

# Catchment Health Indicator Program

2014–15



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This report was written using data collected by over 160 Waterwatch volunteers. Many thanks to them.

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The views and opinions expressed in this document do not necessarily reflect those of the ACT Government or Icon Water.

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: [root.ala.org.au/bdrs-core/umww/home.htm](http://root.ala.org.au/bdrs-core/umww/home.htm)

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# 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 near Yass, an area of more than 13,000km<sup>2</sup>.

Two primary functions of the Waterwatch program are firstly to facilitate community engagement in the monitoring and care of local waterways, and secondly provide data (water quality, macro-invertebrate [water bug] and riparian condition) to contribute to an early warning system for aquatic ecosystem health issues. A key output of this program is the annual Catchment Health Indicator Program (CHIP), which provides a numerical score of catchment health using the data collected by Waterwatch volunteers.

In early 2015, Waterwatch released a pilot 2013–14 CHIP report. This report presented data on aquatic ecosystem health across 63 reaches in the Upper Murrumbidgee catchment, with 1,184 water quality records and 78 water bug surveys conducted across 184 sites. Feedback was sought on the pilot report and used to improve the quality of the 2014–15 CHIP report.

The 2014–15 CHIP report is based on **1,556 water quality surveys, 206 water bug surveys and 178 riparian condition surveys**. The total number of sites surveyed has increased from 184 in 2013–14 to 229 in 2014–15. A total of 90 reaches are covered in this report. Furthermore, the Yass catchment is included for the first time, with an additional 5 reaches defined. A CHIP score is presented for only one of the Yass reaches due to most reaches being in the initial stages of data collection. Yass catchment is now a focal area for growth of the Waterwatch program and brings the catchment area the CHIP covers up from 8,600km<sup>2</sup> in 2013–14 to 11,400km<sup>2</sup>.

The increase in data, sites and catchment area covered through the Waterwatch program in 2014–15 would not have been possible without the generous financial support from ACT Government in association with the Commonwealth-funded Basin Priority Project and additional ongoing support from Icon Water.

Numerous changes have occurred since the pilot report. A major inclusion has been assessments of riparian condition. Riparian condition has been assessed using the 'Rapid Appraisal of Riparian Condition' (RARC), which assesses the functional characteristics of river bank vegetation. Riparian condition is vitally important to aquatic ecosystem health. A healthy riparian zone assists in the filtering of water before it enters the waterway, reduces sediment movement, and provides food and shelter for aquatic organisms. Land-clearing has historically reduced the extent of riparian vegetation throughout the catchment, but the replanting of riparian vegetation is a major component of river health restoration works throughout the catchment. RARC not only offers a means of assessing current riparian condition, but can identify key areas for improvement (for eg, lack of native groundcover) that can be targeted for future remediation works.



The second major change to occur has been the development of new thresholds to define water quality using a 'reference condition' approach, as outlined in the Australian and New Zealand Environment and Conservation Council (ANZECC) guidelines. Using water quality data taken from the upper Cotter River and Goodradigbee River catchments, new threshold values were defined, which were then applied to each of the 6 water quality parameters used in the CHIP report. This approach provides locally relevant thresholds and enables a comparison of aquatic health relative to 'reference condition'. See Appendix III for more information. Thanks to Icon Water and University of Canberra for providing water quality data.

The changes in thresholds preclude direct comparisons to the 2013–14 pilot CHIP report. **Of the 90 reaches presented in this report, 4 were scored as in 'excellent' condition**; two in the Cooma catchment, and two in Southern ACT. **45 reaches were scored as being in 'good' condition**, with the majority being found in the Molonglo and Southern ACT catchments. The percentage of reaches scored as 'good' (50%) is down from the pilot CHIP report, however the inclusion of RARC and increased water bug data is likely to have driven this change, rather than an actual change in ecosystem health occurring in this time. **36 reaches (40%) were scored to be in 'fair' condition**. Of particular note, 8 out of 11 reaches in the Ginninderra creek catchment were scored as 'fair'. Again, this may be attributed to the inclusion of RARCs that would not have favoured urban Ginninderra's highly modified riparian zone. Finally, **5 reaches were scored as 'poor'**, with 2 reaches in Southern ACT, and 1 apiece in Cooma, Ginninderra and Molonglo catchments. All 5 reaches were in urban areas.

**Table 1: CHIP results for 2014–15**

CHIP Result	Cooma	Ginninderra	Molonglo	Yass	Southern ACT	Total
Excellent	2	0	0	0	2	4
Good	10	4	17	1	13	45
Fair	9	8	8	0	11	36
Poor	1	1	1	0	2	5
Degraded	0	0	0	0	0	0

Some general trends are revealed. Aquatic ecosystem health is generally lower in urban reaches compared to rural reaches, while reaches in areas with high native canopy cover tend to be in better health, relative to the reference condition. Within urbanised catchments, increased electrical conductivity, decreased dissolved oxygen saturation and increased nutrient levels (total phosphorus and nitrates) tend to drive water quality down. Likewise, heavily urbanised catchments tend to have incomplete riparian zones, and this reduced habitat complexity affects the abundance and diversity of water bugs in these reaches.

Some fascinating patterns with regards to water quality can be seen in the Murrumbidgee River. As water enters the ACT (CMM6) it has some water quality issues such as high electrical conductivity levels (compared to the reference condition) from the rural dominated Cooma-Monaro region. Water quality actually improves as it goes through Pine Island (CMM8) and down to Uriarra crossing (CMM9). After water passes by the Molonglo confluence, however, (CMM10), the water quality score declines – most notably due to increased nitrate levels (average of 3.25 mg/L). These high levels were not observed in CMM9 or MOL6 (the lower Molonglo River between Scrivener Dam and Coppins Crossing). This is a great example of how regular monitoring of sites can reveal point-source events in our waterways.

Finally, still-water (lentic) systems have generally lower ecosystem health than naturally flowing waterways. As most of the lentic systems are urban wetlands, this is perhaps not surprising, given their main function is to contain and process urban pollution. Future CHIP reports will aim to provide a more holistic examination of the health and function of urban wetlands.

**Finally, thanks as always to the Waterwatch volunteers. This report would not be possible without you.**

# 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 River catchment upstream of Burrinjuck Dam, an area of more than 13,000km<sup>2</sup>.

Four Waterwatch co-ordinators support volunteers in the major sub-catchments of Cooma, Molonglo, Southern ACT, Ginninderra and Yass (see figure 1). Each of these sub-catchments are presented in this report. The Goodradigbee River catchment is not currently sampled by Waterwatch. This year is the first year that Yass has been included in this report, and will be an area of growth over the foreseeable future.

As at June 30 2015, Waterwatch had 229 active monitoring sites, being monitored by over 170 volunteers. This is significantly higher than the 2013–14 report due to a return to full capacity for Waterwatch thanks to generous funding from ACT Government in association with the Commonwealth-funded Basin Priority Project as well as ongoing support from Icon Water.

## The purpose of the CHIP

In the past, Waterwatch has produced a report card 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 a 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 new ACT Water Strategy 2014–44 – Striking the Balance as a way to ‘*Enhance knowledge and spatial planning for water and catchment management*’.

The 2013–14 CHIP was released in February 2015 as a pilot study, following a review of the CHIP reporting system that was undertaken by University of Canberra<sup>1</sup>. A key recommendation from the UC report included a shift away from an ecosystem health report at a sub-catchment scale, to assessing individual stretches of rivers in a ‘reach’-based approach. This allows for finer-scale assessment on the condition of our waterways where data exists and highlights areas in the catchment that are unsampled.

## How does the CHIP work?

Waterwatch volunteers and co-ordinators collect data relating to water quality, macro-invertebrates (water bugs), and riverbank vegetation (riparian) condition. The frequency of this data collection is outlined in table 2. Data on riparian condition has been included for the first time in this CHIP report, allowing for the first time, a composite CHIP score that encompasses physio-chemical properties of water, in-stream water bug diversity and abundance, and riparian vegetation condition. Riparian condition has been assessed using the ‘Rapid Appraisal of Riparian Condition’ (RARC). When combined for an individual reach, the data gives us a score that indicates the overall health of that stretch of waterway (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 co-ordinator. This provides further insight into the state of that reach and possible issues influencing the score. Technical details regarding data collection and methodologies for the 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
	Total Phosphorus	Monthly	All sites
	Nitrates	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 5 major catchment areas represented in this report. Goodradigbee is not included in this report.



## Changes since the 2013–14 CHIP pilot study

Following the release of the pilot CHIP report, we sought feedback from a wide range of stakeholders to help improve future editions of the report. Recommendations from this review process have been incorporated into this CHIP. Thank you to all those people who took the time to provide the Waterwatch team with feedback and advice on improving the CHIP report. Since the pilot CHIP report, four major changes have been incorporated.

### Water quality parameters

A major re-working of the water quality parameter thresholds was undertaken (Appendix III) using data from 'reference condition' sites in the upper Cotter River and Goodradigbee River catchments. Data from these sites represent environmental conditions that have minimal impacts of agriculture and urbanisation, and form a useful benchmark to compare the health of reaches throughout the upper Murrumbidgee catchment.

### pH testing

Following the review by University of Canberra<sup>1</sup>, an analysis of Quality Assurance, Quality Control (QAQC) data was undertaken to determine if equipment failure could be a source of error in the accuracy and precision of water quality parameters. Analysis revealed that the digital pH meters were performing outside of acceptable accuracy limits. Further testing revealed that while calibration was possible for many units, accuracy and precision of measurements of water samples was unacceptable. Likely causes include poor maintenance and storage, age, and faulty units from factory. As of March 2015, all digital pH probes have been replaced with pH test strips (range 4.5 – 10, 0.5 unit increments). Based on preliminary testing and review of QAQC data, this change will lead to improved accuracy and precision of pH data collected by volunteers.

### Incorporation of riparian assessments

A concerted effort was made in 2014–15 to perform RARCs at a majority of Waterwatch sites. A total of 178 RARC surveys were conducted. These surveys produce a score based on 5 key functional attributes of the riparian zone. Sites that contain healthy native ground cover, mid storey, canopy and a diverse array of hollow trees, fallen logs, leaf litter etc, receive a high score. Conversely, sites that are missing one or more of these key attributes, and are dominated by introduced species will score poorly. While this RARC assessment tool has been developed for use in floodplain ecosystems, it holds great promise as a broadly applicable metric for reporting on riparian condition. Further review and refinement of this method, particularly for wetlands, will be undertaken in the near future. A general note is that the inclusion of RARC has driven CHIP scores downward, and highlights the fact that in much of the upper Murrumbidgee River catchment, riparian condition is not particularly healthy. Restoration works aimed at protecting and restoring riparian vegetation will improve the CHIP score over time.

### Inclusion of Yass report cards

In this CHIP report we have included 5 reaches from the Yass catchment. The Yass catchment is situated to the north of the Molonglo and Ginninderra catchments, and flows into Lake Burrinjuck from the northeast of the Murrumbidgee catchment (Figure 1). A handful of dedicated volunteers have been collecting data in this catchment for a couple of years (and we thank them for their patience), but a new focus on integrating Yass into CHIP reports is underway. We see this CHIP report as an exercise in identifying areas needing further sampling.

1. Harrison, E., Dyer, F., Nichols, S., Gruber, B. & Tschierschke, A. (2013) Waterwatch data and catchment health indicator data review . Prepared for ACT Government [http://www.act.waterwatch.org.au/Files/Waterwatch\\_ACT\\_report\\_final.pdf](http://www.act.waterwatch.org.au/Files/Waterwatch_ACT_report_final.pdf)

## 2014–15 CHIP

The 2014–15 CHIP report is based upon **1,556 water quality surveys, 206 water bug surveys and 178 riparian condition surveys**. The total number of sites surveyed has increased from 184 in 2013–14 to 229. A total of 90 reaches are covered in this CHIP report.

Finally, thank you to the volunteers. This report would not be possible without your continued efforts to collect this important data on the health of our waterways. The increase in data collected this year is a real credit to the dedication of the volunteers who have demonstrated that with support, they are capable of making a significant contribution to improving ongoing management of the upper Murrumbidgee waterways.



# Cooma Region Catchment Facts

The Cooma Region is comprised of the upper Murrumbidgee, Bredbo, Numeralla, Kybeyan and Badja Rivers and their respective tributaries. Landuse in the catchment includes rural (grazing, irrigated and dryland cropping), urban, rural-residential and conservation.

Characteristically, catchments contain modified vegetation with more intensive rural use in the flatter, more fertile areas, while the steeper and more remote areas retain native vegetation cover and are used less intensively. The Cooma Region has one major urban centre, Cooma, situated on the Cooma Creek and a number of smaller villages around which rural-residential landuse is common.

Carp have been recorded in many reaches, however there are notable exceptions including the headwaters of the upper Murrumbidgee, Badja, Kybeyan and Bredbo Rivers. The Cooma Region includes high priority catchments identified by the Actions for Clean Water Plan (ACWA), which aims to provide a strategic plan for investment to reduce turbidity in the upper Murrumbidgee. High priority catchments include the Numeralla and Bredbo Rivers. The Upper Murrumbidgee Demonstration Reach (UMDR) initiative focuses on the upper Murrumbidgee River downstream of Bredbo. It is currently the focus for riparian rehabilitation and streambank stabilisation works.

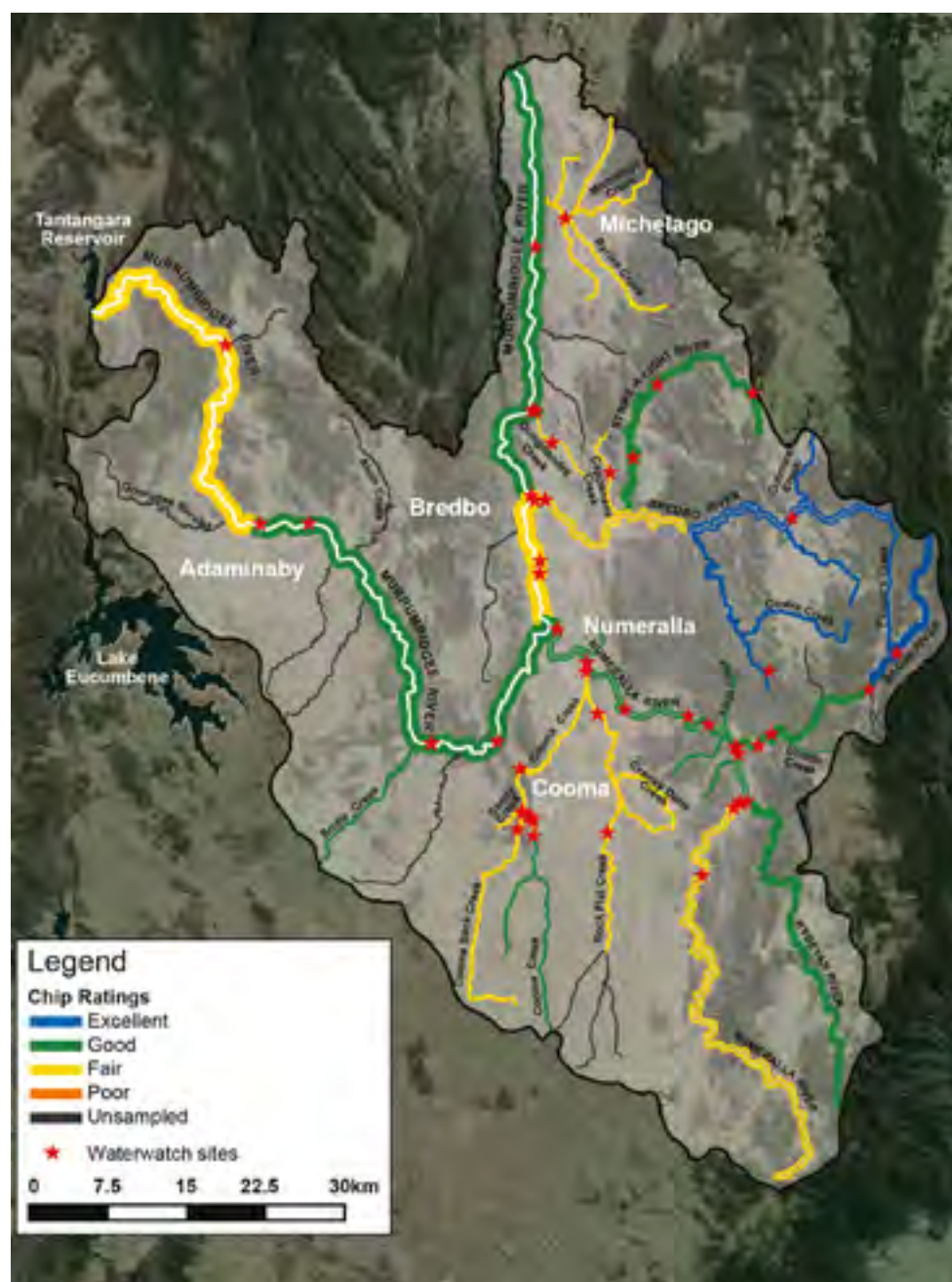


## Cooma Catchment Health Summary

The CHIP ratings for reaches in the Cooma Region catchment (see map) show that river health ratings vary from 'excellent' to 'fair'. Some reaches remained unsampled in 2014-2015 and we welcome more volunteers to assist us with our data collection.

Excellent ratings were found for reaches that are surrounded by largely unmodified catchments and where intact riparian and in-stream habitat is characteristic along the length of the reach. Consequently water quality is also excellent in these reaches, such as those in the upper Badja and Bredbo Rivers.

Reaches which have a 'good' rating are usually found in catchments which retain good native vegetation cover and where areas of high quality instream and riparian vegetation are found either within or directly upstream of the reach. The Upper Murrumbidgee River is an example of the latter showing reaches which contain remote, unmodified gorge country that have a 'good' rating, downstream of a reach which is 'fair'. Catchment projects targeting willow control, gully and bank stabilisation, excluding stock and riparian plantings such as those occurring in the Upper Murrumbidgee Demonstration Reach area are beneficial and will help to improve health scores over time.



Reaches which scored as 'fair' are characterised by catchments where reduced groundcover is a factor contributing to issues such as soil erosion and where current and historical landuse have resulted in loss of riparian and instream habitat. Along the Cooma Creek, urban impacts such as stormwater runoff, including litter, are issues affecting stream health. The ongoing Keep Cooma Creek Clean Campaign aims to address the latter by raising awareness about litter washing into the Creek.

# Badja River BAD1

## Headwaters to Undoo

CHIP Result A- (Excellent)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>16</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>3</b>
<b>Riparian condition</b>	<b>Good</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 51km

*Dominant land uses:* Rural and conservation

This reach encompasses the headwaters of the Badja River which includes the Badja Swamps Nature Reserve. The upper section of this reach contains cleared open country predominantly used for grazing and then falls through unmodified, gorge country which contains high quality riparian zones and aquatic habitat. The Undoo Environment Protection Reserve is at the bottom of the reach.

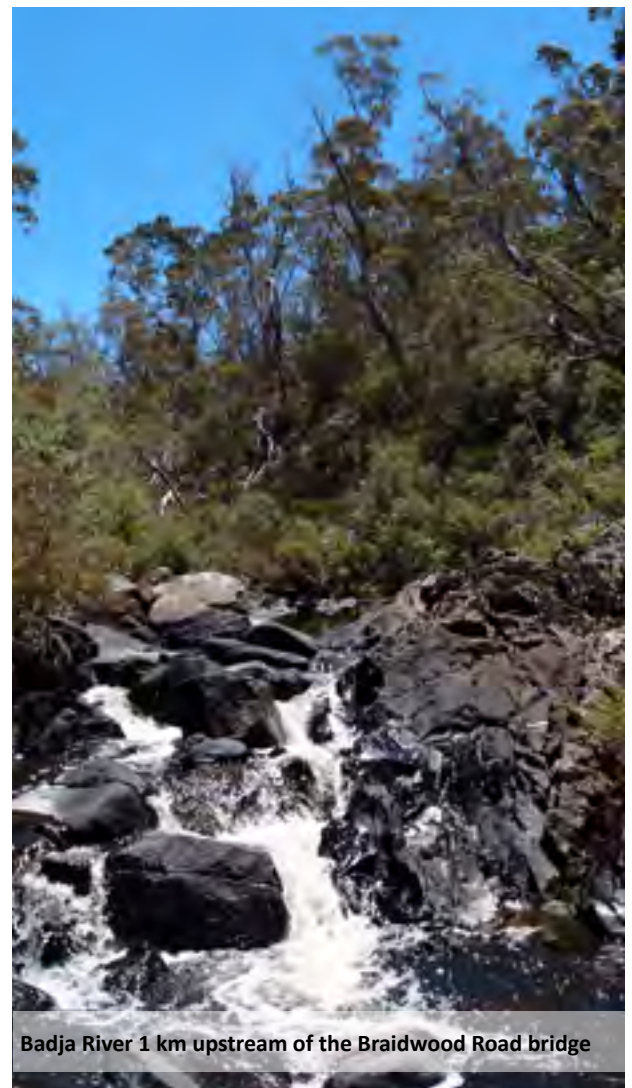


### Reach Condition

Water quality rated as 'excellent'. This reflects the intact in stream and riparian habitats that exist along this reach. Turbidity is consistently low which reflects the quality of the riparian zones and catchment integrity surrounding this reach.

The water bug score indicated 'good' stream health. Riparian surveys found that riparian condition was 'good' overall, including high levels of ground cover, good native vegetation cover and presence of habitat features such as River Tussock and debris.

The top of this reach is the area known as the Big Badja Swamps which is listed on the directory of important wetlands in Australia. Carp sightings are not recorded for this reach.



Badja River 1 km upstream of the Braidwood Road bridge

# Badja River BAD2

## Undoo to Numeralla River confluence

### CHIP Result B+ (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>34</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Good	
<b>Water bug</b>	<b>Good</b>	<b>4</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 8.6km

*Dominant land uses:* Rural

This reach includes the lower section of the Badja River from the downstream end of the Undoo Environment Protection Reserve to the Numeralla River. The reach has open, cleared country used predominantly for grazing (sheep and horses).

