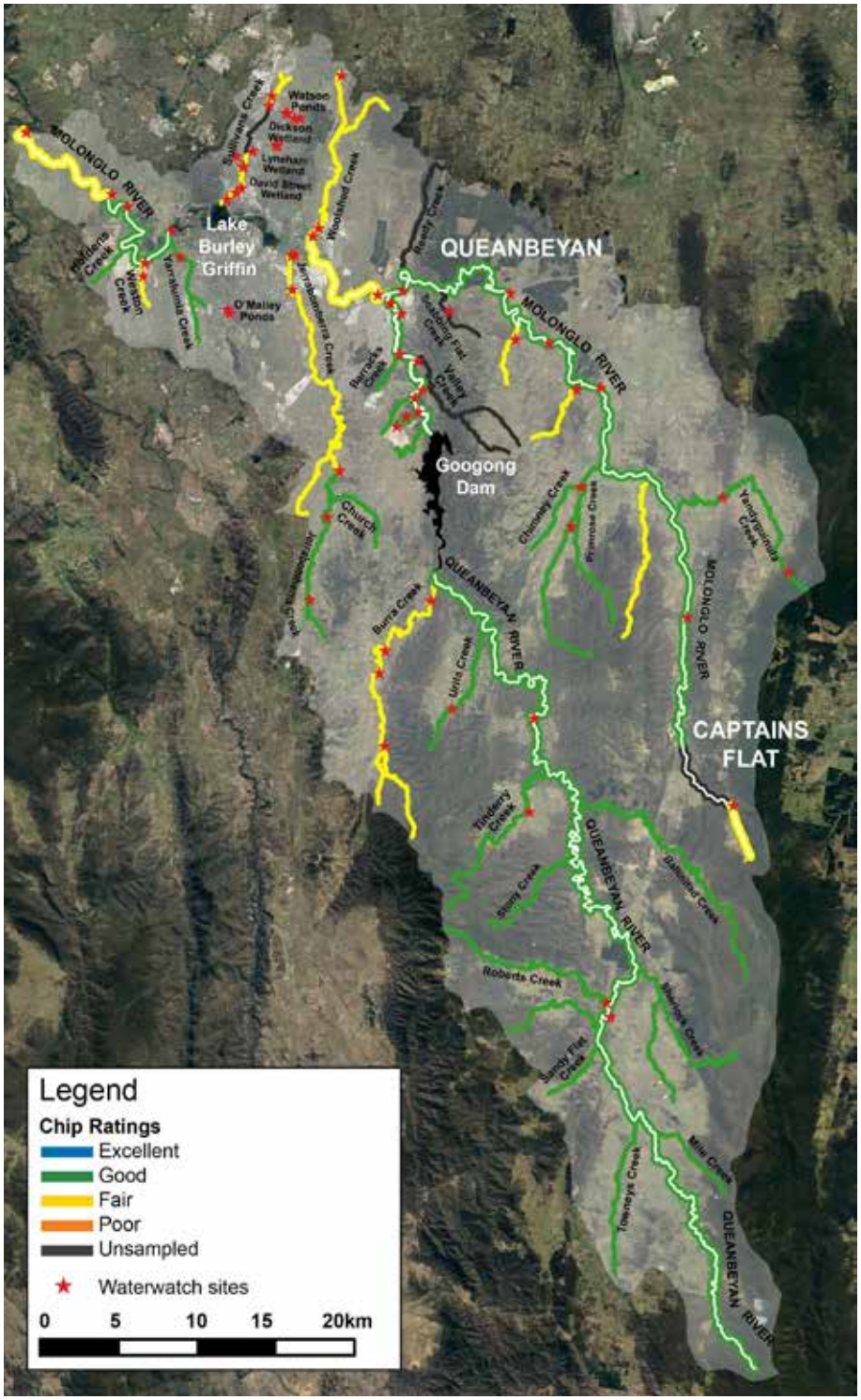
Molonglo Catchment Health Summary

2019 around the Molonglo catchment saw lower rainfall than the previous year, and much lower rainfall than long-term averages. Despite this lack of rain, however, overall water quality unexpectedly improved compared to the previous year: 11 reaches had better water quality, 8 had the same, and 5 had worse water quality.

Overall CHIP ratings improved in 2019, with 14 *good* , 11 *fair*, and one *poor* reach, largely due to the improved water quality.

The improvement was smaller for waterbugs scores but still evident, with six reaches better, 16 the same, and two worse than the previous year.

With so much variation in sites across the Molonglo catchment, explaining the improved water quality is difficult but it may be, as the 2019 ACT State of the Environment report suggests, that "Dry conditions decreased the amount of pollutants entering waterways from rainfall run-off." (ACT SOE 2019, Report Summary p. 41). Five of the 6 reaches with urban wetlands had better water quality this year, supporting this suggestion.



Whilst dissolved oxygen and electrical conductivity ratings are concerning in many reaches, there were fewer incidents of high turbidity captured in 2019 data - this too could be for the reasons stated above. Plant nutrient levels, particularly high nitrate from water treatment plants, and high phosphorus from many of our urban catchments, are an ongoing concern. They require vigilance from land managers, developers and builders, control measures in anticipation of rainfall events, protection of existing vegetation, and future improvements to address these environmentally important issues.

Pleasingly, the ACT Healthy Waterways projects specifically target some of these concerns, and as these raingardens and wetlands' plants establish and begin to function fully, we expect to see improvements in water quality in those sub-catchments.

We also saw improvements in riparian habitat at sites where extensive plantings have been undertaken. All these longer-term projects will benefit water quality, habitats and catchment health, and the people, plants and animals that call them home.

Banksia Street Wetland SUW2

Sullivans Creek in O'Connor

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 0.2Ha
Dominant land uses: Urban, recreation

Banksia Street is an artificial 'off-line' wetland, constructed in 2010. Low flows are diverted from the westerly arm of Sullivans Creek concrete channel to pass through the wetland, then overflow back into the westerly channel when water levels are sufficiently high.

Banksia Street Wetland Carer group look after this loved and well-visited Wetland.

Despite only a *fair* vegetation condition rating, this attractive Wetland has a great selection of riparian, edge and submergent plant species, as well as other habitat features such as logs, rating it the best of the urban Wetlands. Only the upstream sections of some creeks and rivers, with good native vegetation, have attracted a better vegetation score.

The ephemeral section (an area that dries out from time to time) of the Wetland provides habitat for frogs away from the large numbers of feral Eastern gambusia fish, which are voracious feeders known to eat tadpoles and frogs' eggs. When rainfall and inflows are low, however, and water level drops, there is substantially less habitat available for frogs and waterbugs.

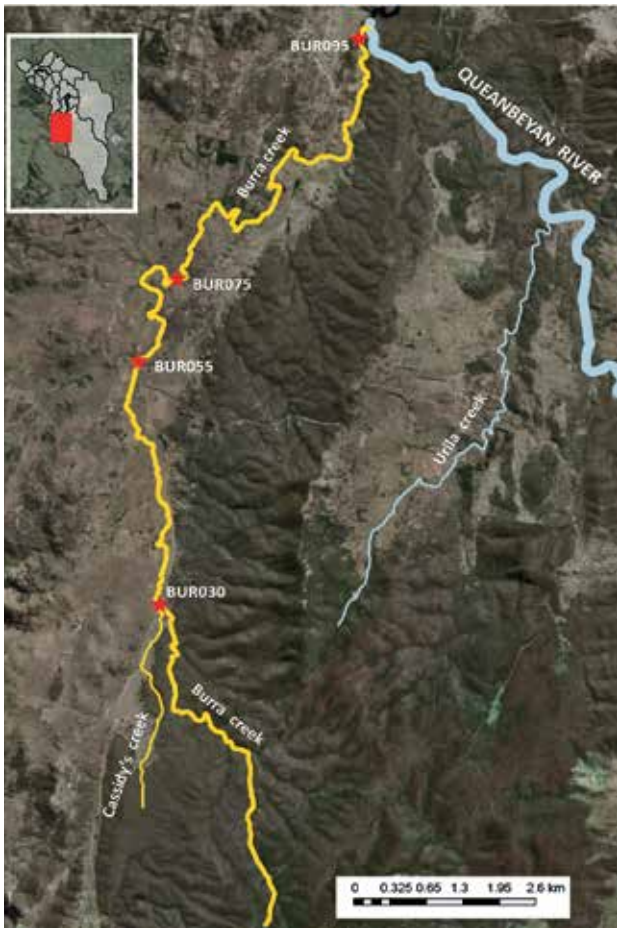
While overall numbers of waterbugs may be low at times, this wetland continues to sustain more sensitive types of waterbugs, supporting indications that overall water quality remains good. This all points to a well-functioning wetland that captures sediment and plant nutrients from the surrounding urban runoff that would otherwise flow into Sullivans Creek.

Banksia Street Wetland volunteers (and Waterwatch video stars!) Louise and Lyn.

Burra Creek BUR1

Headwaters to Googong Foreshores NR

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**47 (3 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**4**



Reach Facts

Reach network length: approx. 40km
Dominant land uses: Native bush, grazing, rural, conservation

Burra Creek arises in the north-western edge of the Tinderry Mountains and flows into the Queanbeyan River just upstream of Googong Dam. It flows through rural subdivisions and includes the outlet of the pipeline from the Murrumbidgee to Googong water transfer scheme, before passing through the southern end of Googong Foreshores nature reserve. Riparian vegetation is largely absent or dominated by Willows and Poplars.

This large reach is highly impacted by historic land clearing, and stock continue to access the creek causing erosion and damage to the minimal riparian vegetation in many places. This lack of vegetation resulted in three out of the four sites being rated as *poor* for riparian condition. With sodic soils (those high in sodium) in the reach, there is also potential for water logging and salt outbreaks, as well as increasing the risk of erosion.

Reed beds along the creek improve water quality and provide habitat for waterbugs. At the waterbug survey site there is a good mix of in-stream habitat. This includes cobbles, pebbles, coarse sand, patches of organic matter, a shallow flowing section, a deeper pool and other areas of vegetation. When there are good flows, these areas all support a good diversity of waterbugs, including many sensitive types.

A recent ACWA report will provide more opportunities for landholders to make improvements that will help stabilise erosion and improve vegetation and water quality.

Volunteer Sarah samples at the Googong Foreshores Nature Reserve site on Burra Creek (BUR095).

David Street Wetland SUW1

Sullivans Creek catchment in O'Connor

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**9**
pH	Good	
Turbidity	Excellent	
Phosphorus	Poor	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 0.21Ha
Dominant land uses: Urban, recreation

David Street Wetland is the second 'offline' wetland along the westerly branch of Sullivans Creek. It was constructed in 2001 and takes a portion of any higher flows from the concrete stormwater channel. These pass through the wetland then overflow back into the westerly concrete channel, just before it joins the main northern branch.

As the oldest and smallest wetland in the inner North, David St Wetland has captured a deep layer of sediment over time, which is part of its intended function. However, such sediment, and a dominance of Acacia trees around the edge, has reduced the growth of water plants and suggests this wetland is not functioning as well as it could to improve water quality. Future tree thinning and understorey planting which includes more shade-tolerant species would improve its functioning.

Dense algal growth and deep sediment make waterbug sampling difficult at this site, and the *poor* waterbug status may not reflect the true condition. However, occasional blue-green algae (cyanobacteria) blooms have been also noted, indicating excess plant nutrients and stagnant conditions.

Plantings at this small wetland are diverse and well established, with successive vegetation assessments only just missing a *good* rating, making this an attractive area, much loved by locals, dog walkers and swimming dogs.

Tall trees surrounding David St Wetland on Sullivan's Creek provide dense shade.

Dickson Wetland DIC1

Sullivans Creek catchment

2019 CHIP Result B+ (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**14**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Good	
Waterbug	**Fair**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach area: approx. 1Ha
Dominant land uses: Urban

Dickson Wetland was constructed in 2011 and is on the lower western slopes near Mt Majura. A large concrete stormwater channel is fed into the constructed wetland, but during high rainfall events the wetland is bypassed. Water from the wetland flows back into the concrete channel and through to Lyneham Wetland, just upstream of the confluence with Sullivans Creek.

This urban wetland has in recent years had one of the three highest water quality ratings in the Molonglo catchment. It has often had pristine looking water even when many creeks and river sites were barely flowing, however water levels dropped considerably in 2019 and a fire also impacted the reeds and trees in one area. Algae is much less evident here compared to the other urban wetlands which may be thanks to the *excellent* nutrient readings.

The Wetland often has large numbers of feral fish including Eastern gambusia, and Redfin perch which make it an attractive place for cormorants.

Dickson Wetland has a diverse habitat of logs, rocks, different water depths, and varied, mostly native plantings. This has seen waterbugs continue to be diverse, with sensitive types well represented. This is despite the reduced waterbug habitat available because of lower water levels in 2019.

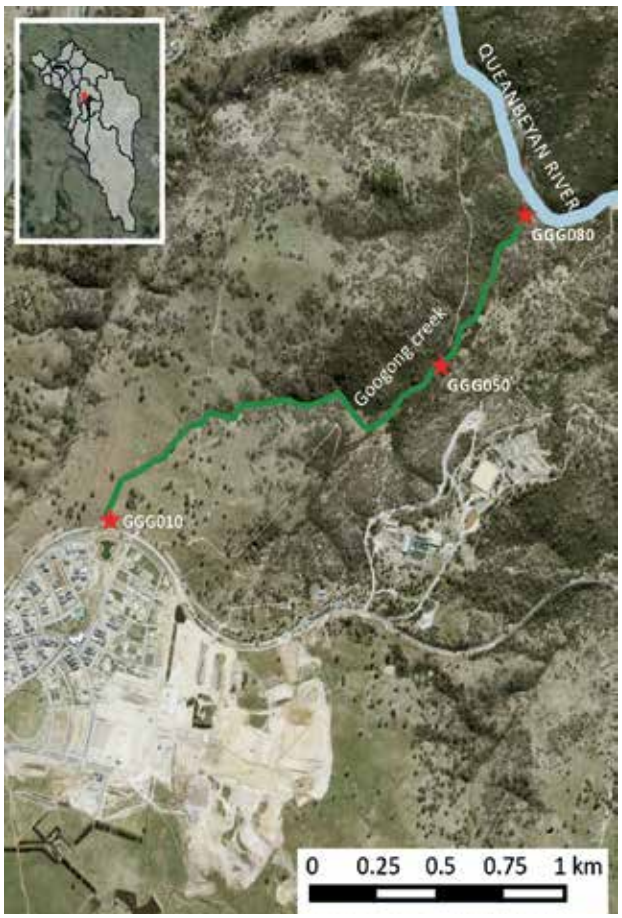
Local residents do weeding and clean up rubbish around the area, which now has well-established native plantings, making this well-designed Wetland and surrounding landscape highly valued by locals and visitors alike.

The good diversity of edge vegetation is starting to mature at Dickson Wetland.

Googong Creek GGG1

Headwaters to Queanbeyan River confluence

2019 CHIP Result B (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**26 (2 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Waterbug	**No Data**	**0**
Riparian condition	**Fair**	**3**



Reach Facts

Reach network length: approx. 2.5km
Dominant land uses: Native bush, grazing, urban, infrastructure, rural residential

Googong Creek rises in the developing township of Googong and runs into the Queanbeyan River downstream from Googong Dam. It passes through a stormwater holding dam on the edge of Googong township and crosses a pipeline access track, creating a second dam on the creek.

There is a weir in the downstream section before the creek reaches the Queanbeyan River upstream of Wickerslack Lane. Googong Creek flows intermittently but now takes discharge from the Googong water recycling plant.

A *degraded* nitrate score is most likely a result of the above-mentioned water recycling plant. Volunteer Sue would usually detect the highest reading (up to 20mg/L) when the plant was discharging water. Dissolved oxygen was highly variable, despite the *excellent* rating. On a better note, concerning high turbidity from previous years has not been seen, with only a single high reading following the highest rainfall for over six months in the region.

Beltana Pond, at the top of this reach, is fed via a channel which passes through the township hub and recycles grey water through reed beds. It is above the discharge point for the water recycling plant. Beltana Pond has diverse edge vegetation, riparian trees and shrubs which are starting to establish. There are also walking tracks and an observation platform, making this a lovely asset to the township of Googong.

Platypus were regularly sighted by Sue on the Queanbeyan River just above the confluence with Googong Creek.

Champion Waterwatch volunteer, Sue Gibson, at the middle site on Googong Creek (GGG050).

Jerrabomberra Creek JER1

Headwaters to Fernleigh Drive

2019 CHIP Result B- (Good)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19 (2 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Fair**	**3**

Reach Facts

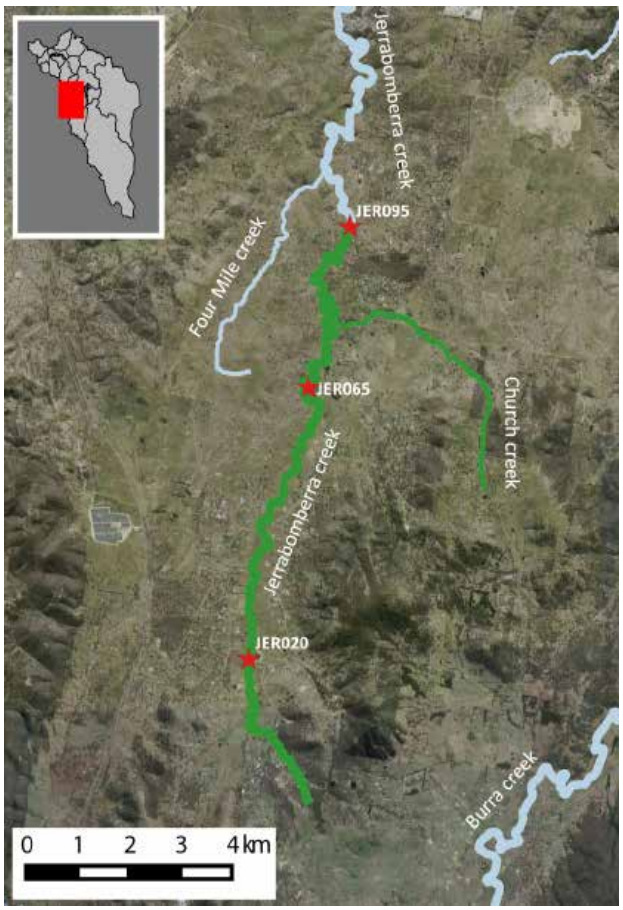
Reach network length: approx. 15km
Dominant land uses: Native bush, Rural residential,

Jerrabomberra Creek arises in the hills surrounding the rural residential area of Royalla along the south-east side of the ACT border. This reach, including a number of small tributaries, has varying degrees of riparian condition ranging from healthy sections, areas through rural subdivisions with very little riparian vegetation and sections with deep gully erosion.

There are new areas of development on the Church Creek tributary with potential to impact this reach, and these developments are largely dependent on groundwater. This increasing use of groundwater has the potential to impact stream flows.

Electrical conductivity is likely to remain *poor* in this catchment in the near future because of long term land clearing. This may be helped over time as Landcare plantings along the creek continue to grow. Overall streambank vegetation condition has improved, despite the dry conditions over two successive years.

When the creek is flowing, the generally good water quality and improving habitat supports good numbers of pollution-sensitive waterbugs including stoneflies, mayflies and caddisflies. When surface flows are low or cease, refuge pools retain water for many months. Areas with pools and vegetation are vital for wildlife, with regular reports at JER020 of a diversity of bird species and frogs. These important habitats enable wildlife to persist and then disperse throughout the creek system again once flows return.

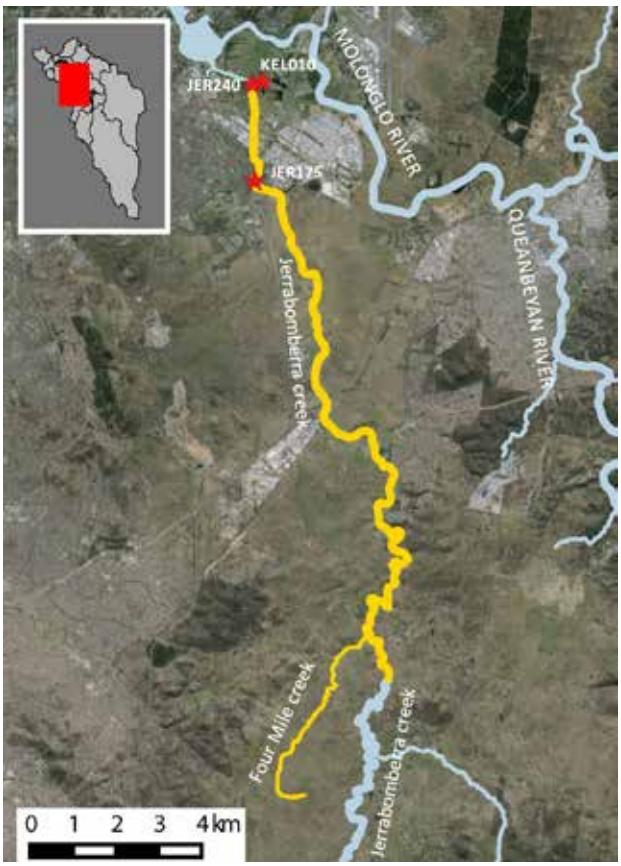


Gully erosion evident on Jerrabomberra Creek upstream of JER020.

Jerrabomberra Creek JER2

Fernleigh Park to Molonglo River confluence

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**32 (3 dry)**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 19km
Dominant land uses: Rural residential, light industrial, urban, conservation, recreation

This reach flows from Fernleigh Park, past residential, rural and industrial areas and a grassland reserve, before ending at the Jerrabomberra Wetlands Nature Reserve. The water in the bottom part of this reach is backed up and slowed down by Scrivener Dam, which contains the waters of Lake Burley Griffin.

This reach has played host to three wetland projects aimed at improving water quality under the ACT Healthy Waterways Program that were all completed in 2019. Water has been diverted off the main channel of Jerrabomberra Creek and sent down a variety of wetlands structures such as swales, bogs and ponds.

Jerrabomberra Wetlands Nature Reserve also has an ephemeral wetland, Kelly's Swamp. It naturally has higher nutrients (like phosphorus), electrical conductivity and turbidity and the cycle of wetting and drying in the Swamp provides rich habitat for an array of birds and other aquatic fauna. It has its own Waterwatch site (KEL010) which tends to pull down the overall CHIP score. As it has been dry for several months this year, the overall water quality score for the reach has improved.

Jerrabomberra Creek within the Nature Reserve plays host to a number of surveys on Platypus and Rakali (native Water rat) during Platypus Month.

A sewage overflow impacted this reach in September and was reported by the local Waterwatch volunteer.

Platypus survey on Jerrabomberra Creek (JER240) during Platypus Month 2019.

Lyneham Wetland LYN1

Sullivans Creek catchment off Wattle Street Lyneham

2019 CHIP Result D+ (Poor)		
2018 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**11**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Degraded	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**1**
Riparian condition	**Poor**	**1**

Reach Facts

Reach area: approx. 1Ha
Dominant land uses: Urban

Lyneham Wetland is a large artificial wetland constructed in 2011–12 fed by stormwater from surrounding suburbs, including Dickson and the large concrete stormwater channel which flows from Dickson Wetlands. Unlike Dickson Wetlands, however, this is an 'online' wetland which takes all runoff, including high flows following storms. Lyneham Wetland overflows into Sullivans Creek when water levels are sufficiently high.

Water quality has dropped over successive dry years, with phosphorus levels particularly concerning. It's not clear what the reason for this is, however if the bottom layer of water in the wetland is depleted of oxygen, this can result in a chemical reaction that releases existing phosphorus from the sediments into the water column.

Waterbugs continue to indicate *degraded* conditions. Small pollution tolerant crustaceans, particularly Daphnia, continue to dominate. This Wetland has water pumped from it as part of the Inner North Reticulation Network. In October, volunteers Lyn and Louise noted "hardly any water, it's like the plug has been pulled out". If the water level drops and leaves the water edge plants high and dry, available habitat for waterbugs is limited. Getting the balance between water recycling, water quality treatment and biodiversity can be a challenge at times in urban wetlands with multiple uses such as this one.

Pleasingly, there is less rubbish again this year in the Wetland compared to earlier years.

Lower water levels at Lyneham Wetland expose the bare banks and limits available water bug habitat.

Molonglo River MOL1

Headwaters to Captains Flat

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**No Data**	**0**
pH	NA	
Turbidity	NA	
Phosphorus	NA	
Nitrate	NA	
Electrical Conductivity	NA	
Dissolved Oxygen	NA	
Waterbug	**Good**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 3.5km
Dominant land uses: Conservation, grazing, rural residential

From its origins in the north-western section of Tallaganda National Park in the Great Dividing Range, the Molonglo River flows north through grazing properties to Captains Flat. Apart from the uppermost section of the reach, which is wet sclerophyll forest, it is largely cleared rural land with limited riparian vegetation.

This is a valuable reference reach for the Molonglo River, being upstream of the Captains Flat mine, but it continues to lack water quality data due to the absence of a volunteer. Thus, only waterbugs and riparian condition surveys are contributing to the overall CHIP score. Please contact us if you're interested in adopting this site where passing locals often stop for a chat.

Despite the low flows, good diversity and large numbers of sensitive waterbugs were found in both the spring and autumn surveys, giving this reach the best waterbug score in the catchment. This reflects the good waterbug habitat provided by dense in-stream vegetation, diverse water-edge plants and a large old Eucalyptus tree giving shade and shelter to the site.

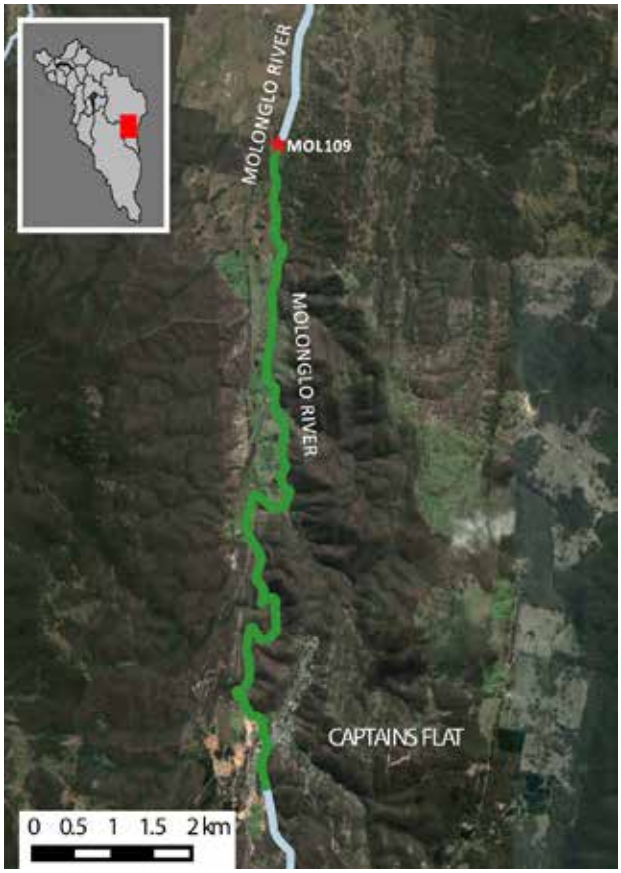
Unusually, there were no frogs or fish detected in the autumn survey, but in spring we heard three frog species despite the drier conditions. There was also evidence of stock directly accessing the waterway immediately upstream of the sample site, potentially causing erosion and reducing water quality.

John, one of our champion Waterwatchers, helps with waterbugs on the upper Molonglo River.

Molonglo River MOL2

Captains Flat to Travelling Stock Reserve

2019 CHIP Result B (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12 (3 dry)**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Excellent**	**1**



Reach Facts

Reach network length: approx. 10km
Dominant land uses: Grazing, rural residential, mining (historical)

The upstream section of this reach of the Molonglo River begins below the Captains Flat Dam. Leachate from a mine closed in the 1960s continues to contaminate the river with acid minewater and potentially with heavy metals. The Molonglo flows mostly through modified rural land and finishes at the Travelling Stock Reserve (TSR) at 'Foxlow'.

