SECTION 2: WATER QUALITY CONDITION

Water Quality Monitoring Program

Environment and Recreation manages a monitoring program for the Australian Capital Territory's water resources that includes the collection of water quality, stream flow and biological data. The monitoring program is based on regular sampling of lakes and rivers. Such information is used to determine whether waters in the ACT are of appropriate quality and if the management strategies used to achieve or maintain such water quality are adequate. The information is not intended to identify specific pollution incidents but rather provide information about changes to water quality over time.

Water quality data is collected by other government agencies, research institutions and authorised dischargers such as ACTEW (Lower Molonglo Water Quality Control Centre, Water Supply Reservoirs) and the Queanbeyan City Council (Queanbeyan Sewage Treatment Plant). Although the EPA may use such data for assessing compliance with licence conditions and the *Environment Protection Regulations 1997*, the data collected by those organisations is not reported in this document.

Sampling Sites

Sites are located so as to be representative of stream and lake conditions in the ACT (Figure 7). It is not possible to monitor all sites and all parameters of interest; consequently those considered most representative of environmental conditions are selected with the intention of generalising to similar areas.

Lakes

The major urban lakes (with the exception of Lake Burley Griffin — a Commonwealth responsibility) are sampled eight months of the year during August, October to March, and May. The ACT Government also monitors Burrinjuck Reservoir as activities in the ACT could potentially impact on this reservoir. Monitoring of blue-green algae in Canberra's lakes is undertaken during the summer months by Environment Protection Officers and encompasses the recreation zones of the lakes. The ACT Health Protection Service undertakes bacterial monitoring of lake recreation areas during peak use times.

Rivers

Stream-flow is measured continuously at a number of sites throughout the ACT at hydrographic stations operated by Ecowise Environmental. This information is valuable for interpreting water quality data as most of the pollutants that enter our waterways do so during storms. Consequently streams are sampled for water quality at different flow levels, rather than at fixed times, to better characterise the pollutant loads. Samples are collected within four flow levels, measured by the flow percentile (5–29%, 30–49%, 50–69% and 70–89%). The 5^{th} percentile flow is the flow exceeded only 5% of the time and represents very high flow; conversely the 90^{th} percentile flow indicates very low flow.

Rivers were sampled four times during this reporting period. In addition to the requirement to sample within flow percentile groups in a year of generally lower flow rates than usual, there is a need to ensure there is a reasonable time period between each sample. The aim of this strategy is to provide a fully representative assessment of river health over time by taking account of the impact of flow on water quality. As in the previous reporting year, the full range of samples, as scheduled in Table 4, were not taken as the flow was not high enough to take all of the high flow percentiles scheduled to be sampled (Figure 5).

Table 4: Flow Percentiles for River Sampling

Flow Percentile Group	Number of Samples
5–29	2
30–49	2
50–69	2
70–89	2

Biological Assessment of Ecosystem Condition

In addition to monitoring the physical and chemical condition of the ACT's waters, an assessment of the status of the aquatic ecosystem is performed. Assessment of ecosystem health is based on the macroinvertebrate monitoring undertaken using the AUSRIVAS protocol. It involves collecting samples of stream invertebrates from stream edge sites in the ACT region during spring and autumn. An AUSRIVAS predictive model is used to assess these sites. The condition of the site, as determined by the model, provides a measure of a stream's biological health. Thirteen sites are sampled and are selected as either reference or test sites. The selection of test sites was based on potential and known impacts from rural degradation, urban runoff, discharge of treated sewage effluent, trace metal contamination, habitat degradation, sedimentation events and river regulation. The three reference sites were selected from those sampled during development of the ACT component of the NRHP. The ten test sites and three reference sites were sampled in November 2006 and March 2007.

Condition of ACT Waters

The water quality in ACT streams and lakes has tended to be good as assessed against the water quality standards (Table1). However in recent years rivers and streams have been stressed by the extreme events of drought and fire. Sites outside the urban area have displayed resilience to these events; they appear to have recovered from the impacts of the 2003 bushfires and are accommodating the ongoing periods of low flow. Sites in urban areas appear to be faring worse than non-urban sites. Urban sites are commonly impacted by human impacts such as altered flow regimes, nutrient enrichment, weed infestation and increased pollutants. Recently urban water quality is thought to have remained poor because, with drought conditions, stream flows are low and any pollutants entering waterways are not diluted and frequently do so as part of storm events. Long dry periods combined with sudden storm events can allow the development of heavy silt loads in runoff water from urban areas under development.

The condition of water quality at the monitoring sites may be assessed by comparison of actual concentrations with concentrations listed in the water quality standards (Table 1).

Summary of Water Quality Observations for Reporting Period 2006–2007

Table 5. Summary of Water Quality in the ACT, 2006–2007.