The (sometimes rather narrow) riparian zone remains intact and continuous on both sides of the river along the reach. In-stream habitat remains largely unmodified.

### Reach Condition

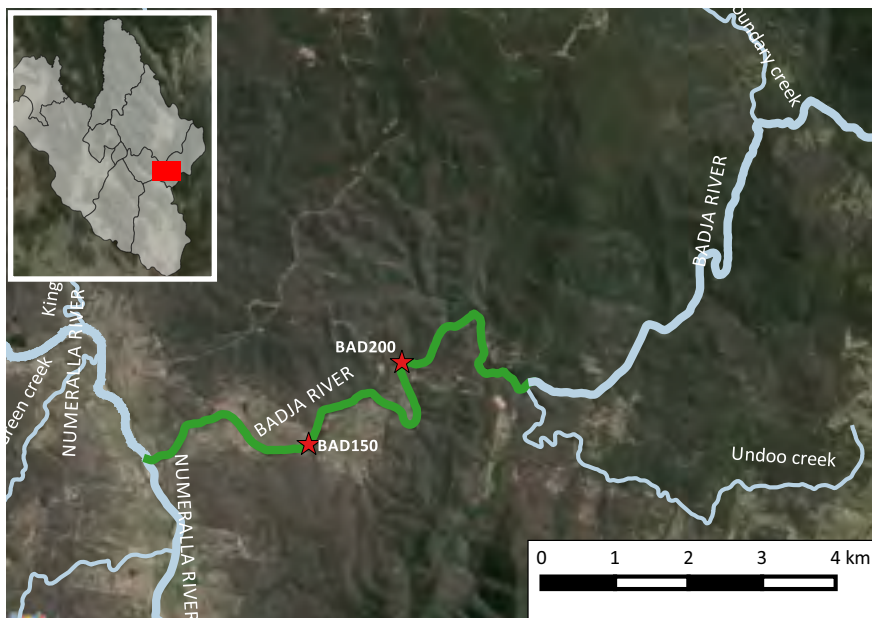
Water quality rated as 'excellent' overall. In contrast to BAD1, turbidity can be elevated during high discharge events, associated with gully erosion in the tributaries of the lower Badja. More intensive landuse (cropping) of the floodplain may also be a source of turbidity.

Water bug surveys indicated 'good' stream condition. The overall riparian survey result was 'fair', with native canopy and understorey vegetation present. Habitat features such as River Tussock, debris and hollow bearing trees were limited. Willows and Blackberry occur, which are the focus of a current Landcare project.

Carp sightings are recorded. Platypus and Water rats have also been sighted.



Badja River looking upstream from the Peakview Road bridge



# Bredbo River BRD1

## Headwaters to Cowra Creek

CHIP Result A- (Excellent)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>19</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Poor	
<b>Water bug</b>	<b>Excellent</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 14km

*Dominant land uses:* Rural

This reach includes the headwaters of the Bredbo River, upstream of the Peakview Road Crossing including Cutmore and Cowra Creeks. The reach flows through a mix of cleared and unmodified country, predominantly used for grazing purposes. Small scale pine plantations have also been established in the catchment.



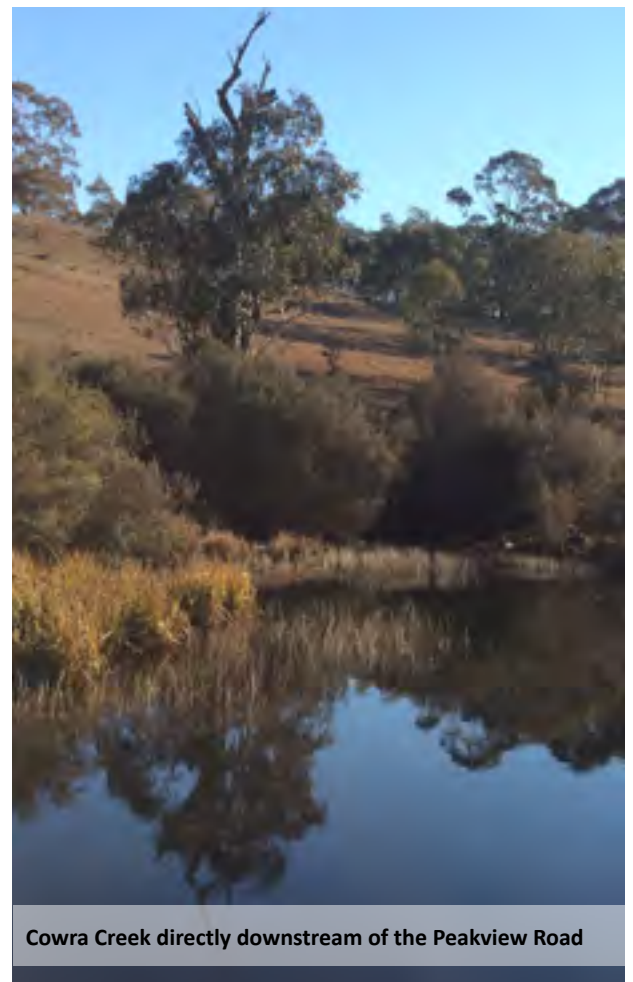
### Reach Condition

Water quality rated as 'excellent' overall. Turbidity is consistently low which reflects the quality of the riparian zones and catchment integrity surrounding this reach.

The water bug score indicated stream health was 'excellent'. Riparian condition was found to be 'fair', due to lack of under storey (possibly due to grazing pressures) and limited presence of habitat features such as logs and hollow bearing trees. River Tussocks (which provide excellent habitat and filtering qualities) and other native vegetation was present in all riparian zones.

No Carp sightings have not been reported. Platypus have been sighted in this reach.

Regular monitoring is required to improve confidence in this CHIP score. Further sites at the top of the Bredbo River are desirable.



Cowra Creek directly downstream of the Peakview Road

# Bredbo River BRD2

## Cowra Creek to Bredbo River confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>18</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 20km

*Dominant land uses:* Rural including dryland cropping and grazing

This reach includes the lower Bredbo River and tributaries (except the Strike-A-Light Creek) up to the confluence of the Cowra Creek. This reach is characterised by a floodplain valley which used for agriculture (dryland cropping and grazing) and is highly modified.

In-stream deposition is widespread. The upper section of the reach flows out of remote, largely unmodified gorge country.

### Reach Condition

Water quality rated as 'good' overall. Event based sampling showed that turbidity levels can be high in conjunction with high discharge events indicating the presence of streambank and gully erosion in the reach.

Water bug surveys indicated stream health was 'good'. Riparian condition rated as 'poor' due to high levels of exotic canopy and understorey cover (Poplars and Blackberry) and lack of habitat features including River Tussock and debris.

This reach is in a priority ACWA catchment and several sites associated with reach tributaries have so far been stabilised on this reach. Carp are often reported in the lower section of this reach.

Regular monitoring is required to improve confidence in this CHIP score. Further sites at the upstream end of the reach are desirable.



Bredbo River at the confluence on the edge of the Bredbo village

# Murrumbidgee River CMM1

## Tantangara Dam to Guroodee Rivulet

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>0</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>3</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 55km

*Dominant land uses:* Rural

This reach includes the Murrumbidgee River and its tributaries in the Yaouk area from below the Tantangara Dam wall. The influence of flow regulation, resulting from the Dam is most evident in this reach. The catchment comprises of open valley floors (which would historically have contained tracts of swampy meadows) with a backdrop of steep unimproved country. Valley floors are now utilised predominantly for grazing purposes.



### Reach Condition

Water bug surveys indicate that stream condition is rated as 'good'. Riparian surveys for the reach were carried out in areas which are characterised by 'open valley floor' type country and condition was rated as 'poor'. These scores were influenced by the lack of canopy cover (may be natural) and the lack of understory (perhaps lost due to grazing) and habitat features such as River Tussock and debris.

The reach is known as a popular Trout fishing stream. There are anecdotal reports of a Carp sighting in the reach Bolaro Station, which is unprecedented.

Regular water quality monitoring is required to improve confidence in the condition score.



Upper Murrumbidgee River 3km downstream of the Yaouk Road bridge

# Murrumbidgee River CMM2

## Guroodee Rivulet confluence to Bridle Creek confluence

### CHIP Result B (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>1</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 43km

*Dominant land uses:* Rural and conservation

This reach includes the Murrumbidgee River from Goroodee Rivulet down to the area known as 'Dry Plains'. Alum Creek is a major tributary which flows in from the north. 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.



### Reach Condition

Water bug surveys indicate 'good' stream health. Macroinvertebrates were sampled from both riffle and macrophyte (reeds and rushes) habitat. Riparian condition was 'fair' comprising of a 'poor' riparian survey result at the bottom of the reach and a 'good' condition score at the top of the reach. The latter was one of the few sites in the Cooma Region where hollow bearing trees were recorded in riparian surveys.

Several tributaries (including Alum Creek and Goroodee Rivulet) flow into this reach and supplement river flows. Carp are regularly sighted at the bottom end of the reach. Gambusia are recorded at the top of the reach.

Regular water quality monitoring will increase confidence in this score.



Upper Murrumbidgee River upstream of the Bridle Creek confluence

# Murrumbidgee River CMM3

## Bridle Creek confluence to Numeralla River confluence

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>13</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Good	
<b>Water bug</b>	<b>Good</b>	<b>4</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 31km

*Dominant land uses:* Rural and conservation

This reach includes the Murrumbidgee River from the Bridle Creek confluence to the Numeralla River confluence. The bottom section of the reach has open, cleared country used for predominantly grazing and cropping purposes. The upper section includes the Binjura Nature Reserve, where the 'Cooma Gorge' is found. Good quality riparian and aquatic habitat are found in this gorge section.

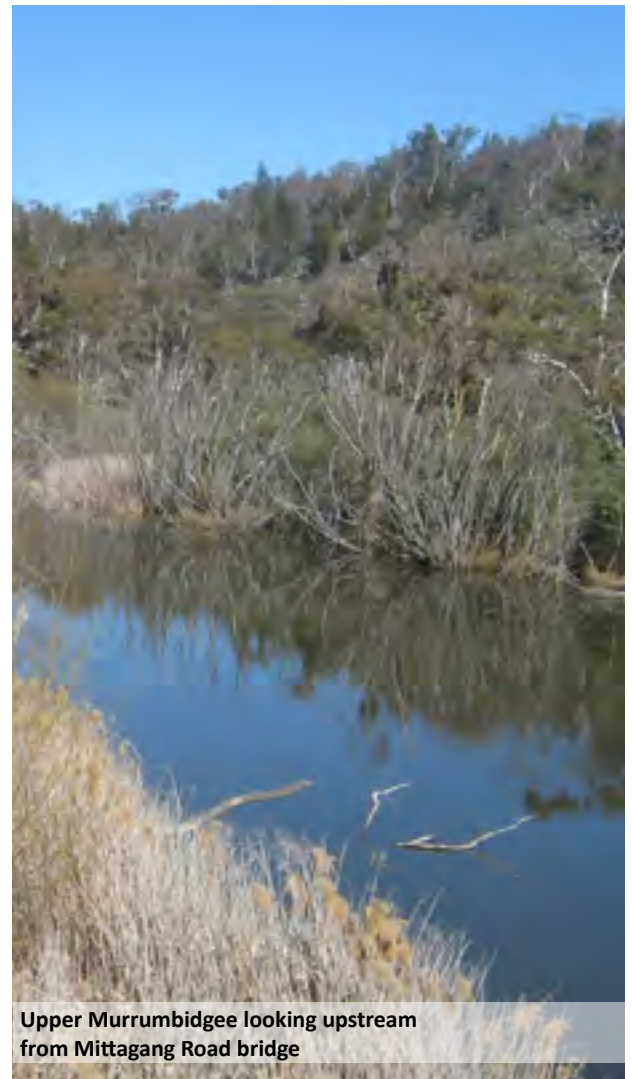


### Reach Condition

Water quality rated as 'excellent' overall. Turbidity can be elevated during high discharge events, which is associated with reduced groundcover on streambanks and gully erosion in the tributaries.

Water bug surveys for this reach indicated that stream health is in 'fair' condition. Riparian condition assessments resulted in an overall 'poor' condition score which was influenced by high levels of exotic canopy (Willows) cover, limited understorey and a lack of habitat features such as River Tussock at the downstream end of the reach. Surveys were carried out at sites which are at sites dominated by rural landuse.

Carp and Gambusia are often sighted in this reach. Platypus sightings have also been reported.



Upper Murrumbidgee looking upstream from Mittagang Road bridge

# Murrumbidgee River CMM4

## Numeralla River confluence to Bredbo River confluence

### CHIP Result C (Fair)

Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>17</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 12km

*Dominant land uses:* Rural

This reach includes the upper Murrumbidgee River from the Numeralla River confluence to Bredbo River confluence (including the Murrumbucca Creek). The river flows through open, cleared country where the predominant landuse is grazing and irrigated agriculture (vegetables and lucerne). The reach contains highly modified, non-native riparian vegetation zones.



### Reach Condition

Water quality rated as 'excellent' overall. Turbidity can be elevated during high discharge events, which is associated with inputs by upstream tributaries (such as the Numeralla River which is a priority ACWA catchment).

Water bug survey results indicated 'poor' stream condition due to water quality and reduced instream habitat. The overall riparian condition score was 'degraded', due to the presence of medium to dense willow infestation, limited understorey, lack of native groundcover and habitat features such as River Tussock and debris. Instream gross sediment deposition has simplified aquatic and riparian habitat in this reach.

Carp are commonly sighted. ACWA streambank erosion control works have been carried out in this reach.



Upper Murrumbidgee River upstream of Billilngra Creek

# Murrumbidgee River CMM5

## Bredbo River confluence to Angle Crossing

### CHIP Result B (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>29</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 58km

*Dominant land uses:* Rural and conservation

This reach takes in the upper Murrumbidgee River from the Bredbo River confluence to Willows Road. This reach flows through the Bredbo and Colinton Gorges which form the upper and lower sections of the reach, which contain good quality riparian and aquatic habitat. The middle section contains more open cleared country. Michelago creek is a major tributary that discharges into this reach.

### Reach Condition

Water quality was rated as 'excellent' overall, with the exception of electrical conductivity, which rated as 'good'. Turbidity can be elevated during high discharge events due to upstream inputs influencing water quality.

Riparian condition scored as 'poor', due to limited native canopy and understorey cover, exotic groundcover (African Lovegrass) and lack of habitat features such as River Tussock and debris. Riparian condition was sampled in the middle section of the reach at sites historically utilised for rural landuse.

The reach includes Bush Heritage Australia's Scottsdale Reserve and the NSW section of the Upper Murrumbidgee Demonstration Reach (UMDR). The UMDR is carrying out riparian rehabilitation works along the reach at Bumbalong. Carp are commonly sighted in this reach. Native fish and Platypus sightings are also recorded.

Water bug surveys are desirable to increase confidence in this rating.



Upper Murrumbidgee River at the bottom end of Black Rock Gorge at Scottsdale Reserve

# Cooma Creek COO1

## Headwaters to Titree Lane

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>13</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Poor	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>No Data</b>	<b>0</b>

### Reach Facts

*Reach network length:* approx. 22km

*Dominant land uses:* Rural and urban

The headwaters of the Cooma Creek rise in what is predominantly open country (part of the Monaro's naturally treeless plains) which is used for dryland cropping and grazing agriculture. Much of the Creek in this reach is unfenced and is readily accessed by stock.



Although there is a lack of canopy cover in the riparian zone, Willows have established at points along the reach (mostly scattered).

### Reach Condition

Water quality sampling showed that elevated electrical conductivity readings reflect geological influences in the catchment. Turbidity can be elevated during high discharge events, which is associated with streambank erosion.

Waterbug sampling indicated that the stream condition was 'good'. Riparian condition was rated as poor due to a lack of native species overall, scarcity of general understorey and habitat features such as River Tussock and debris and large numbers of exotic trees (Willows). Riparian fencing would greatly improve condition along this reach.

This reach is in a priority ACWA catchment. No Carp sightings have not been reported in this reach.

An additional site upstream on this reach would increase confidence in the CHIP result



Cooma Creek adjacent to the Myalla Road

# Cooma Creek COO2

## Titree Lane to Cooma Back Creek confluence

### CHIP Result D+ (Poor)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>52</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>4</b>

### Reach Facts

*Reach network length:* approx. 3km

*Dominant land uses:* Urban

This reach includes the section of the Cooma Creek that flows through the township of Cooma. Flood mitigation works have been carried out to protect urban assets in times of high flows. Stormwater from the town is discharged into the creek. Litter is an ongoing problem that has been detected. There is a popular walking path along the length of this reach.



### Reach Condition

Water quality rated as 'fair' overall showing the influence of urban inputs on water quality, however elevated readings for electrical conductivity are partly due to geological influences in the catchment. Turbidity can be very elevated during high discharge events.

Riparian condition scored as 'degraded' in this reach due to lack of native species, understorey and groundcover, minimal canopy cover dominated by exotics and lack of habitat features such as reeds, River Tussock and debris.

Riparian areas are mown and grass clippings may contribute to total phosphorus inputs. Litter is associated with stormwater drains in the Cooma CBD area along this reach. Platypus, Water Rats and Gambusia are recorded in this reach.



Cooma Creek upstream from Nijong Oval footbridge

# Cooma Creek COO3

## Cooma Creek (below Cooma Back Creek) to confluence

CHIP Result C+ (Fair)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>17</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>3</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### 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 the confluence of the Numeralla River. The reach is flanked by the North Ridge Nature Reserve at its upper end, then flowing through more open, rural residential holdings (in the Mittagang Road area) and finally through the open rural area of Bunyan which is dominated by river flats used for irrigated cropping flats.



### Reach Condition

Electrical conductivity rated as 'degraded' which may be partly due to geological influences in the catchment. Turbidity can be very elevated during high discharge events associated with streambank and gully erosion.

Water bug surveys indicate 'good' stream condition. Riparian condition scored as 'poor' and was surveyed at sites dominated by rural landuse. The score was influenced by the lack of native vegetation, scarcity of understorey and habitat features such as River Tussock and debris.

Cooma Sewage Treatment plant discharges in this reach. Carp have been reported including individuals less than 10cm long (indicating nursery habitat). Platypus have been sighted at the top end of the reach, just downstream of town.



Cooma Creek at Chakola

# Cooma Back Creek COB1

## Headwaters to confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>7</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Fair</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 30 km

*Dominant land uses:* Conservation, rural residential and rural

This reach includes the Cooma Back Creek and tributaries, including Jillimatong and Sandy Creeks. The upper sections of the reach are surrounded by predominantly rural landuse which is open cleared country. The urban section of the reach (lower) includes the Lambie Gorge area which is a site of European and Aboriginal cultural significance.



### Reach Condition

The inclusion of water quality sampling data will increase confidence in the rating score.

This reach is data deficient as regular monitoring at for at least one site is required.

Water quality sampling shows dissolved oxygen can be very low (less than 4mg/L), while Phosphates and Electrical conductivity high. These levels will impact life in the creek.

Aquatic surveys show macro-invertebrates indicate that the condition of the stream is good.

Riparian surveys taken for urban sites in this reach show 'poor' scores due to lack of understorey, grasses and reeds, minimal canopy cover dominated by exotics as well as exotic groundcover which is grazed/mown.

Lambie Gorge is a site of Indigenous and European cultural significance and retains native vegetation and aquatic habitat which is being managed for conservation purposes in the Cooma township. Reeds (*Phragmites* sp.- a native ) are spreading in the creek channel in the heart of Cooma. This is advantageous for filtering and stabilisation purposes.

The inclusion of water quality sampling data will increase confidence in the CHIP score. A further site towards the top of the reach is desirable.



Cooma Back Creek adjacent to Kiah Avenue

# Gungoandra Creek GUD1

## Headwaters to Murrumbidgee River confluence

CHIP Result C+ (Fair)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>11</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 9km

*Dominant land uses:* Rural and conservation

This reach includes the entire Gungoandra Creek which flows into the upper Murrumbidgee River downstream of Bredbo Gorge. The upper section of the Creek has been cleared and is grazed, while the lower section runs through Bush Heritage Australia's Scottsdale Reserve. Revegetation is occurring on the Reserve in the Creek's catchment area and stands of in-stream macrophytes continue to establish.



### Reach Condition

Water bug and riparian condition surveys undertaken at both the upstream and downstream end of Bush Heritage Australia's Scottsdale Reserve which covers the downstream end of this reach.

Water quality was rated as 'good' overall, except for electrical conductivity which was consistently 'degraded' and is many due to geological influences in the catchment.

Water bug surveys indicate stream health to be 'fair'. Riparian condition was 'poor' due to the lack of native canopy, understorey species and habitat features such as River Tussock and debris.

ACWA works have been carried out at Scottsdale including stabilisation of an instream nick-point, which is improving water quality. Carp have been sighted at the bottom end of this reach.



Gungoandra Creek upstream of the bottom ford at Scottsdale Reserve

# Kybean River KYB1

## Headwaters to confluence

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>9</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 49km

*Dominant land uses:* Rural

This reach includes the entire Kybeyan River catchment. This reach is characterised by both rural (grazing) country towards its headwaters, from where it flows through steep, unmodified country (including the Kybeyan State Conservation Area) to adjoin the floodplains of the Numeralla River at its confluence. The lower floodplains of the reach are utilised for both grazing and cropping purposes.



### Reach Condition

Water quality sampling shows that most parameters were classed as 'excellent'. Turbidity may be slightly elevated due to rural influences at the downstream end of the reach, while the upper section maintains good catchment cover.

Riparian condition scores were 'fair' due to marginal quantities of understorey vegetation and presence of exotic canopy and groundcover. Riparian condition was surveyed in the lower reaches where rural landuse adjoins the river corridor.

This reach includes an ACWA site in the lower section. Carp are also recorded in the lower sections of this reach, but not at the top end.

The inclusion of water quality sampling data will increase confidence in the CHIP score. More sites upstream are desirable.