This reach had the only *excellent* riparian condition score in the Molonglo catchment but, with only one site, this score is not representative of the majority of the reach. It does, however, indicate the importance of this TSR in providing excellent habitat and refuge for birds and other animals. It is also a vital connection to Yanununbeyan National Park which extends into higher altitudes. Waterwatchers Wendy and Steve often noted signs of feral animals eg. *"Lots of goat droppings"*, as well as many rare native woodland birds and a few frog species.

Exotic Broom (Cytisus and Genista species) dominates the riparian area immediately across the river and has been an issue in this reach. Despite some localised effective control in recent years, ongoing control is needed to effectively manage this serious and dominating plant.

It is concerning that flows were very low for most of the year, and the river stopped flowing twice, with only one pool enduring in the TSR by December. This lack of water resulted in waterbug scores that were one of the worst in the catchment this year.

The dry Molonglo River at the Travelling Stock Reserve showing the intact riparian zone (Photo: S.Hodgman).

Molonglo River MOL3

Downstream of Travelling Stock Reserve near 'Foxlow'

2019 CHIP Result B- (Good)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**50 (1 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**1**
Riparian condition	**Fair**	**5**

Reach Facts

Reach network length: approx. 54km
Dominant land uses: Grazing, rural residential

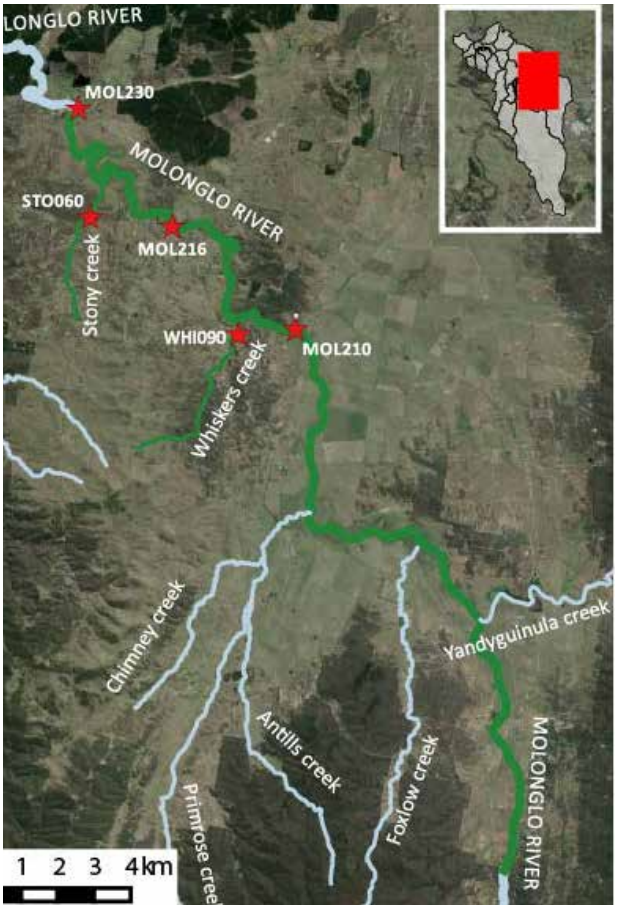
This reach extends from below the Travelling Stock Reserve south of 'Foxlow' to Burbong Bridge on the Kings Highway and flows through modified rural land and rural subdivisions. The reach includes Plains Creek, Whiskers Creek and Stony Creek, with runoff from the Hoskinstown Plain, which as a frost hollow, is largely treeless.

Willows continue to re-establish along this reach, and riverside vegetation at many sites is either dominated by exotic species or absent for large stretches. Large rural properties with highly cleared landscapes dominate the main river channel, but some of the smaller creeks have better vegetation condition.

A localised rainfall event in April of 60+ mm was reported by Waterwatch volunteers in the nearby area. It caused a flash flood and major changes to the smaller creeks in the Carwoola area, carrying huge boulders and reshaping creeklines.

The smaller tributaries of Stony and Whiskers Creek often have some of the highest electrical conductivity results in the catchment with Stony Creek regularly in excess of 1000µS/cm in 2019. That said, the influence of these creeks on the overall result is small, particularly given the low flows recorded this year.

With little or no flow at most sites in this reach over the past two years, Waterwatchers have noted the importance of pools to the local wildlife. For example, "Footprints of wombats, kangaroo and Water rats on muddy bank" was noted by Hilary at Whiskers Creek in January.



Handing over Stony Creek site from long term Waterwatchers Christine and Hilary to new recruit Blaine, who is also testing at Whiskers Creek.

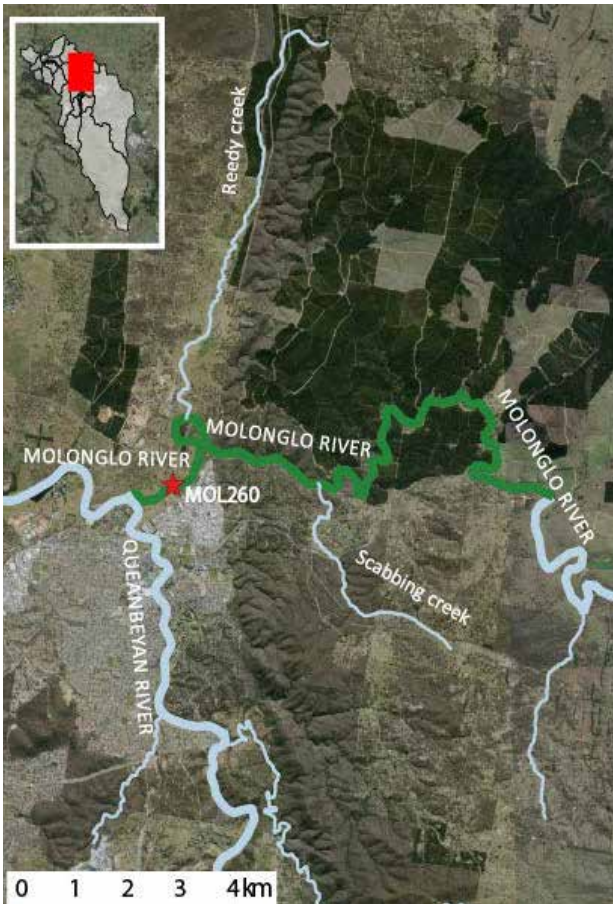
Molonglo River MOL4

Downstream of Burbong Bridge to Queanbeyan River confluence

2019 CHIP Result B- (Good)

2018 CHIP Result C+ (Fair)

Parameter	Rating	No. Survey
Water quality	**Excellent**	**10**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Good	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**1**



Reach Facts

Reach network length: approx. 16km
Dominant land uses: Grazing, rural residential, forestry, conservation, urban

This reach begins downstream of the Kings Highway at Burbong Bridge on the NSW/ACT border, passes through the southern section of Kowen Forest pine plantation, and through Molonglo Gorge with its faster flows and intact native vegetation, and ends above the confluence with the Queanbeyan River at Oaks Estate.

Water quality in 2019 was better than the previous year, with improved dissolved oxygen, but the turbidity was variable (9-80NTU).

The low flows reduced available habitat and there were lower numbers of most types of waterbugs. One highlight in the spring waterbug survey was three types of damselfly nymphs with their very distinct three “tails” (actually gills). A highlight in the autumn survey was three types of freshwater mites (Acarina), one of them with distinctive red patterning similar to a red-back spider and bright blue legs.

Extensive riparian plantings immediately upstream were unfortunately heavily impacted by lack of rain and high temperatures in 2019, but any plants that survive will improve this reach progressively over time, both through improved habitat and the flow on effects to water quality.

This reach is monitored at only one site and another volunteer to monitor an additional site upstream would greatly enhance our knowledge of this section of river.

The spring water bug survey at MOL260 found three different types of damselfy nymphs.

Molonglo River MOL5

Upstream of Lake Burley Griffin

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**15**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban, industrial, horticulture, grazing

This section of the Molonglo River begins at its confluence with the Queanbeyan River at Oaks Estate, continues on past the Queanbeyan Sewage Treatment Plant near Beard, Fyshwick industrial estate and Pialligo nurseries, close to Canberra airport, then passes an extensive turf growing business. It forms the northern boundary of Jerrabomberra Wetlands Nature Reserve before entering Lake Burley Griffin.

Much of the water in this part of the Molonglo River is backed up and slowed down by the presence of Scrivener Dam at the bottom of Lake Burley Griffin. Unusually, the low inflows and high evaporation this year have resulted in Lake Burley Griffin's water level dropping half a metre.

Lower water levels did not appear to affect the waterbugs this year, with reasonable diversity for a site with little habitat variation. The water was teeming with Copepods (tiny crustaceans) in the autumn survey and had an abundance of waterboatmen (Hemiptera or 'true bugs') in both autumn and spring.

There were fewer high nitrate readings this year for the reach overall, although readings were still concerning, with six *degraded* readings (3 mg/L or more) at site MOL295.

With many large deciduous trees lining this section of the river, leaves and the fluff from white Poplar trees is often evident.

New Waterwatcher Ollie Andrews helping with the spring water bug survey at MOL295.

Molonglo River MOL6

Scrivener Dam to below Deep Creek confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 10km
Dominant land uses: Urban, grazing, conservation

This section of the Molonglo River extends from downstream of Lake Burley Griffin to below the Deep Creek confluence, due south of Kama Nature Reserve. This reach encompasses the new and future Molonglo Valley urban developments and the Molonglo River Reserve runs its entire length.

The bottom site has been split off into a new reach (MOL7) because it differs so markedly from this upstream section due to inputs from the Lower Molonglo Water Quality Control Centre. This has resulted in a slight improvement to the water quality score for this reach.

Despite an *excellent* score for turbidity, this reach has suffered over 2019 from high turbidity following significant rain events. Both resident Rangers and Waterwatch volunteers have photographed muddy inflows coming off the Denman Prospect and Whitlam developments into the Molonglo River.

This reach contains one of five sites where annual Platypus Month surveys are conducted by Waterwatch. Two to three Platypus have been recorded at surveys during the previous two years but no platypus were observed at the four surveys in 2019. More details can be found in the summary of Platypus Month 2019 at the end of this report.

The in-stream habitat and riverside vegetation in the Molonglo River Reserve should improve over time as rehabilitation works are carried out. This will improve connectivity and assist a range of flora and fauna including the endangered Pink-tailed worm-lizard.

Faithful assistant 'Rocky' helps out during riparian assessments below Scrivener Dam (MOL330).

Molonglo River MOL7

Deep Creek confluence to Murrumbidgee River confluence

2019 CHIP Result C (Fair)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**9**
pH	Fair	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 16km
Dominant land uses: Urban, infrastructure, grazing, conservation

This new reach on the Molonglo River was formerly the downstream section of MOL6. It extends from below Deep Creek confluence to the Murrumbidgee River confluence. It includes the new Molonglo River Reserve and the Lower Molonglo Water Quality Control Centre (LMWQCC) just above the confluence.

The reach is strongly impacted by outflows from the LMWQCC, with nitrate levels at least ten times higher than upstream and most other sites in the catchment (12-60 mg/L) and electrical conductivity also being much higher than the next site upstream (range 460-770 µS/cm). There were higher phosphorus levels detected in the last few months of 2019 (0.04 - 0.17mg/L) which is likely, in part, due to low river levels not sufficiently diluting the outflows.

Water temperature remains high over the cooler months (min 15.5 degrees C in July), with the temperature and higher nutrients the likely cause of consistently notable amounts of algae.

Carp are often observed here although, pleasingly, a 30cm Murray Cod was spotted by the Waterwatch volunteer in May.

Some unusual waterbugs are found in this reach from time to time. This year, moth larvae (Leptoceridae) and net-spinning caddisfly larvae (Hydropsychidae) were amongst the waterbugs detected. The net-spinners are common in flowing water and spin their nets from silk, similar to their close relative the moth.

Waterwatch sampling at MOL401.

Primrose Creek PRI1

Headwaters to Molonglo River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 34km
Dominant land uses: Conservation, grazing, rural

Primrose Creek is a chain of ponds flowing mostly through rural land. Its headwaters are in Yanununbeyan State Conservation Area and Mount Foxlow. It includes Chimney Creek and Antills Creek, and flows into the Molonglo River near Carwoola. The lower section of Primrose Creek is actively eroding. Except at the headwaters of Primrose Creek and Antills Creek, there is little or no native riparian vegetation, and just a scattering of exotic trees.

High electrical conductivity is associated with low flows in these ephemeral streams, resulting from the geology and hydrology of the local area as well as extensive historical land clearing.

There are frequently horses, cows and sheep in or near the creeks, potentially causing erosion, damaging in-stream vegetation and reducing water quality.

Despite all this, Primrose Creek itself has diverse aquatic vegetation and is often teeming with life - even though it is known to freeze over in winter. It is always impressive how many diverse waterbugs, including sensitive types, are found in this small but ecologically important creek, even following long periods of low flows.

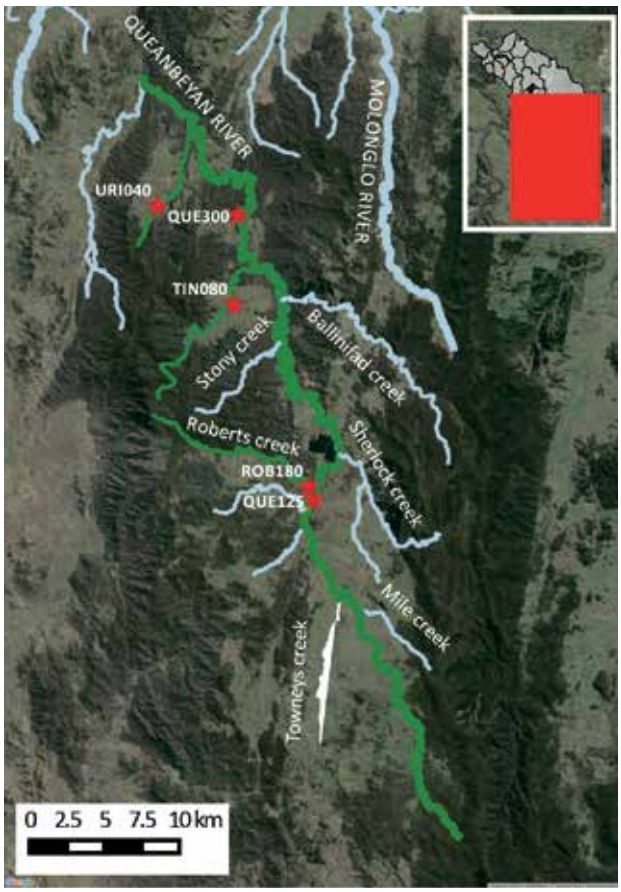
An Eastern long-necked turtle and Mountain galaxias (small native fish) have been seen in previous years.

Colleen McMahon sampling at Chimney Creek (photo: N.Loades).

Queanbeyan River QUE1

Upstream of Googong Dam

2019 CHIP Result B+ (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**55 (23 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**2**
Riparian condition	**Fair**	**5**



Reach Facts

Reach network length: approx. 143km
Dominant land uses: Conservation, grazing, rural residential

This reach is the largest in the catchment. The upper section of the Queanbeyan River runs from its origins on the southern slopes of the western Tinderry Ranges to Googong Dam in the north. The reach includes Sherlock, Urialla, Tinderry, Lyons, Roberts and Bradleys creeks.

Sites on this reach have some of the best vegetation condition scores in the Molonglo catchment. Despite some cleared rural areas, the land surrounding the upper Queanbeyan River has largely intact native vegetation, with trees, understorey and good groundcover vegetation. This all enhances the catchment's ability to capture and slow down runoff which improves water quality and helps the groundwater to recharge.

Tinderry and Urialla Creeks were dry again all year, and even the Queanbeyan River ceased flowing at QUE300 in March and again late in the year, with volunteer Sandy noting an 'eerie silence in a normally gushing scene'.

This reach is exceptional in having no Carp, but there are often signs of feral deer. There were also regular sightings of Platypus in earlier months of 2019 and again seen in the deeper refuge pools in November when the river had stopped flowing. Such pools are vital for the Platypus' survival.

Waterbugs continued to be diverse this year but there were fewer sensitive types and lower numbers overall. Unusually for the bottom site on this reach, abundant fine, green filamentous algae was noted in the autumn bug survey.

Long term Waterwatcher Sandy at our spring water bug survey.

Queanbeyan River QUE2

Downstream of Googong Dam to city of Queanbeyan

2019 CHIP Result B+ (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**45 (2 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**2**
Riparian condition	**Fair**	**5**

Reach Facts

Reach network length: approx. 6.7km
Dominant land uses: Urban, rural residential

This section of the Queanbeyan River extends downstream from Googong Dam to the edge of Queanbeyan city. Googong, Montgomery and Gorge Creeks near the Googong township, feed into this reach and have their own Waterwatch sites. The Valley Creek flowing out of Cuumbuen Nature Reserve also feeds into this reach. Googong Creek (GGG1) is treated as a separate reach in this report.

Less water was released from Googong Dam into the Queanbeyan River over 2019 because of low inflows to the dam. This resulted in river flows being reduced to about one-third of usual flow. However, a continued regime of "riffle releases" every 2 months saw short-term high flows released with the aim of flushing out the build-up of algae from shallower, rocky sections of the river. This helps to restore the functioning of these riffle sections which are important habitat zones and also helps to oxygenate the water.

Montgomery Creek was dry for the final two months of the year, but Gorge Creek continued flowing well again all year, despite being a small creek in a small subcatchment.

Given the Queanbeyan River here receives water from Googong Dam, it has some of the best water quality in the catchment. The only parameter to not score an *excellent* result was electrical conductivity. This is in part due to low flows, especially in the smaller tributaries, leading to the salts and minerals in the water becoming more concentrated.

A Rakali (native Water rat) was sighted by the Waterwatch volunteer at QUE455 in April.

New volunteer Chad on the Queanbeyan River below Googong Dam (QUE430).

Queanbeyan River QUE3

Queanbeyan city to Molonglo River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**26**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Good	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 9.4km
Dominant land uses: Urban

This section of the Queanbeyan River extends through the city of Queanbeyan to its confluence with the Molonglo River. It takes runoff from Queanbeyan and its suburbs, Cuumbuen Nature Reserve and the eastern slopes of Mt Jerrabomberra. The reach includes Barracks Creek and the Queanbeyan Weir.

A large new bridge over the Queanbeyan River, a long-planned bypass of Queanbeyan city, is nearing completion in the upstream section of this reach. It will be important to monitor this section of the reach for potential impacts as it holds some important ecological values such as some excellent Frogwatch sites with high abundance and diversity.

River vegetation condition along the reach is variable, There are, however, native plantings continuing in the lower part of the reach which may improve the riparian condition score over time.

The waterbugs at the bottom site (QUE495) were low in numbers despite good available habitat for waterbugs. That said, diversity was reasonable overall, with seven species of caddisfly larvae (Trichoptera) detected.

Three feral fish species were caught during the spring waterbug survey: Oriental weatherloach, young Carp and Eastern gambusia.

Platypus are seen regularly in this reach with Waterwatch running Platypus walks for the public here every year during Platypus Month.

Queanbeyan River (QUE495) under railway bridge at Oaks Estate.

Scabbing Flat Creek SCA1

Headwaters to Kings Highway

2019 CHIP Result DD (Data Deficient)		
2018 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**DD**	**10 (10 dry)**
pH	DD	
Turbidity	DD	
Phosphorus	DD	
Nitrate	DD	
Electrical Conductivity	DD	
Dissolved Oxygen	DD	
Waterbug	**No Data**	**0**
Riparian condition	**Good**	**1**

Reach Facts

Reach network length: approx. 5.1km
Dominant land uses: Conservation

Scabbing Flat Creek is an ephemeral creek (intermittently flowing) which arises in Cuumbeun Nature Reserve. Most of the catchment is in the Nature Reserve, which is high value Grassy Box Woodland, bisected by Captains Flat Road. The Kings Highway marks the northern edge of the Reserve and the creek flows in a concrete culvert under the Kings Highway, where it eventually flows into the Molonglo River beyond this reach.

The creek was dry for all of 2019. Such a small ephemeral creek is too small and fragile to sample waterbugs. It is, however, an ecologically important creek which rapidly begins to hum with life when the water returns.

Volunteer John continued to visit the site each month in the hope there would be water to test.

With access to the downstream end of the site largely restricted, the dumping problems of previous years are much reduced, and only the rubbish from earlier years and the council roadwork piles remain.

The photo below shows how beautiful the creek is upstream in Cuumbean Nature Reserve when there is water. The stream forms pools and disappears underground for short distances.

Scabbing Flat Creek in Cuumbean Nature Reserve, back in 2018.

Sullivans Creek SUL1

Headwaters to Randwick and Flemington Road Pond, Mitchell

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 6km
Dominant land uses: Conservation, grazing (historical), industrial

Sullivans Creek originates in Goorooyarroo Nature Reserve, flowing through historical grazing land then into a concrete stormwater channel. It then flows through the new suburb of Kenny, west of Watson, and adjoins the industrial area of Mitchell where it includes the stormwater channel from Exhibition Park (EPIC) and flows through two constructed wetlands. The two Waterwatch sites are located at the inflow and outflow of the most downstream of these wetlands (Flemington Pond).

Earlier in 2019, the Waterwatch volunteer noted a lot of rubbish at SUL015 both in and around the water, much of it apparently coming from an adjacent construction storage yard. Despite this, there is generally a good diversity of water birds using the wetland. One exception was in June, when a cooking oil spill in Mitchell, or possible residue from the clean-up, impacted the wetland. The birdlife on the pond was notably 'reduced' but had returned again by the July sampling.

Phosphorus levels in the wetland continue to exhibit concerning spikes with over a quarter of the readings being between 0.06-0.1 mg/L.

Waterbugs were diverse and in good numbers though were dominated by more pollution tolerant species. The bug diversity is assisted by the good density of water plants surrounding the wetland and some diversity of habitat along the substrate. Sampling for waterbugs at Flemington Pond, however, can be difficult at times due to the strong, dark green strands of algae that are often present there.

Volunteer Philippa takes a water sample from Flemington Pond.

Sullivans Creek ANU SUL3

Lyneham Wetland to Lake Burley Griffin confluence

2019 CHIP Result C+ (Fair)

2018 CHIP Result C+ (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**33**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network length: approx. 3.7km
Dominant land uses: Urban, recreation

Once known as Ngambri Creek, this section of Sullivans Creek flows into a concrete channel through playing fields and parklands in O'Connor and Turner. It crosses under a number of minor roads and through the Barry Drive gross pollution trap, before entering ANU campus. It passes Toad Hall Pond before continuing through the campus, flowing through some short reed-filled sections and on into Lake Burley Griffin.

Feral fish are regularly recorded in the lower section of Sullivans Creek, with Carp observed spawning and Eastern gambusia seen in large numbers. On a better note, native Western carp gudgeon fish are also common and there are regular sightings of Rakali (native Water rats).

High phosphorus is a continuing problem in this reach, increasing the potential for algal blooms in Lake Burley Griffin. Water quality in this large urban catchment could be improved if more sections of the creek supported vegetation or were filtered through functioning wetlands.

Water quality is similar from year to year because water from Lake Burley Griffin backs up into the creek and provides stable conditions. The waterbug surveys show diversity with eleven bug types found but with most of these being pollution-tolerant. The spring survey saw black water, caused by inflows of carbon rich organic matter following rain. There were larger numbers of waterbugs in this survey than in autumn.

Water levels in Lake Burley Griffin influence the lower sites on Sullivans Creek.

Watson Wetlands and Ponds WAT1

Justice Robert Hope Park to Aspinall Street

2019 CHIP Result B (Good)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**19**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 1.4km
Dominant land uses: Conservation, urban

Watson Wetlands and ponds are on the lower western slopes of Mt Majura. They comprise a drainage line, with two dams, in remnant yellow box/ red gum grassy woodland, which overflow during high rainfall. Further down, a small constructed wetland receives runoff from the adjacent suburb, and a small wetland "soak" takes overflows at the bottom of the reach. The water then flows via pipes into Sullivans Creek.

The land between Justice Robert Hope Park and Mount Majura was recently rezoned as nature reserve to extend the area of yellow box/red gum grassy woodland under protection from development.

With big differences in the sites along this reach, water quality sampling this year was done in the North Watson Wetland (WAT010) and the bottom-most wetland "soak" (WAT040). This resulted in more stable water levels, less variable water parameters and the best water quality in the Molonglo catchment this year.

There are often very high numbers of the feral fish, Eastern gambusia, at both these sites. This fish can be detrimental to frog breeding success.

Waterbugs are always sampled at the bottom site. The reeds, sedges and aquatic plants there are healthy and dense, supporting a variety of waterbugs in this small pool. This year they were lower in numbers and heavily dominated by pollution tolerant types which is most likely a result of the dry conditions.

North Watson Wetland (WAT010).

Weston Creek WES1

Headwaters to Molonglo River confluence

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 6.7km
Dominant land uses: Urban

This reach includes drainage from the western side of Mt Taylor, and Stirling Ridge. It flows in a concrete stormwater channel through the Canberra suburban area of Weston Creek before entering ponds south-east of the new Molonglo development. It then passes close to the new Molonglo development's eastern side and on to the confluence with the Molonglo River.

During drier times, most water at the downstream site (WES450) comes from underground storage. This flows out into a small pool and on through a dense reed bed before flowing down a more natural, narrow channel to the Molonglo River. Upstream of the pool, a concrete channel carries any overflow water from the large connected ponds beside Cotter Road.

As with similar urban catchments, flows can vary considerably, with evidence of short term and very high flows after heavy rain.

Phosphorus is an ongoing concern in this reach as well as spikes of higher nitrate, making algal blooms more likely. Eutrophic conditions were noted in March with black water and low dissolved oxygen at WES410, and blue-green algae (cyanobacteria) was observed in February and March at the downstream site (WES450).

Two fishing spiders (Dolomedes sp.) were found in the spring waterbug survey, and blackfly larvae (Simuliidae) are a common feature of this site. Blackfly larvae are filter feeders in fast-flowing water.

Weston Creek (WES450) with the Molonglo Valley houses in the background.

Woolshed Creek WOO1

Headwaters to Molonglo River confluence

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 19km
Dominant land uses: Rural, urban, site of Majura Parkway

Woolshed Creek originates at a farm dam situated over a spring. It flows through highly modified rural land with some native riparian vegetation in the upper sections and some significant waterholes. Two short sections of the creek were moved to make way for Majura Parkway. The creek joins the Molonglo River near Fairbairn Avenue, just upstream of Lake Burley Griffin. Lower Woolshed Creek has an important fossil site.

This reach has the poorest vegetation condition score in the Molonglo catchment. In addition, a very busy road system adjacent to the lower site presents challenges for this small but ecologically important creek. Rubbish washes in from road drains and there is considerable dust and fumes with the high volume of traffic.

Eastern long-necked turtles were regularly sighted in the farm dam at the top site, which dropped in level during the dry conditions but did not dry up completely.

Given its hydrogeology and extensive historical land clearing, the Majura Valley has salt outbreaks in the landscape which can strongly affect electrical conductivity in the creek. Rainfall may heighten electrical conductivity levels when flows increase at the downstream site (WOO090), which is the opposite to most other creeks. The creek stopped flowing for some of the year, but it typically rises rapidly after rainfall.

The farm dam at the top of Woolshed Creek (WOO010).

Yandyguinula Creek YAN1

Headwaters to Molonglo River confluence

2019 CHIP Result B (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19 (9 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Good**	**2**

Reach Facts

Reach network length: approx. 18km
Dominant land uses: Conservation, grazing, wetlands

Yandyguinula Creek is an ephemeral tributary of the Molonglo River, with the confluence on 'Foxlow' near Hoskinstown. It arises in Tallaganda National Park on the western side of the Great Dividing Range and flows into modified rural land with little or no riparian vegetation other than Willows. Near its confluence with the Molonglo River, it passes through an extensive wetland area which supports a significant bird population.

Volunteer John, who samples six other sites around the catchment, found the remote upstream site (YAN020) dry for all of 2019, and inaccessible in December because of the bushfires. The lower site (YAN080) also ceased flowing but the large pool upstream of the crossing retained some water all year.