Parameter	Reg. Limit	Sources	Consequences of exceeding limits	Incidents in reporting period
Total Phosphorus	<0.1mg/mL	Soil and humus	With high TN, turbidity, water temperature and low flow, may lead to cyanobacterial bloom.	New Year's Eve 2006 storm event
Total Nitrogen	N.A. [<150 µg/L]	Organic matter breakdown, + biological Nitrogen fixation	With high TP, turbidity, water temperature and low flow, may lead to cyanobacterial bloom.	New Year's Eve 2006 storm event
Suspended Solids	<25mg/L	Disturbance of soil by storm damage, human activity causing catchment disturbance, and in upland river, watercourse creep.	Silt slugs; bank scouring; burial of riffles or aquatic vegetation; increased (long-term) turbidity	New Year's Eve 2006 causing silt slug in Murrumbidgee River; Winter rain.
Turbidity	<10 NTU, flowing <30 NTU, standing	Soil and country rock clay fraction; humic 'tea'	Modification of biological light regime; poor aesthetics.	New Year's Eve 2006 storm event; Winter rain
Faecal Coliforms	<150 cfu (swimming) 1000 cfu /mL	Rural and urban animal waste, fertilizers [sewage]	Closure of recreational waters because of health risk from associated (hard to monitor) pathogens	New Year's Eve 2006, temporary closure of river swimming.
Conductivity	N.A.	Salts in country rock and ground water; sewage treatment plants.	Salinity or corrosion problems, where water is used.	N.A.
pH	6–9	Catchment geology	Changes to biodynamics; may release toxic metals	N.A.
Dissolved Oxygen	> 4.0 mg/L	Normal plant (including algal) activity and physical exchange with atmosphere through wind and water movement	Hot weather and low flows drive O_2 out of water, leading to biological stress, with fish kills being the worst outcome.	Summer lows at Angle Crossing, Sutton Road bridge, Queanbeyan River at the cemetery, Ginninderra Creek and in Point Hut Pond.
Chlorophyll 'a'	< 10 µg/L	phytoplankton	Poor aesthetics; scums; unpleasant smells (geosmin); blooms outside of normal population fluctuation.	1 short closure, March 2007 Lake Tuggeranong.

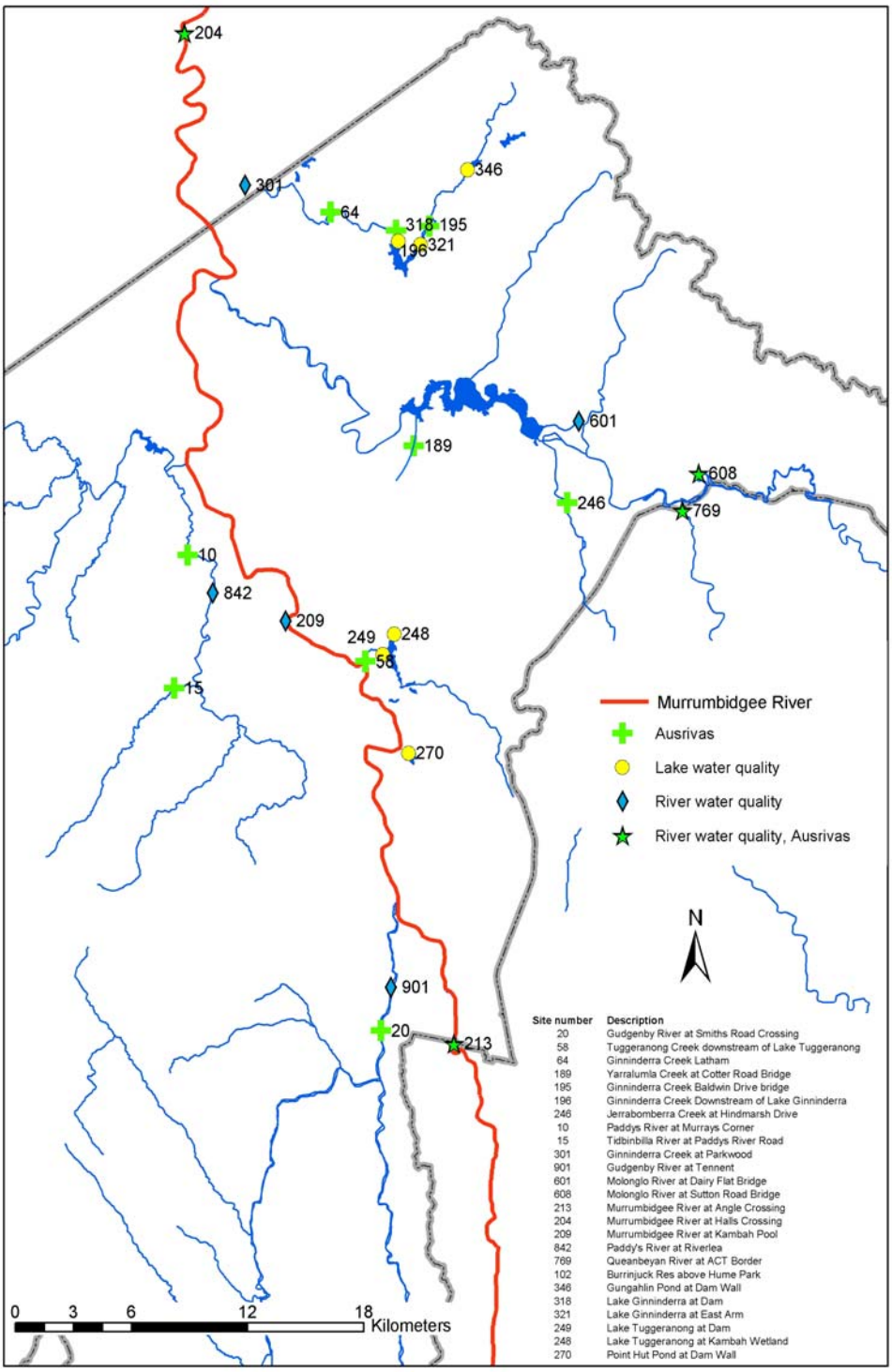


Figure 7: Locations of Water Quality and Biological (AUSRIVAS) Sampling Sites in the ACT Water Quality Monitoring Program