Kybeyan River downstream of the Warrens Corner Road

# Michelago Creek MIC1

## Headwaters to Murrumbidgee River confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>5</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Poor	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 54.6km

*Dominant land uses:* Rural, rural residential and conservation

This reach the entire catchment of the Michelago Creek, including Ryries and Teatree Creeks. Sections of the upper reaches retain native, unmodified vegetation including the steep headwater areas in the Tinderry Nature Reserve. The lower sections runs through flatter, more open country, predominantly used for grazing agriculture.



The village of Michelago is situated on the banks of the creek.

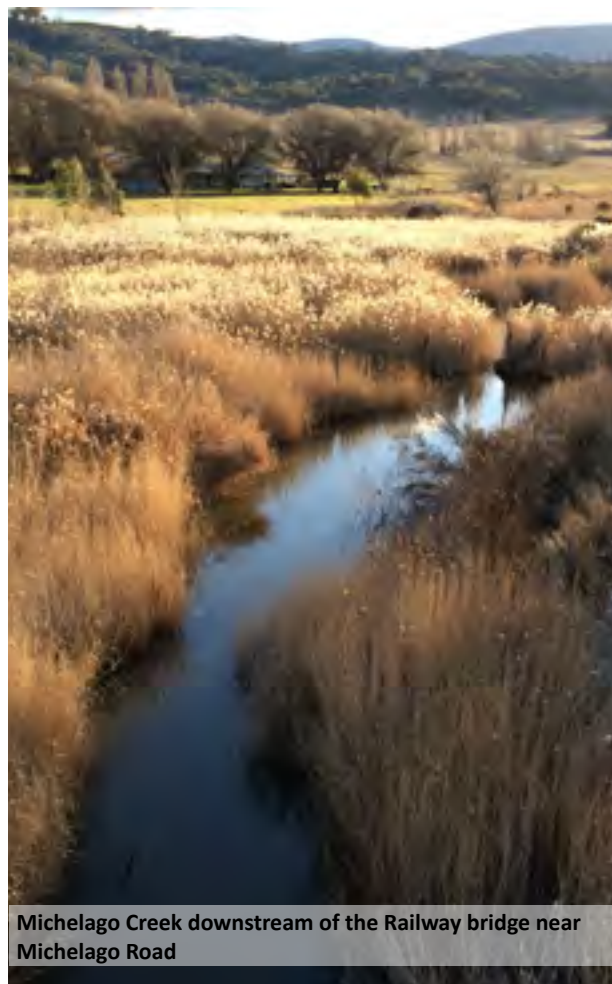
### Reach Condition

The CHIP rating is based on water quality and riparian sampling in the lower section of the reach. Further sites upstream are desirable.

Water quality data parameters were recorded as 'excellent' except for electrical conductivity which was high and is due to geological influences in the catchment.

Riparian surveys showed a 'poor' result, due to the lack of native canopy cover, limited understorey and general lack of habitat features such as River Tussock and debris. This is characteristic of the riparian zones in rural (and floodplain dominated) parts of this reach.

The Michelago Creek has been the focus for instream erosion stabilisation and Willow control works, carried out by the Michelago Landcare group.



Michelago Creek downstream of the Railway bridge near Michelago Road

# Numeralla River NUM1

## Headwaters to Kybean River confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>33</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Poor</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>4</b>

### 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. Landuse adjoining the reach includes use for dryland cropping and grazing agriculture in the mid to lower sections. Sections of the upper reaches retain native vegetation including the Dangelong Nature Reserve. The top of the reach remain unmodified with good riparian and in-stream habitat remains.



### Reach Condition

Water quality was rated as 'excellent' overall. Turbidity can be elevated especially in association with high rainfall and runoff events indicating streambank and gully erosion.

Water bug surveys indicated that stream condition was 'poor'. Riparian condition was rated as poor, due to lack of canopy cover and habitat features. It was sampled in the lower section of the reach at a site dominated by rural landuse.

This reach is included in a high priority ACWA catchment. Actions which stabilise streambanks, gully floors and encourage groundcover throughout the catchment are desirable. Carp sightings are reported up to the middle of this reach.

Further sites upstream are desirable.



Numeralla River upstream of Mt Forest Road

# Numeralla River NUM2

## Kybean River confluence to Badja River confluence

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>14</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Excellent</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 40km

*Dominant land uses:* Rural and conservation

This reach includes the Numeralla River downstream of the Kybeyan River confluence to the Badja River confluence. The Numeralla River in this reach is flanked by wide floodplains used for agriculture, including dryland cropping and grazing.

### Reach Condition

Water quality scored as 'good' overall. Turbidity can be elevated in association with high discharge events indicating the presence of streambank and gully erosion.

Water bug surveys indicated 'excellent' stream health. Riparian condition was rated as 'fair' due to the exotic canopy cover and only limited abundance of understorey and habitat features such as River Tussocks and debris.

The reach is included in a priority ACWA catchment and includes two remediated ACWA sites. Waterwatch monitoring shows how these have stabilised. Numeralla village is situated at the bottom end of this reach. Instream stabilisation, weed control and riparian revegetation are a focus of the Numeralla Landcare group in this reach.



Numeralla River upstream of Kybeyan confluence

# Numeralla River NUM3

## Badja River confluence to Rose Valley Road

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>33</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 14km

*Dominant land uses:* Rural and rural residential

This reach includes the Numeralla River from the Rose Valley Road Crossing to the Badja River confluence, including the Cowra Creek catchment. The reach is characterised by floodplain areas used for agriculture including dryland cropping and grazing at various levels. It has modified riparian zones and sediment deposition is also found in-stream. Tributaries feeding into the Numeralla River have retained good native vegetation.



### Reach Condition

Water quality was rated as 'good' overall reflecting upstream influences. The Badja River is a source of 'excellent' water quality. Turbidity can be elevated associated with high discharge events which indicate streambank and gully erosion in the catchment.

Riparian condition scores were 'fair' overall. Downstream sites were grazed and lacked native vegetation, understorey and habitat features such as River Tussock and debris.

This reach is in a priority ACWA catchment with very high erosion risk. Rose Creek is an identified high priority ACWA site. Carp sightings are reported in this reach including spawning upstream of Rose Valley Crossing.



Numeralla River upstream of the weir at 'Arnika'

# Numeralla River NUM4

## Rose Valley Road to Murrumbidgee River confluence

### CHIP Result B (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>12</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Excellent</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 17km

*Dominant land uses:* Rural

This reach includes the lower section of the Numeralla River from the Rose Valley Road Crossing to its confluence with the Murrumbidgee River. The catchment includes wide floodplain areas on both sides of the Numeralla River which are used for agriculture including grazing, dryland and irrigated cropping. Riparian zones are highly modified and sediment deposition is widespread in the river.

### Reach Condition

While turbidity has rated 'excellent' it can be elevated during high discharge events, which indicate streambank and gully erosion in the catchment.

Water bug surveys indicated stream health was 'excellent' and reflects good instream habitat at survey sites. In contrast, riparian condition was found to be 'degraded' due to lack of native vegetation, understorey and habitat features. Riparian condition was sampled at sites dominated by rural landuse which is characteristic of riparian zones along the reach.

This reach is in a priority ACWA catchment for which erosion risk was assessed to be very high. Carp are often reported in this reach, including 'spawning runs'.



Numeralla River at Chakola

# Rock Flat Creek ROC1

## Headwaters to Cottage Hill Road crossing

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>18</b>
pH	Poor	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 42km

*Dominant land uses:* Rural

This reach includes the entire Rock Flat Creek from the headwaters down to its confluence with the Cooma Creek. The catchment flows through predominantly open basalt country, which is used for grazing agriculture. Wide floodplains at the bottom end of the reach have been historically prized for cropping and hence riparian zones are highly modified in this catchment.



### Reach Condition

Electrical conductivity is consistently high and is most likely due to geological influences. Turbidity levels can be high in conjunction with high discharge events indicating the presence of streambank and gully erosion in the reach.

Water bug surveys indicated 'good' stream condition reflecting presence of instream habitat. Riparian condition was 'degraded' due to the lack of canopy and understorey cover, heavy grazing at some sites and lack of habitat features such as River Tussock and debris.

This reach is in a medium priority ACWA catchment which includes a high priority ACWA site.



Rock Flat Creek downstream of the Cottage Hill Road

# Strike-A-Light River STR1

## Headwaters to Bredbo River confluence

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>17</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Excellent</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 38km

*Dominant land uses:* Rural

This reach includes the entire Strike-A-Light River catchment from its headwaters down to its confluence. The catchment includes both cleared open country, utilised predominantly for grazing agriculture at the top and bottom ends of the reach. In these areas riparian vegetation has been modified. The middle of the reach is largely native vegetation with intact riparian areas and good instream habitat.



### Reach Condition

Water quality parameters were 'excellent'. Water bug surveys, taken at upstream sites, indicated 'excellent' stream health also reflect the integrity of instream and riparian habitat along the upper parts of the reach.

Riparian condition was 'fair', especially in rural sites due to lack of native canopy and limited understorey and lack of habitat features such as River Tussock and debris. Sites in the upper catchment are swampy type meadows which also lack canopy and understorey, but this is natural.

This reach is in a moderate priority ACWA catchment which includes an identified ACWA site at the downstream end. Galaxias (small native fish) have been sighted.



Strike A Light River upstream of Jerangle Road bridge

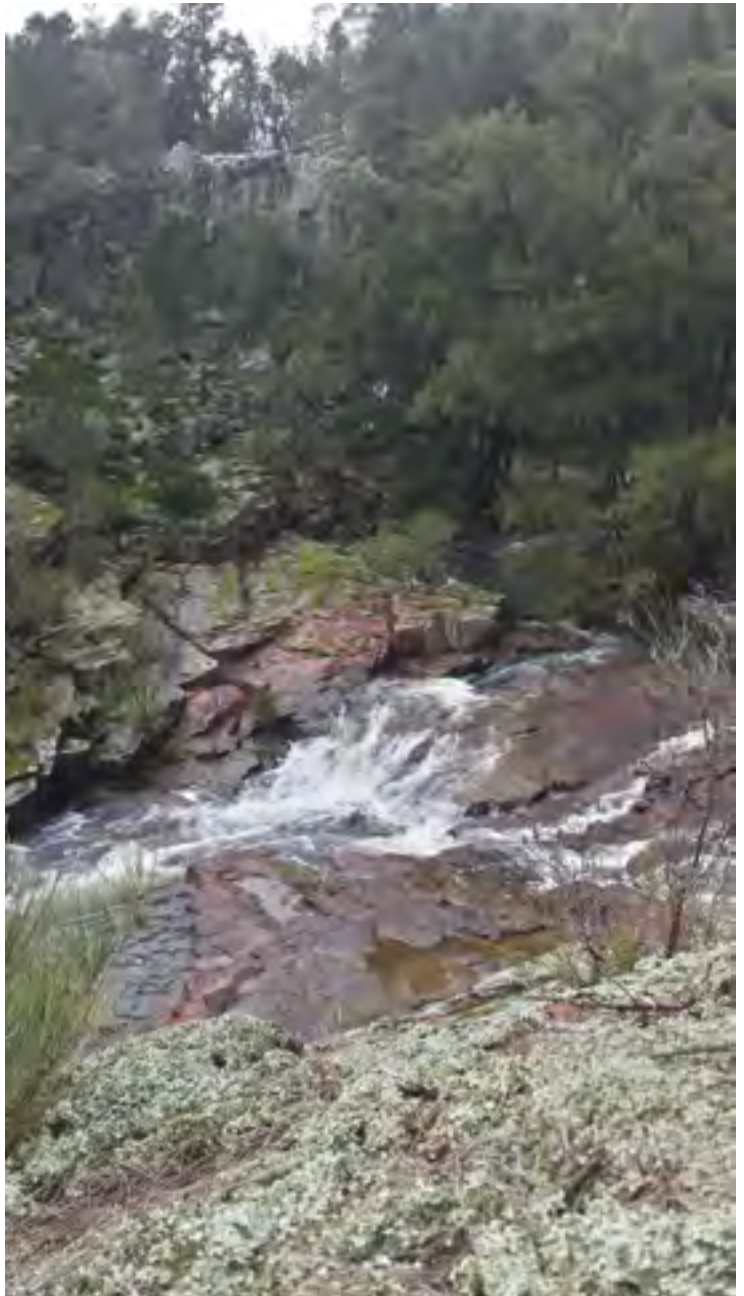
# Ginninderra Catchment Facts

Over 35% 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 and also includes Hall Creek.

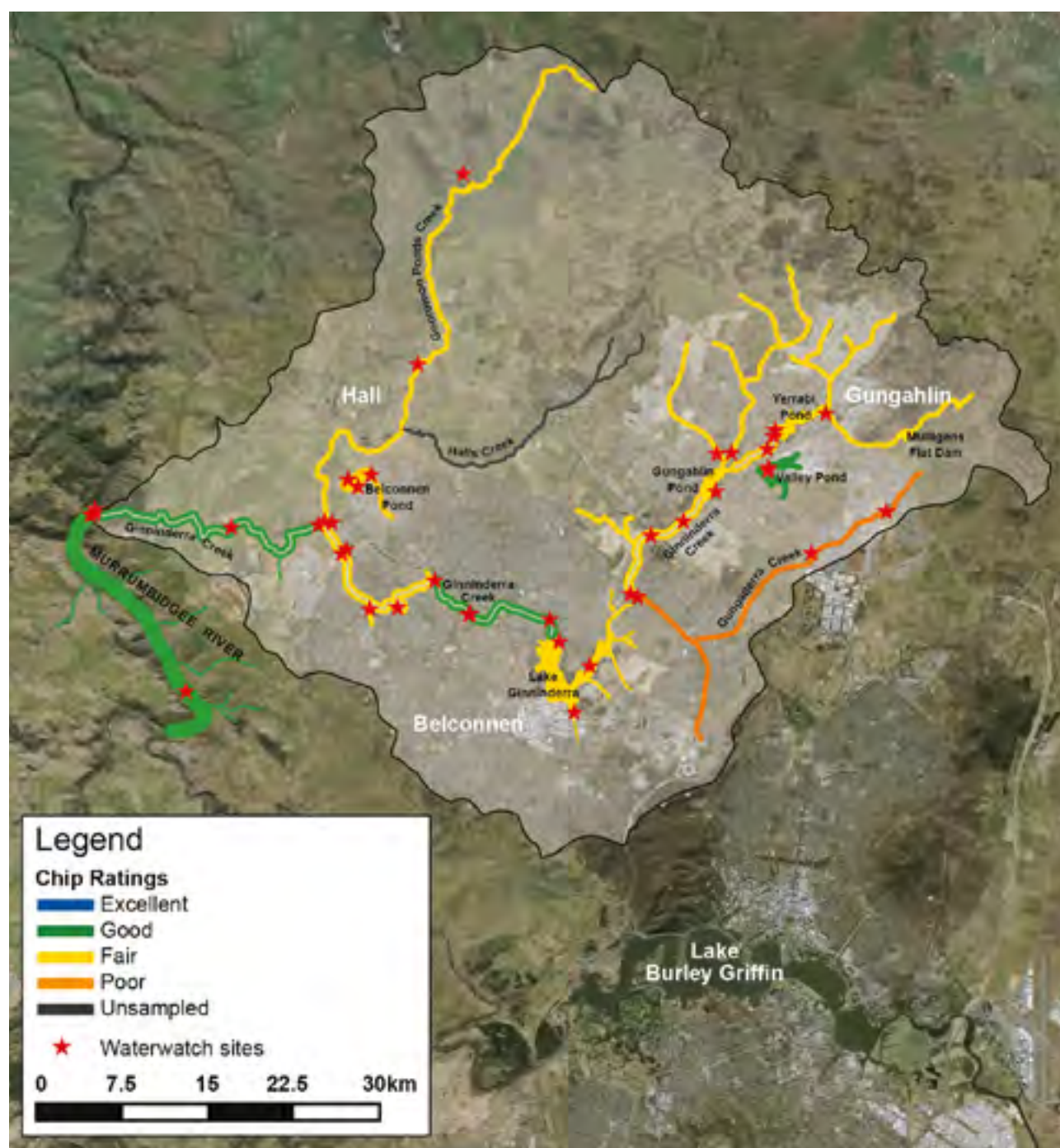
Steady development in Canberra's north has impacted significantly over the past 30 years with sediment from development sites and weeds the two most significant issues. The Riparian zone for most of the creek is dominated by exotic grasses with a mix of native and exotic mid-storey and canopy. Some notable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

Ginninderra Waterwatch Volunteers have been monitoring this catchment since 1997.



## Ginninderra Catchment Health Summary

CHIP ratings for the Ginninderra catchment show water quality mostly in the 'fair' to 'good' range. The only exception was the poor rating for GDC1 which was data deficient for water quality meaning the score was based on water bug and riparian vegetation assessments (RARC) reflecting the poorer habitat value of this reach. In general water bug and RARC sampling showed poorer results than the monthly physical/chemical monitoring. This is to be expected as both give a more complete measure of ecosystem health and habitat value which are negatively impacted in this heavily urbanised area. Two significant events occurred during the reporting period; a fish kill (predominantly Murray Cod) in Yerrabi pond thought to be related to low dissolved oxygen but no evidence was found to confirm. The other was a very high nitrate reading in Kippax Creek of 30mg/L which may have resulted from cleaning of the gross pollutant trap or a dumping event. Again, no evidence was found to confirm. The poorest results in most reaches were following larger rain events, again consistent with expectations in an urban catchment.



# West Belconnen Ponds BEL1

## Dunlop, Belconnen

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>6</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>3</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### Reach Facts

*Reach area:* 9.9Ha

*Dominant land use:* Urban and recreation

This urban wetland was constructed in the early 2000s and captures water from the adjacent suburb of Dunlop and the Dunlop Grassland Nature Reserve. Outflows from this wetland flow into Gooromon Ponds Creek just upstream of the confluence with Ginninderra Creek. West Belconnen Pond is popular with bird watchers and recreational anglers.



### Reach Condition

Despite insufficient water quality data across three Waterwatch sites in this wetland, riparian condition and water bug surveys indicate that this wetland is in fair condition. A poor riparian condition score was obtained due to very limited canopy cover and midstorey, however groundcover is good. Water bug scores were good, which is commendable for a still-water pond with considerable urban inflows.

The limited water quality records suggest that pH can vary from 'good' to 'poor' across this wetland (range 6-8.3), while electrical conductivity and turbidity are consistently 'excellent'.

Total phosphorus can vary between 'excellent' and 'poor', while nitrates are generally good. Dissolved oxygen levels can vary greatly, with oxygen saturation consistently below 100% (range: 69-89%). Further planting of riparian vegetation is required to improve the riparian condition score for this site.



West Belconnen Pond in Dunlop

# Murrumbidgee River CMM10

## Molonglo confluence to Ginninderra Creek confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>8</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Fair</b>	<b>4</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### 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 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 Sewerage Treatment Plant (STP).

### Reach Condition

Water quality varies between parameters and sampling dates with large rainfall events contributing to poorer scores. The lower Molonglo STP releases higher amounts of salt compared to catchment derived salt loads however this does not appear to increase electrical conductivity levels significantly in the larger Murrumbidgee River. Nitrate readings were notably 'degraded' in this reach but were 'excellent' in the next reach upstream, above the confluence with the Molonglo River.

Water bug results showed 'fair' condition and may have been influenced by recent flooding prior to Autumn surveys. This wide shallow and rocky section has limited reed and macrophyte beds which reduces habitat value for certain types of bugs.

The riparian vegetation (score was also 'fair'; this reach is characterised by extensive exotic vegetation with some good native canopy and mid-storey in patches. Flooding debris has provided extensive logs and other in systems habitat along this reach.



Murrumbidgee River Above Ginninderra Confluence

# Gungaderra Creek GDC1

## Gungahlin to Giralang Pond

### CHIP Result D+ (Poor)

#### Data Collected

Parameter	Rating	Survey
<b>Water quality</b>	<b>No Data</b>	<b>6</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Poor</b>	<b>5</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### 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. The reach also includes a stormwater channel from the University of Canberra and Canberra Stadium and has moderate urban stormwater inflow



### Reach Condition

Whilst water quality data did not meet the data density cut off, results that were recorded suggest 'fair' condition. Results varied greatly as a result of the ephemeral nature of this reach.

Large sections of wholly exotic riparian vegetation and sections of concrete stormwater drains have resulted in a 'poor' riparian scores.

The combination of poor riparian habitat and variable flows also resulted in 'poor' macro-invertebrate (water bug) scores. At some sites only 6 different types of water bug were recorded with most in the tolerant category.



Gungaderra grassland reserve pond

# Ginninderra Creek GIN1

## Crace to Giralang Pond

CHIP Result C+ (Fair)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>20</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Good</b>	<b>3</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>3</b>

### 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 the recent development of Crace. The middle of the reach receives runoff from the CSIRO field test facility. The downstream section flows through the Old Palmerville township historic site and Landcare Forest.



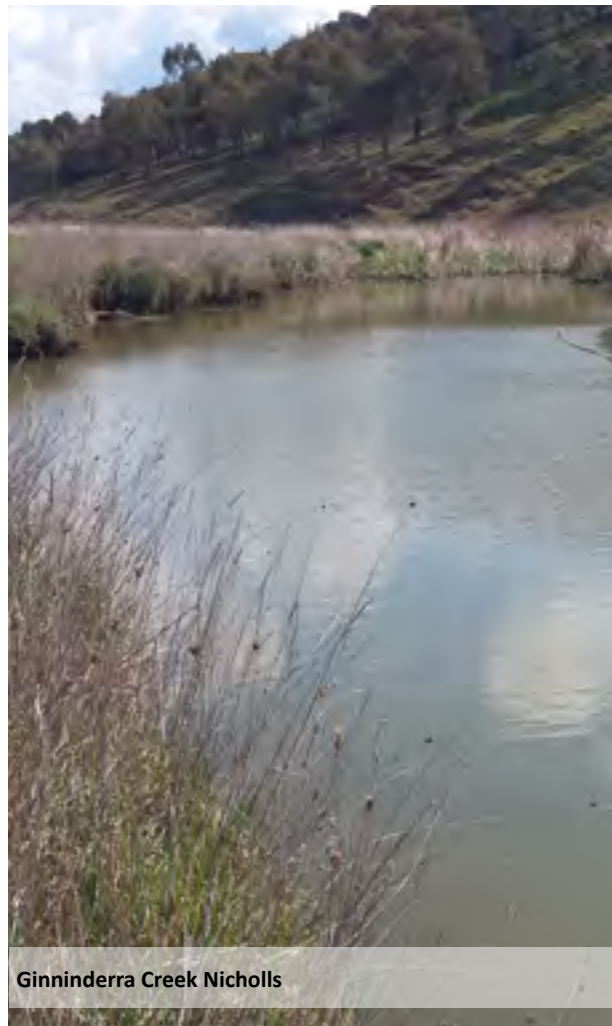
The end point for this reach is Giralang Pond which is the only small stream pond on the Ginninderra Creek.