The waterbug diversity here is one of the highest in the catchment with high abundance and diversity found among the dense water milfoil and reeds. Highlights were two species of very pollution-sensitive stonefly larvae (Plectopera), many "scuds" (Amphipoda) and creeping waterbugs (Naucoridae), a large true bug (Hemiptera). The dense array of aquatic water plants also had a resident Eastern long-necked turtle.

Despite the dry conditions, frogs were heard calling throughout much of the year at the lower site, with up to four species heard in spring.

An Eastern long-necked turtle hiding in the Water milfoil in Yandyguinula Creek (YAN080).

Yarralumla Creek YAR1

Headwaters to Molonglo River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**35**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Fair**	**3**

Reach Facts

Reach network length: approx. 9km
Dominant land uses: Conservation, urban

Yarralumla Creek includes three drainage lines which run largely in concrete channels, one along the west side of Mt Mugga Mugga, one from Farrer to Phillip, and one from Long Gully to Garran. The reach also includes East O'Malley Pond. Yarralumla Creek then runs parallel with Curtin in a concrete stormwater channel and down to the Molonglo River, immediately below Scrivener Dam.

Various ACT Healthy Waterways projects were undertaken upstream on the network of concrete channels which form much of this creek. Aiming to reduce high flows and provide better filtration of sediment, unwanted nutrients and pollutants, these projects were completed in 2019 but will take several years to be fully functional, as plants grow and establish.

A highly altered section of the Creek around Cotter Rd (bottom site, YAR400), which had suffered serious erosion over many years, has been gabion-lined with a staggered series of rock groynes to slow the water and reduce the scouring of the channel.

Autumn waterbugs were sampled in East O'Malley Pond because there was no access at YAR400. Waterbugs at the bottom site in Spring were better than anticipated following such alterations and loss of some habitat features including natural banks, edge vegetation, reeds and riffle sections. That said, there were eight bug types detected there in high abundance and this has improved the overall waterbug score for this reach.

Yarralumla Creek looking upstream from YAR400.

Southern ACT Catchment Facts

For this CHIP report, the Southern ACT area is divided into sub-catchments based around eight main systems in the region. These are: Murrumbidgee River, Naas River, Gudgenby River, Cotter River, Paddy's River, Lake Tuggeranong, Point Hut Ponds and Guises Creek.

The Naas and the Gudgenby River systems originate in the mountains of the Namadji National Park. The Cotter River provides our main drinking supply and flows north, adjacent to the Brindabella Ranges. Paddy's River is a smaller rural waterway flowing to the west of the Bullen Range, past forestry land and grazing properties to the immediate west of Canberra.

The Lake Tuggeranong and Point Hut Ponds systems comprise predominately urban waterways flowing from the east of the ACT into the two lakes at their western ends. The Lake Tuggeranong inflows are extensively engineered with pipes and concrete channels. The Point Hut Ponds inflows are younger and feature upstream wetlands and terraced, vegetated stormwater channels.

Guises Creek is a small creek on the eastern edge of the ACT adjacent to the Monaro Highway. It is being monitored by Waterwatch for the first time in 2019.

All of these waterways join the Murrumbidgee River in the ACT, which flows north from Angle Crossing, near Tharwa, to Uriarra Crossing, just above the Molonglo River confluence in the north west corner of the ACT.

The Upper Murrumbidgee Demonstration Reach (UMDR) partnership works with Waterwatch to protect and improve health in the Murrumbidgee River. From 2019, it has expanded its region to include all of the Murrumbidgee main stem in southern ACT (CMM7-10).

Southern ACT Catchment Health Summary

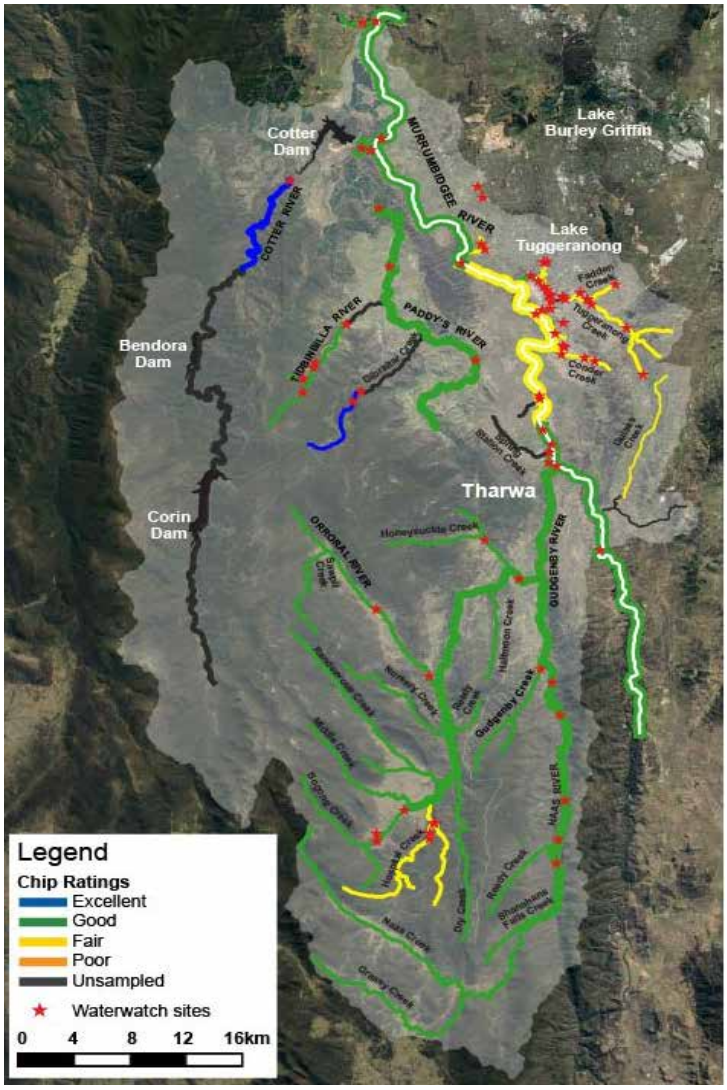
The continued dry conditions in 2019 resulted in a 40% decline in average annual rainfall in the southern ACT catchments. The driest months were April (10mm), July (5mm) and December where only 1.2mm of rain fell.

As the dry has continued from 2018, southern ACT catchment has seen a downward shift in *excellent* and *good* results and an increase of *fair* results from seven in 2018 to 14 in 2019. While two of these were new or 'returning' reaches (Guises Creek is a new rural reach and Isabella Pond received a score this year after being offline in 2018 for Healthy Waterways operations) the remainder of declining sites appear to be a result of continued stress on the drying landscape. Eleven Waterwatch sites had no water to test at some time during the year and many others were reduced to pools.

While the upper, protected areas of the catchment in Namadgi and the Cotter Reserves maintained healthy scores, the exception was the upland bog systems of Bogong and Hospital Creeks which dried up completely in places and had much poorer water bug scores than previous years. Three of the four Murrumbidgee River reaches also had declining scores. At one point in December there was a mere 0.09ML/day flowing down the Murrumbidgee at Tharwa.

The urban and lowland rural systems also continued to suffer in the conditions and this was displayed most spectacularly by a huge blue-green algal bloom in Lake Tuggeranong that appeared in mid Summer and lasted all the way through to late April. Early findings from blue-green algae research currently being undertaken by the University of Canberra indicates that there are ample nutrients both coming into the Lake and in the sediments on the bottom to feed many a bloom into the future.

On a positive note, while the Naas River was dry or ceased to flow for most of 2019, refuge pools in the upper section in Namadgi National Park produced an incredible diversity of water bugs in the spring and autumn surveys. This included two different types of the very sensitive stoneflies. This demonstrates that a system with good native riparian vegetation and water quality will continue to show resilience even under harsh conditions.



Barney's Gully MMB1

Woodcock Drive, Gordon to confluence with Murrumbidgee River

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**11 (4 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**2**
Riparian condition	**Fair**	**1**

Reach Facts

Reach network length: approx. 1km
Dominant land uses: Peri urban, conservation and recreation

Barney's Gully is an ephemeral creek near Woodcock Drive, Gordon. This natural creek is connected to this suburb and flows into the Murrumbidgee River just over a kilometre downstream of Point Hut Crossing. It is one of the last original clay bed creeks that form a chain of pools, full of rushes, only flowing after periods of rain. Most other creeks of this kind in the Tuggeranong valley were converted to concrete stormwater channels and/or dammed to form urban lakes.

This small creek is showing the positive effects of years of hard work by Parkcare volunteers (mostly Parkcarers of Southern Murrumbidgee 'POSM'). Leaky weirs and erosion control works have promoted abundant reeds and ground cover to support multiple species of frogs that are regularly reported calling in the reach. As the vegetation grows around the gully and planted trees provide shade, the water temperature fluctuations decrease and the microclimate of the gully will provides a valuable haven for aquatic life.

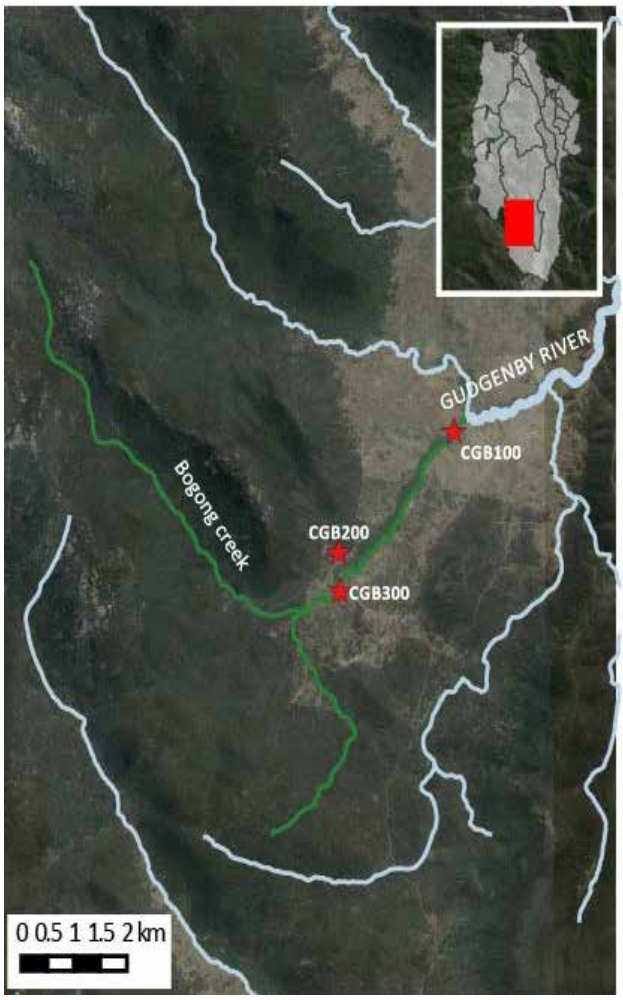
In 2019 Barney's Gulley fluctuated markedly with changes in rainfall. It was completely dry for four months and when it had water it quickly filled with fine green filamentous algae. Both surveys for macroinvertebrates (waterbugs) revealed extremely low diversity. The large number of yabbies often seen here were absent in the spring.

A dry, but green Barney's Gully.

Bogong Creek Catchment CGB1

Headwaters to Yankee Hat trail bridge

2019 CHIP Result B+ (Good)		
2018 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**36 (10 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Good**	**1**



Reach Facts

Reach network length: approx 13km
Dominant land uses: Conservation

This reach is in the Namadgi National Park and is part of the Gudgenby River catchment. At its downstream end, the creek is a wide and mostly treeless upland creek/bog.

The overall water quality in this reach is good and the two bog sites often have clear, slow flowing water even in very dry conditions. Like other upland bogs, however, oxygen levels become depleted over the long, hot summer period. If no relief is provided by rain this will ultimately affect the abundance of very pollution sensitive waterbugs. Many aquatic bug species were found feed on the rotting vegetation including water snails and Calocidae caddisfly larvae, known as 'shingle' caddis.

While the overall phosphorus levels this year were *excellent*, the lower site on Bogong Creek (CGB100) consistently recorded high results of up to 0.07mg/L. The lower stretch of this reach had low water levels for most of the year even though the upper section varied significantly. In March at CGB300, the Brindabella Venturers noted *'…a worry as the first time in two years no flow seen here'.* Then in July *'Ice on surface of the creek. Long reeds flattened by water flow/snow'.*

Waterbug surveys conducted by both Waterwatch teams at the northern site found good diversity with up to eleven different types found. Pobblebonk tadpoles and native Galaxias fish were found in the spring survey.

The Brindabella Venturers conducting waterbug surveys at Bogong Ck (CBG100), spring 2019

Cooleman Ridge Dams RAN1

Two dams on Cooleman Ridge

2019 CHIP Result D+ (Poor)		
2018 CHIP Result D+ (Poor)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**16 (10 dry)**
pH	Fair	
Turbidity	Degraded	
Phosphorus	Fair	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**1**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network area: approx. Kathner Street Dam 0.05Ha, Old Dam 0.15Ha
Dominant land uses: Suburban reserve

Kathner Street Dam (MBK100) is a small dam in Cooleman Ridge Nature Park. It was built to provide water for horses as part of the bicentennial trail. The 'Old Dam' (CMC100) is on the eastern slopes of Cooleman Ridge. It is a reference site for the ACT Frogwatch program. Cattle and feral pig activity have caused major water quality issues in the past. In April 2019 stock exclusion fencing was assembled around the Old Dam.

In 2019 both dams were dry for most of the year. When water was present it was extremely shallow. The Old Dam developed a healthy array of plants around its nutrient-rich water in January. It also played host to many birds throughout the year. By August, the Old Dam was so dry that a wombat had dug a burrow in the northern end.

Kathner Street Dam also sprouted a population of various water plants including water couch and tall Persicaria, which was enjoyed by Yellow-rumped thornbills in large numbers in May.

Waterbugs were only surveyed at the Kathner Street Dam in autumn as both dams were dry by spring. It was the first time water had been seen in the dam for many months and was extremely shallow. Whirligigs, scavenger and diving beetles were present along with lots of mosquito wrigglers and blood worms (a type of fly larvae).

Martin on a 'stick jetty' to access the waterbugs at the Old Dam (Photo: C.Carpenter).

Cotter River MCC1

Cotter Dam to Murrumbidgee River confluence

2018 CHIP Result B+ (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**14**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Good**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 2.5km
Dominant land uses: Recreation

Water flowing through this reach is heavily influenced by water from the Murrumbidgee River that is regularly pumped from the Cotter Pumphouse to the base of the Dam wall to augment environmental releases (known as the 'M2C' flows).

Extensive algae growth is common in this stretch of the Cotter on the rocks and sand. It forms a fine slippery film that reduces available habitat for many aquatic invertebrates in times of low river flows.

In 2019 water releases from the Cotter Dam made up only 25% of the flows in this reach. Not surprisingly, the water coming out of the dam is a better quality than that being pumped from the Murrumbidgee. This appears to have slightly pulled down the water quality score with electrical conductivity relatively high for this reach at times (150µS/cm). Turbidity also had some high results with 110NTU in January which was noted as '*unusual for this site*' by the volunteer.

Waterbug surveys in 2019 found a good diversity of nine bug types in both autumn and spring. Some sensitive bugs were present in low numbers but black fly larvae were the dominant bug with hundreds present in both surveys.

A side benefit of Waterwatching in a site frequented by visitors happened for the volunteers when they were *'observed by a very interested Canadian and his 4 year old!! It made the heart sing to be able to communicate as a citizen scientist..'*

Volunteer Jill sampling on the Cotter River (Photo:M.Blume).

Cotter River MCC2

Pipeline Road Crossing to Vanity's Crossing

2019 CHIP Result A- (Excellent)		
2018 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**13**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Excellent**	**2**
Riparian condition	**Good**	**1**

Reach Facts

Reach network length: approx. 11km
Dominant land uses: Drinking water catchment, Conservation

This reach runs along the stretch of the Cotter River between the Cotter and Bendora dams. Vanity's Crossing is the only current Waterwatch site and sits just upstream of the tail of the Cotter Dam. This section of the Cotter River has restricted access for vehicles and is heavily monitored and managed by Icon Water and the ACT Government. This is in part due to the area being a significant part of the ACT's drinking water catchment as well as having a remnant population of the endangered Macquarie perch. Restricted access also means that monitoring is exclusively conducted by Waterwatch or ACT Parks and Conservation staff.

Despite low flows recorded through much of 2019, the reach fared well with mostly *excellent* water quality. The main exception here was dissolved oxygen that appeared to drop in the latter half of the year when the dry condition persisted. Bimonthly releases of water from Bendora dam combined with the ongoing environmental releases help maintain this reach's condition.

Ranger Bernie noted ongoing algal scum on the in-stream rocks, but when flows increased after dam releases, this helped flush the river.

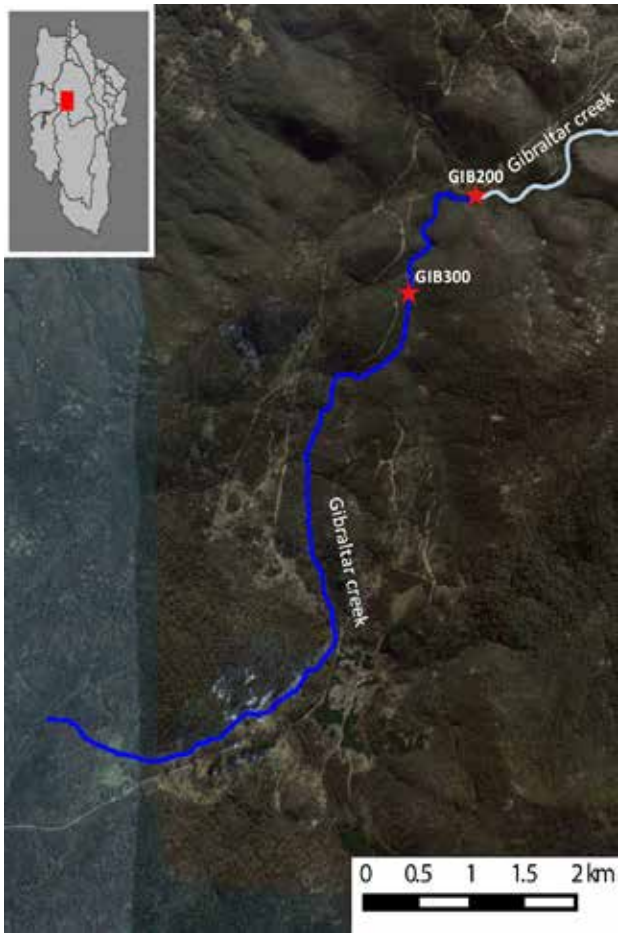
The waterbug survey in spring contributed to a National Waterbug Blitz workshop. Twenty keen bugblitzers were treated to a healthy diversity of bugs to test their identification skills. There were eleven bug types detected, many of them pollution-sensitive, with a range of diversity within these types such as six different kinds of mayflies!

The clear Cotter River water at Vanity's Crossing, November 2019.

Gibraltar Creek GIB1

Headwaters to Woods Reserve

2019 CHIP Result A- (Excellent)		
2018 CHIP Result A+ (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**24**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Excellent**	**2**



Reach Facts

Reach network length: approx. 8.5km
Dominant land uses: Recreation and forestry.

Gibraltar Creek is a small stream running from near Corin Dam and flowing east into Paddy's River. The upper sections form upland bogs. Most of the surrounding land was used for softwood plantations up until the 2003 bushfires. The catchment also has a high recreational use with a large campsite, public walking tracks plus a popular commercial facility at Corin Forest.

Gibraltar Creek was able to maintain clear, cool water again this year despite the water level being recorded as 'low' for all months except December - when it stopped flowing altogether. The low flows continued to adversely affect the dissolved oxygen levels with *degraded* levels for the second year in a row.

This emphasises the crucial role that healthy riparian vegetation has in supporting the overall condition of a waterway, with this creek continuing to achieve a near perfect score for catchment health despite the dry conditions.

Increased use of barriers by ACT Parks and Conservation to limit public entry to old forestry roads has had a positive impact reducing potential erosion and activities such as dumping.

The general lack of water plants, both on the edge and in-stream at the Waterwatch sites, mean that waterbugs dependant on these habitats are largely absent. Thus, this can reduce the diversity found in the surveys. That said, waterbug surveys do usually score *excellent* here with an abundance of sensitive bugs detected. In spring, however, the survey did not detect a large diversity of bug types and this pulled the waterbug score down.

Gibralter Creek at Gibralter Falls (GIB300).

Goodwin Village Pond RAN2

Small Pond at Goodwin Village Monash

2019 CHIP Result C+(Fair)		
2018 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**12**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Degraded**	**1**

Reach Facts

Reach network area: approx. 0.4Ha
Dominant land uses: Recreation

Goodwin Village Pond is a small pond built into a natural drainage line at the southern end of the suburb of Monash. Its primary role is to provide recreational space and amenity for the residents of Goodwin Village retirement home. The site hosts a trial floating wetland project. The overall effect this has on water quality is difficult to assess. Nutrient levels here are certainly healthier than other small urban ponds in the southern ACT catchment.

Two waterbug surveys produced *fair* results. The autumn survey, assisted by Greg formerly from Streamwatch, found caenid mayfly and leptocerid caddisfly larvae, red flatworms and damselfly nymphs as well as the numerous water boatmen. Freshwater limpets were also found, a rare sight around southern ACT waterways. During the spring survey, there were at least five Pobblebonk frogs *Limnodynastes dumerilii* calling. There was also good waterbug diversity with ten types found, including two types of leptocerid caddisflies, caenid mayflies and 'water tiger' beetle larvae.

The water level varied little throughout 2019. It rose from low to medium briefly in July. The manicured nature of the pond's surrounds guarantees a low riparian condition assessment score.

Carp and exotic water birds are a regular feature of this reach.

The floating wetlands at Goodwin Village Pond.

Gudgenby River Catchment CGG1

Headwaters of small creeks and Orroral River to the Murrumbidgee River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**43**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**

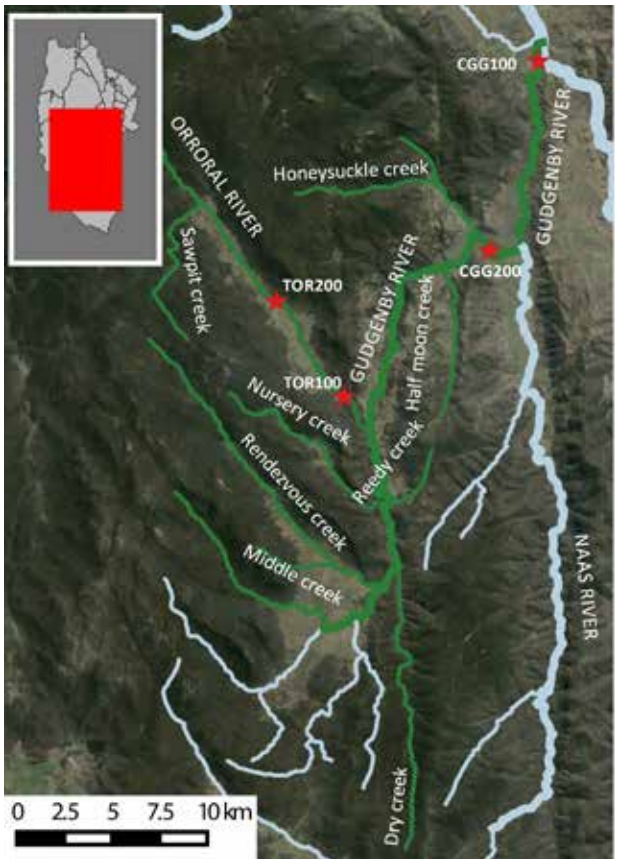
Reach Facts

Reach network length: approx 120km
Dominant land uses: Conservation and rural grazing

This reach includes five branches off the Gudgenby River: the Orroral River as well as Nursery, Middle, Honersuckle and Dry Creeks, in the Namadji National Park. The main arm is the lower stretch of the Gudgenby River, running mostly through mixed grazing properties. The Orroral River section largely comprises upland bogs. The vegetation along many of the creeks in this network lacks significant native tree cover and understorey, possibly due to clearing. The three main arms of this reach have different characteristics that influence the overall assessment.

Water quality in this reach is some of the best in the Southern ACT catchment and the upper tributaries managed to maintain a low to medium flow throughout the year despite the dry conditions.

The lower Gudgenby River sites, however, did stop flowing twice in 2019 with volunteer Deb noting in March '*the first time I've ever seen this creek cease to flow'*. The water was still *'crystal clear'* and supported a good variety of waterbugs with nine types being detected in the autumn waterbug survey. By the end of the year volunteer Davina found her site upstream on the Gudgenby River at Naas Road Bridge (CGG200), *'very low'* and the *'main body of water was isolated from the usual stream.'*.

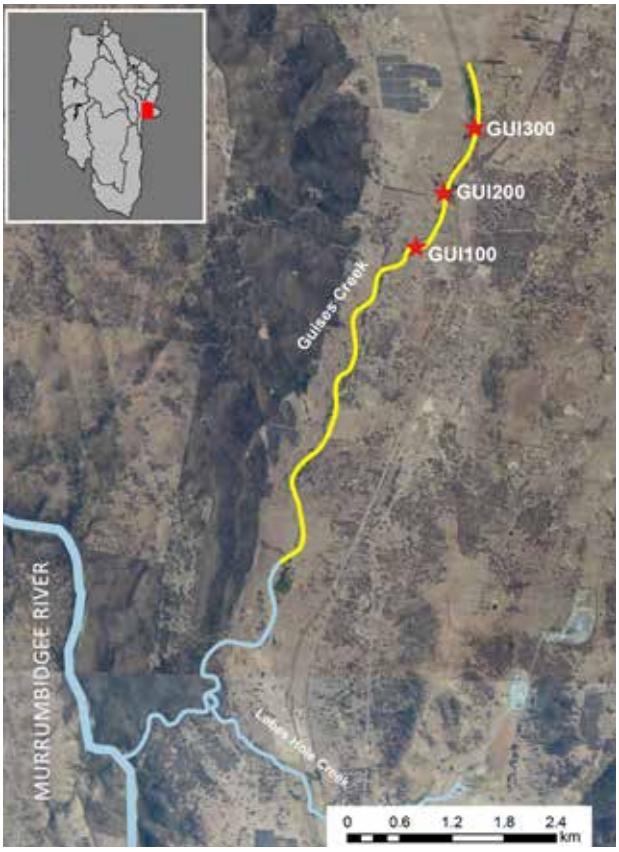


The Gudgenby River at Naas Rd Bridge (CGG200) scored *poor* for riparian condition.

Guises Creek Catchment GUI1

Headwaters to confluence with Murrumbidgee River

2019 CHIP Result C+ (Fair)		
NEW REACH		
Parameter	**Rating**	**No. Survey**
Water quality	**DD**	**0**
pH	DD	
Turbidity	DD	
Phosphorus	DD	
Nitrate	DD	
Electrical Conductivity	DD	
Dissolved Oxygen	DD	
Waterbug	**Good**	**2**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx 120km
Dominant land uses: Conservation and rural grazing

This new reach is a permanent spring sitting on igneous bedrock adjacent to the Monaro Highway on the eastern border of the ACT. Unique to the southern ACT, it flows nearly due south to the Murrumbidgee River in the Gigerline Gorge, 2.5km north of Angle Crossing. The reach extends from the junction of two creeks at its head, due west of Royalla, to a large dam on a property 4km south of the Rosevue Homestead boundary. The landscape is all rural grazing and any riparian vegetation found is mostly weed species and other exotics.

Three Waterwatch sampling locations were identified in 2019 and riparian surveys were conducted at these. Water quality data is yet to be received.