Indicators

Nutrient Levels (Phosphorus and Nitrogen)

Nutrients are a natural component of all water bodies, but increases in their supply often have undesirable effects, including the eutrophication of aquatic ecosystems. Eutrophication is the presence of an abnormally high quantity of plant nutrients and can lead to excess algal growth including toxic algal blooms. This can also produce other unwanted side effects e.g. low dissolved oxygen levels in the water. The two most important plant nutrients for aquatic ecosystems are phosphorus and nitrogen.

Total Phosphorus

Total phosphorus is the sum of dissolved and particulate phosphorus in the water. The standard is 0.1 mg/L for both aquatic health and recreational use. In ACT water bodies total phosphorus availability is what commonly determines algal activity.

Nutrients such as phosphorus are bound within soil/sediment particles and the movement of phosphorus through the landscape and waterways is closely linked to soil erosion and sediment transport dynamics.

Phosphorus levels in the southern catchments (sites 209, 213 and 901) show a dramatic spike in January 2007. This rise is coincident with the New Year's Eve storm event in the southern catchments in summer 2007. The spike is also seen in sites 248, 249 and 270, although partly masked by the generally heightened levels of phosphorous in 270. The other waterways have phosphorous levels generally well within regulation limits.

Table 6. Total Phosphorus (mg/L) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	0.04	0.15	0.07	0.05	0.10
248	Lake Tuggeranong at Kambah Wetland	0.05	0.20	0.10	0.06	0.10
249	Lake Tuggeranong at Dam	0.05	0.16	0.09	0.04	0.10
270	Point Hut Pond at Dam Wall	0.08	0.16	0.11	0.02	0.10
318	Lake Ginninderra at Dam	0.01	0.04	0.03	0.01	0.10
321	Lake Ginninderra at East Arm	0.02	0.13	0.05	0.03	0.10
346	Gungahlin Pond at Dam Wall	0.02	0.08	0.04	0.02	0.10
204	Murrumbidgee River at Halls Crossing	0.04	0.20	0.14	0.08	0.10
209	Murrumbidgee River at Kambah Pool	0.04	1.60	0.61	0.70	0.10
213	Murrumbidgee River at Angle Crossing	0.03	1.80	0.66	0.78	0.10
301	Ginninderra Creek at Parkwood	0.05	0.11	0.07	0.03	0.10
601	Molonglo River at Dairy Flat Bridge	0.02	0.15	0.07	0.06	0.10
608	Molonglo River at Sutton Road Bridge	0.02	0.13	0.06	0.05	0.10
769	Queanbeyan River at ACT Border	0.03	0.12	0.09	0.04	0.10
842	Paddy's River at Riverlea	0.03	0.11	0.07	0.04	0.10
901	Gudgenby River at Tennent	0.03	0.21	0.15	0.10	0.10

Total Nitrogen

There is no regulation limit for total nitrogen for the ACT. Nitrogen is not generally a limiting factor in algal growth in regional waters and it is non-toxic to organisms. Nitrogen values are normally consistently highest at two sampling sites (601 and 204), which are downstream of the Queanbeyan and Canberra sewage treatment plants. These high levels generally decrease rapidly along the stream. International standards for discharged wastewater recommend 15 mg/L or less. In situations where nitrogen is limiting, research indicates a potential for the growth of nitrogen fixing blue-green (including some scum and toxicant forming) algae. In these situations, the discharge of nitrogen in sewage effluent could discourage the growth of nitrogen fixing blue-green algae. For these reasons management and discharge authorisation arrangements in the ACT concentrate on minimising the input of phosphorus to waterways as a priority, with nitrogen reduction encouraged as a second priority.

Elevated levels of nitrogen (relative to other sites in the ACT) were found in the river corridor (sites 204, 209 and 213) in the summer and continued into the winter of 2007, associated with run-off from summer storms and later good autumn and winter rains. This exceeded the usual elevated levels at sites 601 and 204 associated with the sewage treatment discharge. Comparison with Chlorophyll 'a' levels (Table 14) indicates high phytoplankton (probably diatomaceous) activity in autumn and winter. Burrinjuck Reservoir (site 102) which acts as a vast nutrient and sediment sink had large fluctuations in nitrogen measurements throughout the year. These variations are not solely because of loading from the ACT but involve other processes such as reservoir draw-down during irrigation supply and internal reservoir circulation dynamics.