### Reach Condition

Riparian vegetation assessments showed 'poor' results due to a very low native component. This reach is dominated by phalaris grassland and exotic canopy species and woody weeds. The reach does have good coverage of native instream reeds and limited erosion of stream banks.

Water bug surveys resulted in a good rating however the bugs comprised mostly of very tolerant types suggesting poorer water quality. Water bugs will also be impacted by the poor riparian vegetation and although there is good coverage of reeds, diversity of instream vegetation is lacking.

Feral fish such as Gambusia, Redfin, Perch and Carp all regularly seen in Giralang Pond.



Ginninderra Creek Nicholls

# Ginninderra Creek GIN2

## Lake Ginninderra

### CHIP Result C (Fair)

#### Data Collected

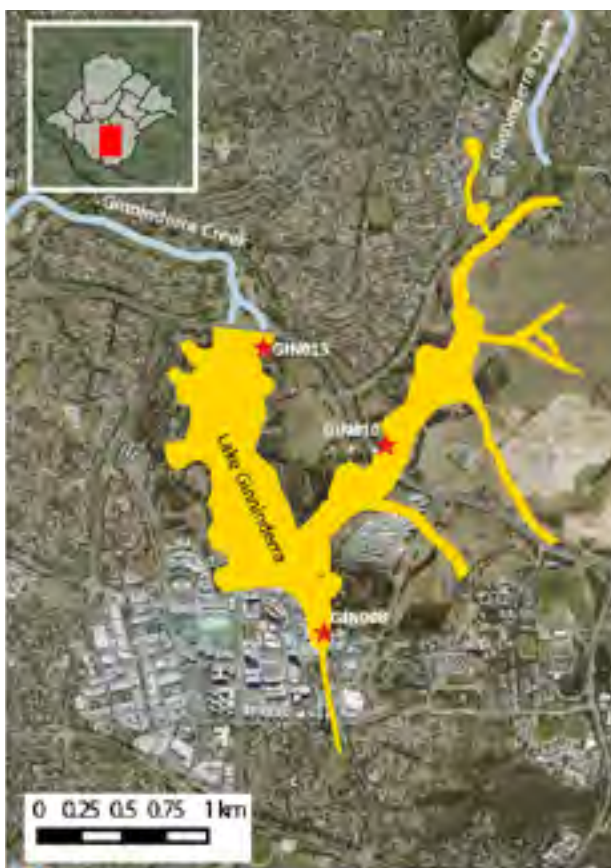
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>44</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>7</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### 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, including the new development suburb of Lawson. The other inflow joins at the southern end of the Lake and is mostly urban stormwater that flows into the recently redeveloped Eastern Valley Way Wetland.



### Reach Condition

While overall the water quality score was 'good', 'degraded' dissolved oxygen results for the reach mainly came from very low results in the new Eastern Valley Way wetland which is not performing as expected. Dissolved oxygen records for the remaining sites were consistent with previous years.

Water bugs surveys in this reach ranged from 'good' to 'poor' reflecting the high variation in habitat around the Lake.

Riparian vegetation scores were 'poor' as expected in a parkland environment scoring very low in habitat features such as leaf litter, logs and native vegetation. This reach includes Lake Ginninderra which has large areas of manicured parkland and does not score well in riparian vegetation assessments.



Eastern Valley Way Wetland Lake Ginninderra

# Ginninderra Creek GIN3

## Dam wall to Ginninderra Drive

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>8</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>7</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 4km

*Dominant land uses:* Urban

Starting below the Lake Ginninderra Dam wall this reach is entirely old established suburbs with high urban stormwater inflow and outflow from the Lake. Like the rest of the lower creek, this section is characterised by abundant reed growth that resulted from the willow removal project in 2000.

### Reach Condition

While the reach score was 'good', this may not reflect the true condition of this reach. High variability between sites is of interest although common in highly urbanised waterways.

Water quality did not meet the data density cut off. The water quality data that was recorded however indicated 'good' results for most parameters with dissolved oxygen and electrical conductivity showing some 'poor' results.

Water bugs varied from 'good' to 'poor' with 'good' results being dominated by tolerant bug types suggesting poorer water quality. This reach has good instream reeds and some patches of good riparian vegetation which explains variation in bug scores throughout.

Riparian vegetation scores were 'poor' resulting from phalaris grassland, woody weeds and exotic canopy species. This reach has some sections of good riparian vegetation an example of which is the section in Evatt below the dam wall.



Ginninderra Creek downstream of Lake Ginninderra

# Ginninderra Creek GIN4

## Ginninderra Creek at Umbagog District Park

### CHIP Result C- (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>26</b>
pH	Excellent	
Turbidity	Good	
Total Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>4</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 6km

*Dominant land uses:* Urban

This reach starts downstream of Ginninderra Drive and flows through the Umbagog District Park, ending at the confluence with Gooromon Ponds Creek. It has high urban runoff from old established suburbs and also includes the inflow from Kippax Creek. The downstream section has some inflow from the developing suburb of Macgregor West.

### Reach Condition

Water quality was lower than adjoining reaches due to the influence of Kippax Creek.

Kippax Creek is impacted by a highly urban catchment and infill development of the shopping centre. Two events were reported to the EPA, during this reporting period; the first was large quantities of plaster products washed into the creek from a building renovation. The second was a very high reading for nitrates of 30mg/L which was possibly the result of cleaning the gross pollutant trap.

Riparian vegetation and macro-invertebrate (water bug) scores were both 'poor'. This reach has some good habitat sections such as through Umbagog District Park and Macgregor but some poor sections along both Ginninderra and Kippax Creek.

Water bug scores were lower than expected given the good sections of riparian habitat. This may be a result of poor water quality due to events like those mentioned above from Kippax Creek. Kippax Creek has had the most reports of dumping of unknown substances in all the Ginninderra reaches.



Gooromon Ponds Creek above Ginninderra Creek confluence

# Ginninderra Creek GIN5

## Gooromon Ponds Creek confluence to Murrumbidgee River confluence

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>15</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>4</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>



Ginninderra Creek below the Lower Falls



### Reach Facts

*Reach network length:* approx. 10km

*Dominant land uses:* Urban/Rural Fringe

Starting at the confluence with Gooromon Ponds, the upstream section has inflow from the developing suburb of Macgregor West. The Creek then flows through rural fringe land into NSW and through the gorge country of Ginninderra Falls and finally joins the Murrumbidgee River below Cusack's Crossing.

### Reach Condition

Electrical conductivity rated as 'poor' resulting from the influence of Gooromon Ponds Creek which carries much higher salt levels than Ginninderra Creek. Dissolved oxygen was 'degraded' for this section and could be attributed to poorer instream vegetation from the upper slower sections of this reach. Dissolved oxygen in the gorge country was 'good' as expected in steep turbulent sections

Water bugs were 'good' for the downstream section of the reach and 'fair' for the upstream. Instream vegetation is 'poor' for much of this reach and severe erosion points are present in the upstream section.

Riparian vegetation scores were 'good' in the downstream section and poor in the upstream. The latter resulting from grazing and weed dominated grasslands. The well protected lower reach through the Ginninderra gorge has the best riparian habitat in the catchment.

A real negative for the downstream section is the amount of plastic bottles through the gorge area. Many thousands of drink bottles have accumulated in flood debris.

# Gooromon Ponds Creek GOO1

## Umbagog to Dunlop

### CHIP Result C- (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>12</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>5</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 17km

*Dominant land uses:* Rural

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

### Reach Condition

Water quality was mostly 'excellent' with 'degraded' results for dissolved oxygen explained by irregular flow and chain of ponds nature of this reach. Electrical conductivity is consistently 'degraded' with readings often over 500 $\mu$ S and reaching as high as 1560 $\mu$ S during this reporting period. Salinity for this reach is a result of historical land clearing underlying geology.

Water level rises quickly during rain events and returns to low levels just as quick. Water bugs scored 'poor' as a result of low flow, high algal growth and limited instream habitat.

Riparian habitat is almost non existent through this reach with only exotic ground cover in many sections. Fast flowing water and a lack of vegetation has resulted in significant gully erosion in this reach. Ginninderra Catchment Group is working with the newly formed Landcare group in the area to improve habitat and address gully erosion.



A dam on the Gooromon Ponds Creek

# The Valley Ponds GUN1

## Wetland to Gungahlin Town Centre

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>6</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### 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.



### Reach Condition

Water quality results were mostly 'excellent' except for electrical conductivity which is possibly due to the fact that this reach is in a highly urbanised catchment with ongoing construction. Dissolved oxygen was 'poor' which is surprising given the amount of newly planted macrophytes. As a new wetland this indicates a settling period may be required for optimum functionality.

The macro-invertebrate (water bug) results were 'good' with a wide range of species including a few sensitive ones. The good macrophyte layer provides a diverse habitat for water bugs.

Riparian vegetation was 'poor' as this is a new wetland and lacks both the canopy and midstorey layers. A diverse habitat has been planted here and it is anticipated that the riparian score will improve. The wetland has good tussock grasses and reeds providing excellent frog habitat.



The Valley Ponds

# Gungahlin Pond GUN2

## Headwaters of Ginninderra Creek north arm to Gungahlin Ponds

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>14</b>
pH	Poor	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>5</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### 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 creeks fragmented by stock dams and flowing into the sediment control pond of Gungahlin. The reach includes a high inflow of urban stormwater from surrounding suburbs and new developing suburbs.



### Reach Condition

Water quality was 'fair' with a significant increase in turbidity resulting from the Casey development. Electrical conductivity and dissolved oxygen results were 'degraded' - also a likely result from the impacts of the Casey construction phase.

Water bug results ranged from 'poor' to 'good' however the good results were dominated by very tolerant bug types. 'Good' results were recorded where there was good riparian habitat and macrophyte layers.

Riparian vegetation scores were 'poor' and is due to the area being managed as a recreational parkland. There are limited sections containing vegetation with better habitat values. Exotic species dominate in many sections.



# Yerrabi Pond YER1

## Headwaters of Ginninderra Creek to Yerrabi Dam Wall

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>12</b>
pH	No Data	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Poor</b>	<b>3</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### 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 fragmented by stock dams and flows into the sediment control pond of Yerrabi.



The reach includes a moderate inflow of urban stormwater from surrounding suburbs.

### Reach Condition

Water quality results were mostly 'good'. One exception was 'poor' electrical conductivity which is expected in a highly urbanised catchment with recent development.

Water bug scores indicate 'poor' condition - mostly due to limited habitat. Macrophyte growth is poor in many parts of the pond resulting in low diversity of species and mostly tolerant bug types recorded.

Riparian vegetation scores were 'poor' due to largely exotic species in all three layers of habitat. Scores were dragged down by a concrete channel site which is part of this reach. The Pond itself is more in the 'fair' range with some better habitat areas. The poor habitat values occur in the more managed/modified areas.



Yerrabi Pond in Gungahlin

# 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<sup>2</sup>

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. 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 can be found at <https://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 in urban catchments where there is little riparian vegetation and habitat to slow down flows and capture and absorb nutrients and sediments.

With mostly good water quality in the catchment, the poorest water quality is in the lower Jerrabomberra Creek and to a lesser extent lower Sullivans Creek. When we combine water quality, water bugs and riparian condition, the lowest overall condition was generally found in the most urbanised reaches of subcatchments, as well as some rural areas with largely cleared land. Of the six priority sub-catchments in the ACT Government's Commonwealth-funded Basin Priority Project, four occur in the Molonglo catchment. These sub-catchment will be the focus of treatment works such as wetlands and riparian works aimed at improving water quality. Waterwatch will be playing their part in observing the effectiveness of these works and look forward to some positive outcomes for the catchment.



## Molonglo Catchment Health Summary

Most of the Molonglo Catchment was in 'good' condition, and about one-third of our reaches were in fair condition, however none were in 'excellent' overall condition.

With excellent water quality in many reaches, especially high in the catchment and immediately below dams, loss of riparian vegetation has a significant impact on catchment health scores.

In the past year, there was a fuel leak into the Queanbeyan River, two sediment pond overflows from new developments, and fish kills in Yangyguinula Creek. The health of Yandyguinula Creek is one of the best in the catchment at the upper Waterwatch site as it flows out of Tallaganda National Park with intact native

vegetation. It then flows through cleared rural land, exemplifying some of the issues impacting catchment health in our region, including extensive loss of riparian vegetation, stock accessing creeks, and sedimentation following heavy rain events.

We love our creeks, rivers and lakes, and Waterwatchers throughout the Molonglo Catchment are continuing to monitor the health of water and our catchment. We use them for swim and see animals such as platypus and water rats continue to thrive in them.



# Burra Creek BUR1

## Headwaters to Queanbeyan River confluence

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>12</b>
pH	Excellent	
Turbidity	Good	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 30km

*Dominant land uses:* Native bush, grazing, rural

Burra Creek arises in the north-western edge of the Tinderry Mountains and continues to its confluence with 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. Riparian vegetation is largely absent or dominated by willows, but has some extensive reed beds.



### Reach Condition

We have more sites on this reach this year, though 2 sites only started being sampled in April. With the revised thresholds, scores for pH and electrical conductivity are more reflective of this reach which has naturally higher pH and electrical conductivity as a result of the parent rock. The reach had some 'excellent' and 'good' water quality results, but dissolved oxygen was only 'fair', and electrical conductivity was 'poor' (130–550  $\mu\text{S}$ ).

The macro-invertebrate (water bug) score was 'good', but the riparian assessment indicated poor habitat given that much of the reach is cleared. Water at some sites on this reach may include water from the Murrumbidgee to Googong pipeline. We now have a Waterwatch site above the pipeline which will improve our knowledge of any potential effects if the pipeline becomes operational in future.



Burra Creek at the M2G pipeline exit

# Dickson Wetland DIC1

## Sullivans Creek catchment

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>6</b>
pH	Degraded	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### 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 flow back into the concrete channel and through to Lyneham Wetland just upstream of the confluence with Sullivans Creek.



### Reach Condition

The reach had some 'excellent' and 'good' water quality measures, but only had 'fair' turbidity (9-21), and the pH was rated as 'degraded' (7.9-9.4). The variable and sometimes highly elevated pH may be normal for artificial wetlands such as this. There was insufficient data to assess dissolved oxygen. The water quality data comes from spring and summer only which may have affected these results.

Water bugs indicated 'good' results, but the riparian vegetation assessment indicated 'poor' habitat. However, extensive plantings around Dickson Wetlands undertaken by volunteers from the Dickson Wetlands Carers group will grow and result in improved riparian condition over time.



Dickson Wetland looking south-west

# Googong Creek GGG1

## Headwaters to Queanbeyan River confluence

### CHIP Result B+ (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>18</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Good</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 1km

*Dominant land uses:* Native bush, grazing, urban, infrastructure, rural residential

Googong Creek arises in the new 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.

This creates another dam on the creek before reaching the Queanbeyan River upstream of Wickerslack Lane. Googong Creek flows intermittently (known as an ephemeral creek).

### Reach Condition

Googong Creek had 'excellent' and 'good' water quality results for all parameters, except electrical conductivity which indicated a 'degraded' system (310-690  $\mu$ S). High electrical conductivity readings, however, can often be associated with ephemeral creeks.

The riparian vegetation assessment indicated 'fair' to 'good' condition, reflecting areas of native bush with weed infestations concentrated along the creekline and access tracks. Assessments were only conducted on the lower section of this creek, below the residential and cleared sections where there are sufficient flows to sample.

The Googong development is likely to have an influence on water quality in this creek so having a Waterwatch volunteer here is important for monitoring any long term effects.



Sue taking samples at Googong Creek

# Jerrabomberra Creek JER1

## Headwaters to Fernleigh Drive

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>25</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### 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. It has a number of small creeks flowing into it along this section of the creek. The creek channel has some healthy riparian vegetation before flowing into rural subdivisions with very little riparian vegetation. This reach has been redefined since the 2013–14 CHIP to include a site in Fernleigh Park rural residential area.



### Reach Condition

Low flows are common in this reach during summer, and because the metamorphic parent rock is producing dissolved minerals, high electrical conductivity (120–640  $\mu\text{S}$ ) occurs frequently at all sites on the reach.

Water bugs on this reach indicated 'good' condition, but the combined riparian vegetation assessments over the reach were 'poor', reflecting large sections of cleared land. Royalla Landcare have been undertaking revegetation activities for many years and the upper section of this reach had a 'fair' riparian assessment, which is likely to improve over time as the vegetation matures. This reach provides a useful reference for the rest of the Jerrabomberra Creek catchment.



Jerrabomberra Creek downstream of the Old Cooma Road

# Jerrabomberra Creek JER2

## Fernleigh Park to Molonglo River confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>24</b>
pH	Poor	
Turbidity	Fair	
Total Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 19km

*Dominant land uses:* Rural residential, light industrial, urban, conservation, recreation

This section of Jerrabomberra Creek flows from Fernleigh Park rural residential area and runs past the suburb of Jerrabomberra, the Hume industrial estate and the Environa development. It then flows through Jerrabomberra Grassland Reserve, through some rural land with little riparian vegetation, and then through to Jerrabomberra Wetlands.



These largely artificial wetlands adjoining the Fyshwick industrial area, capture runoff and stormwater flowing into the creek. The reach also includes the ephemeral Woden Creek and Kelly's Swamp. The water in the bottom part of this reach is backed up and slowed down by Scrivener Dam at the head of Lake Burley Griffin. This reach has been redefined since the 2013–14 CHIP.

### Reach Condition

Water quality surveys showed that turbidity was 'fair', pH was 'poor', and electrical conductivity (160-1770  $\mu$ S), total phosphorus (TP) (0-1.8 mg/L), and dissolved oxygen (40-109%) were 'degraded'.

Kelly's Swamp is ephemeral and had consistently very high electrical conductivity and TP and sometimes very low dissolved oxygen. However the Jerrabomberra Creek site also had generally 'poor' water quality results and only TP was significantly skewed by Kelly's Swamp.

The water bug survey was done in the Creek with a 'good' result. The riparian vegetation assessments indicated 'poor' condition. There is some riparian revegetation work in the Narrabundah section immediately before Jerrabomberra Wetlands as well as along the Creek in the reserve. These may help improve the riparian score over time.

The entire wetland attracts many birds, with both migratory and resident populations. Platypus and Water Rats are also seen in this reach.



Jerrabomberra Creek at Jerrabomberra Wetlands

# Lyneham Wetland LYN1

## Sullivans Creek catchment off Wattle Street Lyneham

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>3</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach area:* approx. 1Ha

*Dominant land uses:* Urban

Lyneham Wetland is a large artificial wetland constructed in 2011–12 and is fed by stormwater from surrounding suburbs, including Dickson, and from 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 Sullivan's Creek when water levels are sufficiently high.

### Reach Condition

Lyneham Wetland is a newly sampled reach, and there was insufficient water quality data this year to calculate a CHIP score.

Water bugs, however, indicated ‘good’ water quality/habitat, but the riparian vegetation assessment indicated ‘fair’ riparian condition. This may be a result of the young nature of this wetland that lacks the complexity of mature plants and multiple vegetation storeys. It would be expected that this score will improve as the wetland develops.



Lyneham Wetland outlet into Sullivan's Creek

# Molonglo River MOL1

## Headwaters to Captains Flat

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>0</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### 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 little or no riparian vegetation.



### Reach Condition

The Molonglo River is small this high up in the catchment, but this is an important reach, providing information about the impacts of the Captain Flat mine on the river in the next reach downstream.

Though there was no water quality data to assess this year, water bug data indicated only 'fair' water quality/habitat, with pollution sensitive water bugs present but only limited diversity. The riparian assessment indicated 'poor' riparian condition, reflecting the highly cleared rural land. Stock also have ready access to the river in this reach. A second site on this reach would increase confidence in the results.



Upper Molonglo River upstream

# Molonglo River MOL2

## Captains Flat to Travelling Stock Reserve

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>10</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>2</b>
<b>Riparian condition</b>	<b>Good</b>	<b>1</b>

### 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 through mostly modified rural land and finishes at the Travelling Stock Reserve (TSR) at 'Foxlow'. The reach may be targeted by the Basin Priority Project with works aimed at improving water quality.

### Reach Condition

Water quality surveys indicated 'excellent' or 'good' water quality for most parameters, but electrical conductivity was 'poor' (150-410  $\mu$ S) and dissolved oxygen (59-84%) indicated a 'degraded' system.

The water bug surveys were 'poor' with little diversity being detected. This is likely to be caused by historical mine leachate impacts. The riparian vegetation assessment in the TSR rated as 'good', however riparian vegetation in this reach varies considerably, with the TSR representing the best condition on the reach.

Captains Flat Landcare have been targeting weeds along 6km in the TSR and south towards Captains Flat, and there is an ongoing weed spraying project this year. Feral pigs were sighted whilst we were conducting the spring water bug survey.



Looking downstream in Travelling Stock Reserve

# Molonglo River MOL3

## Downstream of Travelling Stock Reserve near 'Foxlow'

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>46</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>5</b>

### Reach Facts

*Reach network length:* approx. 54km

*Dominant land uses:* Grazing, rural residential

This reach of the Molonglo River 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 is largely treeless due to being a frost hollow. Whiskers Creek and Stony Creek are adjacent to small rural subdivisions. The reach may be targeted by the Basin Priority Project with works aimed at improving water quality.

### Reach Condition

While most water quality parameters in this reach were 'excellent' or 'good', electrical conductivity (EC 150–1320  $\mu\text{S}$ ) was 'poor' and dissolved oxygen (22–92%) indicated a 'degraded' system.