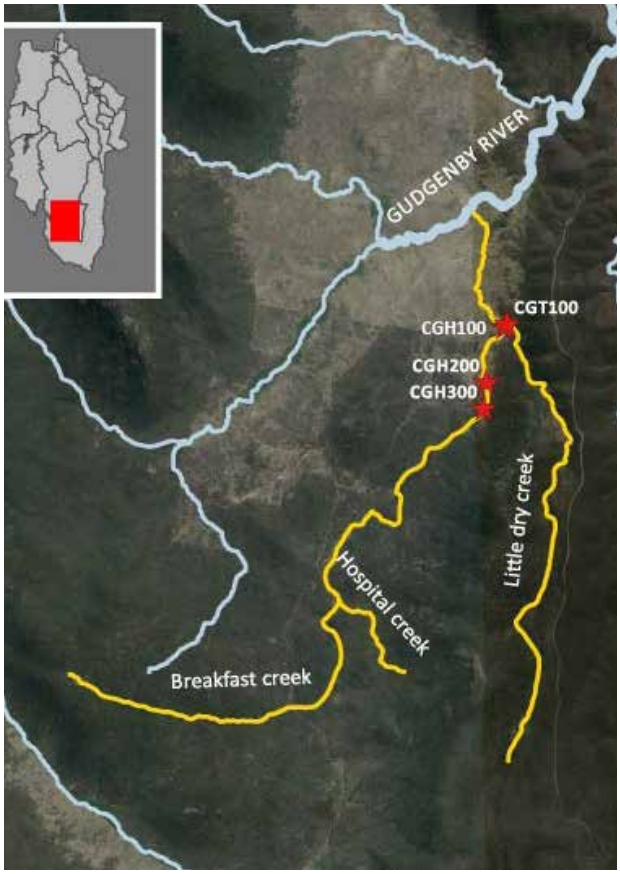
Waterbug surveys were done at the site upstream under the Monaro Highway. Ten types of waterbugs were found in autumn including hundreds of introduced hydrobidae (sheep fluke) snails which can thrive in nutrient-rich rural streams such as this one. Two types of the more sensitive caddisflies and mayflies were also found as well as riffle and diving beetles, many small dragonfly nymphs and a huge black flatworm. Notonemourid stonefly nymphs were found in spring living in the very shallow, clear water, which was also full of submerged water plants and water reeds. These stoneflies are efficient dispersers and can be found at times in remote refuge pools.

Guises Creek at Rosevue Homestead, July 2019.

Hospital Creek Catchment CGH1

Headwaters of Hospital, Breakfast and Little Dry Creeks to the confluence with the Gudgenby River

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**47 (28 dry)**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Good**	**2**



Reach Facts

Reach network length: Hospital Creek arm (on the left) 12km, Little Dry Creek arm (on right) 7km
Dominant land uses: Conservation

Hospital Creek is mostly a forested gully situated south east of Bogong Creek, in Namadgi National Park. It runs north, forming as upland bog before joining the Gudgenby River near its headwaters. Little Dry Creek is an ephemeral arm to the east of Hospital Creek. Dry conditions affect the bog section of this reach more than other upland bogs in Namadgi National Park because of its comparatively small area.

The higher creeks in our catchment are more susceptible to the impacts of reduced rainfall and higher temperatures than the larger rivers further downstream. Hospital Creek was a significant area for cattle grazing from the mid 1800s to early 1900s and the area was also used for pine forest production until the 2003 bushfires. This legacy is still very evident. Significant rehabilitation work conducted by the Gudgenby Bush Regenerators to restore the National Park back to native forest after the 2003 fires has had significant positive results, however blackberry infestation and feral pig activity are continuing problems.

In 2019 the reach continued to suffer from the extended dry. The site where waterbugs are usually collected in spring (CGH100) was completely dry so the 'Gudgenby Bushies' had to survey a small pool at the upper site instead (CGH300). This returned a *poor* sample with only six bug types of mostly water mites and large adult diving beetles.

Volunteer Michaela walks through the dry landscape of Hospital Creek, December 2019 (Photo: S.Donohue).

Isabella Pond TIP1

Large pond south of Monash

2019 CHIP Result C- (Fair)		
2018 CHIP Result DD (Data Deficient)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**36 (6 dry)**
pH	Excellent	
Turbidity	Good	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**2**
Riparian condition	**Poor**	**3**

Reach Facts

Reach network area: approx. 5.8Ha
Dominant land uses: Suburban

This reach is the main settlement pond for stormwater entering Lake Tuggeranong from the south western Tuggeranong suburbs. Water flows over a high weir at its western end into Lake Tuggeranong (TLT1).

Isabella Pond underwent an extensive facelift from 2018 to 2019 as part of the ACT Healthy Waterways initiative. It was the largest refurbishment undertaken in the Southern ACT catchment with several hectares of wetland vegetation plantings. There was also a restructure of the pond's bed to enhance capture of stormwater runoff before it flows into Lake Tuggeranong. The aim in future years will be to trap nutrients that would otherwise be carried into the main Lake which then can contribute to toxic blue-green algal blooms.

Isabella Pond also had a comprehensive removal of several tons of Carp when it was drained in 2017.

In 2019 the reach could not be accessed for two months due to construction repairs. The other months mostly had low water levels in step with the dry conditions experienced throughout the region.

Two waterbug surveys, one at the dam wall in autumn and the other downstream of the large southern gross pollution trap, revealed a lake with currently little diversity after many months of being empty.

It will be interesting to see how the water quality and waterbug scores change over time as the riparian and in-stream plantings become more established.

Isabella Pond looking south from TIP210 starting to fill with water again, October 2019.

Lake Tuggeranong Wetlands TLT1

Drakeford Drive weir to South Quay foot-bridge weir

2019 CHIP Result C (Fair)

2018 CHIP Result D+ (Poor)

Parameter	Rating	No. Survey
Water quality	**Good**	**20**
pH	Excellent	
Turbidity	Poor	
Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Degraded**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network area: approx. 4.3Ha
Dominant land uses: Urban

This is the southern section of Lake Tuggeranong, upstream of the weir that runs under a pedestrian walkway near the South quay development. It forms a narrow neck at the southern end which is fed by a large zigzag dam wall which overflows from Isabella Pond.

There is a healthy stand of Casuarinas on either bank of this stretch of the Lake. Part of the function of this body of water is to treat water quality before it enters Lake Tuggeranong proper.

This reach experienced low levels for the first half of 2019 and then was drained in July for dam wall repairs. The water refilling the wetland in September was quite turbid with 60NTU recorded at both sites. Turbidity continued to be an issue as water levels fluctuated significantly over the rest of the year with December leaving the wetlands at low levels in the dry conditions and a turbidity reading of 80NTU. It is hoped these issues will settle down once the adverse effects from the repairs has passed.

The autumn waterbug survey found only five types and most of the specimens were bloodworms (a type of fly larvae). In spring, only six waterbug types were found, including one micro-caddisfly larvae.

Eastern long-necked turtles are a common sight here along with pest fish Carp and Eastern gambusia. Black swans and an Eastern water dragon were also spotted. This reach is a popular fishing site due to the shady canopy and ready access.

New apartments on the shores of Lake Tuggeranong Wetlands among some stands of Casuarinas.

Lake Tuggeranong TLT2
Main lake body

2019 CHIP Result C- (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**38**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Degraded**	**2**
Riparian condition	**Degraded**	**5**

Reach Facts

Reach network area: approx. 56Ha
Dominant land uses: Urban and recreation

This is the main body of Lake Tuggeranong, which is fed by the stormwater systems of thirteen southern suburbs. Two major gross pollution traps are at the northern end of this reach. Lake Tuggeranong wetlands, to the south (TLT1) are immediately upstream of this reach.

That the Lake is a still waterbody will always have some bearing on the outcomes of waterbug surveys as the very sensitive bugs favour systems with fresh running water where oxygen levels are higher. The waterbug survey results, conducted with the team from Lake Tuggeranong College, showed low diversity with mostly pollution tolerant types such as 'true bugs' (Hemiptera) and fly larvae. That said, the more sensitive water mites were also present in good numbers.

The *degraded* riparian vegetation scores reflect the highly urbanised nature of the surrounding landscape.

Blue-green algae made a spectacular return to the main body of the Lake early in January and persisted through until April. The University of Canberra is studying the sources of nutrients in the Lake in order to better manage blue-green algae. Early findings indicate that there are ample nutrients, both coming into the Lake and in the sediments on the bottom to feed many a bloom into the future.

The algae was gone at the northern end of the Lake by May but the water was opaque with lots of plastic rubbish on the banks.

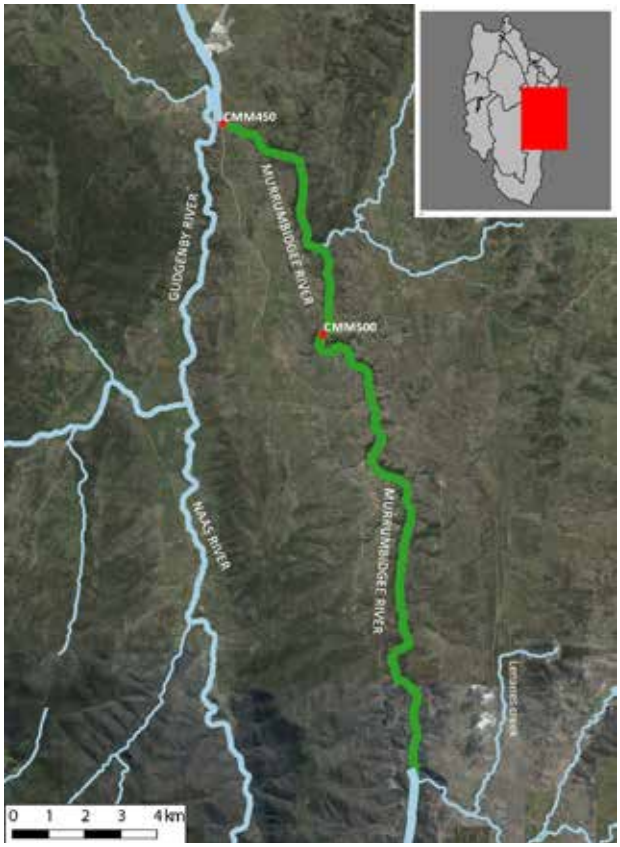
Volunteer Emily found a large school of fish, most likely Carp, near the northern inlets in April.

Lake Tuggeranong College students waterbugging at the Jetty, October 2019.

Murrumbidgee River CMM7

Michelago Creek confluence to Tharwa Sandwash

2019 CHIP Result B+ (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**21**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Excellent**	**2**
Riparian condition	**Fair**	**2**



Reach Facts

Reach network length: approx. 24km
Dominant land uses: Rural grazing and conservation

This stretch of the Murrumbidgee River begins at Willows Road, NSW and includes Angle Crossing on the ACT/NSW border. It then runs through the Gigerline Gorge and ends at Tharwa Sandwash.

Recreational fishing is banned in the ACT section of this reach and the riparian vegetation is significantly healthier than in the next reach downstream around the Tharwa township. Around Angle Crossing, however, there are lower amounts of emergent and edge vegetation although the abundant riffle zone provides fairly good habitat for many of the pollution sensitive waterbugs such as stoneflies. The river slows by the time it reaches the Sandwash and the exposed midstream sand bars give this site its name. A build-up of diatom algae can be common here as a result of slow flows.

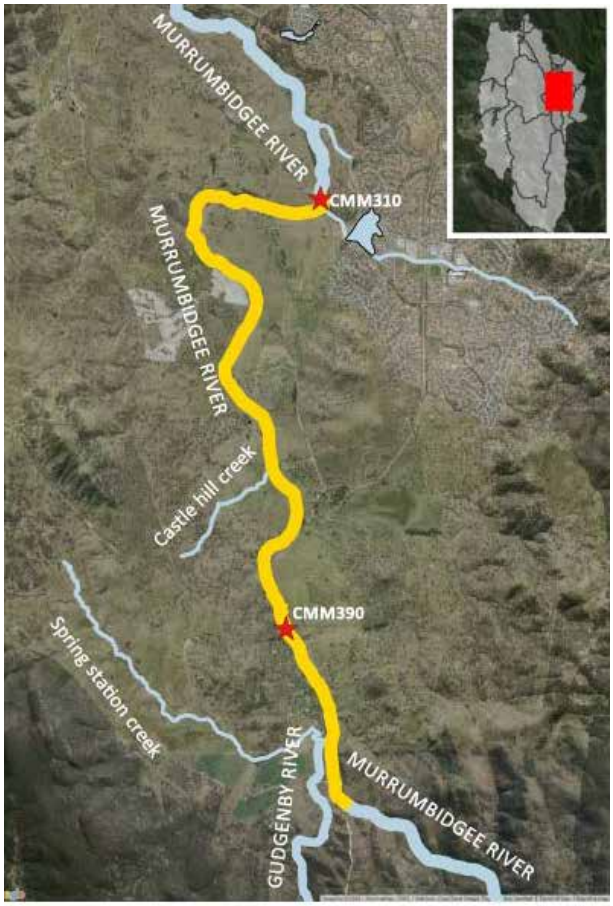
This reach can at times show the signs of the erosion issues upstream in the Monaro region. In mid January 2019, an isolated and intense thunderstorm at Numeralla in the south east corner of the upper Murrumbidgee catchment sent a pulse of muddy water down the Numeralla River. When volunteer Bernie tested the water at Angle Crossing a few days later, she got a reading of 200NTU, combined with a higher nitrate and phosphorus reading than is usually seen at that site. The effects were still being felt a week later when volunteer Deb recorded 70NTU downstream at the Sandwash and described the river as being *'like chocolate milk'.* This highlights the importance of monitoring water quality on a catchment scale.

The Murrumbidgee River looking upstream at Tharwa Sandwash (CMM450), January 2019.

Murrumbidgee River CMM8

Tharwa sandwash to Point Hut Crossing

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**14**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 10km
Dominant land uses: Rural grazing

This reach covers the stretch of Murrumbidgee River from Tharwa Sandwash to Point Hut Crossing. Most of the eastern bank of this reach borders Lanyon Homestead. The western bank flows past a number of properties including Castle Hill and Lambrigg Homesteads in the Tharwa district.

The riparian vegetation in this reach is extremely poor with very few mature canopy species. The shallow gradient of this section of the river also compounds the problem of sediment build up which reduces the chances for in-stream habitat to establish. The shallow depths, combined with a lack of shading and in-stream habitat, means the average water temperature at the Tharwa log jam is greater than at sites up and downstream. 2019 saw the river almost stop flowing at Tharwa Bridge as it was reduced to 0.09ML/day by mid December. These areas of the river are virtually impassable for aquatic fauna such as native fish and Platypus.

The Engineered Log Jam, constructed in 2012 downstream of the Tharwa Bridge, is trying to address this issue of connectivity and fish habitat. The Log Jam has deepened the adjacent channel considerably, with juvenile Murray Cod and Murray River crayfish having been observed at the site.

Platypus surveys conducted near CMM390 in 2015 and 2016 failed to record a single sighting. Surveys subsequently conducted at the northern end at Point Hut Crossing (CMM310) have shown reasonable numbers of Platypus and Rakali (native Water rat). See a report on Platypus Month 2019 at the back of this report.

The Murrumbidgee River at Tharwa Bridge was flowing at just 0.09ML/day by December 2019 (Photo H.Chester).

Murrumbidgee River CMM9

Point Hut Crossing to Kambah Pool

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**8**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Degraded**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 6.7km
Dominant land uses: Urban, conservation and recreation

This reach covers the section of Murrumbidgee River from Point Hut Crossing to Kambah Pool which includes Pine Island reserve. All these sites are popular recreational sites. Red Rock Gorge also occurs within this reach. Urban inputs such as Tuggeranong Creek, Stranger Pond and Point Hut Ponds are also received into this section of the Murrumbidgee River.

This stretch is unique for the Murrumbidgee in the ACT in that it has shown little variance in overall waterway health from year to year. The faster flows, deeper water and slightly more abundant bank vegetation give refuge to aquatic fauna and see the health of the Murrumbidgee River improve as it flows down from the sandy shallow treeless sections at Tharwa.

The dry conditions in 2019 may have contributed to the lower diversity and abundance found in the two waterbug surveys. Mary McKillop College senior students only found seven types at Pine Island and only six types were found at Kambah Pool in spring by the Mt Taylor Joey Scouts. The dominant species were hardier bug types such as water boatman with only small numbers of sensitive species such as mayflies that persist in the river's riffle section.

Feral fish such as Carp and Eastern gambusia are regularly sighted in this reach.

Mt Taylor helping out with waterbug surveys at Kambah Pool, November 2019 (Photo: P.Bamford).

Murrumbidgee River CMM10

Kambah Pool to Uriarra Crossing

2019 CHIP Result B- (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**24**
pH	Excellent	
Turbidity	Fair	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**2**

Reach Facts

Reach network length: approx. 11km
Dominant land uses: Rural grazing, forestry, recreation and conservation

This reach covers the section of Murrumbidgee River from Kambah Pool to Uriarra Crossing. Much of it flows past old pine forest plantations and areas still used for grazing and farming. This section of the river receives inputs from both the Paddy's and Cotter Rivers entering just upstream of Casuarina Sands reserve.

In mid January 2019, an isolated and intense thunderstorm upstream in the sheep grazing region of Numeralla sent a pulse of muddy water down the Numeralla River. This took four days to reach Casuarina Sands and resulted in this popular swimming spot being closed to primary contact due to high *Enterococci* counts being observed.

During 2019 this section of the Murrumbidgee had extremely low water levels for most of the year. In-stream rocks, usually submerged, became visible at Casuarina Sands by April and the water was noted by the 'Sands' Waterwatchers as being green in September - an observation also noted by volunteers upstream. The river ceased to flow at Uriarra Crossing by November.

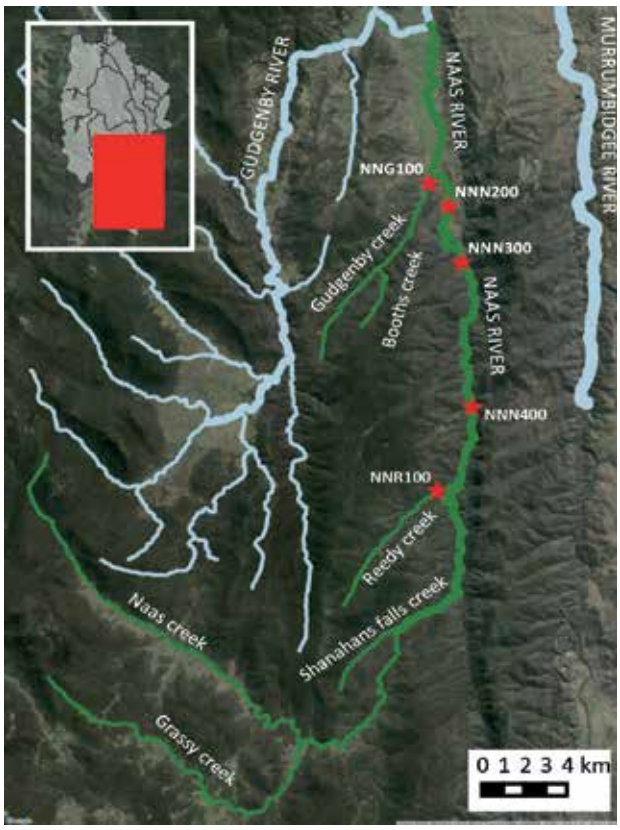
The waterbug surveys showed good diversity of aquatic life but an absence of sensitive types which are usually found in this river after good rainfall. The heavy layer of algal silt seen this year, clogs up the rocky riverbed habitat essential for the survival of orders such as stonefly nymphs.

Long time volunteer, Wendy, sampling at Casuarina Sands (CMM200), April 2019.

Naas River NNN1

Headwaters to Gudgenby River confluence

2019 CHIP Result B+ (Good)		
2018 CHIP Result B+ (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**25 (16 dry)**
pH	Good	
Turbidity	Excellent	
Phosphorus	DD	
Nitrate	Excellent	
Electrical Conductivity	DD	
Dissolved Oxygen	DD	
Waterbug	**Good**	**2**
Riparian condition	**Fair**	**5**



Reach Facts

Reach network length: approx. 40km
Dominant land uses: Rural residential, grazing, conservation

The Naas River runs south then hooks east and flows north, running through the southern tip of the ACT in Namadgi National park. The lower part of the river flows past grazing properties before joining the Gudgenby River 10km south of Tharwa. This reach also includes a site on the bottom of Gudgenby Creek.

Sedimentation in this sub-catchment is a concern highlighted in the 2012 Action for Clean Water (ACWA) plan. The Naas Valley is identified as an erosion hotspot.

In 2019 volunteers Davina and Alannah only found enough water to test in the Naas River at Caloola farm (NNN200) in August. All other months were dry. They also found Gudgenby Creek dry all year.

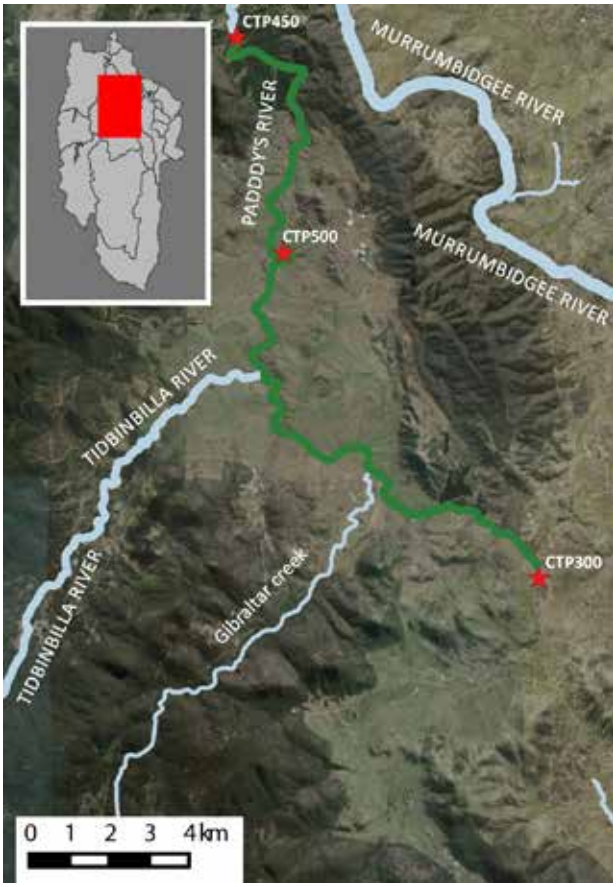
At the top of the reach (NNN400) in February volunteer Rod only found 'large pools' but no flow. These refuge pools held an incredibly good diversity of nine waterbugs types in the autumn survey including glass shrimp, three kinds of caddisfly and two kinds of mayfly nymphs even though the rest of the river was dry. In spring, at the same site, eleven bug types were found including a great diversity of caddisfly larvae, stonefly and mayfly nymphs – all of which are pollution sensitive bugs, plus an array of beetles and some yabbies. This all added up to an *excellent* waterbug assessment which was impressive for a river experiencing such harsh conditions.

Eleven waterbug types were found in the remnant pools of the upper Naas (NNN400) in October 2019.

Paddy's River Catchment CTP1

Tidbinbilla Road bridge to Murray's Corner

2019 CHIP Result B- (Good)		
2018 CHIP Result B (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**36 (5 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Good**	**2**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 24km
Dominant land uses: Rural grazing

Paddy's River runs mostly through active grazing properties and softwood plantations that also provide public access dirt roads, popular with recreational off-road drivers. This reach covers the section below the headwaters high up on Mt Tennent in the Namadgi National Park.

The river has been subject to massive erosion through large flooding events in previous years. The consequence of this soil disturbance is a sandy river bed lacking habitat complexity along much of the reach, similar to the Murrumbidgee near Tharwa. Steep unstable soils in the headwaters above Booroomba Homestead are a key contributor. Much of the riparian zone along Paddy's River lacks significant native vegetation.

The river remained mostly at low levels all through 2019. After 50+mm of rain in May, volunteer Maree commented on young casuarina foliage look lush and healthy. Maree also wrote *'A beautiful morning to be a Waterwatch volunteer!'* and *'delightful trickling sound of water flowing over the rocks again!'.*

During hotter months this year the river was either dry or reduced to pools. Murray's Corner was closed to swimmers in June and again in October, because of high levels of bacteria.

Cattle are regularly seen at this river and were often observed at Flint's Crossing (CTP500).

Looking upstream on Paddy's River at Murray's Corner (CTP150).

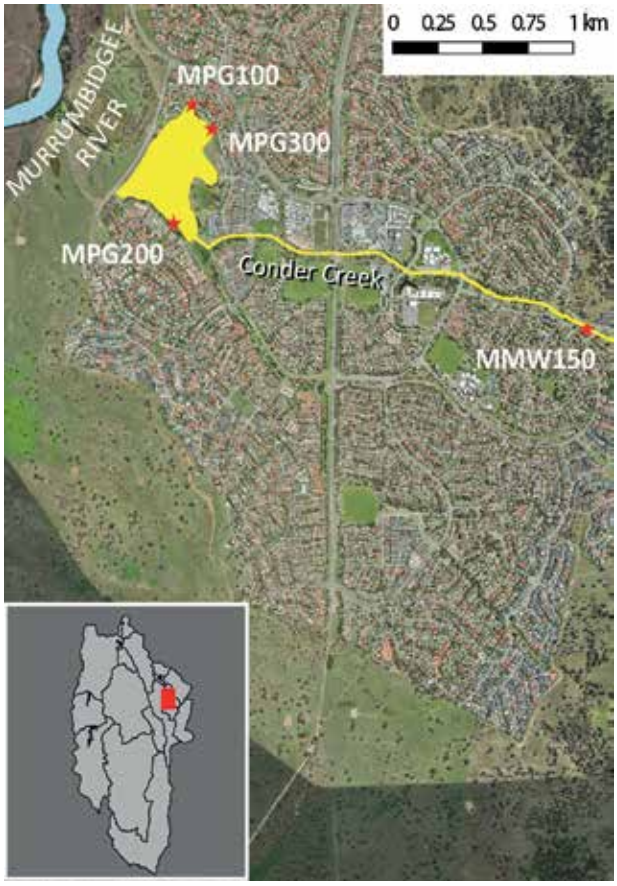
Point Hut Ponds MPG1

Headwaters of Conder Creek to Murrumbidgee River confluence

2019 CHIP Result C (Fair)

2018 CHIP Result C+ (Fair)

Parameter	Rating	No. Survey
Water quality	**Good**	**48 (2 dry)**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**2**
Riparian condition	**Poor**	**4**



Reach Facts

Reach network length: approx. 2.5km
Dominant land uses: Urban

The drainage line that feeds this reach arises in the Rob Roy Nature reserve and flows down through the suburbs into Conder Wetland, which then drains to Point Hut Pond, a sediment control pond in Gordon. Together they make up a stormwater system that has been engineered with flow reduction features and verge vegetation to reduce some of the negative impacts from suburban runoff. The water from this system then flows into the Murrumbidgee River just downstream of Point Hut Crossing.

Pest fish Carp and Eastern gambusia are often seen becoming very active in large numbers in Point Hut Pond when the water warms to around 20°C.

While water levels were lower than normal in 2019, Point Hut Pond continued to be a refuge for many water bird species. The Carers of Point Hut Pond Urban waterway group spotted no less than eight types including Ibis, pelicans and herons over the twelve months.

Volunteer Stephen noted *'I have been visiting this site for about 20 years now, including through the last drought, and this is the lowest water level I have ever seen.'*

Blue green algae, along with its distinctive smell, was also recorded for four months, including all through spring.

Stands of Casuarinas at Point Hut Ponds.

Stranger Pond MSP1

Stranger Pond in North Bonython

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**24**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

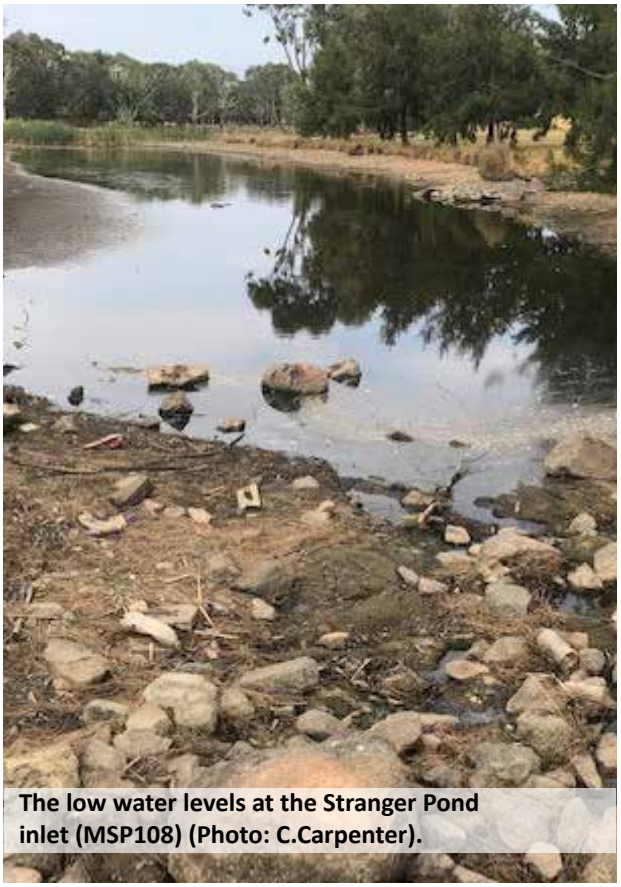
Reach network area: approx. 4Ha
Dominant land uses: Urban.