Table 7. Total Nitrogen (mg/L) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	0.57	6.90	3.85	1.83	N/A
248	Lake Tuggeranong at Kambah Wetland	0.66	1.90	1.02	0.46	N/A
249	Lake Tuggeranong at Dam	0.68	1.80	0.99	0.38	N/A
270	Point Hut Pond at Dam Wall	0.76	1.40	1.04	0.21	N/A
318	Lake Ginninderra at Dam	0.52	0.66	0.57	0.05	N/A
321	Lake Ginninderra at East Arm	0.53	0.86	0.67	0.12	N/A
346	Gungahlin Pond at Dam Wall	0.42	0.73	0.58	0.11	N/A
204	Murrumbidgee River at Halls Crossing	1.50	6.70	3.40	2.31	N/A[15]
209	Murrumbidgee River at Kambah Pool	0.40	5.20	2.30	2.08	N/A
213	Murrumbidgee River at Angle Crossing	0.32	16.00	4.88	7.44	N/A
301	Ginninderra Creek at Parkwood	0.63	1.30	0.88	0.30	N/A
601	Molonglo River at Dairy Flat Bridge	0.85	3.60	1.89	1.21	N/A[15]
608	Molonglo River at Sutton Road Bridge	0.38	1.40	0.76	0.46	N/A
769	Queanbeyan River at ACT Border	0.51	1.70	0.93	0.53	N/A
842	Paddy's River at Riverlea	0.24	0.72	0.54	0.26	N/A
901	Gudgenby River at Tennent	0.28	1.30	0.86	0.52	N/A

Suspended Solids

All streams and rivers naturally carry some suspended material as organic and inorganic particles of varying sizes. Most land uses and activities have the potential to increase the concentrations of suspended solids in streams. An increase in the concentration of suspended solids can have two major impacts on aquatic ecosystems. Firstly, higher concentrations of suspended solids reduce the light penetration of water, slowing plant growth and changing the type of algae present. Secondly, increases in suspended solids concentrations ultimately result in increased sedimentation in streams and lakes, choking habitats for bottom dwelling organisms with sediment.

In general the average suspended sediment concentrations in ACT waterways were outside the water quality standard in this reporting period. The Murrumbidgee corridor sites (209 and 213) show the most elevated levels, associated with both localised storm events in summer 2007 and autumn-winter rains. There were also high suspended solid loads in other waterways in June 2007. Flow based sampling highlights storm effects, while the long term average may indicate closer general conformity to regulation limits. High concentrations continue to occur in some streams downstream of current areas of urban development, for example Lake Ginninderra at East Arm. The effectiveness of the interception of this sediment by the lake can be seen by the average concentrations at the top of the lake (27 mg/l) and at the dam wall (7 mg/l). The dramatic silt slug in the Murrumbidgee River associated with storm run-off after the New Year's Eve storm illustrates the coincidence of drought loosened soil swept down from rural areas (250 mg/L at Angle Crossing) and dried out soil from urban development sites (780 mg/L at Kambah Pool).

Table 8. Suspended Solids (mg/L) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	8.00	96.00	49.50	30.91	25
248	Lake Tuggeranong at Kambah Wetland	3.00	24.00	12.50	6.80	25
249	Lake Tuggeranong at Dam	6.00	13.00	9.50	2.83	25
270	Point Hut Pond at Dam Wall	9.00	39.00	21.75	9.39	25
318	Lake Ginninderra at Dam	5.00	8.00	7.00	1.41	25
321	Lake Ginninderra at East Arm	6.00	110.00	27.13	34.01	25
346	Gungahlin Pond at Dam Wall	3.00	35.00	13.25	10.67	25
204	Murrumbidgee River at Halls Crossing	7.00	180.00	75.50	75.50	25
209	Murrumbidgee River at Kambah Pool	13.00	780.00	353.25	356.66	25
213	Murrumbidgee River at Angle Crossing	10.00	380.00	207.50	153.70	25
301	Ginninderra Creek at Parkwood	11.00	23.00	17.50	5.51	25
601	Molonglo River at Dairy Flat Bridge	4.00	120.00	35.85	56.20	25
608	Molonglo River at Sutton Road Bridge	7.00	50.00	18.75	20.87	25
769	Queanbeyan River at ACT Border	4.90	24.00	11.73	8.57	25
842	Paddy's River at Riverlea	4.00	17.00	9.70	6.65	25
901	Gudgenby River at Tennent	2.00	77.00	29.67	41.19	25

Turbidity

Turbidity or opacity of a water body is related to the suspended solids concentration but also includes colouration. A stream may have very low levels of suspended material but be strongly coloured, for example the tannin rich streams in Namadgi National Park. Turbidity has an important ecological effect in determining the depth to which light penetrates the water, affecting plant growth and changing the kinds of algae present.

Canberra has soils with very fine clay particles that can cause high turbidity levels even though the actual amount of material suspended in the water column is not large. Also the small clay particles remain floating in the water long after the heaver sediments have settled on the bottom.

Rivers often experience pulses of high turbidity related to rainfall events that wash soil into the waterway however, in general turbidity in ACT lakes and rivers is down compared to the previous reporting period. This is likely a result of the lower levels of erosion and streambed disturbance because of relatively stable climatic conditions. Erosion in rural stream catchments, as an ongoing effect of the 2003 bushfires, appears to have been stabilised, as those waterways most directly affected (sites 842 and 901) show mean turbidity well within the regulation limits. The dramatic spike in turbidity at Kambah Pool (site 209) almost 10 times the nearest high reading, and 110 times the regulatory limit is coincident with the New Year's Eve storm event. Anecdotal evidence suggests that the urban run-off at that time was exceptional, and caused local flooding in parts of Kambah and surrounding suburbs.