Stony Creek particularly, but also Whiskers Creek, were the main contributors to the 'degraded' electrical conductivity readings, due most likely to their underlying geology. There was a pollution event reported to the EPA by landholders, which affected this section of the Molonglo River. This pollution event coincided with some of the very low Waterwatch dissolved oxygen readings but no cause could be drawn from the EPA investigation.

The water bug surveys gave 'fair' results, and riparian vegetation assessments also rated 'fair'. This is not unexpected given some river stretches have no riparian vegetation and some are dominated by willows.

Hoskinstown Landcare and Carwoola Landcare have been undertaking revegetation work along this reach for many years. The Molonglo River Rescue project in 2010–11 focussed on the stretch from Briars Sharrow Road to Burbong.



Molonglo River near the Kings Highway

# Molonglo River MOL4

## Downstream of Burbong Bridge to Queanbeyan River confluence

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>0</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 15.5km

*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 intact native vegetation, and ends above the Molonglo River's confluence with the Queanbeyan River at Oaks Estate.

The reach includes Reedy Creek which arises in the western section of Kowen Forest and joins the Molonglo River at few kilometres north of Oaks Estate. The reach may be targeted by the Basin Priority Project with works aimed at improving water quality.

### Reach Condition

There are no active Waterwatchers in this reach, but macro-invertebrates (water bugs) were sampled in spring and autumn to provide bioindicators of water quality. The spring water bug score was 'good', but the autumn score was 'poor', averaging to a rating of 'fair'. Water bugs are influenced by disturbances, including weather events, and this may have been a factor in the 'poor' autumn water bug score.

The landuse, landform and riparian vegetation vary considerably over this reach, so the one riparian assessment is only indicative of the bottom section of this reach.

Reedy Creek, a tributary into this reach, is not currently sampled but it was for several years and consistently had high electrical conductivity, so this may be a factor affecting reach condition.



Below weir, Yass Road

# Molonglo River MOL5

## Upstream of Lake Burley Griffin

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>15</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Good	
Dissolved Oxygen	Good	
<b>Water bug</b>	<b>Poor</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### 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 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 head of Lake Burley Griffin.

### Reach Condition

Turbidity last year for this area was considerably higher, particularly in the first half of the year, and was likely to have been partly caused by the construction of a major new bridge over the River. It has improved this year, and is positively affected by the change to thresholds in this year's CHIP, resulting in a rating of 'excellent'. Generally higher total phosphorus and electrical conductivity last year compared to this year were also likely to have been caused by disturbed sediments from the bridge construction.

This is a highly altered environment, impacting the water bug and riparian assessment scores. However, Platypus and Water Rats have often been observed in this section of the Molonglo River.



Water ski area on Molonglo River in Fyshwick

# Molonglo River MOL6

## Lake Burley Griffin to Coppins Crossing

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>8</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Poor	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 26km

*Dominant land uses:* Urban, grazing, conservation

This section of the Molonglo River extends from immediately below Scrivener Dam on Lake Burley Griffin to Coppins Crossing. It includes the new Molonglo urban development and Coppins Crossing picnic area. The lower Molonglo will be targeted by the Basin Priority Project with works aimed at improving water quality.



### Reach Condition

With turbidity and nutrients improved by Lake Burley Griffin upstream, water quality assessments on this reach indicate most parameters were 'excellent' or 'good', with dissolved oxygen 'fair' and only electrical conductivity being assessed as 'poor' (190-260µS). There was no water quality data from the winter period.

The water bug score gave a 'good' result, however the riparian vegetation assessment reflected the largely cleared areas on most of the reach, with willows and other introduced species being the dominant vegetation type.

Increased monitoring along the reach in the coming year will improve our knowledge of potential impacts arising from the large Molonglo urban development, adjacent to this reach, which has a projected population of 55,000. Planned riparian revegetation should have a positive impact on reach condition in coming years.



Coppins Crossing Bridge looking north-east

# Primrose Creek PRI1

## Headwaters to Molonglo River confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>16</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 34km

*Dominant land uses:* Conservation, grazing, rural

Primrose Creek is a chain of ponds with headwaters 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 slightly incised.



There is little or no riparian vegetation except at the headwaters of Primrose Creek and Antills Creek, and the reach flows through mostly rural land.

### Reach Condition

The creeks in this reach had 'excellent' water quality, apart from electrical conductivity (EC) (170-800  $\mu$ S) which indicated a 'degraded' system.

Although the EC was variable, it was consistently high. High EC is associated with low flows in these ephemeral streams (such as JER1), which often results from the geology and hydrology of the local area.

Apart from the conservation areas in the upper catchment, there is very little or no riparian vegetation along these creeks and stock generally have free access to the creeks. The riparian assessment score was one of the worst in the catchment, however Mountain galaxids (a small native fish) have been observed in this reach in recent times.



Rural cleared land along Primrose Creek

# Queanbeyan River QUE1

## Upstream of Googong Dam

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>56</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Good</b>	<b>4</b>

### Reach Facts

*Reach network length:* approx. 143km

*Dominant land uses:* Conservation, grazing, rural residential

The upper section of the Queanbeyan River is a extensive stretch of river that runs from its origins on the southern slopes of the western Tinderry Ranges to Googong Dam. The reach includes Sherlock Creek, Urialla Creek, Tinderry Creek, Roberts Creek and Bradleys Creek.



### Reach Condition

Water quality in the upper Queanbeyan River reach was 'excellent' or 'good' for most parameters.

Dissolved oxygen (DO) (56-97%) however indicated a 'degraded' system.

Of the 5 monitoring sites, DO was only measured at 3 sites, with 2 of those sites being ephemeral creeks where low flows can contribute to low DO levels. Thus, the DO score did not necessarily reflect the catchment and this will be addressed by having DO measured at all 5 sites in the coming year.

The reach varies from intact native riparian vegetation to poor riparian vegetation on cleared rural land, so riparian assessments ranged from 'good' to 'fair'.

This is a particularly long reach and an increase in Waterwatch sites would enable the development of more reaches and a better indication of change across this catchment.



Boolboolma Road crossing

# Queanbeyan River QUE2

## Downstream of Googong Dam to city of Queanbeyan

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>10</b>
pH	Fair	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### 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 as well as Valley Creek flowing out of Cuumbuen Nature Reserve. Googong Creek is now defined as a separate reach (*see p50*) and has a CHIP score very similar to this reach.

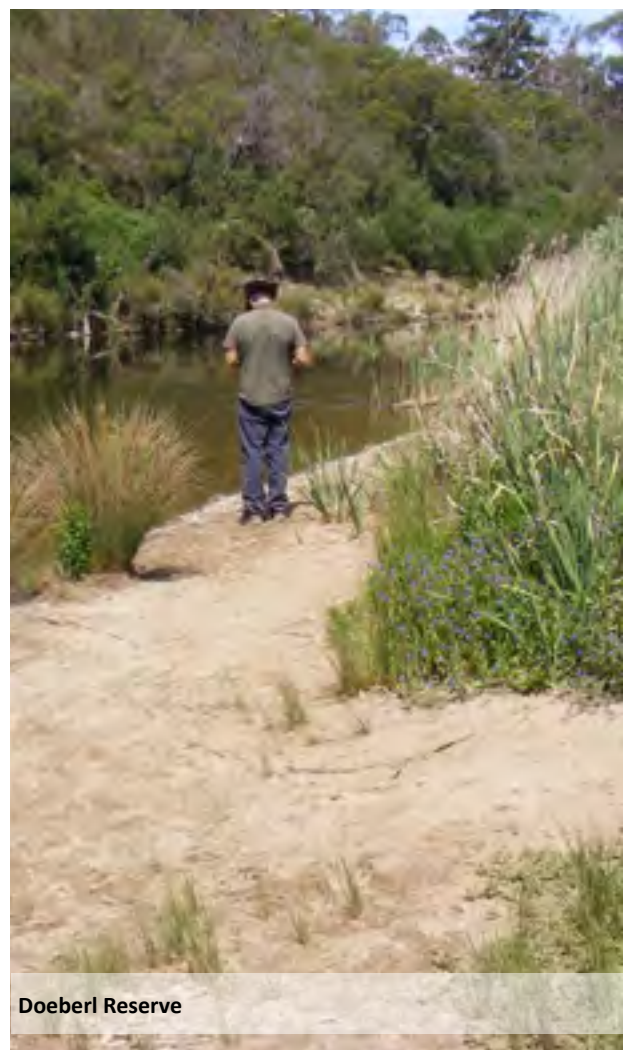


### Reach Condition

Whilst most measures of water quality were 'excellent' or 'good', pH (7-8.3) was only assessed as 'fair'. This may indicate a naturally low buffering capacity, which may allow pH to fluctuate more as a result of rainfall and/or changes in flow regimes.

Riparian vegetation along this reach was previously dominated by Willows, many of which have been removed by Queanbeyan City Council as part of a long term river management plan, and there are native plantings in the lower part of the reach.

This reach was impacted by development activities at the new township of Googong (sediment control failures) and there is potential for ongoing impacts such as from associated infrastructure (treated sewerage will be released into Montgomery Creek). With more Waterwatch sites coming online in the coming year, this reach will be monitored more extensively. Platypus are regularly sighted in the reach.



# Queanbeyan River QUE3

## Queanbeyan city to Molonglo River confluence

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>24</b>
pH	Fair	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### 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 in runoff from Queanbeyan and its suburbs (including a golf course), the Cuumbuen Nature Reserve and the eastern slopes of Mt Jerrabomberra. The reach includes Barracks Creek and the Queanbeyan weir.



### Reach Condition

Most water quality parameters assessed as 'good' or 'excellent', pH (7.5-9.4) was only 'fair', and electrical conductivity (EC) (110-990  $\mu$ S) was assessed as 'degraded'. However, it was the Barracks Creek site that had consistently very high EC, whereas the EC on the Queanbeyan River site was assessed as 'good'. Since Barracks Creek contributes only a small volume of water, it skewed results for the reach. The high EC in Barracks Creek may result from natural geology and hydrology, however it may be exacerbated by runoff from the extensive road system.

Water bugs continued to be good in this reach, and riparian vegetation is progressively improving following Willow removal by Queanbeyan City Council. That said, riparian condition overall rated as 'poor'.

This section of the Queanbeyan River supports a healthy population of platypus.



Railway bridge in Queanbeyan

# Scabbing Flat Creek SCA1

## Headwaters to Kings Highway

### CHIP Result B- (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>12</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Fair	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 5.1km

*Dominant land uses:* Conservation

Scabbing Flat Creek is an ephemeral creek which arises in Cuumbeun Nature Reserve. Most of the creek 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.



### Reach Condition

Being a highly ephemeral creek, Scabbing Flat Creek was not flowing for most of the sampling events. When the creek was flowing, it had 'excellent' or 'good' water quality, with the exception of electrical conductivity and dissolved oxygen, which as expected became progressively worse as flows dropped.

Riparian condition was assessed as 'fair', being at its worst close to the Kings Highway culvert, and rapidly improving upstream in Cuumbeun Nature Reserve.

There is a council storage of tree roots, chunks of concrete and fill above the sample site which has the potential to impact the creek if not managed. The recent closing off of this area will reduce the risk of impacts from illegal dumping.



Scabbing Flat Creek near the Kings Highway

# Sullivans Creek SUL1

## Headwaters to Randwick and Flemington Road Pond, Mitchell

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>12</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>3</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 6km

*Dominant land uses:* Conservation, grazing (historical), industrial

Sullivans Creek originates in Goorooyarroo Nature Reserve, flows through historical grazing land then into a concrete 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.



### Reach Condition

This section of Sullivan's Creek is ephemeral and one site is often dry. There was insufficient water quality data to form a CHIP score, however total phosphorus was often rated as 'poor' and this is worthy of investigation. Electrical conductivity was rated as 'excellent', pH was 'good', turbidity was 'fair', but dissolved oxygen and nitrates weren't tested.

Water bugs in the constructed wetlands were 'good', despite the overall riparian condition being 'fair' to 'poor'.

The lower section of this catchment was affected by a chemical fire at Mitchell in 2011. The constructed wetlands have limited the impacts further downstream.



Sullivans Creek near Exhibition Park

# Sullivans Creek ANU SUL3

## Lyneham Wetland to Lake Burley Griffin confluence

### CHIP Result B (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>36</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Poor	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 3.7km

*Dominant land uses:* Urban, recreation

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 and flowing into Lake Burley Griffin.



### Reach Condition

Water quality in this reach was quite varied. Total phosphorus (0-0.43 mg/L) was variable but 'degraded', dissolved oxygen (26-63%) was consistently 'degraded', and electrical conductivity (53-345  $\mu$ S) was 'poor'.

Water bugs had 'good' diversity, but riparian condition was 'poor', reflecting the highly altered landscape with little understorey and mostly exotic plantings.

This is the bottom reach of a highly urbanised catchment which includes drainage from Canberra City. Recent structural improvements to Toad Hall Pond may improve water quality.



Sullivans Creek downstream of the MacPherson Bridge

# David Street Wetland SUW1

## Sullivans Creek catchment in O'Connor

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>14</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Good</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 0.21ha

*Dominant land uses:* Urban, recreation

David Street Wetland is the 2nd 'offline' wetland along the westerly branch of Sullivan's Creek which flows in a concrete stormwater channel. This wetland was constructed in 2001 and takes low flows which pass through the Wetland then overflow back into the westerly concrete channel just before it joins the main northern branch.



### Reach Condition

Water quality in wetlands, including artificial wetlands, is often different to creeks and rivers. Total phosphorus, dissolved oxygen, and to a lesser extent turbidity, indicated degraded to fair water quality.

That said, these constructed wetlands are intended to capture sediment and nutrients. After 10 years, trees planted at the wetland are out-shading the understorey plants, so the earlier dense growth of water plants (macrophytes) and grasses is much reduced, reducing the functioning of this wetland. Future tree thinning and understorey planting which includes more shade tolerant species would improve its functioning.

With low flows or no flows, wetlands are likely to have low dissolved oxygen much of the time, apart from when water plants are strongly photosynthesising.

Water bugs and the riparian assessment suggest 'good' water quality and habitat.



David Street wetland in O'Connor

# Banksia Street Wetland SUW2

## Sullivans Creek in O'Connor

### CHIP Result B (Good)

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>0</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 0.2ha

*Dominant land uses:* Urban, recreation

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



### Reach Condition

Though there was insufficient water quality data to calculate a CHIP score, water bugs suggest 'good' water quality/habitat and the riparian assessment indicated 'fair' riparian condition.

Volunteers from the Banksia Street Wetland Carer Group, including local residents and school children, did extensive plantings around the wetland in 2010, with further work required to protect plantings from the many cockatoos in the area. Small native fish such as western carp gudgeon were also introduced. Some good growing years have seen pleasing results, with the riparian vegetation, waterplants (macrophytes) and fish species contributing to the functioning and habitat value of this wetland, as suggested by the 'good' water bug score.



Banksia Street wetland in O'Connor

# Watson Wetlands and Ponds WAT1

## Justice Robert Hope Park to Aspinall Street

CHIP Result D+ (Poor)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>3</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Poor</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 1.4km

*Dominant land uses:* Conservation, urban

Watson Wetlands and ponds on the lower western slopes of Mt Majura comprise a drainage line, with several dams which overflow during high rainfall into constructed wetlands and from there via pipes into Sullivans Creek.



### Reach Condition

There was insufficient water quality data this year to calculate a CHIP score, however both water bugs and the riparian assessment indicated poor water quality and riparian condition, giving this reach a 'poor' result.

There are big differences along this 'reach': the upper sites are dams in remnant yellow box/red gum grassy woodland with an active Landcare group caring for the area (Watson Woodland Working Group); the lower sites, adjacent to the north Watson housing development comprise a small, constructed wetland which takes stormwater and runoff from the adjacent suburb, and the last site is an overflow 'soak' which forms a small pond.

The water bug and riparian assessments were done on the lower site only, and this is likely to have affected the CHIP score for the reach. Increased sampling at a number of sites in this reach will increase confidence in results.



Bottom pond near Aspinall Street

# Weston Creek WES1

## Headwaters to Molonglo River confluence

### CHIP Result C- (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>7</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Poor	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>No Data</b>	<b>0</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 6.7km

*Dominant land uses:* Urban

Weston Creek 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. Some Weston Creek water flows into underwater storage.



It then passes close to the new Molonglo development's eastern side and on to the confluence with the Molonglo River downstream of Lake Burley Griffin.

### Reach Condition

The CHIP score for this reach is 'poor' with water quality being very variable across the parameters measured. The worst result was a 'poor' total phosphorus score (0.05-0.2 mg/L) and 'degraded' dissolved oxygen (11-73%).

Water in this reach comes almost entirely from urban runoff. Flows are often very low, and the water flows in concrete channels with very limited riparian vegetation, before entering Coombs sediment ponds. The ponds have recently been sparsely planted with emergent and riparian species, however much of the riparian area is still bare. Below Coombs pond, the concrete channel becomes a grassy channel with large rock armoured sections before joining the main Weston Creek concrete channel flowing from underground. The final section of the creek has a mix of native and exotic riparian vegetation above the Molonglo River confluence. This reach had the worst riparian assessment score in the catchment.

Efforts to gather more data for this reach, including water bug sampling, would prove very valuable.



Coombs Pond in the new Molonglo development

# Woolshed Creek W001

## Headwaters to Molonglo River confluence

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>29</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>3</b>

### 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 at the top of the catchment. It flows through highly modified rural land with some native riparian vegetation in the higher section 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.

### Reach Condition

Most parameters indicated 'excellent' or 'good' water quality, but electrical conductivity (70-2230  $\mu$ S) and dissolved oxygen (36-90%) were rated 'degraded'.

High electrical conductivity readings on the mid to downstream sections of the reach are believed to be influenced by groundwater entering near the middle site. This is an ephemeral creek with frequent periods of no flow, and waterholes along the reach provide important habitat. Groundwater seems to be a significant component of the water in this creek, and the low flows are likely to result in lower dissolved oxygen. A recent hydro-geological survey will improve knowledge of this reach.

The water bug survey indicated 'good' water quality and further riparian plantings along this extensively cleared reach would improve the riparian condition score and overall reach condition.



# Yandyguinula Creek YAN1

## Headwaters to Molonglo River confluence

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>24</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Good</b>	<b>2</b>

### 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.

### Reach Condition

Apart from dissolved oxygen (35-93%) which was 'fair', water quality overall in this reach was 'excellent' and water bugs received a 'good' rating.

Whilst the combined riparian assessment score was 'good' to 'fair', the upper site on this reach had the highest riparian condition score in the catchment, being in wet sclerophyll forest with intact native riparian vegetation, and good cover, structure and habitat features. This contrasts with the lower site which had limited riparian vegetation.

There was an apparent pollution event in the lower part of this reach during this reporting period. Local landholders reported fish and water bug deaths to the EPA and dissolved oxygen measurements over 2 months were extremely low (35%). Unfortunately no cause was found for the event.



Yandyguinula Creek near the Tallaganda National Park

# Yarralumla Creek YAR1

## Headwaters to Molonglo River confluence

CHIP Result C+ (Fair)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>45</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>4</b>

### Reach Facts

*Reach network length:* approx. 9km

*Dominant land uses:* Conservation, urban

This is one of two main creek systems draining into the Molonglo River below Scrivener Dam. Yarralumla Creek includes three drain lines, one along the west side of Mt Mugga Mugga, one from Farrer to Phillip, and one from Long Gully to Garran. These drain lines run largely in concrete channels.

Yarralumla Creek then runs parallel with Curtin in a concrete stormwater channel then down through a deeply incised channel to the Molonglo River immediately below Scrivener Dam. The reach includes East O'Malley Pond and Eddison Park Pond. Yarralumla Creek is a priority catchment for the Basin Priority Project with works aimed at improving water quality.

### Reach Condition

This reach scored a 'fair' rating and was one of the poorer scores in the Molonglo catchment. Most water quality parameters rated 'excellent' or 'good' but were pulled down by electrical conductivity (150–940  $\mu$ S) and dissolved oxygen (19–144%) which rates as a 'degraded'.

There were very high total phosphorus readings at one site over several months following a burst sewerage pipe detected by the local Waterwatcher. The other sites on the reach, however, generally had low readings, resulting in a score of 'excellent'.

Riparian assessments ranged from 'fair' to 'poor' across the sites assessed. Water bugs were rated as 'fair', but were only sampled at the bottom site on this reach which is ~100m below a gross pollution trap.



Erosion downstream of the Cotter Road

# Southern Catchment Facts

For this CHIP report, the Southern ACT area is divided into sub-catchments based around 7 main rivers/ lake systems in the region which are Murrumbidgee River, Naas River, Gudgenby River, Cotter River, Paddy's River, Lake Tuggeranong and Point Hut Ponds.

The Naas and the Gudgenby river systems are the highest in the ACT and 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 water way 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.