The 'Stranger Pond' system consists of Upper Stranger and Lower Stranger Ponds connected by a tapped pipe (normally closed) under Drakeford Drive. The whole system is immediately to the south of Lake Tuggeranong and provides storm water treatment for the suburb of Bonython. Overflow enters the Murrumbidgee River at Pine Island Reserve. Waterwatch monitoring has only been conducted at Lower Stranger Pond.

Eastern Gambusia, leaping Carp and Redfin perch are all regularly seen in the lower pond. A comprehensive pest fish removal project was undertaken in Upper Stranger Pond in 2017 when the Pond was drained, and 2.6 tonnes of Carp were removed.

In 2019, dissolved oxygen levels dropped in Lower Stranger Pond as the flow dropped and the water warmed up. Dissolved oxygen levels measured as low as 3mg/L at the inlet in January. The surrounding reed beds also became exposed and the water became murky with regular turbidity recordings above 30NTU. Thankfully no blue green algae was noted.

A good diversity of waterbugs were found in autumn including three types of leptocerid caddisfly nymphs including ones that hollow out 'logs', ones that use reeds and ones that build their homes from sand grains. Three families of mayfly nymphs were also found. In spring the number dropped to only six bug types with no caddisfly nymphs found at all.

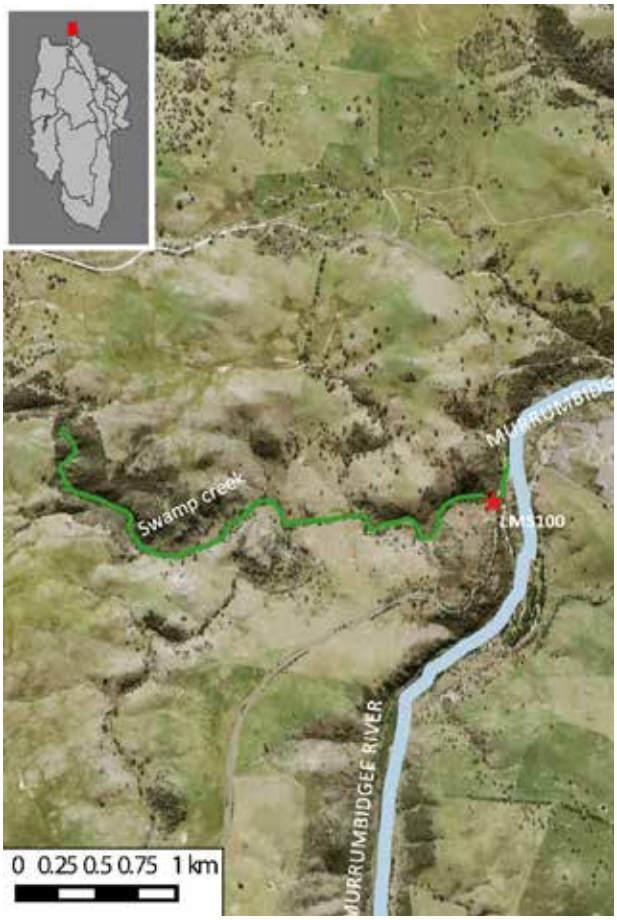


The low water levels at the Stranger Pond inlet (MSP108) (Photo: C.Carpenter).

Swamp Creek LMS1

Uriarra Creek confluence to Murrumbidgee River Confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**11**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**1**



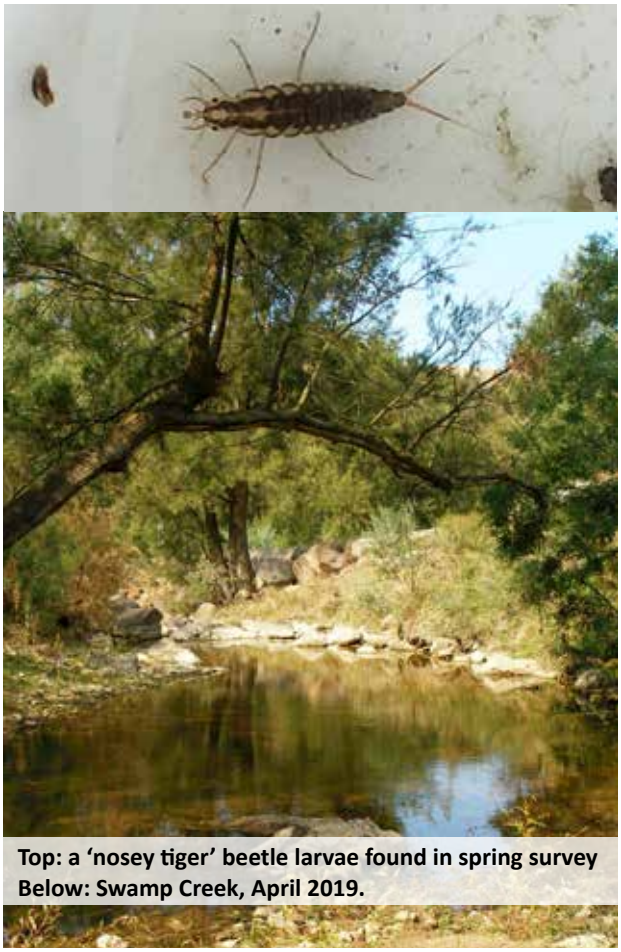
Reach Facts

Reach network length: approx. 1.5km
Dominant land uses: Rural grazing.

Swamp Creek is an ephemeral creek running through the Uriarra Homestead property. It intersects with Uriarra Creek 1km upstream to the west and flows under the Fairlight Road and into the Murrumbidgee River at Uriarra Crossing. Old maps name the stretch of the creek to the Murrumbidgee 'Uriarra Creek'. Signage at the reserve refers to it as Swamp Creek. We have opted for the latter.

Swamp Creek's assessment is based on one Waterwatch site below the level road crossing at its mouth. Most of the creek is on private rural lease land. Riparian vegetation at the monitoring site is in *fair* condition but lacks the instream and edge plants required to host a good diversity of waterbugs.

In 2019 Swamp Creek was noticeably impacted by the dry summer of 2018/19. Conducting the autumn waterbug survey was difficult as it took several sweeps of the remaining pools of water to find enough specimens to qualify for a valid sample. Even then only five bug types were found. The low flows that returned by spring made a difference and twice as many types were found including 80 mayfly nymphs, 'nosey tiger' beetle larvae, a good-sized yabby and a rarely-found toad bug!



Top: a 'nosey tiger' beetle larvae found in spring survey
Below: Swamp Creek, April 2019.

Tidbinbilla River CTT1

Headwaters of Tidbinbilla River & Ashbrook Ck to Gilmores Rd crossing

2019 CHIP Result B- (Good)		
2018 CHIP Result A- (Excellent)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**54 (15 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
Waterbug	**Degraded**	**2**
Riparian condition	**Good**	**5**

Reach Facts

Reach network length: approx. 8.5km
Dominant land uses: Conservation, tourism and rural grazing

This reach covers most of the Tidbinbilla River and the adjacent artificial wetlands (the 'Sanctuary'). The reach also includes a site on Ashbrook Creek which is a small upland stream in the reserve's west.

Most of the river is in the Tidbinbilla Nature Reserve and has recovered substantially from the catastrophic bushfire in 2003 after which the river substrate changed dramatically. A once complex and rocky riverbed became full of sandy sediment.

The CHIP score reflects an averaging between the *good* water quality found in the upper creeks and the often *poor* water quality of the Sanctuary, where water is diverted to the pond system. The artificial wetlands of the Sanctuary can suffer from depleted dissolved oxygen levels. The rich and diverse riparian condition along most of this reach is reflective of a well-managed nature reserve.

In 2019 this reach suffered from a lack of rainfall. In the 'Sanctuary' volunteer Tony said; *'Pond 5 is a dry and cracked .. with a very small amount of stagnant water at its southern end nearest to the small weir. Residual water.. is very muddy and contained large amounts of decaying organic matter.'*

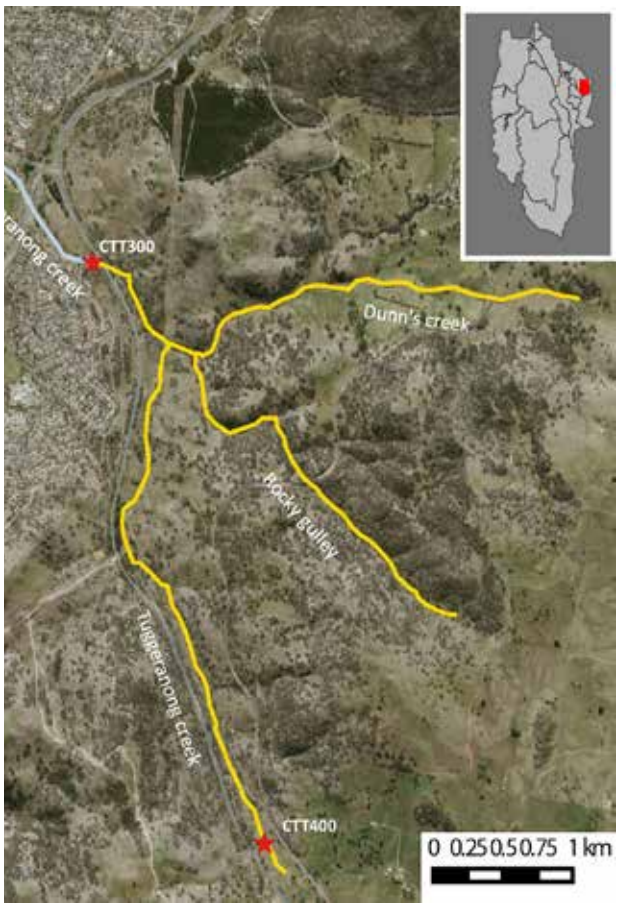
Down at Shannahan's Crossing (CTT050) any water disappeared under the sandy riverbed, surfacing briefly in August and September.

Kids loved catching the waterbugs at the Tidbinbilla Open Day, September 2019.

Tuggeranong Creek, Upper TUG1

Headwaters of Tuggeranong Creek catchment to Theodore

2019 CHIP Result C (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**19 (10 dry)**
pH	Excellent	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Poor**	**2**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: Monks Creek (upper arm 3.2km), Tuggeranong Creek (lower arm) 4km
Dominant land uses: Rural grazing

The main monitoring site for this reach is under the Monaro Highway at the eastern border with NSW. The system is fed from Monk's and Dunn's Creeks to the east and Tuggeranong Creek to the south. The Tuggeranong Creek arm runs adjacent to the Monaro Highway.

The riparian vegetation comprises mostly weedy species. The canopy is almost exclusively Poplars with many of their wilding saplings as the understorey. This can make surveying waterbugs in autumn difficult due to the extensive leaf litter.

The upper creek arises from farming country with smooth, ignimbrite bedrock and the water is naturally higher in salts and minerals than our larger rivers. The lower site is unfortunately a hotspot for frequent rubbish dumping.

The headwaters of this creek were dry for most of 2019. The site under the Monaro Highway (CTT300) was also extremely low and ceased to flow in December. Dissolved oxygen levels also dropped below 4 mg/L late in the year.

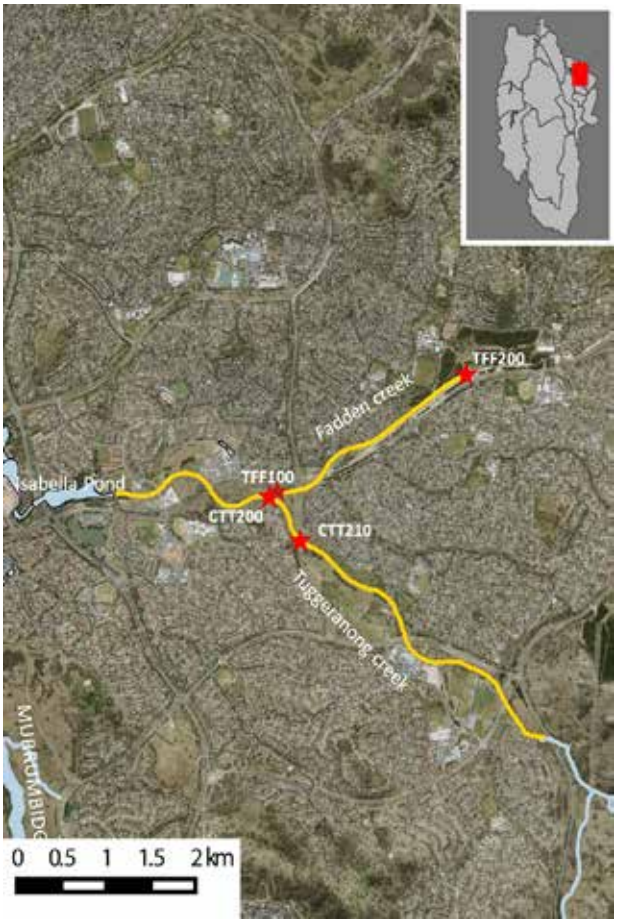
The spring waterbug survey found low diversity with only four types detected. This included around 80 Atalophlebia mayfly nymphs, a large and distinctive genus of mayfly (22mm) with very fluffy gills that enables it to efficiently extract oxygen out of slower flowing waters and wetlands. These were painstakingly picked off the many poplar leaves that were scooped up in the net.

The headwaters of Tuggeranong Creek, August 2019.

Tuggeranong Creek, Middle TUG2

Concrete drain system upstream of Isabella Pond

2019 CHIP Result C- (Fair)		
2018 CHIP Result C- (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**41 (2 dry)**
pH	Fair	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
Waterbug	**Degraded**	**2**
Riparian condition	**Degraded**	**4**



Reach Facts

Reach network length: approx. 8km
Dominant land uses: Urban.

This reach consists of a Y shaped network of two concrete stormwater channels. The main arm runs north west from Leinhop Street in Theodore. This joins another channel following south west from Fadden near Isabella Drive where the channel then flows into Isabella Pond.

No riparian vegetation, other than algal filaments, and almost no aquatic organisms are found in this reach as it consists entirely of concrete. CHIP assessments of this reach really only vary based on measured water quality. Consequently, the highest score this reach can attain is *fair* if all the water quality parameters are *excellent*. This reach is important in demonstrating the crucial roles waterbug and riparian surveys play in assessing waterway health. A concrete drain is a barren habitat.

In 2019 the drains had low trickles of water all year fed by runoff from gardens in the surrounding suburbs. An orange tinge to water was noted in January by the students of Chisholm High School along with high pH and elevated electrical conductivity (salts and minerals). An algal fringe was the only form of plant life seen in June and the waterbug surveys only found one or two fly larvae. By December the Tuggeranong Creek under Ashley Drive (CTT210) was dry.

Confluence of Tuggeranong Creek and Fadden stormwater channel.

Tuggeranong Creek, Lower TUG3

Tuggeranong Creek to Murrumbidgee River confluence

2019 CHIP Result B- (Good)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Excellent**	**9**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**1**

Reach Facts

Reach network length: approx. 1.8km
Dominant land uses: Suburban reserve

This reach includes the remaining natural stretch of Tuggeranong Creek fed by the overflow from Lake Tuggeranong. The creek enters the Murrumbidgee River two kilometres downstream of Pine Island Reserve.

Although well lined with Casuarinas, most of the understorey along the creek consists of weed species. The creek itself is heavily overgrown with algae for most of the year. This is driven by the high levels of nutrients often entering the water from the surrounding catchment. Water quality is also affected by the same seasonal issues that occur in our other small creeks. This includes a loss of dissolved oxygen when the water warms beyond optimum temperatures.

Eastern long-necked turtles and Platypus have been spotted here on occasion.

This section of creek ran low for the first half of 2019, increasing to medium levels later in the year. Green flecks of algae were spotted by new Waterwatch volunteer, Catherine, in late winter and early spring but this had gone by October. The water was described as 'murky' on several occasions, displaying a milky appearance with half the turbidity measurements reading at 15 or 20NTU.

Waterbug surveys found a good diversity of orders with a few sensitive types found such as two types of mayfly nymphs and Hydrobiosid or 'naked' caddisfly larvae in the riffles below the crossing. Most of the bugs found, however, were tolerant types with 'true bugs' (Hemiptera) dominating the numbers.

A 'murky' Tuggeranong Creek - looking upstream towards Lake Tuggeranong, August 2019.

Westwood Farm TMM1

McQuoid's Hill to Murrumbidgee River

2019 CHIP Result C (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**24 (3 dry)**
pH	Excellent	
Turbidity	Degraded	
Total Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

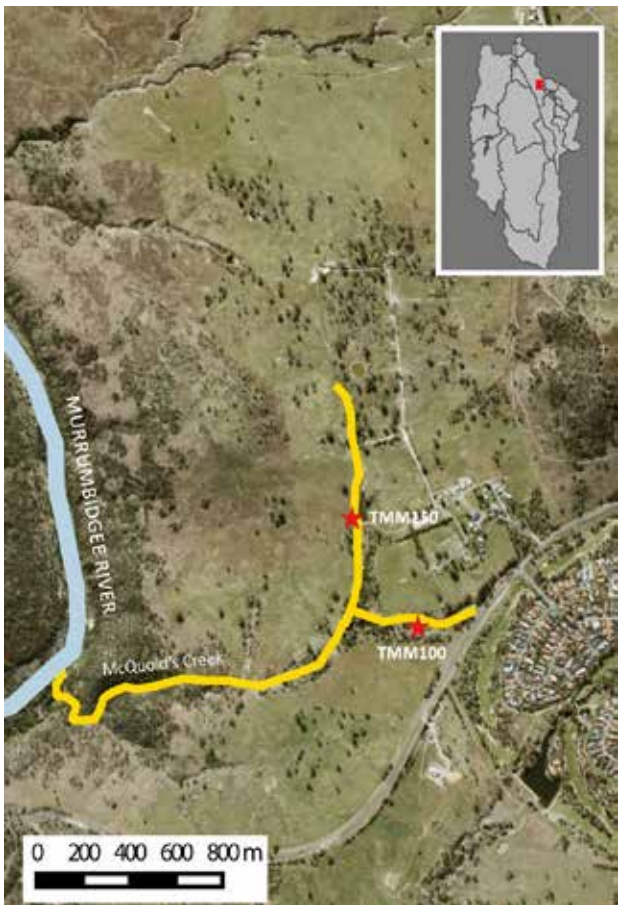
Reach network length: approx. 2.5km
Dominant land uses: Rural grazing and recreation

This reach covers McQuoid's Creek and the associated dam on Westwood Farm, Kambah. A tributary of the creek runs past the Murrumbidgee Golf Club. McQuoid's Creek flows into the Murrumbidgee River near Kambah Pool. The upstream sections are predominately cleared land, while the downstream secton has some good vegetation.

The riparian zone in this reach is generally low in dead trees and logs that contribute greatly to the overall habitat health. The sites monitored for this reach reveal similar stressors affecting water quality as seen in our other small rural waterways. High electrical conductivity and low oxygen levels are common.

In 2019 the farm dam was home to a family of wood ducks for most of the year as it slowly dried out. A clutch of newly hatched ducklings were seen by teacher Ian and students of the 'Ed Shed' in February. In March the creek ceased to flow and turtles began congregating in the receding water of the dam.

In April the waterbug survey, assisted by students from Duffy Primary School, found yabbies, damselfly nymphs and a huge leech hiding in the pools along the creek line. In spring a notonemourid stonefly nymph was found, one of the few to survive in the drying waterways.



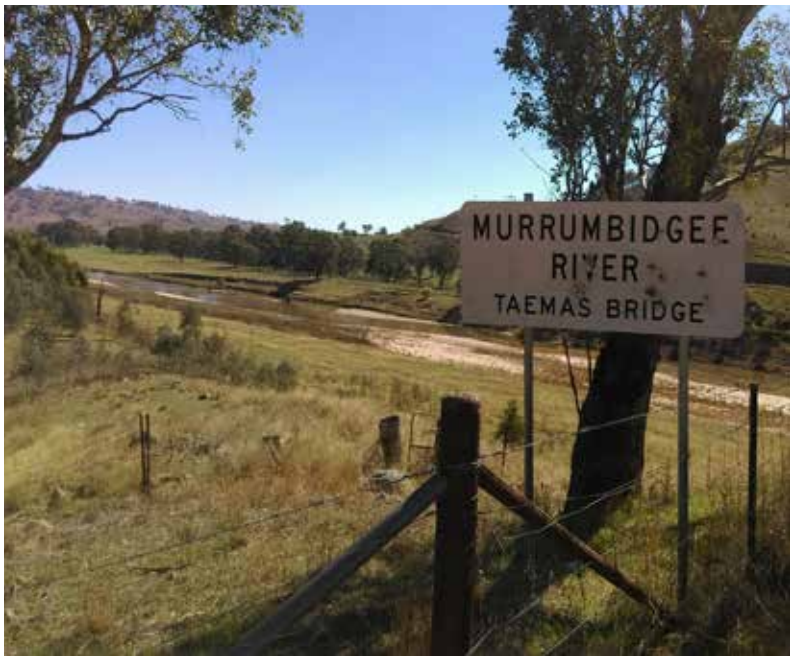
Duffy Primary School students helping catch waterbugs at McQuoid's Creek, April 2019.

Yass Catchment Facts

The Yass catchment is approximately 2,800km^2 , and is situated to the north of the ACT. It is made up of two major rivers. The first is the Yass River that has its headwaters approximately 100km to the southeast around Wamboin. The river flows northwest past Sutton and downstream to the township of Yass and then through steep gorge country until it flows into Burrinjuck Dam from the east. The major tributaries of the Yass River include Brooks Creek, Gundaroo Creek, Murrumbateman Creek, Dicks Creek and Manton Creek.

The second major river is the Murrumbidgee River that becomes part of the Yass catchment (in terms of the CHIP report) below the confluence with Ginninderra Creek just after both waterways exit the ACT. The Murrumbidgee runs north through Wallaroo and Cavan, to the west of Murrumbateman, before entering Burrinjuck Dam from the south. This lower section of the Murrumbidgee has large sand deposits resulting from reduced flows and the impounded waters of Lake Burrinjuck. The natural river bed is smothered by the sand creating wide shallow sections with little or no in-stream structure.

A large portion of this catchment is cleared grazing land and, as a result, major issues include dryland salinity and erosion. Many of these issues could be ameliorated through stock exclusion and the regeneration of the riparian zone. This is occurring on a number of fronts throughout the region with the Yass Area Network of Landcare Groups (YAN) playing a major role.



Yass Catchment Health Summary

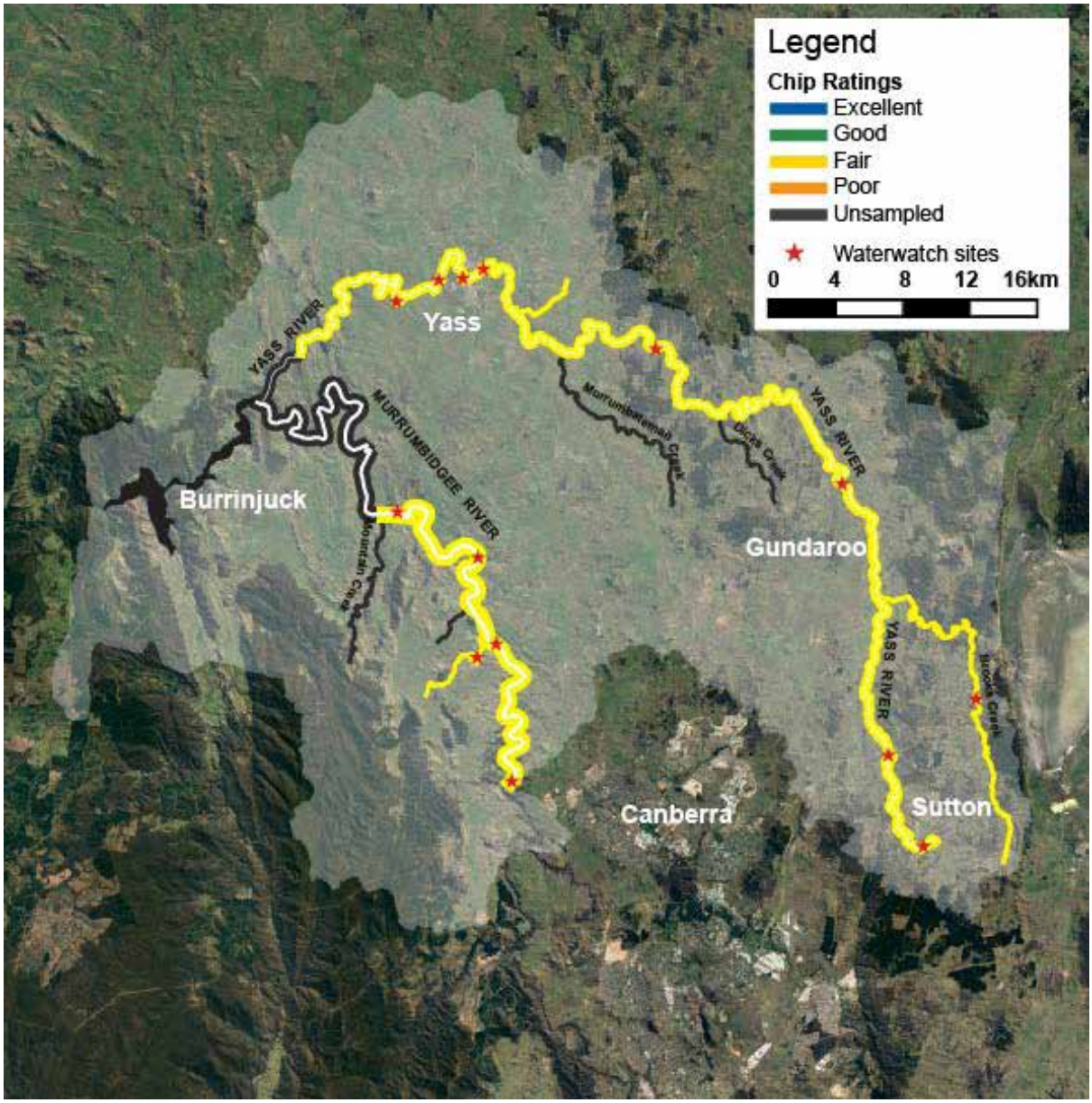
This is the fifth year that data has been collected in the Yass catchment thanks to all the volunteer efforts. Overall, all six reaches had *fair* scores in the Yass region. Compared to last year's CHIP results, half of the reaches kept similar scores (CMM12, CMM13 and YAS4), while the other half (YAS1, YAS2 and YAS3) dropped from *good* to *fair*.

It seems the main reason for the decline in scores in YAS1 and YAS2 was a poorer condition in the riparian zone in these reaches, while YAS3 has seen a decline in all parameters: water quality, water bugs and riparian vegetation. The reduced rainfall totals is likely one of the reasons why no reach showed improvements in 2019 in the Yass region.

Water levels in the Yass region have fluctuated this year and our volunteers have observed 'isolated pools' or 'dry' waterways 38% of the time, 'low' water levels (31%), 'medium' levels (31%), while 'high' levels were not listed at all in 2019.

Elevated nitrate readings continue to be detected in the Murrumbidgee River with up to 17mg/L recorded. The Lower Molonglo Water Quality Control Centre (LMWQCC) is a likeyl contributor to these high reading (see CMM11). The lower Yass River (YAS4) also continues to get elevated nitrate results of up to 7mg/L below the township, while the above town reaches have received *excellent* scores.