Table 9. Turbidity (NTU) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	7.00	57.00	25.84	19.37	30
248	Lake Tuggeranong at Kambah Wetland	7.10	21.00	11.73	4.37	30
249	Lake Tuggeranong at Dam	8.00	17.00	12.68	3.47	30
270	Point Hut Pond at Dam Wall	39.00	110.00	61.63	21.88	30
318	Lake Ginninderra at Dam	3.60	9.20	6.43	2.13	30
321	Lake Ginninderra at East Arm	6.30	80.00	22.16	23.86	30
346	Gungahlin Pond at Dam Wall	4.80	29.00	12.18	8.49	30
204	Murrumbidgee River at Halls Crossing	4.40	99.00	45.47	48.52	10
209	Murrumbidgee River at Kambah Pool	11.00	1100.00	477.00	561.22	10
213	Murrumbidgee River at Angle Crossing	6.40	310.00	168.80	152.91	10
301	Ginninderra Creek at Parkwood	9.50	17.00	13.50	3.77	10
601	Molonglo River at Dairy Flat Bridge	2.90	140.00	50.47	77.59	10
608	Molonglo River at Sutton Road Bridge	5.90	69.00	29.30	34.56	10
769	Queanbeyan River at ACT Border	6.80	34.00	16.00	15.59	10
842	Paddy's River at Riverlea	4.30	26.00	15.15	15.34	10
901	Gudgenby River at Tennent	2.40	60.00	31.20	40.73	10

Faecal Coliform bacteria

Bacteria occur naturally in all water bodies. The presence of faecal coliforms in a water sample may be an indication that human or animal faeces have contaminated the water and that harmful, less easily detectable pathogens such as *Cryptosporidium* or *Giardia* may be present. High levels of faecal coliforms are not necessarily a problem for aquatic ecosystems. Faecal coliforms generally do not infect aquatic organisms, and may serve as a food source.

The presence of high numbers of faecal coliforms is a problem for some human uses of water bodies, particularly water supply and recreation involving bodily contact. This report looks at bacterial levels in water used for primary and secondary contact recreational use, but does not deal with the quality of drinking water.

Results are expressed as colony forming units (cfu) per 100 mL. The standard for water based recreation–swimming–is 150 cfu/100 mL and for boating and secondary contact is 1000 cfu/100ml. These standards apply to individual sites depending on whether they are classed for swimming or secondary contact recreation in the Territory Plan.

Faecal coliform levels generally compared favourably with the standard designated under in the Environment Protection Regulations. This provides some indication that land use planning and the quality of the ACT's sewerage system are protecting recreational opportunities. In the present reporting period, the highly elevated levels of faecal coliforms in the Murrumbidgee River corridor and Lake Tuggeranong (sites 204, 209, 213, 248 and 249) are associated with storm run-off. Although 12000 cfu/100 mL is a high count, the likely sources were urban and rural animal and garden manure, and not associated with human sewage. The next samples, in March 2007, show coliform counts at or under regulation limits. In general the annual means reflect the trend towards levels well under regulation limit, not withstanding unusual weather events.

Table 10. Faecal Coliforms (cfu/100mL) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	6.00	380.00	164.25	129.58	N/A
248	Lake Tuggeranong at Kambah Wetland	5.00	690.00	141.83	269.95	1000
249	Lake Tuggeranong at Dam	1.00	64.00	25.33	27.11	150
270	Point Hut Pond at Dam Wall	10.00	70.00	31.00	22.58	1000
318	Lake Ginninderra at Dam	2.00	22.00	6.43	7.30	150
321	Lake Ginninderra at East Arm	2.00	56.00	15.00	21.16	1000
346	Gungahlin Pond at Dam Wall	2.00	16.00	7.75	4.83	1000
204	Murrumbidgee River at Halls Crossing	8.00	1800.00	537.00	847.39	150
209	Murrumbidgee River at Kambah Pool	2.00	12000.00	3067.50	5956.08	150
213	Murrumbidgee River at Angle Crossing	10.00	12000.00	3115.00	5924.94	150
301	Ginninderra Creek at Parkwood	20.00	610.00	236.50	270.50	1000
601	Molonglo River at Dairy Flat Bridge	2.00	1600.00	425.50	783.71	1000
608	Molonglo River at Sutton Road Bridge	2.00	660.00	253.00	283.35	1000
769	Queanbeyan River at ACT Border	22.00	840.00	333.00	377.46	1000
842	Paddy's River at Riverlea	110.00	690.00	436.67	296.87	150
901	Gudgenby River at Tennent	80.00	360.00	223.33	140.12	1000

Conductivity

Conductivity – the ability of electricity to pass through water – is a measure of the salts and ions present in the water body. Pure de-ionised water does not conduct electricity; organic compounds like oil, alcohol, charcoal are poor conductors whereas salts (sodium, potassium, calcium), and metals (aluminium, iron) conduct electricity well.