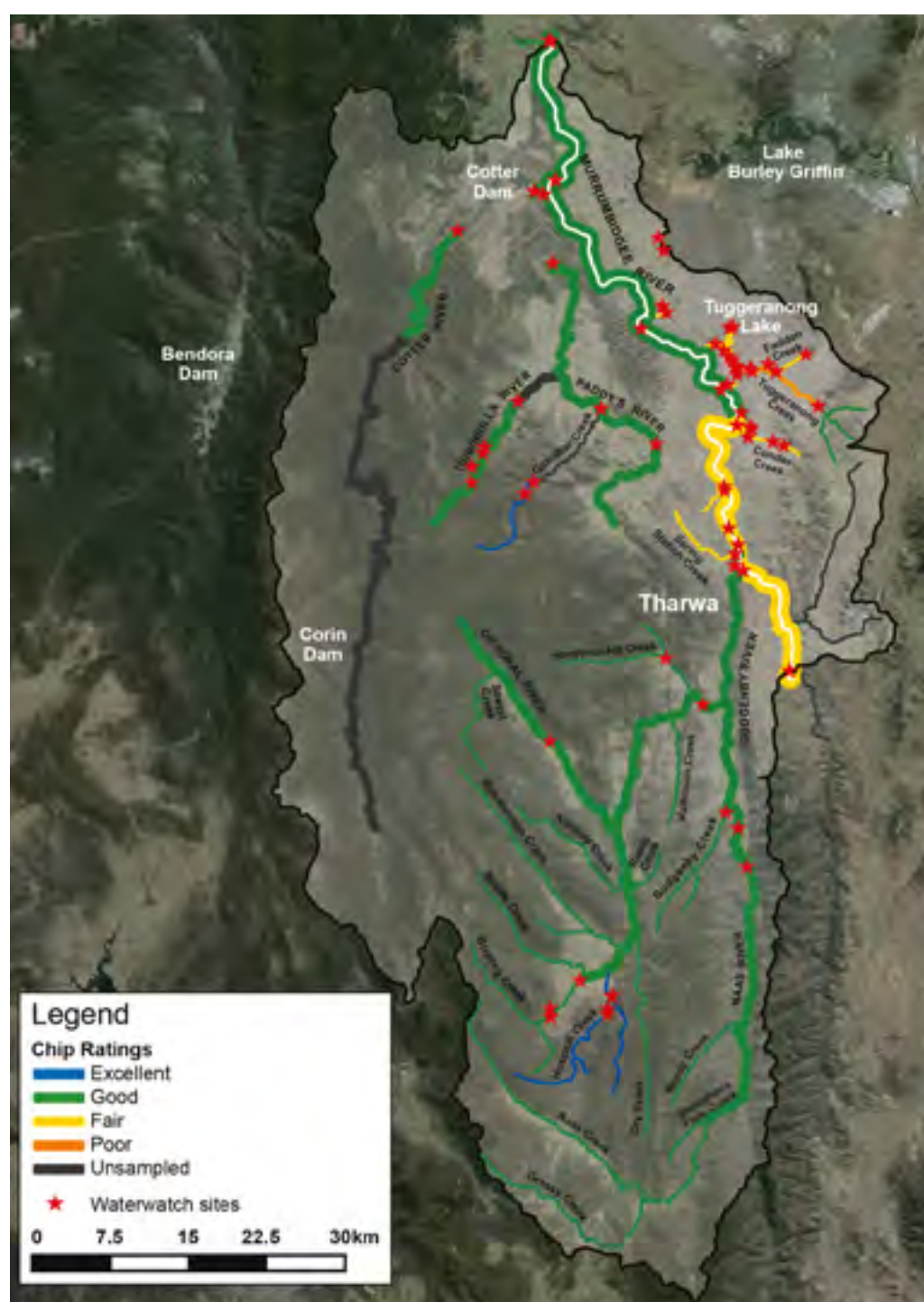
All of these waterways join the Murrumbidgee River in the ACT, which flows north from Angle Crossing near Tharwa to Uriarra Crossing just before the Molonglo River confluence in the north west corner of the ACT.



## Southern Catchment Health Summary

The Southern ACT catchment reaches have again enjoyed relative good catchment health this period. The onset of an El Niño event this year led to the prediction of a return to dry conditions in the region. We have been very lucky this has not been as bad as was feared. A relatively mild summer has also meant the waterways of the Southern ACT continued to enjoy good water quality scores. With the fantastic efforts of many groups in the south this year a more comprehensive image developed of overall catchment health. Special thanks need to be given to the Green Army, Lake Tuggeranong College and Chisholm School teams for going above and beyond to ensure water bug surveys and/or riparian assessments were conducted in all of our reaches this period.

The individual reach reports hold few surprises. Engineered urban waterways such as Tuggeranong 'Creek' which is a concrete channel for most of its length, and our rural creeks that have experienced a history of intensive clearing and land use, for instance McQuoid's Creek in Kambah, have suffered in overall health as a result. Waterways found in the ACT's high country, even in areas once used for soft wood forestry such as Corin Forest, reveal catchments in markedly better health than in our lower waterways. Barney's Gully, a small reach with a history of high erosion and degraded habitat, is already showing the benefits of the hard work of the local Parkcare group. This was a pleasant surprise of this analysis.



# Bogong Creek catchment CGB1

## Headwaters of creek to the Yankee Hat trail bridge

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>18</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx 13km

*Dominant land uses:* Conservation

Part of the Gudgenby River catchment. At its downstream end Bogong Creek is a wide and mostly treeless upland creek/bog flowing north-east in the middle of Namadji National Park.

### Reach Condition

The overall water quality score for this upland creek was generally good. However like its neighbour Hospital Creek, the naturally boggy conditions for much of its length lead to depleted oxygen levels as water flow slows. This can be exasperated in summer by high temperatures.

The macro-invertebrates (water bug) score was 'fair' too and may be linked to the low flows and 'degraded' oxygen levels at the bog sites expelling the more sensitive species. The riparian vegetation assessment is also affected by the natural condition in this part of the national park and is not necessarily an indictment on the creek's health. Sparse canopy vegetation is to be expected in upland wetlands. Much of the area was pine forest until 2003 when the region was comprehensively burnt out.



Bogong Creek looking upstream from the Yankee Hat trial foot bridge.

# Gudgenby River Catchment CCG1

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

### CHIP Result B- (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>28</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Fair</b>	<b>4</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>4</b>

### Reach Facts

*Reach network length:* 22.7km

*Dominant land uses:* Conservation and rural grazing

This reach includes 3 branches. The main arm is the lower stretch of Gudgenby River, running mostly through rural cattle grazing properties. The Honeysuckle Creek arm runs adjacent to Apollo Road which heads up to the old Honey Suckle Creek Tracking Station site next to Namadji National Park.



Honeysuckle Creek is mostly surrounded by healthy wooded vegetation. The Orroral River section largely comprises upland bogs.

### Reach Condition

The water quality in this system is one of the best in the southern region but the catchment as whole scores badly on both the macro-invertebrate (water bug) and riparian vegetation (RARC) scores. The 3 main arms of this reach do have different characteristics that influence the overall assessment. The Orroral Valley naturally gets a low RARC score as it is mostly bog and the dominant vegetation are macrophytes (large aquatic plants). Honey Suckle Creek has good riparian vegetation along most of its length but the water bug survey showed few sensitive species. The same is seen at the sites on the Gudgenby river itself. Low dissolved oxygen and possible land use factors drive down the water bug score on the Gudgenby and RARC results are also moderate due to the dominance of exotic plant species.



Gudgenby River downstream from the under Naas Road bridge.

# Hospital Creek Catchment CGH1

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

## CHIP Result A- (Excellent)

### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>24</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Excellent</b>	<b>1</b>
<b>Riparian condition</b>	<b>Good</b>	<b>4</b>

## Reach Condition

This reach scored the healthiest overall result for the Southern ACT in 2014–15. A excellent water bug score, highlighting the abundance of highly sensitive water bugs, was a reflection of how good the water quality was in this upland reach. A healthy score was also recorded for the riparian survey revealing good vegetation condition. A concern can be low dissolved oxygen levels in the boggy section of the creek. This is possibly a natural effect of low flows as the water spreads out. The Little Dry Creek arm of the reach had water flowing for most of this period which is a good indicator of how much rain Namadji has experienced.

## 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 south and parallel to Bogong Creek. It turns north forming an upland bog before joining Bogong Creek. Little Dry Creek is an ephemeral arm to the east of Hospital Creek.



Hospital Creek looking south

# Murrumbidgee River CMM6

## Willows Road to Tharwa Sandwash

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>15</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Poor</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 30km

*Dominant land uses:* Rural grazing and conservation

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



Recreational fishing is banned in this reach and the riparian vegetation is significantly healthier than downstream around the Tharwa township.

### Reach Condition

The water quality of the Murrumbidgee River as it leaves the Southern ACT Catchment at Uriarra Crossing is actually better than when it enters at Angle Crossing. However, the overall CHIP score for this Gigerline Gorge section of the Murrumbidgee is in the same 'fair' condition as it is at CMM9 due to consistently low water bug and riparian scores downstream.

The Murrumbidgee at the top and bottom of the ACT is a river that is not in great shape. The water often has 'degraded' electrical conductivity and only 'fair' dissolved oxygen levels. Water bug surveys reveal a depressing paucity in diversity and an absence of pollution sensitive species. The riparian vegetation is in fair condition at best.



Murrumbidgee River at Angle Crossing

# Murrumbidgee River CMM7

## Tharwa sandwash to Point Hut Crossing

### CHIP Result B- (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>29</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Good</b>	<b>5</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 10km

*Dominant land uses:* Rural grazing

This reach covers the stretch of Murrumbidgee River from Tharwa's Outward Bound Centre to Point Hut Crossing. The entire eastern bank of this reach borders Lanyon Homestead. The western bank flows past a number of properties including Castle Hill and Lambrig Homesteads among others in the Tharwa district.

### Reach Condition

Good water quality, albeit with high electrical conductivity and good water bug survey results were found along the 4 sites of this very rural reach.

The riparian vegetation in this reach is extremely poor with very little mature canopy species. The shallow gradient of this section of river also compounds the problem of sediment build up, which reduces in-stream habitat. The Tharwa logjam project continues to be monitored with interest for its effectiveness at scouring out the substrate sediments and improving fish passage. Other projects have begun in the last year to revegetate the riparian zone on the Castle Hill Homestead bank of this reach. An extension of this much needed work is planned for the coming year.



Murrumbidgee river looking south from Tharwa Bridge.

# Murrumbidgee River CMM8

## Point Hut Crossing to Kambah Pool

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>12</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Good	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Fair</b>	<b>4</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### 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. Both spots are popular recreational sites. Red Rock Gorge and the confluence with Tuggeranong Creek are also within this reach.



### Reach Condition

This stretch of the Murrumbidgee is unique in the ACT in that it had no stand out catchment health concerns over this period. Dissolved oxygen was 'fair' but all other water quality parameters were 'good' or 'excellent'. The clarity of the water, measured by turbidity, was excellent this year. The surveys for water bugs showed a 'fair' level of species diversity and sensitivity and the riparian vegetation surveys conducted at either end of the reach also recorded 'fair' habitat health.



Top image: Murrumbidgee river at Kambah Pool.  
Bottom image: Point Hut Crossing bridge looking south.

# Murrumbidgee River CMM9

## Casuarina Sands to Uriarra Crossing

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>16</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Good	
<b>Water bug</b>	<b>Poor</b>	<b>3</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 10.5km

*Dominant land uses:* Rural grazing, forestry, recreation and conservation

This reach covers the section of Murrumbidgee River from Casuarina Sands to Uriarra Crossing. Much of this reach flows past old pine forest plantations and areas still used for grazing and farming.

### Reach Condition

'Sands' Waterwatch volunteer group said:

*"During winter and early spring, 2015, the Murrumbidgee River at Casuarina Sands has been flowing at high levels and swiftly, and is clear. Good readings."*

Their data and that of the various teams who have monitored at Uriarra Crossing support this sentiment. The clarity of the water has not been this good for many years giving an 'excellent' overall score for water quality.

Water bugs do have a hard time in this stretch of the Murrumbidgee though and this is probably an indicator of the sandy river bed and lack of water plants present at either Waterwatch site. The riparian vegetation surveys also give testament to a stretch of river lacking mature native trees.



Murrumbidgee River downstream of Uriarra Crossing

# Spring Station Creek CMS1

Top of creek to confluence with Murrumbidgee River

## CHIP Result C (Fair)

### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>6</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	No Data	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Poor</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

## Reach Facts

*Reach network length:* approx. 4km

*Dominant land uses:* Rural grazing

This reach covers most of this small rural creek separating a grazing property to its south and a property with high conservation value woodland to its north. This creek is immediately adjacent to the township of Tharwa. During high rain fall events it is subject to severe flooding at its lowest end where it crosses the Naas Road.



## Reach Condition

Some water quality parameters were absent for this new reach due to the operational considerations of the Outward Bound Waterwatch group. Missing were reliable dissolved oxygen and total phosphorus readings. Thanks to the Outward Bound teams commitment and flexibility this has been resolved for future CHIP reports.

The pH, turbidity and nitrate levels recorded were 'excellent' on average. Electrical conductivity had a high 'degraded' level which is typical of many small, rural creeks in the Southern ACT catchment. The water quality overall however, was 'good' and actually the best of similar rural creeks in the region. Riparian vegetation assessments and water bug surveys conducted on this reach scored poorly. The 'poor' water bugs result suggests poorer water quality than currently assessed.



Mouth of Spring Station Creek looking up stream.

# Paddy's River Catchment CTP1

## Tidbinbilla Road bridge to Murray's Corner

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>17</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>2</b>

### Reach Facts

*Reach network length:* approx. 24km

*Dominant land uses:* Rural grazing

Paddy's River runs mostly through active grazing properties and softwood plantations. This reach covers the section below the headwaters high up on Mt Tennant in the Namadji National Park. The river has been subject to massive erosion through large flooding events in recent years. The consequences of this soil disturbance is still significant.

### Reach Condition

Water quality scores at the 2 regularly monitored sites at Murray's Corner and at the Tidbinbilla Road Bridge show almost pristine conditions. Turbidity is still an issue in this river but the absence of severe storm events this year has spared it from swallowing huge amounts of mud from the surrounding catchment.

While water quality was 'excellent', the overall CHIP score was reduced as a result of the water bug (Signal 2) and riparian vegetation evaluations which scored 'fair'. Much of the riparian zone along Paddy's River lacks significant native vegetation. The water bug surveys revealed the absence of many highly sensitive bugs which raises questions about the instream habitat.



Paddy's River at Miowera Homestead crossing.

# Tidbinbilla River CTT1

## Headwater of Tidbinbilla River and Ashbrook Creek to Gilmores Road crossing

### CHIP Result B+ (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>46</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>8</b>
<b>Riparian condition</b>	<b>Good</b>	<b>5</b>

### 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). Most of the river is in the Tidbinbilla Nature Reserve and has significantly recovered from a catastrophic bush fire 11 years ago.

Ashbrook Creek is a small upland creek running from the top of the reserve past the Hanging Rock Aboriginal shelter site.

### Reach Condition

Tidbinbilla Nature Reserve maintained a good level of health in this 12 month period. Tidbinbilla River is very small and suffers dramatically when there is little rain and has been known to dry up completely at the downstream end. Fortunately this has not been the case this year thanks to a mild summer and some good rains throughout the year. As a result the water quality remained close to pristine. The riparian condition along most of this reach is what one would expect from a well managed nature reserve, rich and diverse. The artificial wetlands of the Sanctuary can suffer from depleted dissolved oxygen levels and 'poor' water bug scores. This can have a negative affect on the overall assessment of the catchment condition.



Tidbinbilla River looking through the ring road crossing pipes.

# Gibraltar Creek GIB1

## Top of river to Woods Reserve

CHIP Result A- (Excellent)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>10</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Fair</b>	<b>3</b>
<b>Riparian condition</b>	<b>Excellent</b>	<b>2</b>

### 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 to Paddy's River. The upper sections have stretches of upland bog habitat. Most of the surrounding land was used for softwood plantations up until the 2003 bush fires.



### Reach Condition

Gibraltar Creek has the highest value riparian condition of all the Southern ACT Reaches. The water quality in this little creek is also invariably pristine. The extensive recreational use of the surrounding Corin Forest seems to have had little impact on Gibraltar Creek's health. It's high altitude and fast flows keep the water well oxygenated and free from any build up of sediment or nutrients. Surprisingly the water bug scores are 'fair'. The absence of water plants in the monitored sections of the creek mean that aquatic invertebrates dependant of these are absent reducing the water bug (Signal 2) assessment. This may be different if one examined much higher in the reach where upland bog conditions occur.



Gibraltar River at Woods Reserve.

# Swamp Creek LMS1

## Uriarra Creek confluence to Murrumbidgee River Confluence

### CHIP Result B (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>3</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	No Data	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 1.5km

*Dominant land uses:* Rural grazing.

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

### Reach Condition

Swamp Creek's assessment is based on one Waterwatch site below the low level road crossing at its mouth. Most of the creek is on private rural lease land.

Water quality showed high salt (electrical conductivity) levels, similar to many other rural creeks in our region. The pH range was 'good' and turbidity and nitrates were at 'excellent' levels, meaning they were extremely low.

Macro-invertebrate (water bugs) surveys revealed a healthy variety were present at the bottom of this small creek. The riparian survey assessed this section of the creek just missed out on a 'good' rating and scored 'fair'. This was partly due to poor native ground cover.



Swamp Creek at the Fairlight Road crossing..

# Cotter River MCC1

## Downstream of the Cotter Dam

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>13</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Good	
<b>Water bug</b>	<b>Poor</b>	<b>2</b>
<b>Riparian condition</b>	<b>Good</b>	<b>2</b>

### Reach Facts

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

This reach covers the relatively short stretch of the Cotter River below the Enlarged Cotter Dam. It includes the confluence with the Paddy's River at Blundell's Flat and terminates at the confluence with the Murrumbidgee River. Water flowing through this reach is heavily influenced by water from the Murrumbidgee River that is regularly pumped from the Cotter Pumpouse to the base of the dam wall.



### Reach Condition

'Excellent' water quality was found below the Enlarged Cotter Dam this year. Riparian surveys also highlighted 'good' habitat condition between the dam wall and the confluence with the Murrumbidgee River.

An ongoing issue are the poor macro- invertebrate (water bug) results. Extensive diatom sludge on the rocks and sand in the river may explain this. Diatoms, a microscopic plant, form a fine silt in high numbers making it almost impossible for invertebrates to live in and around the rock bed. If the level of silt becomes high enough a symptom known as 'armouring' occurs where all available spaces in the creek substrate become clogged. Constant flow with little variation enable the formation of algal communities that drives down bug condition. This is symptomatic of waterways immediately downstream of dams.



Cotter River at the Cotter Campground. (Photo F Horan)

# Cotter River MCC2

## Pipeline Road Crossing to Vanity's Crossing

### CHIP Result B+ (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>2</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Excellent</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### 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 Enlarged Cotter Dam. This section of the Cotter has restricted access for vehicles and is heavily monitored and managed by Icon Water and the ACT Government.

This is due to this area being a significant part of the ACT's water utility as well as having a remnant population of the endangered Macquarie Perch.

### Reach Condition

Since 2013 little monitoring by Waterwatch has happened in this reach. Consequently this reach was unrepresented in the previous CHIP report. Restricted access makes the site unattractive for volunteers so monitoring has been exclusively conducted by Water watch coordinators or ACT Parks and Conservation staff. While the amount of water quality data collected this period was insufficient to generate a score, macro-invertebrate (water bug) surveys and riparian vegetation assessments gave us enough information to give a catchment health score. The water bug survey was one of only 2 in the Southern ACT to score a 'excellent' rating. The riparian vegetation at Vanity's Crossing however was only of 'fair' quality. Overall though, this reach is one of the healthiest in the Southern ACT catchment.



# Barney's Gully MMB1

Woodcock Drive, Gordon to confluence with Murrumbidgee River

CHIP Result B+ (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>11</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Poor	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>No Data</b>	<b>0</b>

## Reach Facts

*Reach network length:* approx. 1km

*Dominant land uses:* Peri urban, conservation and recreation

Barney's Gully is an ephemeral creek off Woodcock Drive Gordon. This natural creek is connected to the suburban stormwater system of the suburb of Gordon and flows into the Murrumbidgee just over a kilometre downstream of Point Hut Crossing.



## Reach Condition

This the first time Barney's Gully gets its own report card. As a small creek close to the suburbs in Tuggeranong, Barney's Gully is showing the positive effects of years of hard work by the 'Park Carers of the Southern Murrumbidgee' Parkcare group. The macro-invertebrate (water bug) survey had one of the highest scores in our catchment with a 'good' rating. The water quality had problems with salinity (electrical conductivity) and dissolved oxygen levels but all other water quality parameters were 'good' or 'excellent'. Salinity has been a recorded problem in this creek as far back as the 1990s when Calwell High School conducted Waterwatch here. This is common issue with small creeks in our region that have a rural heritage. A riparian assessment is yet to be conducted.



Barney's Gully looking east toward Gordon.

# Point Hut Ponds MPG1

## Headwater of Conder Creek to Point Hut Pond

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>53</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>6</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>4</b>

### Reach Facts

*Reach network length:* approx. 2.5km

*Dominant land uses:* Urban

Conder Creek arises in the Rob Roy Nature Reserve and flows into Point Hut Pond. Point Hut Pond is a sediment control pond in the suburb of Gordon. Together they make up a stormwater system that has been engineered with flow reduction and verge vegetation to reduce negative impacts from suburban runoff.



The water from this system then flows into the Murrumbidgee River just downstream of Point Hut Crossing.

### Reach Condition

The Point Hut Ponds system produced one of the best results this period out of the large urban ponds. It had significantly lower levels of total phosphorus compared to Lake Tuggeranong. This may be due to the inclusion of wetlands high in the catchment and the vegetated (as apposed to concrete) stormwater channels providing some uptake of nutrients. Other parameters were fairly typical of the urban waterways. High electrical conductivity and low dissolved oxygen levels were common and turbidity is an ongoing concern especially considering how extremely shallow the pond is at its northern end. Water bug scores were extremely 'poor' as were the riparian vegetation assessments. Both of these health indicators are symptomatic of large artificially bodies of water with their heavily modified surrounding landscapes.



Conder Creek off Tom Roberts Drive, Conder. (Photo V Kurz/J Marriott)

# Stranger Pond MSP1

## Stranger Pond in North Bonython

### CHIP Result C- (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>3</b>
pH	Degraded	
Turbidity	Good	
Total Phosphorus	Poor	
Nitrate	No Data	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Fair	
<b>Water bug</b>	<b>Poor</b>	<b>3</b>
<b>Riparian condition</b>	<b>No Data</b>	<b>0</b>

### Reach Facts

Reach network area: approx. 4Ha

Dominant land uses: Urban.

Stranger Pond is the small lake to the south of Lake Tuggeranong providing similar stormwater treatment for the suburb of Bonython. Overflow enters the Murrumbidgee River at Pine Island reserve.

### Reach Condition

This is the first time Stranger Pond has had its own report card. It has had an intermittent water quality monitoring for this period.