From 2019 the Upper Murrumbidgee Demonstration Reach (UMDR) partnership, which works to protect and improve river health in the Murrumbidgee River, has expanded its region to include the area encompassing CMM12 and CMM13. We look forward to working with UMDR to improve the health of the Murrumbidgee.



Murrumbidgee River CMM12

Ginninderra Creek confluence to above Mullion Creek confluence

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**6**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 18km
Dominant land uses: Grazing, conservation

This Murrumbidgee River reach starts at the confluence with Ginninderra Creek and ends above the confluence with Mullion Creek in Wallaroo. Much of this reach is surrounded by cleared grazing lands, and has a very narrow riparian zone. In a few notable places, private landowners are undertaking riparian vegetation replantings to improve river condition.

The riparian condition varies considerably through this reach. The upper section contains some of the most intact remnant patches in the area with steep rough terrain providing refuge for native species. In contrast the lower section has many areas dominated by exotic weed species, which is surrounded by sheep farms. The inaccessibility of the upper section means that this is a good place to see Platypus, with kayakers reporting regular sightings. Unfortunately, Carp are also commonly sighted in the river.

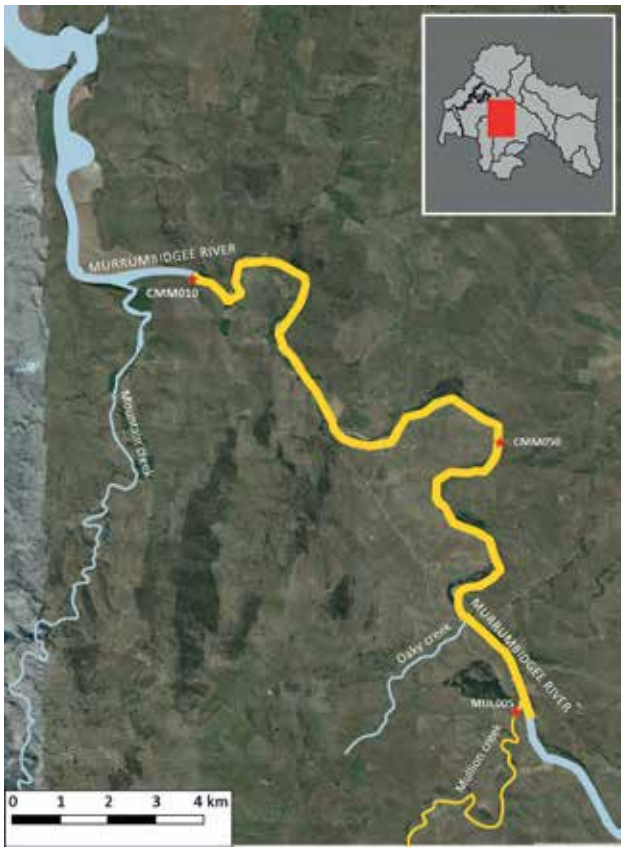
The most concerning parameter in this reach over the past few year is nitrate, with concentrations of up to 30mg/L. The source of this is most likely the Lower Molonglo Water Quality Control Centre (see also reach CMM11). In 2019, lower concentrations of nitrate were observed, with a range of 4 - 17 mg/L. It is thought that this coincided with higher than usual phosphorus readings that may have driven the notable algal growth in this reach and these algae were then consuming the available nitrate. Waterbugs sampling in spring was also made difficult due to the algae, with only six orders being detected.

The Murrumbidgee River below CMM110.

Murrumbidgee River CMM13

Mullion Creek confluence to Taemas Bridge above Burrinjuck Dam

2019 CHIP Result C+ (Fair)		
2018 CHIP Result C (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**18**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Poor	
Dissolved Oxygen	Excellent	
Waterbug	**Fair**	**2**
Riparian condition	**Poor**	**3**



Reach Facts

Reach network length: approx. 20km
Dominant land uses: Rural

This reach is the most downstream of the 13 reaches on the Murrumbidgee River. The bottom site at Taemas Bridge is immediately upstream of the impounded waters of Lake Burrinjuck. Much of this catchment is cleared grazing land, with poor in-stream habitat and a narrow and at times, heavily degraded riparian zone. Stock have direct access to the river in places, further impacting the riparian zone.

Low water levels are common in this reach, and this is particularly evident at site CMM010, where the Murrumbidgee River is shallow, has a sandy bottom and little in-stream habitat. The large 'sand slugs' (a large intrusion of sand within a river channel) in this lower section are mainly a result of upstream land use practices as well as the damming of the river at Burrinjuck Dam.

Although the reach has good ground cover on the surrounding landscape, it is mainly composed of exotic grasses. The limited presence of native trees in the riparian zone also drags down the riparian condition scores.

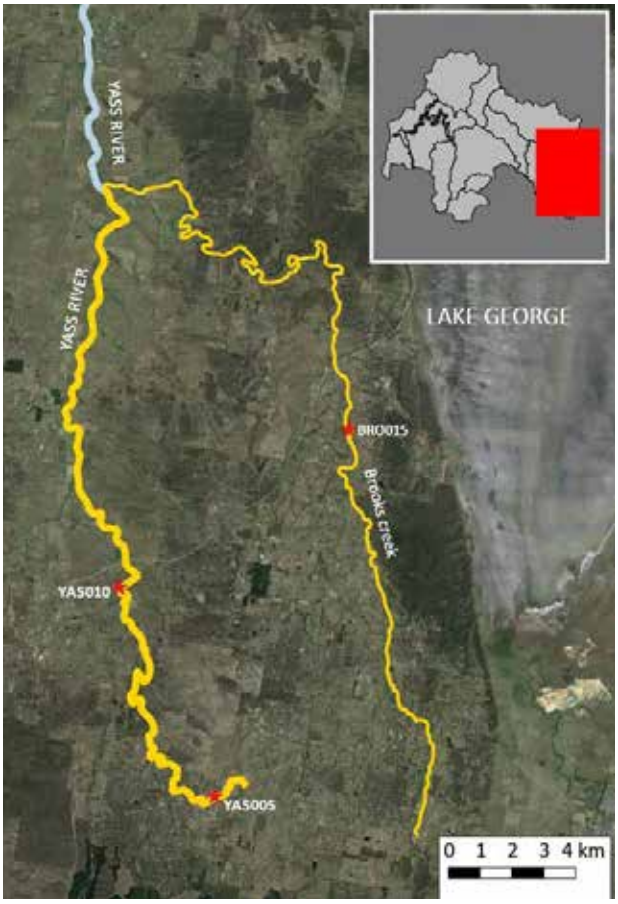
High levels of nitrate (up to 15mg/L) on the upstream Murrumbidgee River site (CMM050) were reduced to 1-3mg/L at Taemas Bridge (CMM010), the most downstream site. This is most likely the influence of the Lower Molonglo Water Quality Control Centre (the likely source) easing as you move downstream (see also reach CMM11). Turbidity levels have varied in this reach in 2019 (9-28NTU) with the higher results occurring over the summer months.

The mighty Murrumbidgee at CMM010.

Yass River YAS1

Headwaters to Brooks Creek confluence, including Brooks Creek

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**13 (3 dry)**
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**3**
Riparian condition	**Poor**	**3**



Reach Facts

Reach length: approx. 60km
Dominant land uses: Rural, rural residential

The upper Yass River and Brooks Creek represent the top of the Yass River catchment. Although good ground cover is present throughout this reach, with the presence of tussock grasses, the overall amount of native vegetation is still limited.

Water levels regularly fluctuate on this section of Yass River. The dry conditions experienced over 2019 saw all 13 water quality surveys conducted on a river listed as having 'no flow', with three surveys having no data collected as the site was completely dry. The dry conditions highlight the importance of good in-stream habitat such as bullrushes, reeds and milfoil that have been recorded at YAS010 over the years. These provide habitat for waterbugs, yabbies and tadpoles and help regulate the temperature of the remaining water.

The waterbug surveys were quite successful, yielding ten orders of bugs in both autumn and spring samplings. Water mites, which are sensitive to pollution, were the most common species (+100). Water mites are known to temporarily live on the surface of aquatic insects during their life cycle.

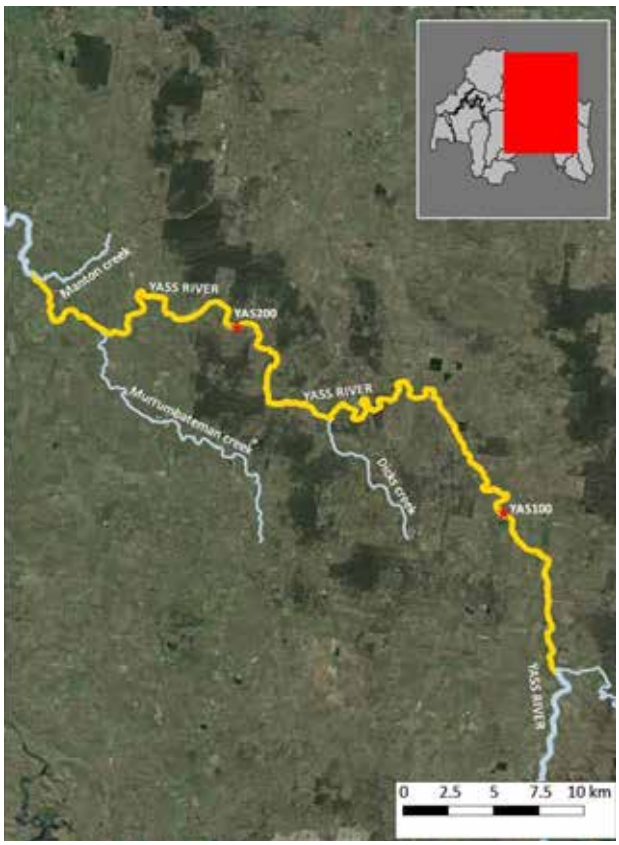
Owing to the extensive presence of Carp in Brooks Creek and their behaviour of 'mumbling' in the sediment on the bottom or banks of water bodies, it is not uncommon for higher turbidity levels to be recorded in the creek (eg. 40NTU in December).

Volunteer Paul sampling for waterbugs at Yass River (YAS005).

Yass River YAS2

Dicks Creek confluence to Manton Creek confluence

2019 CHIP Result C+ (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**16**
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
Waterbug	**Fair**	**2**
Riparian condition	**Fair**	**2**



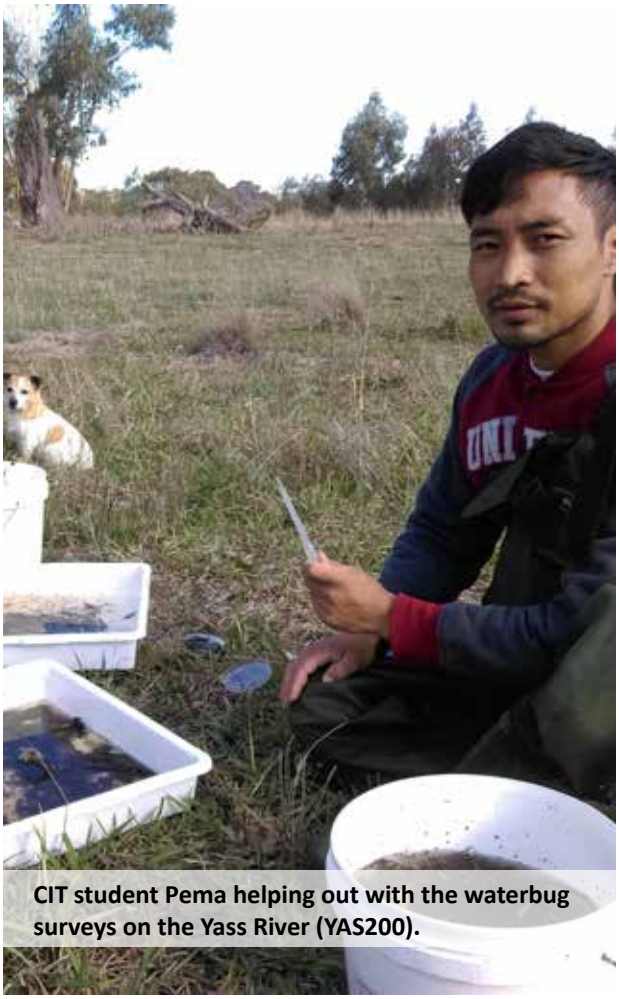
Reach Facts

Reach length: approx. 30km
Dominant land uses: Rural

This mid-section of the Yass River contains the major tributaries of the Murrumbateman and Manton creeks. The catchment is largely cleared and used for grazing. Riparian condition is generally poor, with pasture improvement right up to the river bank with stock access to the river being evident. River management issues in this reach include high sedimentation leading to reduced in-stream habitat and high electrical conductivity due to historical land use and geology.

Riparian condition surveys portray contrasting results. Good riparian condition can be found at 'Goldenholm' (YAS200) with good native canopy cover, midstorey and groundcover, supporting a highly functional riparian zone. Conversely Booth's Crossing (YAS100) has minimal canopy cover and depauperate groundcover, which gives this reach its *poor* rating. Carp leaping and flapping above the water is common in spring in this reach.

In 2019, we observed nine species of waterbugs recorded in both autumn and spring sampling, with good numbers of the pollution-sensitive mayflies, caddisflies and water mites. Mayflies were mainly represented by the Leptophlebidae family, which are known for their prominent, feather-like gills that increase the surface area to help absorb oxygen.



CIT student Pema helping out with the waterbug surveys on the Yass River (YAS200).

Yass River YAS3

Yass township

2019 CHIP Result C (Fair)		
2018 CHIP Result B- (Good)		
Parameter	**Rating**	**No. Survey**
Water quality	**Fair**	**11**
pH	Excellent	
Turbidity	Good	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Poor	
Waterbug	**Poor**	**2**
Riparian condition	**Fair**	**2**

Reach Facts

Reach network length: approx. 10km

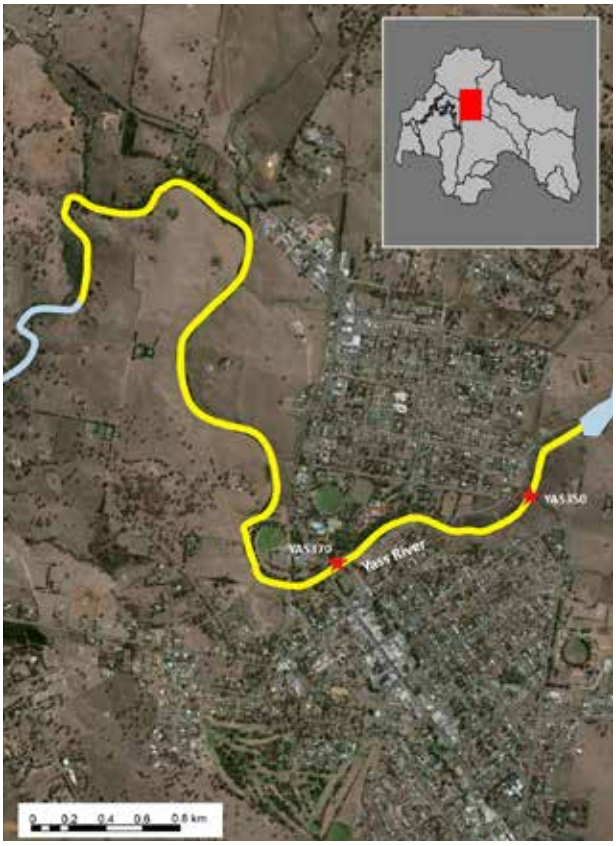
Dominant land uses: Urban/Rural Fringe

This section of the Yass River includes the township of Yass. Flow is heavily influenced by Yass Dam located just above the town, and urban inputs are also likely to influence water quality in this reach. There is ongoing habitat rehabilitation occurring in the Yass Gorge at the top of the reach. The township of Yass was named after Yarrh or Yharr, the word for running water in the Ngunnawal language.

The Yass Gorge (YAS350) is a heritage site and one of the most conserved sections of Yass River, with good numbers of large, native trees, shrubs and lomandra plants. The Friends of Yass Gorge have been instrumental in restoring this landscape and controlling weed species.

The large presence of in-stream vegetation in YAS370, such as ribbon weed, serves as habitat for waterbugs, fish and turtles. Wood ducks, Coots and Dusky moorhens are commonly observed and Pobblebonks *Limnodynastes dumerilii* are regularly heard calling. Carp have also been sighted in this reach.

In 2019, it is interesting to note how nitrate in the Yass River goes from *excellent* in the YAS1 and YAS2 reaches to *degraded* when passing through the township. Continued monitoring to identify potential sources of nitrate is highly recommended. While phosphorus levels were *excellent* overall, spikes of 0.05mg/L were observed at both sites following rain in March. Algae was noted on a couple of occasions and may be related to the higher nutrient levels.

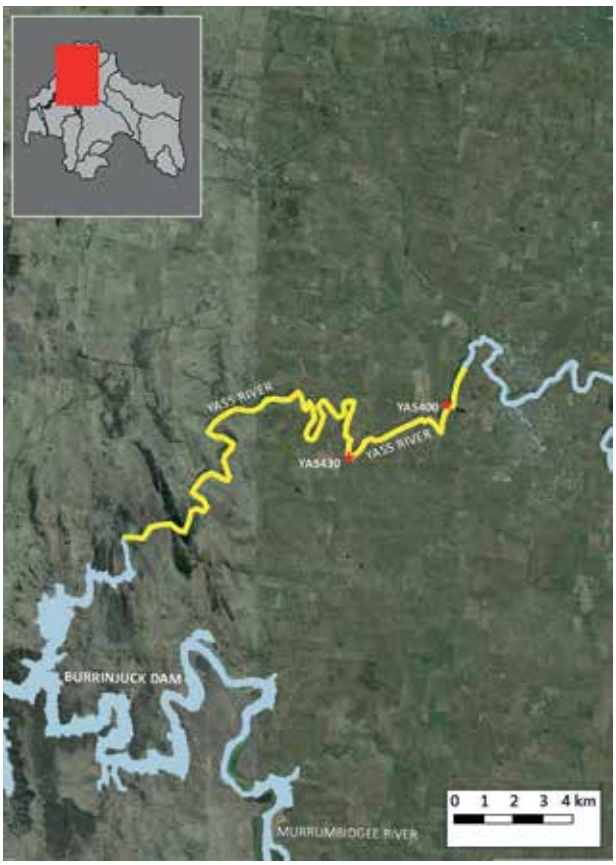


Yass River at the township (YAS370).

Yass River YAS4

Hattons Corner to Burrinjuck Dam

2019 CHIP Result C (Fair)		
2018 CHIP Result C+ (Fair)		
Parameter	**Rating**	**No. Survey**
Water quality	**Good**	**9**
pH	Good	
Turbidity	Excellent	
Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
Waterbug	**Poor**	**2**
Riparian condition	**Poor**	**2**



Reach Facts

Reach network length: approx. 23km

Dominant land uses: Rural Fringe

This downstream section of the Yass River runs through gorge country and farmlands before flowing into Lake Burrinjuck. This reach is marked by its scenic beauty and significant geological history. The Hume Limestone, which caps the escarpment above the River at Hatton's Corner, is particularly rich in fossils. Habitat restoration projects are underway, led by landowners below the township. This should have a positive impact on the catchment health over the long term.

Despite the presence of reeds along the River and some patches of native tree regeneration, most of the riparian zone is lacking good canopy cover and shrubs, which are necessary to provide shade, erosion control, and habitat for birds and other fauna.

Nitrate levels continue to be a problem in this reach, especially at Hattons Corner (YAS400) where levels as high at 7mg/L were recorded in July. Phosphorus levels are also problematic after rain events with 0.05mg/L being recorded in March. The same rain event also produced a turbidity reading of 70NTU.

In 2019, the most common waterbugs observed in our surveys in this reach were the 'true bugs' order (Hemiptera), represented by water boatmen, backswimmers and water striders (+400). These bugs all have piercing and sucking mouthparts, which defines the Hemiptera group.

Yass River at Hattons Corner (YAS400).

Platypus Month

While these dry times haven't necessarily produced big numbers of Platypus in our surveys, they have mobilised a record-breaking number of volunteers to look for them! The 2019 Platypus Month census in August was the most popular to date with 158 volunteers signed up to the 22 surveys at five 'river reach' sites across the ACT region.

Waterwatch went with the approach again this year to do more surveys at fewer sites. This is aimed at improving our confidence in the number of Platypus and Rakali (Water rats) that are detected. The five survey sites (each averaging ten volunteers on a one kilometre transect) were on Cooma Creek near the township of Cooma, Jerrabomberra Creek within the Nature Reserve, the Molonglo River below Coppins Crossing, and two on the Murrumbidgee River: at Bush Heritage Australia's Scottsdale Reserve near Bredbo and Point Hut Crossing in southern Canberra.

A total of eleven individual Platypus were sighted over the five reaches which was the same number as last year's census (down from 13 in 2017). While these lower numbers once again seem to be reflecting the dry conditions, the results this year were more mixed. The Murrumbidgee River sites appeared to be supporting higher numbers with Point Hut Crossing detecting three individuals (possibly four) and Scottsdale conservatively estimating five individuals (possibly as many as seven). In contrast, Cooma and Jerrabomberra Creeks detected low numbers with just one and two individuals respectively.

Location	Surveys	Number Of Individual Rakali (Water Rat)	Number Of Individual Platypus
Molonglo River below Coppins Crossing	4	1	0
Jerrabomberra Creek within Nature Reserve	4	3	2
Murrumbidgee River, Point Hut Crossing	4	2	3
Murrumbidgee River, Scottsdale Bush Heritage Reserve	6	1	5
Cooma Creek, Cooma	4	0	1
Total	**22**	**7**	**11**

Of concern was that no Platypus were detected on the Molonglo River below Coppins Crossing, particularly given as many as three individuals have been noted in previous years. This is an area of high development with the new suburbs of Denman Prospect and Whitlam in close proximity. During one morning survey, we experienced the loud noise of rock breaking in the Denman Prospect development. It was noted by volunteers that this action was not only reverberating through the landscape but was sending vibrations through the water. Given the Platypus's bill has receptors that make it particularly sensitive to touch or pressure, it is possible that it is moving out of this area of the Molonglo River to avoid disturbance. We have received sightings upstream and downstream of this reach since August and a member of the public observed a Platypus below Butters Bridge (ie. in the survey area) over two days in late September. More work is needed in this reach to better understand the Platypus population and the pressures that face them.

Rakali numbers were slightly up on last year with every site except Cooma Creek recording them. Jerrabomberra Creek hosted the greatest numbers with two/three Rakali sighted at all four surveys. The Coppins Crossing site recorded them for the first time since surveys began there in 2017.

As mentioned earlier, there was an amazing response to surveys with nearly 160 people signing up. And people didn't just sign up once, but many people signed up for multiple surveys with a total of 515 volunteer hours going into Platypus Month in 2019. With the additional volunteer time, there could have been four extra group surveys conducted at an entirely new site – further extending our understanding of Platypus numbers in the region.

SO WHAT'S NEXT?

The high interest in Platypus Month in 2019 from both the community and media resulted in some interesting discussions with academics and land managers working in this space. Waterwatch recognises that the methods we use for monitoring can only tell us some of what we need to know to better manage Platypus. We are aiming to pursue some great collaborations in 2020 to increase our awareness and understanding of platypus in this region.

One thing being considered for 2020 is setting up some extra sites given the increased capacity demonstrated in 2019. The Queanbeyan River is a strong contender given it is known for its population of Platypus and may be hosting some more formal studies in the near future. We are also talking to our friends at Tidbinbilla who have been doing terrific work on platypus for some years now and hope that we may include The Sanctuary in Platypus Month next year as well.

If you are keen to do more between now and next August, then there is also some sites on the Australian Platypus Conservancy's (APC) Australian Platypus Monitoring Network.(APMN) page. The sites overlap with the survey areas and are aimed at gaining a better understanding of Platypus numbers over the course of the year. This suits people who would regularly visit these areas and can look for Platypus there preferably once or twice a week (more if you have time) for around ten minutes at a time. The more people signing up to a site the better, as this will increase the number of data points for that site and improve data confidence. The sites are: Butters Bridge below Coppins Crossing, one directly above Point Hut Crossing and one just below, plus one at both Jerrabomberra and Cooma Creeks. Go to 'View Findings' on the APMN homepage to see the sites and feel free to contact Waterwatch or Geoff Williams (APC) if you have any questions.

ABOVE: Only hardy volunteers need apply for Cooma Platypus surveys. The first survey of Platypus Month saw the Cooma Creek partially frozen over! No ice-skating platypus were sighted.

FrogWatch

FrogCensus 2019 Summary

The ACT and Region FrogWatch Program (FrogWatch) is run by the Ginninderra Catchment Group. FrogWatch has been engaging volunteers since 2002 to monitor, restore and protect local frog habitat, and to raise awareness and educate. The program covers the ACT and its surrounding NSW region from Cooma in the south to Gundaroo in the north and from the Cotter River in the west to Captains Flat in the east.

FrogWatch and Waterwatch adopted a more formal partnership in June 2019. This will result in a more cost-effective approach, drawing on the knowledge and resources within the Waterwatch program to enhance capacity and add value to the FrogWatch dataset.

One of the main outputs of the FrogWatch program is to facilitate community engagement through the monitoring of frog populations at local wetlands through the annual FrogCensus. The annual FrogCensus report provides an overview of the distribution of our local frog species, particularly in the urban setting, and aims to detect change over time.

For the first time in 2019, the FrogCensus was extended to cover the entire month of October. FrogWatch also reduced the number of sites monitored from approximately 500 to around 250 in preparation for the FrogCensus. These actions combined are aimed at boosting detection of species during optimum conditions as well as improving data continuity by ensuring key sites are surveyed every year.

Four training events were run in 2019, three at the Jerrabomberra Wetlands and one in Cooma. In addition, numerous smaller training events were run for keen volunteers, such as Scout groups. An online booking sheet assisted volunteers in choosing their monitoring sites and helped spreading the volunteer effort evenly across all sites.

A total of 366 surveys were submitted for the October 2019 FrogCensus by over 200 trained FrogWatch volunteers. 186 FrogWatch sites were monitored, 161 of which are located in the ACT and the remaining 25 in neighbouring NSW. Sites were visited between one and nine times during the FrogCensus. The average number of visits per site was two.

Many ponds were dry or nearly dry for most of 2019 due to record breaking average daytime temperatures and well below average rainfall. A high proportion of sites were visited only once as a total of 27 sites were dry during the FrogCensus and therefore did not provide optimal frog-breeding conditions (Figure 1).

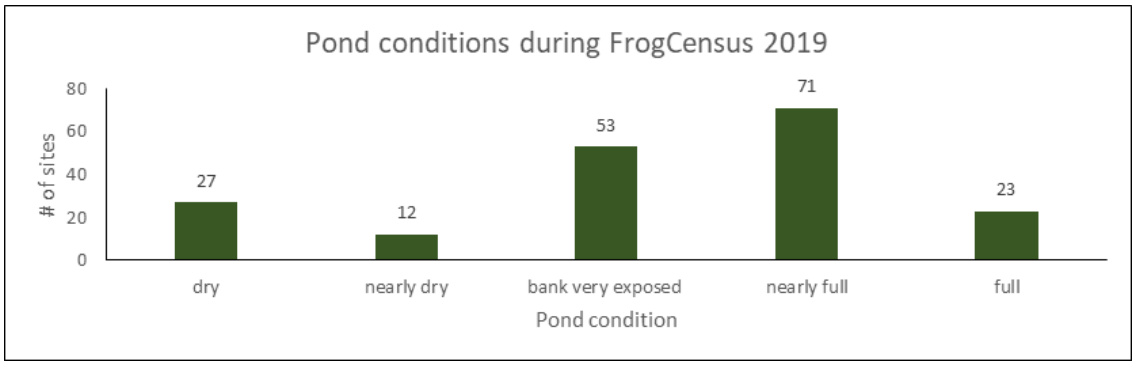


Figure 1: Pond conditions in relation to available water for breeding, October 2019.

Moreover, 66 additional survey sites provided highly unsuitable breeding habitat by being either nearly dry (n=12) or having very exposed banks (n=53). Only 50% of all surveyed sites were either full or nearly full and therefore provided good breeding conditions in relation to available water for mating and tadpole development.