Unless there is an unusual occurrence, conductivity measures provide good indication of the amount of salt in the water. Urban runoff can be high in salts as many cleaning agents, fertilisers and surfaces (paint, concrete, roads) contain salts and these salts are washed into streams during rainfall. Salts can also come from naturally occurring salt in soils and be mobilised by erosion and ground water seepages in drought periods.

There continues to be a long-term downward trend in conductivity in the majority of lake sites and some sites on the Murrumbidgee River. The highest readings for this period were recorded at sites along the Molonglo River, where leaching from ground water in rural areas and old mine tailings as a consequence of drought may be important, and also Burrinjuck Reservoir which captures runoff from the highly salinised area of the Yass River catchment outside of the ACT.

Table 11. Conductivity (uS/cm) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

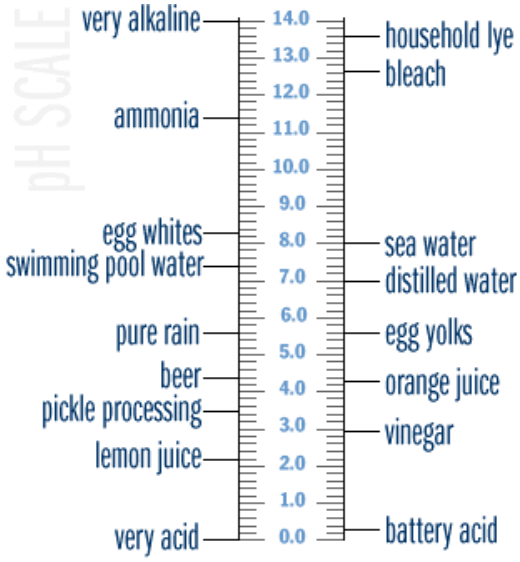
Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	230.00	465.00	357.86	77.02	N/A
248	Lake Tuggeranong at Kambah Wetland	16.00	150.00	119.50	42.79	N/A
249	Lake Tuggeranong at Dam	110.00	150.00	128.75	13.56	N/A
270	Point Hut Pond at Dam Wall	170.00	230.00	200.00	20.00	N/A
318	Lake Ginninderra at Dam	210.00	260.00	238.75	17.27	N/A
321	Lake Ginninderra at East Arm	230.00	260.00	242.50	11.65	N/A
346	Gungahlin Pond at Dam Wall	290.00	410.00	341.25	36.82	N/A
204	Murrumbidgee River at Halls Crossing	200.00	300.00	252.50	49.92	N/A
209	Murrumbidgee River at Kambah Pool	84.00	140.00	102.25	25.49	N/A
213	Murrumbidgee River at Angle Crossing	71.00	140.00	96.75	31.02	N/A
301	Ginninderra Creek at Parkwood	210.00	540.00	312.50	153.05	N/A
601	Molonglo River at Dairy Flat Bridge	110.00	450.00	342.50	160.70	N/A
608	Molonglo River at Sutton Road Bridge	90.00	640.00	385.00	254.89	N/A
769	Queanbeyan River at ACT Border	170.00	300.00	235.00	53.23	N/A
842	Paddy's River at Riverlea	81.00	150.00	113.67	34.65	N/A
901	Gudgenby River at Tennent	87.00	160.00	114.33	39.80	N/A

pH (Acidity)

The pH refers to the degree of acidity or alkalinity of the water. A pH of 7 is neutral. A value above 7 indicates that the water is alkaline and a pH below 7 indicates acidic conditions (see figure to right).

If the pH of the water is altered substantially then there can be changes to chemical processes, which could release nutrients or toxic metals that were previously bound safely in lake or river sediments. All sites had pH within an acceptable range throughout the year.

The source of run-off may influence the direction that pH takes in relation to rain. Gungahlin Pond (Site 346) has more alkaline reports in the dry early summer of 2006 and this may reflect ground water influences in urban areas. Run-off with much organic matter, like that in January 2007 at Kambah, may be more acidic than usual.



http://watertheweb.org/under/waterquality/pH.html

Table 12. pH summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	7.90	8.40	8.21	0.17	6-9
248	Lake Tuggeranong at Kambah Wetland	7.10	8.20	7.70	0.39	6-9
249	Lake Tuggeranong at Dam	7.00	8.00	7.55	0.36	6-9
270	Point Hut Pond at Dam Wall	7.20	8.20	7.76	0.36	6-9
318	Lake Ginninderra at Dam	7.90	8.50	8.19	0.23	6-9
321	Lake Ginninderra at East Arm	7.80	8.60	8.19	0.30	6-9
346	Gungahlin Pond at Dam Wall	8.30	9.40	8.76	0.42	6-9
204	Murrumbidgee River at Halls Crossing	7.50	9.10	8.10	0.70	6-9
209	Murrumbidgee River at Kambah Pool	6.50	7.80	7.35	0.58	6-9
213	Murrumbidgee River at Angle Crossing	6.60	7.60	7.28	0.46	6-9
301	Ginninderra Creek at Parkwood	6.90	7.80	7.33	0.40	6-9
601	Molonglo River at Dairy Flat Bridge	7.30	7.70	7.43	0.19	6-9
608	Molonglo River at Sutton Road Bridge	6.90	7.60	7.25	0.29	6-9
769	Queanbeyan River at ACT Border	7.00	7.60	7.28	0.25	6-9
842	Paddy's River at Riverlea	7.70	7.80	7.73	0.06	6-9
901	Gudgenby River at Tennent	7.40	7.70	7.53	0.15	6-9