The results show a the pond is under considerable strain. The water tests we did receive showed pH levels and electrical conductivity that were 'degraded', total phosphorus levels that were 'poor' and only 'fair' levels of dissolved oxygen. Macro-invertebrate (water bug) surveys conducted by both Erindale College and the Green Army told a similar story to other still water reaches with a 'poor' assessment overall.

A riparian survey is yet to be connected for this site. More monitoring on this pond is necessary to gain a complete picture of its ongoing health.



Stranger Pond looking north.

# Naas River NNN1

## Headwater to Gudgenby River confluence

CHIP Result B (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>21</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Excellent	
<b>Water bug</b>	<b>Poor</b>	<b>3</b>
<b>Riparian condition</b>	<b>Good</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 40km

*Dominant land uses:* Rural residential, grazing, conservation

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



### Reach Condition

This reach missed out on a CHIP evaluation last year due to data deficiency. The successful completion of water quality, macro-invertebrates (water bugs) and riparian vegetation (RARC) assessments this year reveal a catchment network in better health than anticipated. Turbidity is possibly an issue according to our results and this supports concerns raised in the regional Actions for Clean Water (ACWA) Plan released in 2012 that highlighted the Naas as an erosion hotspot. The 'good' RARC score is most likely due to a significant stretch of the Naas River running through national park.

Water bugs results were not as positive, as on average the surveys scored poorly. Two of the surveyed sites are in rural sections and these appear to have caused issues for highly sensitive water bugs even though water quality tests failed to detect results of concern.



Naas River at Caloola Farm.

# Coolleman Ridge dams RAN1

## Two dams on Coolleman Ridge

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>23</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Degraded	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Good	
<b>Water bug</b>	<b>Poor</b>	<b>3</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### Reach Facts

*Reach network area:* approx. Kathner Street Dam 0.05Ha, Old Dam 0.15Ha

*Dominant land uses:* Suburban reserve

Kathner Street Dam is a small dam in Coolleman Ridge Nature Park. It was built to provide water for horses as part of the bicentennial horse trail. The 'Old Dam' is on the eastern slopes of Coolleman Ridge.

### Reach Condition

The Coolleman Ridge dams continue to exhibit the same water quality issues as last time. Extreme total phosphorus (TP) readings are common at these sites. The source of the TP, as well as the high electrical conductivity readings, are not conclusively known. A possible reason is the extensive use of pasture improvement chemicals in the rural history of the ridge having a lasting impact by leaching chemicals into the dams. The 'old dam' is still regularly accessed by cattle and this would definitely exacerbate nutrient and turbidity levels. But this alone does not explain the high total phosphorus in the Kathner Street dam where no stock are present.

Water bugs surveys had the expected 'poor' results for the above reasons and the 'poor' riparian vegetation assessment would have also contributed to this.



Coolleman Ridge 'Old Dam'.

# Goodwin Village Pond RAN2

## Small Pond at Goodwin Village Monash

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>10</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Excellent	
Nitrate	Good	
Electrical Conductivity	Excellent	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>2</b>
<b>Riparian condition</b>	<b>No Data</b>	<b>0</b>

### 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. It's primary purpose is to provide recreational space and visual amenity for the residents of Goodwin Village retirement home.

### Reach Condition

This new reach was set up by Chisholm High School to combine their new Waterwatch program and their existing outreach program that involves students spending time with residents of the retirement home. The site provides the only opportunity for the students to see any water bugs when conducting water bug surveys. Their main monitoring program in the TUG2 reach (see p101) does not provide this experience.

Water quality was the best for of any of our urban ponds. It's young age is arguably a key factor. Water bug survey scores were 'poor' for this still-water reach.

The site also hosts the trial floating wetland project of the 'Tuggeranong Lake Carers' Landcare group. The students conduct photo monitoring points of this structure.



Goodwin Village Pond looking east

# Isabella Pond TIP1

## Large pond south of Monash

### CHIP Result D+ (Poor)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>4</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Poor</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### 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 pours over a high weir at its western end into Lake Tuggeranong (TLT1).



### Reach Condition

There was an unfortunate hiatus in water quality monitoring at Isabella Pond in the last 12 months. This has now been resolved but unfortunately not in time for this report. One monitoring location used in the previous CHIP report was inside the northern gross pollution trap. This has been cancelled and a new site established to better reflect the ponds in situ water condition. To assess the reach for this period 2 macro-invertebrate (water bug) surveys and a riparian vegetation (RARC) survey along the southern bank were used to calculate the CHIP score.

The water bug surveys yielded unsurprisingly poor results, as did the RARC survey as there is little significant vegetation around this still-water reach. The return of water quality data for next year may lift the assessment for this reach.



Main channel into Isabella Pond. (Photo N Mylordi)

# Lake Tuggeranong Wetlands TLT1

## Drakeford Drive weir to South Quay foot-bridge weir

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>36</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Poor	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>9</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* 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 new 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 Ponds.

### Reach Condition

In the last 12 months the southern stretch of Lake Tuggeranong has been host to a major development on its western side. The 'South Quay Development' project included the building of a promenade into the bank of a section of the Lake. To achieve this, the reach needed to be drained of most of its water. The water level variation and habitat disturbance out seems to have had no positive effect on the reach's subsequent water quality. The only acceptable reading for this period was pH. Turbidity was 'fair', total phosphorus levels were poor and all other measures categorised as 'degraded'.

The overlays of macro-invertebrate (water bug) and riparian vegetation surveys give little improvement to the overall picture. There is a healthy stand of Casuarinas on either bank of this stretch of the lake. All but the toughest of water bugs were absent.



Lake Tuggeranong looking north west from the south eastern section.

# Lake Tuggeranong TLT2

## Main lake body

### CHIP Result C- (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>36</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>6</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### 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 13 southern suburbs. Two major gross pollutant traps are at the northern end of this reach. Lake Tuggeranong wetlands (TLT1) are immediately upstream of this reach.



### Reach Condition

The water quality improved marginally in the body of the lake compared to its southern tail (the 'Wetlands'). Nutrient levels improved to a 'good' level, turbidity remained 'fair' and dissolved oxygen was still far too low and rated as 'degraded'. Water bug surveys were conducted extensively around all the Waterwatch sites on the lake in spring and autumn. That the lake is a still-water body will always have some bearing on the outcomes of monitoring water bugs. The very sensitive ones are only found in fresh running water, so no matter how good the lake water quality becomes the water bug score will be affected. Similarly the riparian vegetation scores are affected by the highly managed nature of the surrounding landscape. This is where these report cards are important to provide context on these highly modified landscapes.



Lake Tuggeranong boardwalk adjacent to the Community Centre.

# Westwood Farm TMM1

## McQuoid's Hill to Murrumbidgee River

CHIP Result B- (Good)		
Data Collected		
Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Excellent</b>	<b>6</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>2</b>

### 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 predominantly cleared land, while the downstream section is still well vegetated.



### Reach Condition

This reach was monitored for this period by the regional 'Green Army' team (an Australian government program for 17-24 year olds to train and work in the environment). Surprisingly, for a rural creek and dam system, the nutrient levels recorded were extremely low and therefore rated as 'excellent'. Salinity (electrical conductivity) is still an issue and this was mainly recorded in the creek line running from the golf club. The overall assessment of the water quality, however, was 'excellent'.

The water bug surveys conducted at the dam and in the creek gave a 'fair' score as a result of a good bug diversity but a lack of many sensitive species. The riparian condition overall was recorded as 'poor'. Like many small, rural creeks it lacks a significant mature native canopy cover.



Creek gully flowing west through Westwood Farm from Kambah Pool Road.

# Upper Tuggeranong Creek TUG1

## Headwaters of Tuggeranong Creeks catchment to Theodore

### CHIP Result B- (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>6</b>
pH	Excellent	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Excellent	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### Reach Facts

*Reach network length:* Monks Creek (upper arm 3.2Km), Tuggeranong Creek (lower arm) 4km

*Dominant land uses:* Rural grazing

The monitoring site is near the Monaro Highway at the eastern border with NSW and is fed from Monks Creek to the east and Tuggeranong Creek to the south. The Tuggeranong Creek arm runs adjacent to the Monaro Highway in NSW.

### Reach Condition

This creek on the very eastern edge of the Southern ACT catchment had an extreme mix of excellent and terrible scores. Most of the water quality parameters such as pH and nutrients were at 'excellent' levels. However the water's dissolved oxygen and salt (electrical conductivity) levels were considered 'degraded'. A good population of water bugs (even with the dreadful oxygen records and saltiness) were found by Calwell High School students, (including the largest leeches ever seen!) but the riparian vegetation comprised mostly weed species. The canopy is almost exclusively old poplars with many of their wilding saplings as the understory. Further monitoring upstream is planned for the next CHIP report. This will add invaluable reference data that is currently missing on this reach.



Tuggeranong Creek 50m upstream of concrete channel.

# Middle Tuggeranong Creek TUG2

## Concrete drain system upstream of Isabella Pond

### CHIP Result D+ (Poor)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>27</b>
pH	Degraded	
Turbidity	Excellent	
Total Phosphorus	Excellent	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Poor</b>	<b>1</b>
<b>Riparian condition</b>	<b>Degraded</b>	<b>3</b>

### Reach Facts

*Reach network length:* approx. 8km

*Dominant land uses:* Urban.

This reach consist of a Y shaped network of 2 concrete stormwater channels. The main arm runs north west from under Leinhop Street in Theodore. This joins another channel following south west from Fadden near Isabella Drive where the channel then flows into Isabella Pond.



### Reach Condition

This reach earns the dubious title of worst in the Southern ACT catchment. That it consists entirely of concrete means it could not get a positive score for riparian vegetation condition, as it has none (other than algal filaments).

Similarly water bugs survey that were conducted in the channels at 3 sites revealed nothing other than a few hardy water snails and the odd blood worm. Many thanks are owed to the intrepid students of Chisholm High School who undertook these surveys in good spirits despite the dismal outcomes and uncomfortable conditions. They also kept an eye on the water quality of these drains, getting on hands and knees to extract water for testing with syringes. Turbidity and total phosphorus levels were 'excellent' in the channel, while all other parameters were 'degraded'.



Tuggeranong Creek (on right) joining channel from Fadden (on left).

# Tuggeranong Creek TUG3

## Tuggeranong Creek to Murrumbidgee River confluence

### CHIP Result C+ (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Fair</b>	<b>12</b>
pH	Good	
Turbidity	Excellent	
Total Phosphorus	Poor	
Nitrate	Degraded	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Degraded	
<b>Water bug</b>	<b>Fair</b>	<b>2</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 1.8km

*Dominant land uses:* Suburban reserve

This reach includes the natural stretch of Tuggeranong Creek line fed by the overflow from Lake Tuggeranong. This creek enters the Murrumbidgee River 2kms downstream of Pine Island Reserve.

### Reach Condition

Although well lined with Casuarinas, most of the understory vegetation along this creek consists of weeds. The Creek itself is heavily overgrown with algae for most of the year. This is no doubt driven by the high levels of nutrients (nitrates and total phosphorus) overflowing from Lake Tuggeranong. The water also showed 'degraded' levels of electrical conductivity and dissolved oxygen for this period. One parameter that can attest to the effectiveness of the Lake as a sediment trap is turbidity. Turbidity levels were extremely low compared to those recorded in the Lake. That the water quality was only marginally better than that entering the Lake at the southern end fuels concerns that the Lake is now struggling to protect the Murrumbidgee River from this urbanised catchment.



Tuggeranong Creek at the low level crossing below Lake Tuggeranong.

# Castle Hill Creek UMC1

## Creek on Castle Hill Homestead

### CHIP Result C (Fair)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>Good</b>	<b>6</b>
pH	Excellent	
Turbidity	Fair	
Total Phosphorus	Good	
Nitrate	Good	
Electrical Conductivity	Degraded	
Dissolved Oxygen	Poor	
<b>Water bug</b>	<b>Poor</b>	<b>1</b>
<b>Riparian condition</b>	<b>Poor</b>	<b>1</b>

### Reach Facts

*Reach network length:* approx. 1km

*Dominant land uses:* Private land. Rural cattle grazing and free range chicken farming.

This reach is the lower half of an ephemeral creek that runs west to east to the Murrumbidgee River through the southern part of Castle Hill Homestead near Tharwa. Forming isolated pools for most of the year much of the creek line has steep banks, with some evidence of erosion.

However it is fenced off from stock and has had some revegetation work along most of its length.

### Reach Condition

Waterwatch monitoring on this reach was conducted by the land managers at Castle Hill Homestead who have an interest in the health of this creek. The water quality results for this period do show high nutrient levels in this creek compared to other creeks with similar attributes. On average, however the results still fell within the 'good' range. Turbidity was worse than other similar creeks, reflecting the unstable steep nature of its banks. Dissolved oxygen levels were 'poor' and salinity levels (electrical conductivity) were 'degraded'. Both of these parameters were the same as a similar tributary named Barney's Gully and were most likely a consequence of the waterway spending most of the time as isolated pools with no flow. Macro-invertebrate (water bug) and riparian vegetation surveys gave poor results. This should improve over time as the planted trees mature.



Castle Hill Creek with Castle Hill in the background.

# Yass Catchment Facts

Yass catchment is approximately 2,800km<sup>2</sup>, and is situated to the north of the ACT. The Yass catchment is made up of two major rivers. The first is the Yass River that has its headwaters approximately 100kms to the east around Wamboin. The River flows 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 Brookes 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) at 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. The fully contained Lake George catchment occurs to the east of the Yass River.

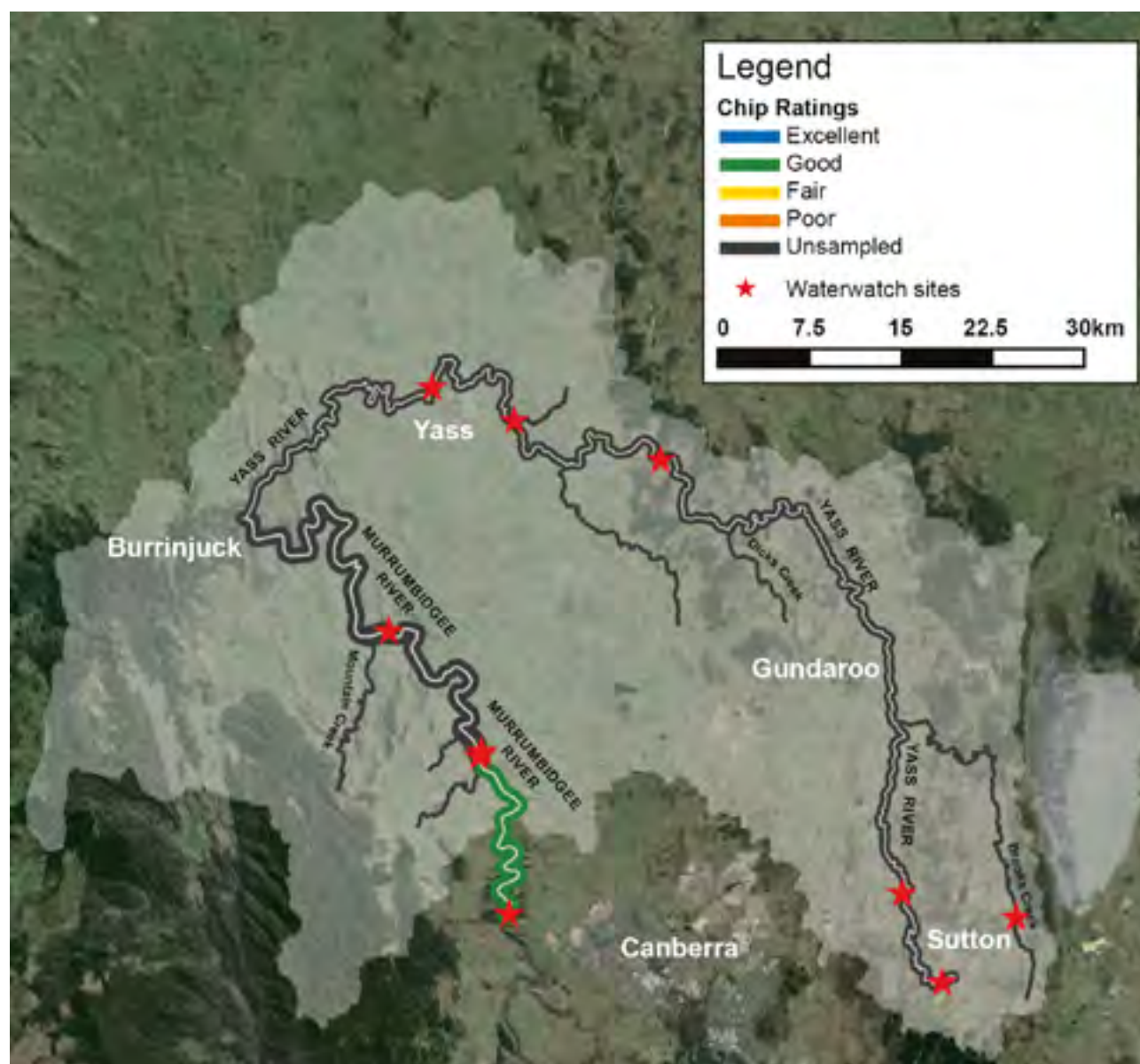
A large proportion of this catchment is cleared grazing land and as a result, major issues in this catchment include high electrical conductivity and erosion. Many of these issues could be ameliorated with regeneration of riparian vegetation, which is occurring on a number of fronts throughout the catchment.



## Yass Catchment Health Summary

A handful of dedicated volunteers have been collecting water quality data in the Yass River catchment over the past couple of years. A number of sites have now also been set up along the Murrumbidgee River section. While insufficient data was collected to produce CHIP scores for all reaches with the exception of CMM11 (Murrumbidgee River downstream of the Ginninderra creek confluence), water quality data from the upper Yass River can provide some indication of catchment health.

Electrical conductivity is relatively high (compared to the reference condition of the upper Cotter River) but still lower than other areas, such as Woolshed Creek in the Molonglo catchment. Additional sampling lower down in the Yass River catchment may reveal a different story, however with areas such as Manton Creek, that enters the Yass River just above the Yass township, producing particularly high electrical conductivity scores. Turbidity tends to be low during low flows, however it increases in both the Yass River and Murrumbidgee River after moderate and heavy rainfall. Nutrient levels tend to be slightly raised, which is commonly observed in a predominantly agricultural catchment. Nitrate levels of 1-3 mg/L are recorded in the Murrumbidgee River at CMM10, which reflects inputs from the lower Molonglo River. Finally, dissolved oxygen levels are often very low, especially during low flow conditions. Increasing the number of sites throughout the catchment, and including water bug and riparian assessments, will lead to stronger inferences of catchment health.



# Murrumbidgee River CMM11

## Ginninderra Creek confluence to above Mullion Creek confluence

### CHIP Result B (Good)

#### Data Collected

Parameter	Rating	No. Survey
<b>Water quality</b>	<b>No Data</b>	<b>4</b>
pH	No Data	
Turbidity	No Data	
Total Phosphorus	No Data	
Nitrate	No Data	
Electrical Conductivity	No Data	
Dissolved Oxygen	No Data	
<b>Water bug</b>	<b>Good</b>	<b>1</b>
<b>Riparian condition</b>	<b>Fair</b>	<b>1</b>

### 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 Mullion Creek in Wamboin. Much of this reach is surrounded by cleared grazing lands, and a very narrow riparian zone. In a few notable places, private landowners are undertaking riparian vegetation replantings to improve river condition.

### Reach Condition

This reach was scored overall as 'good', based upon a 'good' water bug survey and a 'fair' riparian condition survey. The riparian zone is generally very narrow, due to past land clearing. Casuarina trees dominate in patches, however there is a general lack of regeneration and midstorey regrowth. African Lovegrass is commonly observed. The water bug score was good, but made up predominantly of tolerant bug types. A limited amount of water quality data from the top of this reach reveals that 'degraded' levels (2-3mg/L) of nitrates are the biggest concern. This is also the case for the reach upstream of this one (CMM10) and is believed to be an input from the lower Molonglo River. Electrical conductivity is scored as 'fair', but this is to be expected in the Murrumbidgee River and is of no cause for concern. In the coming year, increased survey effort will increase our understanding of this reach.



# Murrumbidgee River CMM12

## Mullion Creek confluence to Taemus Bridge above Burrinjuck Dam

### Reach Facts

This reach of the Murrumbidgee River is the most downstream of 12 reaches on the Murrumbidgee River. The downstream end at Taemus bridge is immediately upstream of the impounded water of Lake Burrinjuck. Much of this catchment is cleared grazing land, with a narrow and at times, heavily degraded riparian zone.

### Reach condition:

No data has been collected for the current CHIP, but future CHIP reports will contain data, collected from 2 sites along this reach. This reach is of vital importance, as it reveals the quality of water entering Lake Burrinjuck from the majority of the upper Murrumbidgee River catchment, with the exception of the Goodradigbee and Yass Rivers.