Subsequently, 92 out of the 366 surveys (25%) did not detect any frogs at all. In comparison with 2017, a recent year of higher rainfall, only 31 surveys out of 274 surveys (11%) showed this result.

Site Diversity

A high diversity of frog species at a survey site can indicate the presence of a wide range of frog-habitat features. Identifying these high-value sites and their species-specific habitat provision is important to inform planning and management decisions regarding areas for frog conservation.

The total number of species detected at each survey site is shown in Figure 2. At 42 sites, no frogs were detected at all. As a result, the average number of species detected at the 186 survey sites was 2.25. However, when excluding the 'no-frog sites' from the analysis, the average number of frog species per site increases to 2.9. The two most species rich sites, with seven species each, were CFR200: a private farm dam in the Captains Flat area, and FOR001: Forde Wetland, Gungahlin.

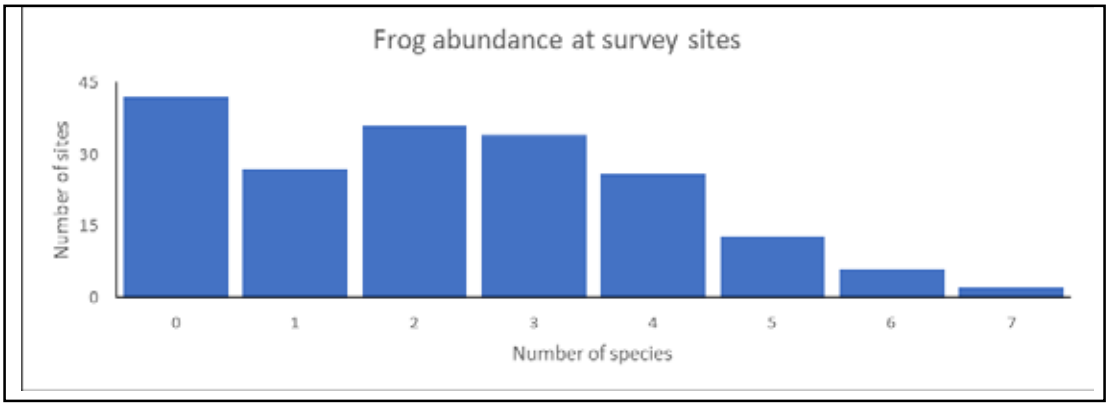


Figure 2: Frog abundance (number of species) across all survey sites (n=186) during the 2019.

Species Detected

As some sites were monitored more than others, there is a risk that some species are over-represented in the results. Because of this, the detection of each species is presented per individual site rather per survey (Figure 3). A total of nine species were detected during the 2019 FrogCensus. As in previous years, the three most frequently detected species were *Crinia signifera, Crinia parinsignifera* and *Limnodynastes tasmaniensis*. The species detected least was *Litoria lesueurii,* which was only heard during two surveys.

Due to the hot and dry conditions, frog numbers were generally low in the 2019 FrogCensus. One of the main observations was the strong negative impact of the dry weather conditions on frog habitat quality. Exposed pond edges, lack of riparian and in-stream vegetation, and the absence of shade trees minimised habitat quality and most likely reduced breeding and survival rates of local frog fauna.

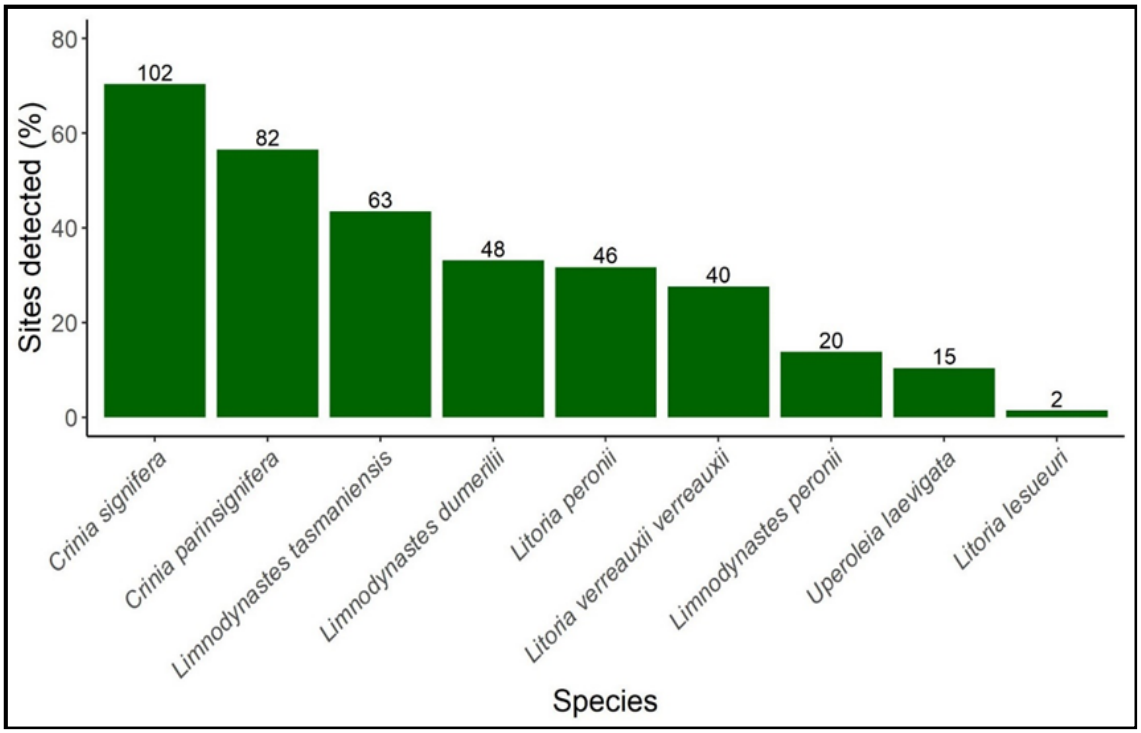


Figure 3: Percentage of sites where species were detected (actual number of sites written above).

THE FOLLOWING TWO PAGES SHOWS ONE OF THE NINE FROG SPECIES PROFILES OUTLINED IN THE FULL FROGCENSUS REPORT FOR 2019. THE FULL REPORT CAN BE FOUND AT:

https://ginninderralandcare.org.au/frogwatch-useful-stuff/

Eastern Banjo Frog or Pobblebonk - *Limnodynastes dumerilii*

The Eastern Banjo Frog *Limnodynastes dumerilii* prefers ponds with lots of structural complexity in the form of rocks and logs and close to patches of forest ≥10Ha. The greater the distance from a reserve, the lower the likelihood of detecting this species.

In the October 2019 FrogCensus *Limnodynastes dumerilii* was recorded during 77 surveys and at 48 sites.

The number of sites annually surveyed during October has varied between years. Figure 1 shows two columns for each survey year since the commencement of the FrogWatch Program in 2002. The blue column indicates the number of sites monitored per year. The red column represents the number of monitored sites where *Limnodynastes dumerilii* was present.

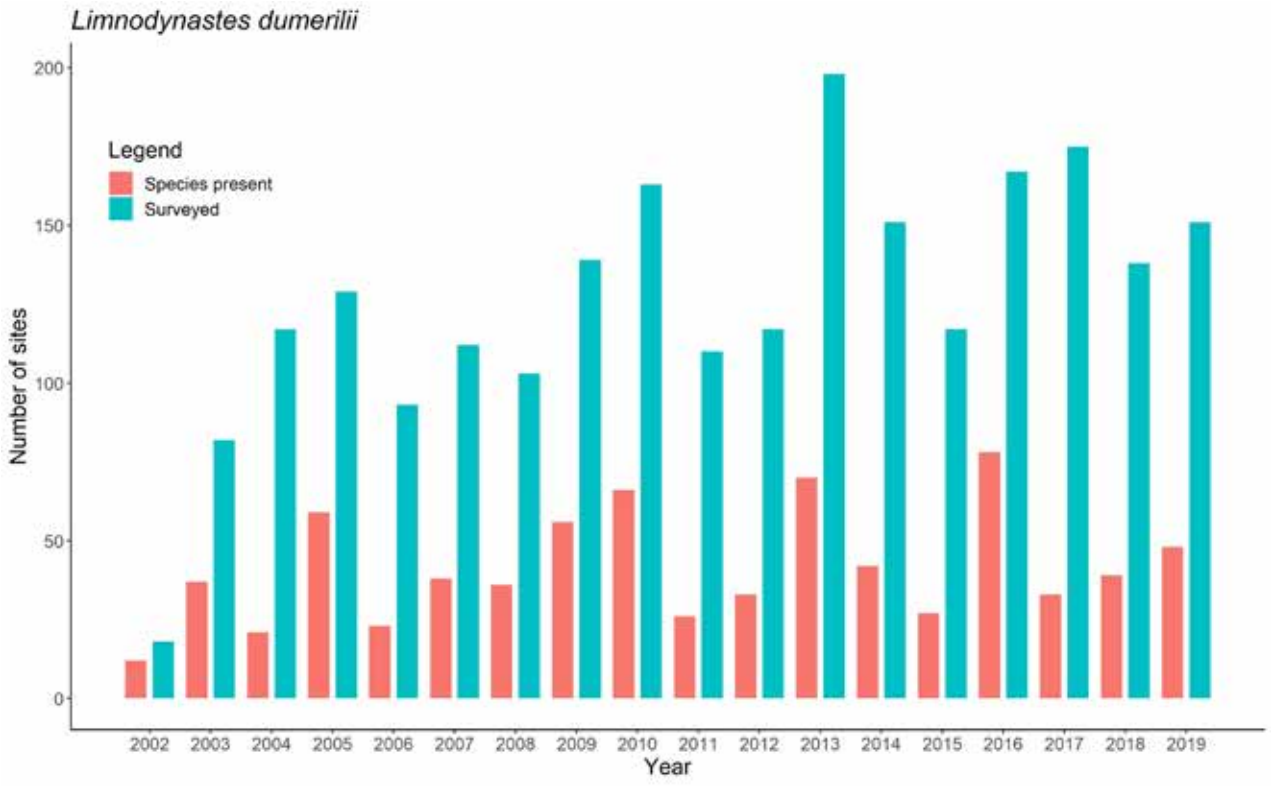
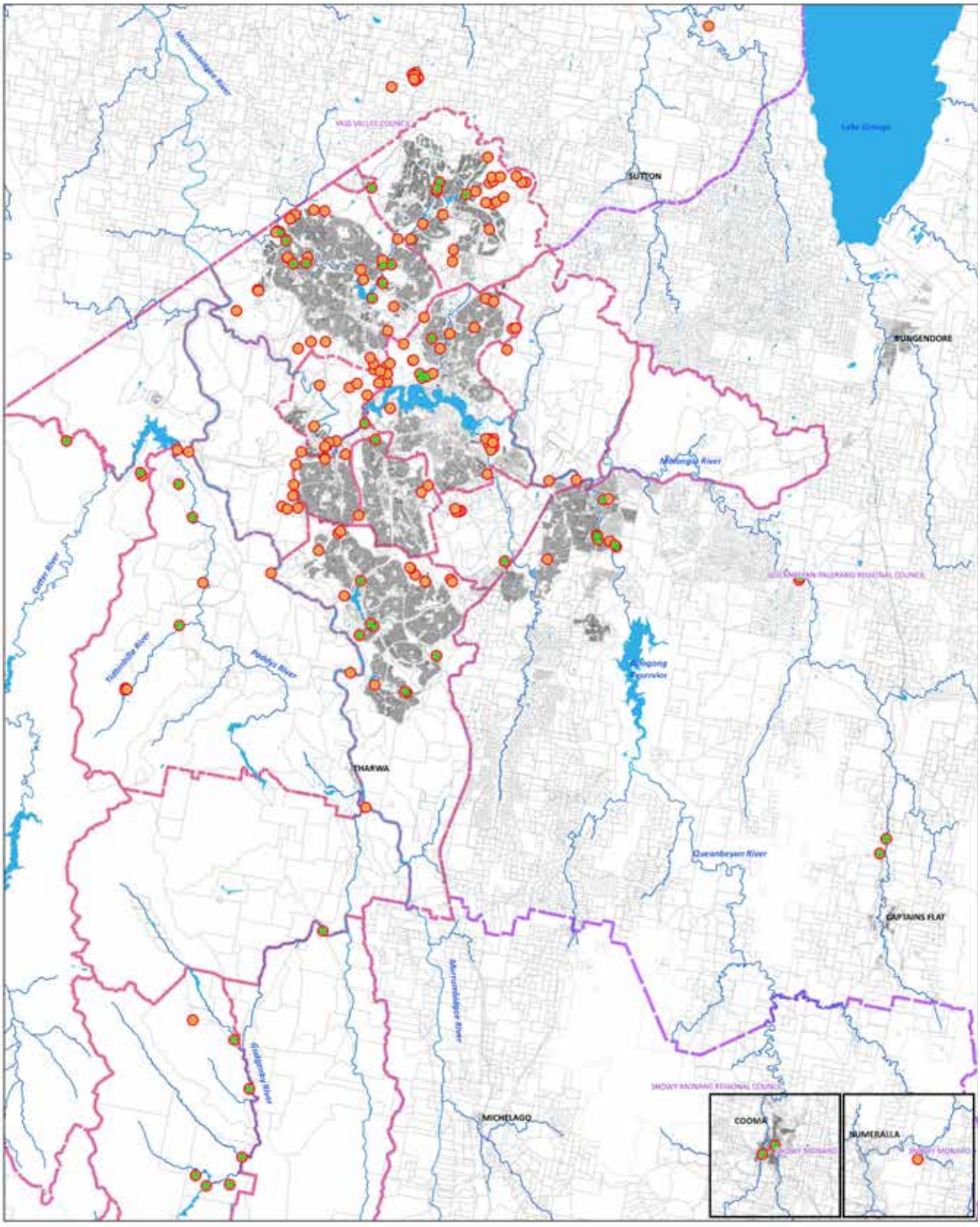


Figure 1: Number of *Limnodynastes dumerilii* detected vs total number of sites surveyed thoughout October 2002-2019.



Legend

- Species Recorded
- All Frogwatch Sites 2019
- Waterbody
- Watercourse
- Block / Lot Boundaries
- ACT Districts
- NSW LGAs

5 0 5 10 15 20 km

Datum: GDA1994

Notes:

A total of 189 sites were surveyed during the 2019 Frogwatch census. All sites are displayed as 'All Frogwatch Sites 2019'. The distribution of the target species displayed in this map is then shown as an overlay as 'Species Recorded'.

Due to their distance from the majority of sites, the Cooma and Numeralla sites are shown as insets.

Last Updated: 23 February 2020

2019 Frogwatch Survey Results - Species Distribution

Eastern Banjo Frog

Limnodynastes dumerilii

FROGWATCH ACT AND REGION

Volunteer list

Cooma

Alison Dooley
Alison Howell
Alistair Bestow
Andrew McCrindell
Ann Henkel
Annie Didcott
Ashley Bolton
Barry Hughes,
Catherine Dodd
Damon Bassett
David Harkins
Edel Stephans
Emily Griffin-Morton
Gill Robinson
Glenn Barry
Hamish McCrindell
Ingrid Hagstrom
Jim Hart
Jim Wharton
John Booker
John Corcoran
Julee Harden
Kerryn Milligan
Kim Gollan
Kim Jarvis
Leonie McNamara
Lesley Hemstridge
Louise Jenkins
Lynton Hurt
Maria Linkenbagh
Mario Russo
Marissa Blunden
Mark Kent
Mark Shubert
Mary Ziesack
Matt Kent
Melinda Kent
Mick Castles
Mike Mannile
Morgan Blaschke-Broad
Nicki Duncan
Peter Gollan
Phil Irons
Phil Palmer
Remi Brademanne
Rita Brademann
Robert Evans
Rosie Gray
Rowena Evans
Samantha Clarke
Sarah Davies
Sarah Essex
Steve Chivers
Theo Schoo
Tim Scrace
Tony Robinson

Ginninderra

Ana Maria Londono
Angela Kaplish
Bruce Cowell
Catherine Gray
Charley-Maree Baum
Connor Skeels
Cynthia Jolly-Rogers
David Fitzsimmons
Deborah Hawke
Diego Bastos
Elizabeth Kretschmer
Fleur Leary
Garry Jolly-Rogers
Gregg Berry
Isis Londoño
James Cumming
Jennifer Grant
Jim Grenfell
Johanna Wallner
John FitzGerald
Julia Boyd
Lesley Harland
Luke Wensing
Mike Bassanelli
Nicole Sergent
Samantha Burn
Sari Ruuska
Scouts ACT – Environment team
Sebastian Mathew
Tim Woolmer
Yeimi A.

Molonglo

Alex James
Anna van Dugteren
ANUgreen Sustainability Office
Ben Huttner-Koros
Bernard Kertesz
Blaine Serafin
Captains Flat & District Landcare
Chad Burton
Colleen McMahon & Nick Loades
David Bromhead
Deb Kellock
Des Cannon
Elvira Currie, Meisha Readman & Tinderry Scouts
Friends of Jerrabomberra Wetlands
Gail Neumann
Greg McDonald
Hilary Gunn & Christine Bond
Jacob
John Bissett
John Moore
Karen Khoo
Kate WK
Kerry Smith
Louise Amos & Lyn Grigg
Lucy Snodgrass
Maree Latimer
Mel McRoberts
Melissa Varty
Michael Burton
Mike Sim
Miranda Gardner
Oliver Andrews
Peter Abbott & Fraser Argue
Peter Robertson & Deb Shaw
Philippa Russell Brown
Royalla Landcare
Richard
Sandy Lloyd
Sarah Essex
Sharon Koh
Sherri
Sue Gibson
Thea Zhu
Tony Patis
Wendy & Steve Hodgman
Woo O'Reilly
Yan Jiang

Southern

ACT Parks & Conservation Service (Ranger Bernie Brown)

Alannah Alley-Freeman

Anthony Cory

Carers of Point Hut Pond (Alan parker, Stephen Dellar & Laureen Harrison)

Caroline Chisholm High School

Catherine Gray

Conder Wetlands Waterwatch group (Vera Kurz & Mark Kerwin)

Cooleman Ridge Parkcare group (Pat Ryan)

David Cahill

Davina Savang

Emily Brooks

Friends of Stranger Pond (Nev Sheather & Colin Carpenter)

Friends of Tidbinbilla Parkcare group

Gudgenby Bush Regenerators Parkcare group (Martin Chalk, Michaela Popham & Samatha Donohoe)

Icon Water (Kate Rhook)

Jan Koehler

Jaydon O'Donoghue

Jeni DeLandre

John Corcoran

John Goodall

Lake Tuggeranong College 'Sustainability Unit'

Lions Youth Haven 'Ed Shed'

Paddy's River Waterwatch group (Marre Blume & Jill Smith)

Parkcarers of Southern Murrumbidgee (P.O.S.M) (Deb Kellock)

Richard Bland

Rodney Yeo

'Sands' Waterwatch group (Wendy Rainbird & Anne I'Ons)

Sijia Ding

Southwell Scout Group Venturers

Uriarra Parkcare group (Barbara Mackin)

Tidbinbilla Sanctuary Volunteer Assist Program

Tom Nilsen

Wendy Warren

Yass

Carol Boughton

Clive Boughton

Fiona Hamer

Iain Fyfe

Jane Major

Janette Ryan

Jill McGovern

Kate Wilson

Paul Churcher

Pema Khandu

Rebecca Widdows

Richard Bland

Richard Miller

Glossary

Baseline monitoring: The collection of data prior to a planned intervention/project

Confluence: The intersection of two waterways

Cyanobacteria: Photosynthesizing bacteria often responsible for blue-green algae blooms

Data deficient: Being either unsampled or having insufficient information to provide a confident assessment

Dissolved oxygen: The amount of oxygen present within water, either presented as an absolute amount (mg/L) or as a percentage of the total oxygen saturation at a given temperature

Eastern gambusia: A small invasive pest fish introduced from north America also known as Mosquito fish

Electrical conductivity: A measurement of the total combined salts/minerals within water and used as a proxy for salinity

Ephemeral: Contains water intermittently, as opposed to permanent

Erosion: The loss of soil from the land into waterways

Eutrophication: The rapid blooming of algae and cyanobacteria in nutrient-rich water, which can lead to depletion of dissolved oxygen

Fish kill: A natural or artificially induced mass die-off of fish occurring in a small space of time, often related to rapid depletion of dissolved oxygen

Flashy: A term used to describe the temporal response of river discharge following intense rain

Fragmented: Areas of habitat that have become disconnected due to habitat change

Frost hollow: An area of land that is subject to severe frosts. Often occurs near waterways

Galaxias: A small species of native freshwater fish

Gorge: A narrow, steep-sided, often rocky area immediately adjacent to a waterway

Groundwater: Water that is sourced from deep within the soil

Hydrograph: The relationship between river discharge and time

Leachate: Liquid effluent containing harmful substances

Macrophytes: Aquatic plants

Nitrate: A naturally occurring form of Nitrogen. High levels can indicate excessive nutrient inputs into waterways

pH: A measure of the acidity or basicity (alkalinity) of a solution

Phosphorus: A naturally occurring element essential to life. High levels are often implicated in algal blooms in waterways. Measured as Orthophosphate in the CHIP

Rakali: Indigenous name for the native Water-rat

Reach: A length of waterway defined by hydrological, environmental, landuse and social attributes for the purpose of reporting on ecosystem health

Riparian: The zone immediately adjacent to a waterway, which both directly receives and contributes to the aquatic ecosystem

Runoff: Water that flows into a waterway after rain

Sand slug: A large intrusion of sand within a river channel

Sediment: Soil that has become washed into a waterway

Stormwater: Water that flows into a waterway after rain from through the urban stormwater system

Stressors: Natural and man-made processes that can negatively affect natural ecosystem function

Turbidity: The degree of suspended solids in water that gives it a muddy colour

Willows: an introduced riparian tree species

Abbreviations

ACWA: Actions for Clean Water Plan (an initiative to reduce turbidity in the upper Murrumbidgee)

mg/L: Milligrams per Litre

µS: MicroSiemens

NTU: Nephelometric Turbidity Units

N: Nitrogen

QAQC: Quality Assurance, Quality Control

RARC: Rapid Appraisal of Riparian Condition

TSR: Travelling Stock Reserve

UMDR: Upper Murrumbidgee Demonstration Reach

Appendix I

Cooma region CHIP scores by parameter

Reach	pH	Turbidity	TP	NO3	EC	DOSat	WQscore	WBscore	RARCscore	CHIPscore	Letter
BAD1	1	1	1	1	1	5	1.67	2	2	1.89	A-
BAD2	1	1	1	1	1	5	1.67	2	3	2.22	B+
BRD1	1	1	1	1	3	1	1.33	3	3	2.44	B
BRD2	1	1	1	1	4	5	2.17	2	4	2.72	B-
CMM1	2	1	1	1	1	3	1.5	2	3.5	2.33	B+
CMM2	1	1	1	1	1	3	1.33	2	4	2.44	B
CMM3	1	1	1	1	1	1	1	2	3	2	B+
CMM4	1	2	1	1	1	1	1.17	2.5	4.5	2.72	B-
CMM5	1	2	1	1	2	1	1.33	2.5	4	2.61	B
CMM6	2	2	1	1	2	1	1.5	2.5	3	2.33	B+
COB1	1	1	5	1	5	5	3	3	4	3.33	C+
COO1	2	3	4	2	5	5	3.5	3	4	3.5	C
COO2	2	1	5	2	5	5	3.33	3	4.5	3.61	C
COO3	1	1	5	5	5	5	3.67	NA	4	3.84	C-
GUD1	2	1	1	1	5	1	1.83	3.5	4	3.11	C+
KYB1	1	1	2	1	2.5	5	2.08	3	4	3.03	C+
MIC1	1	1	1	1	5	5	2.33	3	4	3.11	C+
NUM1	1	1	2	1	4	5	2.33	4	4	3.44	C
NUM2	1	2	2	1	4	3	2.17	3	3	2.72	B-
NUM3	1	1	2	1	2	5	2	3	3	2.67	B
NUM4	1	1	2	1.5	3	5	2.25	3	4.5	3.25	C+
ROC1	2	1	1	1	5	1	1.83	3	5	3.28	C+
STR1	1	1	1	1	5	5	2.33	2.5	4	2.94	B-
	1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded.										

Molonglo region CHIP scores by parameter

Reach	pH	Turbidity	TP	NO3	EC	DOSat	WQscore	WBscore	RARCscore	CHIPscore	Letter
BUR1	1	1	1	1	5	5	2.33	3	4	3.11	C+
DIC1	1	1	1	1	3	2	1.5	3	DD	2.25	B+
GGG1	1	1	1	5	5	1	2.33	DD	3	2.66	B
JER1	1	1	1	1	5	5	2.33	3	3	2.78	B-
JER2	1	3	1	1	5	5	2.67	3	4	3.22	C+
LYN1	1	3	5	2	2	5	3	5	4	4	D+
MOL1	DD	DD	DD	DD	DD	DD	DD	2	4	3	C+
MOL2	2	1	1	1	5	5	2.5	4.5	1	2.67	B
MOL3	1	1	1	2	5	5	2.5	3	3	2.83	B-
MOL4	1	1	2	1	4.5	2	1.92	3	4	2.97	B-
MOL5	1	3	1	1	4	5	2.5	3	4	3.17	C+
MOL6	1	1	1	2	4	1	1.67	3	4	2.89	B-
MOL7	3	1	2	5	5	5	3.5	4	3	3.5	C
PRI1	1	1	1	1	5	5	2.33	2.5	4	2.94	B-
QUE1	1	1	1	1	2	1	1.17	2.5	3	2.22	B+
QUE2	1	1	1	1	4	1	1.5	2.5	3	2.33	B+
QUE3	1	1	2	1	4	2	1.83	3	4	2.94	B-
SCA1	DD	DD	DD	DD	DD	DD	DD	DD	2	NS	NS
SUL1	1	1	2	2	2	5	2.17	3	4	3.06	C+
SUL3	1	1	5	1	4	5	2.83	3	4	3.28	C+
SUW1	2	1	4	1	2	5	2.5	4	3	3.17	C+
SUW2	1	2	2.5	2	1	5	2.25	4	3	3.08	C+
WAT1	1	1	1	1	1	1	1	3	4	2.67	B
WES1	1	1	4	2	2	5	2.5	3	4	3.17	C+
WOO1	1	1	1	1	5	5	2.33	3	4.5	3.28	C+
YAN1	1	1	1.5	1	5	5	2.42	2.5	2.5	2.47	B
YAR1	1	1	1	1	4	5	2.17	3	3	2.72	B-
	1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded.										

Ginninderra region CHIP scores by parameter

Reach	pH	Turbidity	TP	NO3	EC	DOSat	WQscore	WBscore	RARCscore	CHIPscore	Letter
CMM11	1	1	1	5	4.5	4	2.75	4	3.5	3.42	C
GDC1	1	1	1	1	2	5	1.83	4	4	3.28	C+
GIN1	1	3	1	1	4	2.5	2.08	3	4	3.03	C+
GIN2	1	1	1	1	4	5	2.17	4	4	3.39	C
GIN3	1	1	1	1	4	5	2.17	3	4	3.06	C+
GIN4	1	3	2	2	4	5	2.83	3	4	3.28	C+
GIN5	1	1	1	2	4	2.5	1.92	3.5	4.5	3.31	C+
GIN6	1	1	1	1.5	4	1	1.58	5	3	3.19	C+
GOO1	1	1	2	2	5	5	2.67	3	5	3.56	C
GUN1	1	1	2	1	5	5	2.5	3	4	3.17	C+
GUN2	1	1	1	1	4	5	2.17	3	4	3.06	C+
KIP1	1	2	2	4	4	5	3	5	4	4	D+
MCW1	1	4	2	2	1	5	2.5	3	4	3.17	C+
MFL1	1	4	5	5	5	5	4.17	5	3.5	4.22	D+
YER1	1	1	1	1	4	1	1.5	3	4	2.83	B-
	1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded.										