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the oxygen in the water available to aquatic organisms. It is important for the maintenance of aquatic organisms as changes in DO can affect the species present. Low levels of DO can stress fish, which can lead to fungal infections and disease or result directly in fish kills. Levels of DO are affected by turbulence, temperature (colder water can hold more dissolved oxygen), photosynthesis (during periods of sunlight algae and other water plants produce oxygen, while in darkness they consume oxygen) and the level of biochemical oxygen demand.

Low flows in the rivers combined with other factors such as inputs of sediment and organic material can cause DO concentrations to fall to life threatening levels. In Ginninderra Creek, the Murrumbidgee River at Angle Crossing, as well as the Queanbeyan and Molonglo rivers near the ACT border there was a period this year, in the summer months, when low DO may have made the creek/river unfit for survival of aquatic life as a consequence of shallow depth, little water movement and elevated water temperatures. Other streams throughout the ACT were in the healthy range for DO concentrations.

Table 13. DO (mg/L) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	7.4	11.5	9.15	1.35	> 4
248	Lake Tuggeranong at Kambah Wetland	0.6	7.5	5.0	3.16	> 4
249	Lake Tuggeranong at Dam	4.6	10.1	7.4	2.50	> 4
270	Point Hut Pond at Dam Wall	3.6	10.9	6.6	2.98	> 4
318	Lake Ginninderra at Dam	7.6	11.7	9.1	1.41	> 4
321	Lake Ginninderra at East Arm	6.5	11.6	8.6	1.30	> 4
346	Gungahlin Pond at Dam Wall	6.7	13.5	9.8	2.31	> 4
204	Murrumbidgee River at Halls Crossing	6.80	11.80	9.30	2.38	> 4
209	Murrumbidgee River at Kambah Pool	7.30	12.90	10.25	2.36	> 4
213	Murrumbidgee River at Angle Crossing	2.40	12.80	8.23	4.62	> 4
301	Ginninderra Creek at Parkwood	2.10	11.00	5.88	4.50	> 4
601	Molonglo River at Dairy Flat Bridge	4.30	11.40	7.65	3.24	> 4
608	Molonglo River at Sutton Road Bridge	1.00	12.00	6.33	4.56	> 4
769	Queanbeyan River at ACT Border	1.10	10.80	5.25	4.83	> 4
842	Paddy's River at Riverlea	8.60	12.50	10.90	2.04	> 4
901	Gudgenby River at Tennent	7.10	14.10	11.23	3.67	> 4

Chlorophyll 'a'

Chlorophyll 'a' is the plant pigment that gives algae their green colour, and is commonly used as a measure of the quantity of algae present (algal biomass). This measure can therefore serve as a useful indicator of the extent to which an ecosystem has been affected by nutrient inputs. There is no standard for streams and rivers in the ACT while a standard of less than 10 μg/L applies for urban lakes and ponds.

Chlorophyll 'a' is measured in micrograms per litre (μg/L). To provide a sense of scale, water with a chlorophyll 'a' concentration of 1 μg/L will be clear, a concentration of 20 μg/L will be slightly green, and 100 μg/L very green and possibly with algal scums on the surface. There are also normal seasonal fluctuations in planktonic algal biomass that may appear in the figures, independent of flow rates or exceptional nutrient loads.

There is little change in Chlorophyll 'a' levels from those of 2005-2006. All lacustrine sites report occasional elevated levels, sometimes associated with low level planktonic blooms. As commented previously (Table 7), the late autumn/winter spikes are probably associated with diatom growth in response to increased flow, oxygen and nutrients.

Table 14. Chlorophyll-a (μg/L) summary results for ACT Water Quality Monitoring Sites - Lakes and Rivers 2006-2007.

Site number	Site name	Minimum	Maximum	Mean 06-07	Standard deviation	Regulation limits
102	Burrinjuck Res above Hume Park	4.00	22.00	12.34	6.71	10
248	Lake Tuggeranong at Kambah Wetland	9.20	52.00	24.03	16.89	10
249	Lake Tuggeranong at Dam	3.70	32.00	14.19	10.49	10
270	Point Hut Pond at Dam Wall	1.30	20.00	6.10	5.99	10
318	Lake Ginninderra at Dam	4.60	14.00	8.50	3.00	10
321	Lake Ginninderra at East Arm	2.90	13.00	9.03	4.18	10
346	Gungahlin Pond at Dam Wall	2.20	15.00	7.93	4.77	10
204	Murrumbidgee River at Halls Crossing	6.10	43.00	18.75	16.99	N/A
209	Murrumbidgee River at Kambah Pool	2.20	35.00	13.80	14.50	N/A
213	Murrumbidgee River at Angle Crossing	2.90	28.00	11.35	11.30	N/A
301	Ginninderra Creek at Parkwood	2.80	33.00	10.68	14.89	N/A
601	Molonglo River at Dairy Flat Bridge	7.50	29.00	14.43	10.02	N/A
608	Molonglo River at Sutton Road Bridge	3.60	8.60	5.23	2.32	N/A
769	Queanbeyan River at ACT Border	2.80	14.00	6.95	4.94	N/A
842	Paddy's River at Riverlea	1.40	2.90	2.27	0.78	N/A
901	Gudgenby River at Tennent	1.30	10.00	4.83	4.57	N/A