# Yass River YAS1

## Headwaters to Brookes Creek confluence, including Brookes Creek

### Reach Facts

*Reach length:* approx. 60km

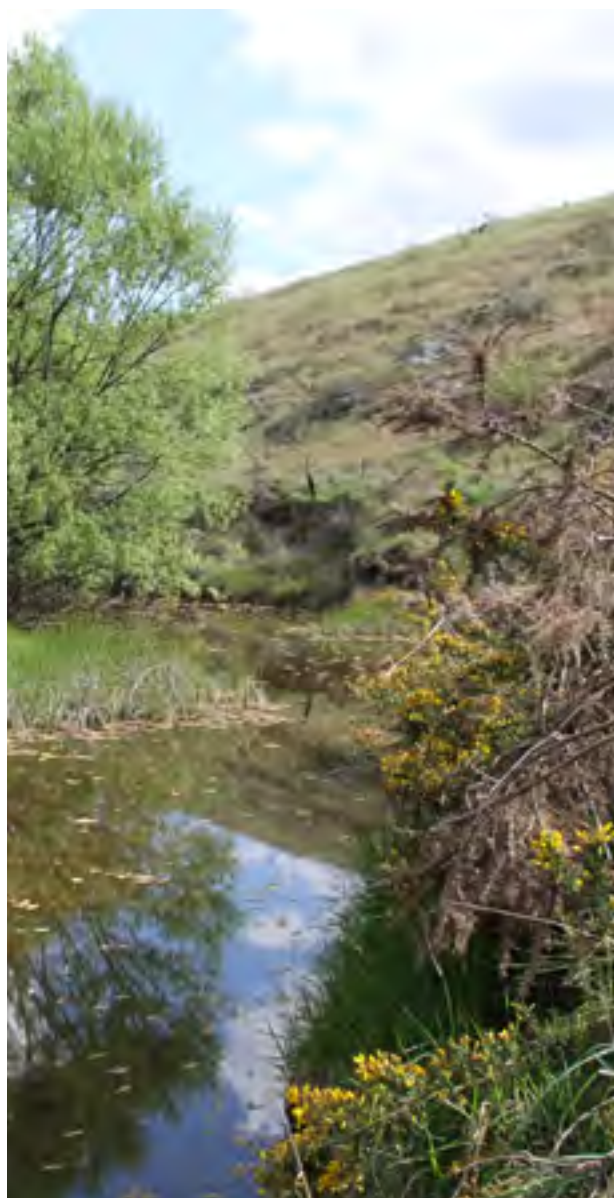
*Dominant land uses:* Rural, rural residential

The upper Yass River and Brookes Creek represent the top of the Yass River catchment. This reach is likely to represent the reference condition for this catchment. Improving condition in this reach will have benefits for the Yass River downstream.



### Reach condition.

This reach contains three waterwatch sites: two on the Yass River, and one on Brookes creek. Unfortunately there was not enough data to produce a CHIP score. Water quality data indicates that this reach is in 'fair' condition. Electrical conductivity levels and dissolved oxygen were both at 'degraded levels', while pH was scored as 'poor', tending to be alkaline. Turbidity is generally 'excellent', however it is likely to rise during high flow events. The addition of water bug surveys and assessments of riparian condition will provide a fuller picture of the health of this reach in the future.



# Yass River YAS2

## Dicks creek confluence to Manton creek confluence

### Reach Facts

*Reach length:* approx. 30km

*Dominant land uses:* rural

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

### Reach condition:

Some water quality surveys on Manton Creek from 2013 indicate very high (degraded) electrical conductivity (EC -  $>1000 \mu\text{S}$ ) and poor turbidity levels. On the Yass River upstream, extensive riparian plantings appears to be having a positive effect on water quality with consistently lower EC readings than downstream - though still at 'degraded' levels ( $400\text{--}580 \mu\text{S}$ ). Addition of water bug surveys and riparian condition surveys will paint a more holistic picture of this reach. Additional sites on this reach are desirable.



# Yass River YAS3

## Yass township to Lake Burrinjuck

### Reach Facts

*Reach length:* approx. 33km  
*Dominant land uses:* urban, rural

This downstream most section of the Yass River is controlled by Yass Dam. Urban inputs from the town of Yass are likely to influence water quality in this reach. This reach includes the Yass Gorge, and there is ongoing habitat rehabilitation occurring in this reach. Monitoring and rehabilitation works are being undertaken by the 'Green Army'.

### Reach condition:

No data is currently present for this reach. Currently 1 site exists on this reach, immediately downstream of Yass township, but more sites are needed.



# Volunteer list

## Cooma

Alan and Marj Jones  
Jenny and Bob Cooper  
Justin Kell and David Campbell  
Tony and Gill Robinson  
Jerangle Public School  
Jim Wharton  
Mark Shubert  
Ann Henkel and James  
Edel Stephans  
Ivan Bek

John Britton  
Tim Scrace  
Shlesha Pathak  
John Chapman  
Robert Outhred  
Kerryn Milligan  
Lauren Van Dyke  
Jon and Fiona MacDonald  
Nicole Clark  
MHS Year 11 (science group)

## Ginninderra

Dylan Williams  
Fred Fawke  
Emily Birks  
Amy McLachlan  
Gregg Berry  
Hannah Selmes  
Jake Lennon  
Johanna Wallner  
Janene Sadler  
Jyotsna VEDI  
Kathryn Vincent  
Lyndsay Britt

Lesley Harland  
Guiling Ren  
Luke Wensing  
Lynette Matthews  
Rachel Everett  
Stephen Toaldo  
Zhou Zhou  
Denise Kay  
Fiona Hamer  
CIT Bruce Certificate 4 Environmental  
Monitoring and Technology students



## Molonglo

Tanya Boston

Chloe & Stewart Foster

Eva Culek

Sue Gibson

Royalla Landcare Group

Peter & Deb Robertson

Bruce Davies

Peter Abbott

Fraser Argue

Ema Falez

Julia McGowan

Captains Flat Landcare Group

Bernard Kertesz

John Bissett

Hilary Gunn

Chris Bond

Stuart Pearson

Tony Patis

Ros Peacock

Phil Sahlqvist

John Moore

Sandy Lloyd

Des & Jenan Cannon

Andy Kaye

ANUgreen Sustainability Office

Julia Jasonsmith

Claudia Benham

Richard Larson

Penny Godwin

Kate Badek

Jo Thompson

Mike Sim

## Southern

Canberra Ornithologists Group

Uriarra Parkcare Group

'Sands' Waterwatch Group  
Wendy Rainbird and Anne l'Ons

Cooleman Ridge Parkcare Group

Green Army

Erindale College

Park Carers of Southern  
Murrumbidgee(P.O.S.M)

Josh Moloney

'Cuppacumbalong' Waterwatch Group

Outward Bound Australia

Cuppacumbalong

Park Carers of Southern  
Murrumbidgee(P.O.S.M)

Kath Dibley and Walt Daley

Eileen and Stuart Becker

Sharon Koh

Ben Bryant,

Tuggeranong Lake Carers

Caroline Oshyer

Lake Tuggeranong College: Sustainability Unit

Tuggeranong Sea Scouts: Ottway Venturer Unit

'FISH' Waterwatch Group

Carolyn Chisholm School

Brad Wilken

Calwell High School

Alan Parker

Carers of Point Hut Pond

'Conder Wetlands' Waterwatch Group

'Steam team' Waterwatch Group

Josh Moloney

Friends of Tidbinbilla Parkcare group

CVA Tidbinbilla Sanctuary Volunteer  
Interpreter Program

Amanda Anderson

Max Schaap

Ana Martinez

Danica Tagaza

Gudgenby Bush Regenerators Waterwatch Group  
(Martin Chalk & Michaela Popham)

## Yass

Carol Boughton

Cathy Campbell

Fiona Hamer

David McDonald

Gordon Allen

Kate Wilson

Murray Goodridge

Yass Green Army

Ross Webster

Pauline Chambers



# 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

**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 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

**Gambusia:** A small invasive pest fish introduced from central America

**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

**Metamorphic:** A type of rock, related to its process of formation

**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

**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:** Same as runoff

**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)

DO: Dissolved Oxygen

EC: Electrical Conductivity

mg/L: Milligrams per Litre

μS: MicroSiemens

NTU: Nephelometric Turbidity Units

N: Nitrogen

QAQC: Quality Assurance, Quality Control

TP: Total Phosphorus

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	EC	Turbidity	TP	DO	Nitrate	WQ score	WB Score	RARC Score	CHIP Score	Lette
BAD1	2	1	1	1	5	1	1.83	2	2	1.94	A-
BAD2	2	1	1	1	2	1	1.33	2	3	2.11	B+
BRD1	1	2	1	1	4	1	1.67	1	3	1.89	A-
BRD2	1	5	1	2	5	1	2.50	3	4	3.17	C+
CMM1	DD	DD	DD	DD	DD	DD	DD	2	4	3.00	C+
CMM2	DD	DD	DD	DD	DD	DD	DD	2	3	2.50	B
CMM3	1	2	1	1	2	1	1.33	2.5	4	2.61	B
CMM4	1	1	1	2	5	1	1.83	3.5	5	3.44	C
CMM5	1	2	1	1	1	1	1.17	DD	4	2.58	B
COO1	1	5	1	4	5	1	2.83	2	DD	2.42	B
COO2	1	5	1	5	5	1	3.00	DD	5	4.00	D+
COO3	1	5	1	5	5	1	3.00	2	4	3.00	C+
COB1	DD	DD	DD	DD	DD	DD	DD	3	4	3.50	C
GUD1	1	5	1	1	3	2	2.17	3	4	3.06	C+
KYB1	1	2	1	1	1	2	1.33	2	3	2.11	B+
MIC1	1	5	1	1	2	2	2.00	DD	4	3.00	C+
NUM1	1	2	1	1	3	1	1.50	4	4	3.17	C+
NUM2	1	2	1	2	5	2	2.17	1	3	2.06	B+
NUM3	1	2	1	2	5	2	2.17	3	3	2.72	B-
NUM4	1	3	1	2	1	2	1.67	1	4.5	2.39	B
ROC1	4	5	1	2	5	2	3.17	2	5	3.39	C
STR1	1	2	1	1	1	2	1.33	1.5	3.5	2.11	B+

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

Molonglo CHIP scores by parameter

Reach	pH	EC	Turbidity	TP	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP Score	Lette
BUR1	1	4	2	1	3	1	2.33	2	4	2.78	B-
DIC1	5	2	3	1	DD	2	2.60	2	4	2.87	B-
GCG1	1	5	1	1	1	2	1.83	DD	2.5	2.17	B+
JER1	1	4	1	1	DD	2	1.80	2	4	2.60	B
JER2	4	5	3	5	5	1	3.83	2	4	3.28	C+
LYN1	DD	DD	DD	DD	DD	DD	DD	2	3.5	2.75	B-
MOL1	DD	DD	DD	DD	DD	DD	DD	3	4	3.50	C
MOL2	1	4	1	2	5	2	2.50	4	2	2.83	B-
MOL3	1	4	1	1	5	2	2.50	3	3	2.83	B-
MOL4	DD	DD	DD	DD	DD	DD	DD	3	4	3.50	C
MOL5	1	2	1	1	2	1	1.33	4	4	3.11	C+
MOL6	1	4	1	1	3	2	1.67	2	4	2.56	B
PRI1	1	5	1	1	1	1	1.67	DD	4.5	3.08	C+
QUE1	2	1	1	2	5	1	2.00	2	2.5	2.17	B+
QUE2	3	2	1	1	1	2	1.67	2	3	2.22	B+
QUE3	3	5	1	2	1	2	2.33	2	4	2.78	B-
SCA1	2	3	1	1	5	2	2.33	DD	3	2.67	B-
SUL1	DD	DD	DD	DD	DD	DD	DD	2	3.5	2.75	B-
SUL3	1	4	1	5	5	1	2.83	2	3	2.61	B
SUW1	1	2	3	4	5	1	2.83	2	2	2.28	B+
SUW2	DD	DD	DD	DD	DD	DD	DD	2	3	2.50	B
WAT1	DD	DD	DD	DD	DD	DD	DD	4	4	4.00	D+
WES1	2	2	1	4	5	2	2.83	DD	5	3.92	C-
WOO1	1	5	1	1	5	2	2.50	2	4	2.83	B-
YAN1	1	1	1	1	3	2	1.50	2	2.5	2.00	B+
YAR1	1	5	1	1	5	2	2.50	3	3.5	3.00	C+

1 = excellent. 2 = good. 3 = fair. 4 = poor. 5 = degraded

### Ginninderra CHIP scores by parameter

Reach	pH	EC	Turbidity	TP	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP Score	Letter
BEL1	DD	DD	DD	DD	DD	DD	DD	2.0	4	3.00	C+
CMM10	1	3	1	2	3	5	2.50	3.5	3	3.00	C+
CMM11	DD	DD	DD	DD	DD	DD	DD	2.0	3	2.50	B
GDC1	DD	DD	DD	DD	DD	DD	DD	4.0	4	4.00	D+
GIN1	1	4	3	1	3	2	2.33	2.0	5	3.11	C+
GIN2	1	4	1	1	5	1	2.17	4.0	4	3.39	C
GIN3	DD	DD	DD	DD	DD	DD	DD	2.0	3.5	2.75	B-
GIN4	1	4	2	4	5	2	3.00	4.0	4	3.67	C-
GIN5	2	4	1	1	5	1	2.33	2.0	3.5	2.61	B
GOO1	1	5	1	1	5	2	2.50	4.0	5	3.83	C-
GUN1	1	4	1	1	5	1	2.17	2.0	4	2.72	B-
GUN2	4	5	3	1	5	2	3.33	2.0	4	3.11	C+
YER1	5	4	1	1	1	2	2.33	4.0	4.5	3.61	C

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

### Southern region CHIP scores by parameter

Reach	pH	EC	Turbidity	TP	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP Score	Letter
CGB1	2	1	1	1	5	2	2.00	3	3	2.67	B-
CGG1	1	1	1	1	3	2	1.50	3.5	3	2.67	B-
CGH1	2	1	1	1	5	2	2.00	1	2	1.67	A-
CMM6	1	5	1	2	3	2	2.33	4	3	3.11	C+
CMM7	1	5	1	2	3	2	2.33	2	4	2.78	B-
CMM8	2	2	1	2	3	2	2.00	3	3	2.67	B-
CMM9	1	5	1	1	2	1	1.83	4	3.5	3.11	C+
CMS1	1	5	1	DD	DD	1	2.00	4	4	3.33	C
CTP1	1	1	1	1	1	2	1.17	3	3	2.39	B
CTT1	1	1	1	1	5	1	1.67	3	2	2.22	B+
GIB1	1	1	1	1	1	2	1.17	3	1	1.72	A-
LMS1	2	5	1	DD	DD	1	2.25	2	3	2.42	B
MCC1	1	1	1	1	2	1	1.17	4	2.5	2.56	B
MCC2	DD	DD	DD	DD	DD	DD	DD	1	3	2.00	B+
MMB1	1	5	1	1	4	2	2.33	2	DD	2.17	B+
MPG1	1	5	3	1	5	2	2.83	4	4	3.61	C
MSP1	5	5	2	4	3	DD	3.80	4	DD	3.90	C-
NNN1	1	1	1	1	1	2	1.17	4	2	2.39	B
RAN1	1	5	3	5	2	1	2.83	4	4	3.61	C
RAN2	1	1	3	1	5	2	2.17	4	DD	3.08	C+
TIP1	DD	DD	DD	DD	DD	DD	DD	4	4	4.00	D+
TLT1	1	5	3	4	5	5	3.83	4	3	3.61	C
TLT2	1	5	3	2	5	2	3.00	4	4	3.67	C-
TMM1	1	5	1	1	DD	1	1.80	3	4	2.93	B-
TUG1	1	5	1	1	5	1	2.33	2	4	2.78	B-
TUG2	5	5	1	1	5	5	3.67	4	5	4.22	D+
TUG3	2	5	1	4	5	5	3.67	3	3	3.22	C+
UMC1	1	5	3	2	4	2	2.83	4	4	3.61	C

1 = excellent, 2 = good, 3 = fair, 4 = poor, 5 = degraded

### Yass region CHIP scores by parameter

Reach	pH	EC	Turbidity	TP	DO	Nitrate	WQ Score	WB Score	RARC Score	CHIP score	lette
CMM11	1	3	1	2	3	5	2	2	3	2.33	B
CMM12	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	
YAS1	4	5	1	1	5	2	3.2	DD	DD	3.2	C+
YAS2	1	5	4	1	5	2	3	DD	DD	3	C+
YAS3	DD	DD	DD	DD	DD	DD	DD	DD	DD	DD	

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. However, multiple complex calculations are involved in producing the CHIP, and numerous catchment groups around Australia produce similar (albeit slightly different) CHIPs. Conversely, specific details regarding these CHIPs are not generally forthcoming. This document aims to clearly outline the underlying philosophy and methodology regarding the Waterwatch 2014–15 CHIP.

### Multiple Types of Data

Waterwatch volunteers and co-ordinators 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 co-ordinators 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 co-ordinators 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 data are combined into the CHIP. Finally, additional data regarding algae abundance and diversity, frog abundance and diversity, and platypus abundance are used to provide context regarding catchment health, but are not formally included in the CHIP calculations (Table 1).

### 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 previously (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 co-ordinators, that are included in the CHI. These values here reflect current goals, but are not always achieved in all instances.**

	Parameter	Frequency	Number of sites
Water Quality	pH	Monthly	All sites
	Electrical Conductivity	Monthly	All sites
	Turbidity	Monthly	All sites
	Total Phosphorus	Monthly	All sites
	Nitrates	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 use 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. This helps to control for the diversity of macro-invertebrates found at a site. This number is transformed (similar to the water quality parameters, above), and the two sampling periods (spring and autumn) averaged, before being included in the CHIP (Table 2).

**Table 2. Summary of SIGNAL 2.0 scores, and thresholds between the CHIP score categories.**

		# of macro-invertebrate orders	
		0 - 7	> 7
SIGNAL score	> 5.5	Fair 3	Excellent = 1
	<= 5.5	Poor 4	Good = 2

## 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. A substantial number of surveys were conducted in Summer and Autumn 2015. This data has been incorporated for the first time into the CHIP in 2014–2015.

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 2014-2015 CHIP are as follows (Table 3).

**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 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.

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# Appendix III

## Refining water quality thresholds for the 2014–15 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 A2 of Appendix III of the 2013-2014 CHIP report (Figure 1).

**Figure 1. Summary of 2013-2014 water quality thresholds from CHIP report.**

Indicator Rating	Excellent 1	Good 2	Fair 3	Poor 4	Degraded 5	Comment
pH	6 – 7	5.5 – 6 or 7 – 8	8 – 8.5	5 – 5.5 or 8.5 – 9	<5 or >9	
EC (µS)	≤65	≤200	≤350	≤400	≥400	
Turbidity (NTU)	≤10	≤12.5	≤15	≤20	>20	
Dissolved oxygen (mg/L)						Not included in CHIP
DO saturation (%)	95 – 105	85 – 95 or 105 – 110	75 – 85	65 – 75 or 115 – 120	<65 or ≥120	
Total 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 are 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 we treated them as based upon expert knowledge.

For the 2014-2015 CHIP report, we aimed to develop a new set of thresholds based upon water quality data collected in the ACT region. The key issues in developing these new thresholds will be outlined here.

### 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 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.

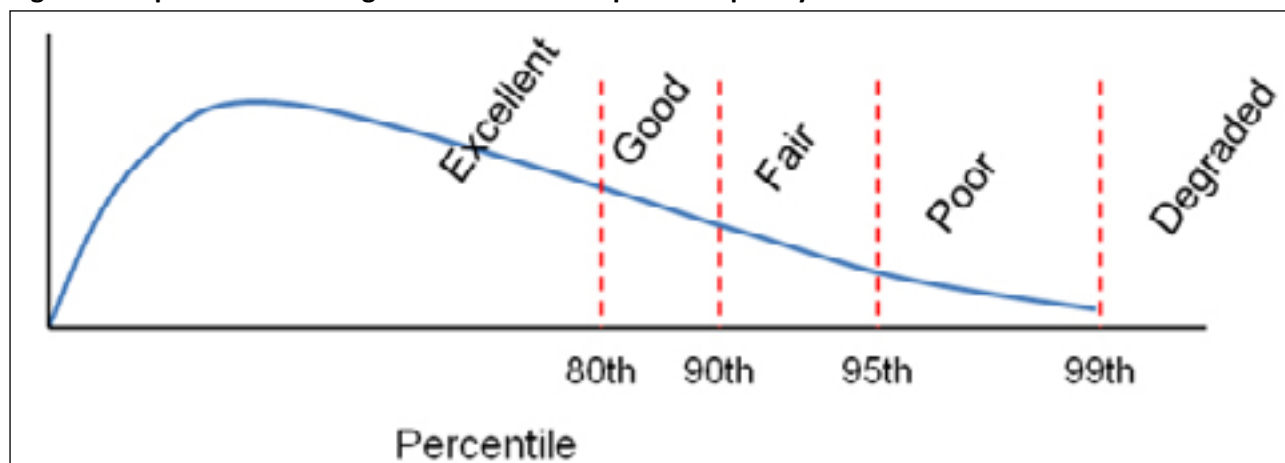
A second key issue is the amount of data available. This is further complicated by the impact that the millennium drought had on reference site condition. For example, data from reference sites of the AUSRIVAS macro-invertebrate monitoring program showed major declines in the relative health of some 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 we 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) percentiles. 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 would 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	Comments
Cotter Hut	2007-2014	pH, turbidity, EC, DO	No nutrient data from this site
Gingera	2003-2015	pH, turbidity, EC, DO	No nutrient data from this site
Corin Reservoir site 7	1994-2015	TN, TP	
Corin Reservoir site 8	1993-2015	TN, TP	
Kangaroo Ck	2003-2015	TN, TP	
Goodradigbee River site 1	2006-2015	pH, Turbidity, EC, TN, TP	Sampled spring and autumn only
Goodradigbee River site 2	2006-2015	pH, Turbidity, EC, TN, TP	Sampled spring and autumn only
Goodradigbee River site 3	2006-2015	pH, Turbidity, EC, TN, TP	Sampled spring and autumn only
Goodradigbee Tributary 1	2006-2015	pH, Turbidity, EC, TN, TP	Sampled spring and autumn only
Goodradigbee Tributary 2	2006-2015	pH, Turbidity, EC, TN, TP	Sampled spring and autumn only
Goodradigbee Tributary 3	2006-2015	pH, Turbidity, EC, TN, TP	Sampled spring and autumn only

### 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. We chose to combine data from the Cotter River and Goodradigbee River to produce EC thresholds for the CHIP as this will better reflect the apparent naturally higher EC readings from other areas in the catchment such as the Molonglo and Ginninderra.

## New thresholds

Table 2 presents the new 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.

**Table 2: New water quality CHIP thresholds for 2014-2015 CHIP.**

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 (uS)	< 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
TP (mg/L)	< 0.02	0.02 – 0.03	0.04 – 0.05	0.06 – 0.08	> 0.08
Nitrates (mg/L)	< 1.0	1.0 – 1.3	1.4 – 1.7	1.8 – 2.6	> 2.6

## Going forward: interpreting the 2014–15 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’.**