Southern region CHIP scores by parameter

Reach	pH	Turbidity	TP	NO3	EC	DOSat	WQscore	WBscore	RARCscore	CHIPscore	Letter
CGB1	1	1	1	1	1	5	1.67	2.5	2	2.06	B+
CGG1	1	1	1	2	1	1	1.17	3	4	2.72	B-
CGH1	1	3	5	1	3	5	3	4	2.5	3.17	C+
CMM10	1	3	1	1	2	1	1.5	3	4	2.83	B-
CMM7	1	3	1	1	2	5	2.17	1	3.5	2.22	B+
CMM8	1	3	1	1	2	1	1.5	3.5	4	3	C+
CMM9	1	1	1	1	2	1	1.17	5	3	3.06	C+
CTP1	1	1	1	1	2	5	1.83	2.5	4	2.78	B-
CTT1	1	1	1	1	2	5	1.83	5	2	2.94	B-
GIB1	1	1	1	1	1	5	1.67	2.5	1.5	1.89	A-
GUI1	NA	NA	NA	NA	NA	NA	NA	2.5	4	3.25	C+
LMS1	1	1	1	1	4	3	1.83	4	3	2.94	B-
MCC1	1	1	1	1.5	2	1	1.25	2.5	3	2.25	B+
MCC2	2	1	1	1	1	5	1.83	1.5	2	1.78	A-
MMB1	1	1	1	1	3	5	2	5	3	3.33	C+
MPG1	1	2	1	1	2	5	2	5	4	3.67	C
MSP1	1	2	1	2	2	5	2.17	4	3.5	3.22	C+
NNN1	2	1	DD	1	DD	DD	1.33	2	3	2.11	B+
RAN1	3.5	5	3	1	5	5	3.75	5	4	4.25	D+
RAN2	1	3	1	1	1	5	2	3	5	3.33	C+
TIP1	1	2	2	2	1	5	2.17	5	4	3.72	C-
TLT1	1	4	2	2	2	1	2	5	3.5	3.5	C
TLT2	1	3	1	2	2	1	1.67	5	5	3.89	C-
TMM1	1	5	4	2	5	5	3.67	3	3.5	3.39	C
TUG1	1	1	1	2	5	5	2.5	4	4.5	3.67	C
TUG2	3	1	1	2	2	1	1.67	5	5	3.89	C-
TUG3	1	2	1	2	2	3	1.83	3	4	2.94	B-
	1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded.										

Yass region CHIP scores by parameter

Reach	pH	Turbidity	TP	NO3	EC	DOSat	WQscore	WBscore	RARCscore	CHIPscore	Letter
CMM12	1.5	1	1	5	4	1	2.25	4	3.5	3.25	C+
CMM13	1	1	1	5	4	1	2.17	3.5	4	3.22	C+
YAS1	1	1	1	1	5	5	2.33	3	4	3.11	C+
YAS2	1	3	1	1	5	5	2.67	3	3.5	3.06	C+
YAS3	1	2	1	5	5	4	3	4	3.5	3.5	C
YAS4	2	1	1	5	5	1	2.5	4	4	3.5	C
	1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded.										

Appendix II

CHIP Methodology

Upper Murrumbidgee Waterwatch (Waterwatch) produces an annual catchment health report called the Catchment Health Indicator Program (CHIP), based upon the data collected by volunteers throughout the preceding year. This report is a key output of this program, and is used as both a communication tool and to inform management and policy regarding water resource use and protection. Multiple complex calculations are involved in producing the CHIP, and numerous catchment groups around Australia produce similar (albeit slightly different) CHIPs. Specific details regarding these CHIPs are not generally forthcoming and so this document aims to clearly outline the underlying philosophy and methodology regarding the Waterwatch CHIP reports.

Multiple Types of Data

Waterwatch volunteers and coordinators collect data relating to water quality, macro-invertebrate abundance and diversity, and riparian condition. Each of these data sources are 'indices' or 'parameters', which, when combined, form an 'indicator'. Currently, the goal for volunteers is to collect water quality data every month, at every site. Volunteers and coordinators also collect aquatic macro-invertebrate data twice a year, in Spring and Autumn at key sites within each reach, generally near the bottom of each reach (to provide an indication of the entire reach). Finally, Rapid Appraisal of Riparian Condition (RARC; Jansen et al. 2005) assessments are conducted by volunteers and coordinators at each site once every 2 years (biennially). RARCs are conducted at lower frequency, as riparian condition changes at a slower rate than macro-invertebrate assemblages, and water quality. All these parameters are combined into the CHIP. Finally, additional data regarding algae abundance, river flow and height, diversity and frog abundance and Platypus abundance are used to provide context regarding catchment health. These, however, are not formally included in the CHIP calculations (Table 1). More details regarding these additional data sources can be found in the section "Additional Data".

Water Quality Parameters

Currently, volunteers strive to collect water quality data for multiple parameters every month (Table 1). These parameters have been widely established as the best indicators of water quality while being relatively easy to measure and have been discussed in detail elsewhere (eg. Waterwatch Victoria 1999). While there are known (and unknown) site-specific variations in these parameters, it is generally accepted for a majority of these that a specific range of values indicate good catchment health (eg. ANZECC 2000). Deviations away from these ideal values indicate declining health of the waterway. It is this philosophy that underpins the computations of the CHIP, and the grading of catchment health (see Appendix III).

Table 1. Summary of waterway health parameters collected by volunteers and coordinators, that are included in the CHIP.

	Parameter	Frequency	Number of sites
Water Quality	pH	Monthly	All sites
	Electrical Conductivity	Monthly	All sites
	Turbidity	Monthly	All sites
	Phosphorus	Monthly	All sites
	Nitrate	Monthly	All sites
	Dissolved oxygen	Monthly	All sites
	Temperature	Monthly	All sites
Macro-invertebrates	SIGNAL 2.0	Biannual (Spring & Autumn)	Key sites (min 1/reach)
Riparian Condition	RARC	Biennial	All sites

Macro-invertebrates

Aquatic fauna (and flora) are ideal indicators of catchment health, as they are entirely dependent on the waterway for their existence. Aquatic macro-invertebrates differ greatly in their requirements, and their tolerances to changes in their aquatic environment. Numerous programs exist to assess waterway health based upon abundance and diversity of macro-invertebrate assemblages (eg. AUSRIVAS, SIGNAL, ALT) and are similar in many respects. Waterwatch uses SIGNAL 2.0, with macro-invertebrate identification to the order level (not family as with AUSRIVAS). Specific details of the sampling methodology are outlined in the SIGNAL 2.0 user manual (Chessman 2001; Chessman 2003).

The SIGNAL 2.0 score obtained at each site receives an additional calculation to produce a modified stream pollution index based on the diversity of macro-invertebrates found at a site. We have included an additional criteria that examines whether the three key sensitive orders of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) are present, to aid with standardising scoring across the three data sources (Water Quality, Waterbugs and RARC). This number is transformed into an index score (similar to the water quality parameters, above), and the median value of all the sampling periods within the reach (including spring and autumn surveys), before being included in the CHIP (Table 2). Further details are present in Appendix III.

Table 2. Summary of SIGNAL 2.0 scores, and thresholds between the CHIP score categories.

Number of Taxa	SIGNAL Score	EPT Present	EPT Absent
>7	> 5.5	Excellent	Good
>7	≤ 5.5	Good	Fair
≤ 7	> 5.5	Fair	Poor
≤ 7	≤ 5.5	Poor	Degraded

Riparian Condition

The riparian zone along a waterway is integral to waterway health. The riparian zone performs several important functions, including acting as a buffer and filter to incoming runoff, and extracting nutrients from the waterway itself. Currently, RARC assessments are conducted biennially at all sites.

RARC was developed for use along the Murrumbidgee River in open floodplains dominated by a River Red Gum overstorey. As such, its applicability to the upper Murrumbidgee River catchment, urban environments and non-riverine habitats is questionable. However, it is still likely to be an effective tool for recording changes in riparian composition over time, irrespective of the score. The thresholds applied in the CHIP are as follows (Table 3). These thresholds may be revised in the future, to better reflect the actual distribution of RARC scores present in the Upper Murrumbidgee River catchment.

Table 3. Summary of RARC scores, and thresholds between CHIP score categories.

RARC Score	CHIP Parameter
41–50	Excellent = 1
31–40	Good = 2
21–30	Fair = 3
11–20	Poor = 4
0–10	Degraded = 5

Combining Water Quality, Macro-invertebrate and RARC Data

Using the scores calculated for water quality, macro-invertebrates and RARC assessments, these values are averaged for each site. Currently, water quality, macro-invertebrates and RARCs are equally weighted in the CHIP. However, in the event that one of these is missing, a CHIP score is still produced. If two of the three assessments are missing for a reach, no CHIP score is produced.

Data Density

A potential source of bias can arise from insufficient data collection at sites within reaches. In order to overcome some of these issues, a rule has been applied to the water quality data to ensure a minimum amount of data is present, before a CHIP score is produced. Currently, a minimum of 25% of total potential water quality data must be present for a CHIP score to be produced. This is calculated by dividing the total number of sampling events available for analysis in the preceding year, by the number of sites within a reach, multiplied by the number of total sampling events that should have occurred (12). This provides a proportional measure of the amount of sampling that has taken place within a reach in the preceding 12 months. In the event that <25% of data was collected, the water quality data is not included in the computation of a CHIP score.

The CHIP Score

The resulting CHIP score for each reach provides an indication of the overall health of that particular reach. While specific site-level variations (eg. some sites have naturally high electrical conductivity, low pH etc) may receive lower scores, it therefore requires that careful interpretation of these CHIP values be undertaken prior to making inferences of catchment health. In addition, the application of SIGNAL 2.0 in non-flowing aquatic habitats and RARC assessments in heavily urbanised environments may produce unusually low scores. In these instances, comparing within reaches, between years will be more appropriate than comparing between reaches, within years. These considerations must be taken into account when using and interpreting the CHIP. Finally, vitally important context is provided by the Waterwatch coordinators, who know the underlying geology, hydrology, landuse and history of the catchments. Their expert knowledge is critical to valid interpretations of the CHIP scores.

References

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Appendix III

Refining macroinvertebrate scores

Background

As part of the continual process of improving the rigour and transparency behind the calculation of CHIP scores, Waterwatch re-evaluated the process regarding how macro-invertebrate survey data contributes to producing final reach scores.

Throughout the 2013-2014 and 2014-2015 CHIP reports, macro-invertebrate scores have been based upon the divisions defined in the SIGNAL 2.0 manual (Chessman 2003; Table 1).

Table 1. Previous approach to computing CHIP scores based on macro-invertebrate sensitivities and and abundance, as defined by SIGNAL 2.0 (Chessman 2003).

	Number of macroinvertebrate orders	
SIGNAL SCORE	**0 - 7**	**>7**
>5.5	Fair	Excellent
≤ 5.5	Poor	Good

Macro-invertebrate surveys are categorised into 1 of 4 categories based on the number of taxonomic groups (Orders) and the weighted sensitivity of those orders collected (Chessman 2003). For example, where the weighted sensitivity is >5.5 and the number of taxa >7, will result in a CHIP score of "Excellent". Conversely, a weighted sensitivity of ≤ 5.5 and ≤ 7 taxa would result in a CHIP score of "Poor".

Unfortunately, this did not fit well with our five category ranking of catchment health. Indeed, under the previous scheme, it would be impossible to score a reach as *degraded*, as there is no *degraded* category for macro-invertebrates.

Adjusting the score to 5 levels

To make the adjustment to a 5-level scoring system for macro-invertebrates, Waterwatch incorporated an additional criteria to the computation of the CHIP score for each macro-invertebrate survey (Table 2). This additional criteria examines whether all three EPTs (Ephemeroptera, Plecoptera and Trichoptera) are present. If 2 or less are present (eg. any one or more of these taxonomic groups are missing), then scores are penalised (Table 2).

Table 2. New macroinvertebrate scoring system for the 2015-16 CHIP.

Number of Taxa	SIGNAL Score	EPT Present	EPT Absent
>7	>5.5	Excellent	Good
>7	≤5.5	Good	Fair
≤ 7	>5.5	Fair	Poor
≤ 7	≤ 5.5	Poor	Degraded

Why EPTs?

The "EPTs" (Ephemeroptera, Plecoptera and Trichoptera) are the three orders of highly sensitive water bugs – the mayflies, stoneflies and caddisflies. These three orders are generally present where both water quality and aquatic habitat are in excellent condition. Indeed, in all surveys undertaken in the Upper Murrumbidgee catchment by Waterwatch in the previous two CHIPs, all surveys listed as "Excellent" contained these three orders. Both nationally and internationally, there is a strong focus on the EPTs as they are universally considered to be good indicators of good catchment health (eg. Marchant et al. 1995).

What do these changes mean for the CHIP?

The main effect this change has on the CHIP report is providing greater differentiation between Good, Fair and Poor reaches. Furthermore, is now mathematically plausible to score a reach as "Degraded". All previous sites scored as Excellent are unlikely to change, however reaches scored as Good, Fair and Poor have greater scope to shift downwards, if these three important taxa are missing from their macro-invertebrate surveys.

How does this change the previous CHIP?

By way of examination of these changes on the CHIP result, here we present a comparison of CHIP scores from the 2014–2015 CHIP report, with the old CHIP scores (Table 3).

Table 3. Summary of changes to the reach scores from the 2014-15 CHIP with the update in macroinvertebrate scoring.

SCORE	OLD	NEW
Excellent	4	4
Good	45	34
Fair	36	42
Poor	5	10
Degraded	0	0

In all reports following the 2015-2016 CHIP, Waterwatch has used the new macro-invertebrate scoring methodology.

References

Chessman, B. (2003) New sensitivity grades for Australian river macroinvertebrates. *Marine and Freshwater Research* **54:** 95-103

Marchant, R., Barmuta, LA., and Chessman, B. (1995) Influence of sample quantification and taxonomic resolution on the ordination of macroinvertebrate communities from running waters in Victoria, Australia. *Marine and Freshwater Research* **46:** 501-506.

Appendix IV

Refining water quality thresholds for the CHIP

Background

In developing the 2013–2014 CHIP, a set of thresholds had to be applied to the water quality parameters in order to produce water quality scores. These are summarised in Table 1.

Table 1. Summary of 2013–2014 water quality thresholds for the CHIP report.

Indicator Rating	Excellent - 1	Good - 2	Fair - 3	Poor - 4	Degraded - 5
pH	6.0 – 6.9	5.5 – 5.9 or 7.0 – 7.9	8.0 – 8.5	5 – 5.5 or 8.5 – 8.9	<5 or >9
EC (µS/cm)	<= 65	<= 200	<= 350	<= 400	> 400
Turbidity (NTU)	<= 10	<= 12.5	<= 15	<= 20	> 20
Dissolved oxygen (mg/L)	*(Not included in CHIP)*				
Dissolved oxygen saturation (%)	95 – 105	85 – 95 or 105 – 110	75 – 85	65 – 75 or 115 – 120	< 65 or > 120
Phosphorus (mg/L)	< 0.01	0.01 – 0.02	0.02 – 0.05	0.05 – 0.09	> 0.09
Nitrate (mg/L)	< 1.0	1 – 4.9	5 – 9.9	10 – 15	> 15

These thresholds were based largely on those developed by the Molonglo CHIP report (M-CHIP). The M-CHIP values were developed in 2 parts – an urban and rural scale. The rural-scale values were used for the 2013–2014 CHIP report, with a few minor tweaks (mostly to dissolved oxygen) before being implemented. Unfortunately, there is no clear evidence trail of how these thresholds were developed, and so Waterwatch treated them as based upon expert knowledge.

For the 2014–2015 CHIP report, Waterwatch aimed to develop a new set of thresholds based upon water quality data collected in the ACT region. The key issues in developing these thresholds are outlines below.

Identifying a data set: independence, data quality and reference sites

Numerous sources (ANZECC, ACT Water Regulations, other catchment report cards) promote the development of meaningful thresholds based upon a 'training dataset'. A training dataset is a relevant water quality dataset used to determine thresholds which can be applied to data collected throughout the catchment for the purposes of reporting. The strengths of this approach are that thresholds are locally relevant, are developed in a transparent manner and are updateable and repeatable.

Ideally, an independent dataset would be used to redefine thresholds. This has two major benefits.

Firstly, an independent dataset would not be burdened with any real or perceived data quality issues that volunteer collected data may have. Key issues regarding sampling bias, accuracy and precision of equipment and reporting of data can be eliminated. Secondly, thresholds developed from an independent dataset may be retrospectively applied to all Waterwatch data. The use of Waterwatch data would prevent the application of thresholds to data used to define the thresholds (a problem of circularity).

There are limited sources of data available in the ACT region which may be used to develop thresholds. The most obvious data sources are those collected and maintained by the ACT Government, Icon Water and University of Canberra.

In examining the external water quality data to develop thresholds, a key consideration is the choice of sites with which to use to create new thresholds. Obviously, the choice of sites will have a major impact on the threshold values produced. Sites that are considered to represent 'reference condition' are preferred over all others. Reference condition is defined, for the purposes of the CHIP, as sites that represent minimally impacted areas in the ACT region. Ideally, these sites will exist in minimally impacted agricultural or conservation managed lands, without significant impacts from urban centres or major developments.

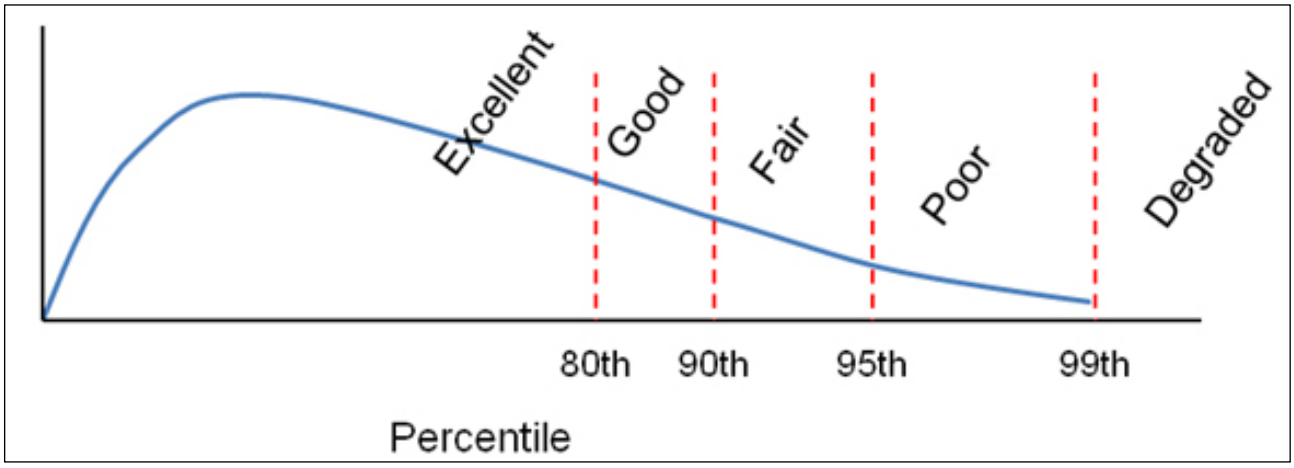
A second key issue is the amount of data available. This is further complicated by the impact that the millennium drought had on reference site condition. For example, data from reference sites of the AUSRIVAS macro-invertebrate monitoring program showed major declines in the relative health of some reference sites during the millennium drought. This is not surprising, but including data that shows negative impacts of drought would influence the discriminatory power that the reference condition approach could provide. These impacts are likely to be present in water quality data that exists from the same time period.

Defining the thresholds

There are numerous ways water quality data could be categorised to produce a score, but Waterwatch have chosen to use percentiles derived from a frequency histogram of water quality data taken from reference sites to define the thresholds for the CHIP.

Our approach is outlined in figure 2. After creating a frequency histogram from reference condition data, the threshold values for each parameter are defined using the 80th (Excellent), 90th (Good), 95th (Fair), 99th (Poor) and >99th (Degraded) percentile. The implicit assumption is that parameter values that occur in excess of 80% of the time in the reference sites reflect excellent quality, with rarer occurring events being of lower quality. Finally, it is assumed that *degraded* water quality would only be observed <1% of the time in a reference condition site.

Figure 2. Depiction of defining thresholds based upon a frequency distribution of data.



Identification of 'reference sites'

The selection of sites from which to produce thresholds will have a major impact on final scores produced in the CHIP report. Site selection is critical to how scores are interpreted. While arguably the score is irrelevant, and rather the change in any site/reach through time is more important, the reality is that scores will be interpreted directly without appropriate thought to how they were derived.

Preference will be to select sites that exhibit minimal levels of agricultural and urban impacts. Avoiding urban influences should be relatively straightforward, however agriculture is widespread throughout the upper Murrumbidgee catchment, hence obtaining sites without agricultural impacts will be difficult. Furthermore, historical impacts from agriculture, mining and land clearing may still be having pervasive impacts on water quality, which may be hard to identify in the first instance, and may not be readily avoidable, in any case. As such, 'reference condition' must not be interpreted as 'pristine'. Rather, it reflects the condition of minimally impacts sites within the catchment. As such, long-term goals aspiring towards water quality in sites equivalent to that of reference condition is a worthy goal, yet by no means suggests a return to pristine or non-impacted conditions.

There are limited sites in the upper Murrumbidgee River catchment that have long-term data records from which to derive frequency distributions. Data available from Icon water for the Upper Cotter River catchment (above, and including Corin reservoir) and water quality collected from the Goodradigbee River catchment represent the most practical 'reference condition' datasets for the CHIP.

The catchments to the east of the Murrumbidgee River have a different underlying geology compared to the catchments west of the Murrumbidgee River (eg. The Cotter River, and Goodradigbee River.) Likewise, the Ginninderra and Yass catchments may tend to exhibit high electrical conductivity compared to other catchments. With additional data, electrical conductivity thresholds could be developed for the Molonglo, Ginninderra and Yass catchments, provided suitable data from 'reference condition' sites could be found. This is highly unlikely to occur.

Data availability

Icon Water generously provided water quality data for 2 riverine sites upstream of Corin reservoir, three sites within the upstream-most section of Corin reservoir, and data from 3 sites on the Goodradigbee River, and 3 sites on tributaries of the Goodradigbee River, collected by University of Canberra (Table 1).

Table 1. Summary of sites used to define reference condition for CHIP thresholds.

Site Name	Years of data	Parameters
Cotter Hut	2007-2014	pH, turbidity, EC, DO
Gingera	2003-2015	pH, turbidity, EC, DO
Corin Reservior site 7	1994-2015	TN, TP
Corin Reservior site 8	1993-2015	TN, TP
Kangaroo Ck	2003-2015	TN, TP
Goodradigbee River site 1	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee River site 2	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee River site 3	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee Tributary 1	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee Tributary 2	2006-2015	pH, Turbidity, EC, TN, TP
Goodradigbee Tributary 3	2006-2015	pH, Turbidity, EC, TN, TP

Data analysis

Data analysis involved producing frequency histograms of each of the water quality parameters at each site. Firstly, the impact of the millennium drought was explored by comparing histograms for data collected 2010-current, against pre-2010 data. If no observable difference in distributions was present, data was combined. If significant differences were present, only data post-2010 was considered for threshold production.

After identifying non-drought impacted data, sites were combined and examined. If substantial differences in distributions were evident across sites, they were not combined. Conversely, if no major discrepancies were present, data across sites was combined. The exception to this rule was made for electrical conductivity – the upper Cotter River is very low in electrical conductivity, compared to the Goodradigbee catchment. Waterwatch chose to combine data from the Cotter River and Goodradigbee River to produce electrical conductivity thresholds for the CHIP as this will better reflect the apparent naturally higher electrical conductivity readings from other areas in the catchment such as the Molonglo and Ginninderra.

Current thresholds

Table 2 presents the threshold values applied in the current CHIP. Thresholds were developed based upon the 80th (excellent), 90th (Good), 95th (Fair), 99th (Poor) and > 99th (Degraded) percentiles, for each parameter. For pH and dissolved oxygen, the 10th and 90th (Excellent), 5th and 95th (Good), 2.5th and 97.5th (Fair), 0.5th and 99.5th (Poor) and <0.5th and >99.5th (Degraded) percentiles were used to define thresholds. These thresholds were redefined for the 2014-15 CHIP report onwards.

Table 2: Water quality CHIP thresholds.

Parameter	Excellent	Good	Fair	Poor	Degraded
pH	6.6 – 7.8	6.1 – 6.5, 7.9 – 8.0	5.7 – 6.0, 8.1 – 8.2	5.4 – 5.6, 8.3 – 8.6	< 5.4, > 8.6
EC (µS/cm)	≤ 98	99 – 156	157 – 212	213 – 404	> 404
Turbidity (NTU)	≤ 10	11 – 16	17 – 36	37 – 90	> 90
DO (mg/L)	*(Not included in CHIP)*				
DO Sat. (%)	88 – 99	84 – 87, 100	81 – 83, 101 – 106	78 – 80, 107 – 115	< 78, > 115
Phosphorus (mg/L)	< 0.02	0.02 – 0.03	0.04 – 0.05	0.06 – 0.08	> 0.08
Nitrate (mg/L)	< 1.0	1.0 – 1.3	1.4 – 1.7	1.8 – 2.6	> 2.6

Going forward: interpreting the CHIP

Interpreting CHIP scores must explicitly consider how the scores were derived. The data used to derive the water quality thresholds come from water quality monitoring sites in the upper Cotter River catchment and the Goodradigbee River catchment.

As such, all WQ CHIP scores are to be considered in relation to the 'reference condition'.

Mick Gentleman MLA

Minister for Advanced Technology and Space Industries
Minister for the Environment and Heritage
Minister for Planning and Land Management
Minister for Police and Emergency Services
Minister for Urban Renewal
Manager of Government Business
Member for Brindabella

XX May 2020

Volunteers are critical to monitoring and managing our waterways

The 2019 reporton water catchment health, using data collected by Waterwatch volunteers, identifies a continued decrease in water quality due mostly to the ongoing dry conditions.

The Catchment Health Indicator Program (CHIP) report provides us with an early warning system for ecosystem health issues through its surveys of water quality, waterbugs and the condition of riverbank vegetation.

The successful citizen science report details condition across 232 sites, representing 98 'reaches' of waterway. More than 200 volunteers conducted over 2000 water quality surveys for the 2019 report.

Three reaches were found to be in 'excellent' condition, 37 were 'good', 53 were 'fair', four were 'poor', none were 'degraded' and one was too dry for too long to produce results. This translated into 59% of reaches being classed poor or fair, up from 55% in 2018 and 47% in 2017.

This downward trend in quality is likely due to the continued below average rainfall experienced across the region in 2019. Most of the Murrumbidgee River reaches showed signs of stress after the extended dry conditions. This included around Tharwa, where the river almost ceased to flow by December.

The bushfires occurred too late in the year to be captured for the 2019 report, volunteers have already begun collecting data to help us better understand the impacts of this devastating event.

I applaud the dedication and hard work of the volunteers that made this data collection and resultant report possible.

ACT Legislative Assembly
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@GENTLEMANMick MickGentleman

I’m also delighted to announce that, after a two-month hiatus due to COVID-19, Waterwatch volunteers are back out on the waterways collecting valuable data.

Long term monitoring conducted by the volunteers is more important than ever in this post-bushfire recovery period and Waterwatch will play a critical role.

Waterwatch receives support through the ACT Government and Icon Water. The ACT Government recently awarded ongoing funding to the Waterwatch program in the 2019/20 mid-year budget review.

For more information, visit: www.act.waterwatch.org.au

Statement ends

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ACT Government
Environment, Planning and Sustainable Development

Ministerial Information Brief Coversheet

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MINISTER	**Minister for the Environment and Heritage - Mick Gentleman MLA**
SUBJECT	2020 Annual CHIP Report
OBJECTIVE NUMBER	20/27302
CRITICAL DATE FOR MINISTER'S SIGNATURE*	Friday, 29 May 2020

	Cleared By	Date
Deputy Director-General	Erin Brady	20/05/2020
Government Services	Tash Hartwig	18/05/2020
Executive Director	Ian Walker	15/05/2020

Contact Officer: Woo O'Reilly	Telephone No: 72246

Further Action/Comment:

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Signature

**All briefs must list a critical date (ie when the Minister is required to sign, even if considered routine)*