Algal Monitoring of Lake Recreation Areas

Algae are simple, usually microscopic plants that live either in water or damp areas. Dense growths of algae can impact on water quality and aesthetics by causing bad smells, strange colours and forming thick scums. When planktonic algal numbers increase dramatically and change the colour of the water the phenomenon is called an algal bloom. Rotting algae will use up oxygen in the water. Severe blooms also use all available dissolved oxygen. The oxygen drop may cause fish to die as a result. Some members of a certain class of algae, "blue-green algae", in some situations can generate toxins which are poisonous to animals and people.

Blue-green algae occur naturally in most ACT water bodies, but usually in low numbers in biological balance with other aquatic life. However, given the right environmental conditions, which include warm weather, low rainfall and the right mix of nutrient levels, planktonic blue-green algae, usually *Microcystis*, *Anabaena* or *Tyconema* in the ACT, may multiply rapidly to high levels, dominate all other algae and pose a health risk. When the TN: TP ratio is >10, and turbidity decreases then the likelihood of a blue-green algal bloom becomes imminent.

Weekly monitoring of visible planktonic algal conditions (especially for blue-green *Microcystis* and *Tyconema*) is performed by Environment Protection Officers and actions on alerts, warnings or lake closures are determined when certain levels of blue-green algae are present (Table 15).

Warm weather combined with other environmental conditions, such as low flows, resulted in high algal levels in Lake Tuggeranong, which was closed for a short time during summer and early autumn and warnings were posted at the other urban lakes. A medium level warning was also given for the water ski area on the Molonglo River for a short period this autumn.

Table 15: Algae Alert Levels for ACT Urban Lakes

Level	Blue-green algal cells/mL	Response
Low	>500 to <5,000	At this level, there is generally no major health risk. The EPA carries out routine monitoring, which includes weekly visual inspections.
Medium	≥5, 000 to <50,000	At this level there is a greater risk of potential health problems. The EPA increases the visual sampling to twice a week and undertakes water sampling weekly. If algal counts are > 20,000 cells/mL then on-site signs are erected to warn potential water users against risk of skin irritation, headache, nausea, and gastrointestinal illness.
High	≥50,000 or scums are consistently present	At this alert level the EPA maintains a twice-weekly visual inspection and weekly water sampling regime. In addition on-site signs are changed to 'Lake Closed' signs.

AUSRIVAS (Biological assessment using benthic macroinvertebrates)

Water chemistry analysis such as pH, total phosphorus and dissolved oxygen provides a snapshot of the water quality at the time when the sample is taken. Biological assessment, in this case the sampling of waterbugs (benthic macroinvertebrates), can indicate much about the water quality over time and show what kind of environment the water and its waterway provide for animals to live in.

Macroinvertebrate biological assessment is based on a comparison between a tally of the range of waterbugs found at a site with those predicted to occur there. If all those animals expected at a site actually occur there, the site is judged to be in good condition. Conversely the absence of expected animals indicates a site has been disturbed. The rating scale for AUSRIVAS outputs is presented below (Table 16). A full explanation of the AUSRIVAS biological assessment method for the ACT is available from http://ausrivas.canberra.edu.au and the full biological assessment reports are available on request from Water Resources.

Seeing who's home…. Collecting water bugs to assess water quality and habitat conditions

Table 16: AUSRIVAS Bands and their O/E Taxa Scores for the ACT Autumn Edge Model and Some Interpretations for Reporting (Ball *et al.* 2001).

Band	Condition	Taxa Interpretations
X	MORE BIOLOGICALLY DIVERSE THAN REFERENCE	More families found than expected. Potential biodiversity 'hot-spot' or mild organic enrichment. Continuous irrigation flow in a normally intermittent stream. Differential loss of pollution-tolerant taxa (potential impact unrelated to water quality).
A	SIMILAR TO REFERENCE	Expected number of families within the range found at 80% of the reference sites.
B	SIGNIFICANTLY IMPAIRED	Fewer families than expected. Potential impact either on water and/or habitat resulting in a loss of families.
C	SEVERELY IMPAIRED	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
D	EXTREMELY IMPAIRED	Few of the expected families and only the hardy, pollution tolerant families remain. Severe impairment.

Table 17: Summary of AUSRIVAS Band Scores for Sites in the ACT from Autumn 2003 to Spring 2006. Note: there is no regulation limit for this parameter.

Site Number	Site Name	Autumn 03	Spring 03	Autumn 04	Spring 04	Autumn 05	Spring 05	Autumn 06	Spring 06	Autumn 07
20	Gudgenby R at Smiths Road	B	A	A	A	A	A	A	A	B
204	Murrumbidgee R at Halls Crossing	B	C	A	C	C	B	A	A	B
58	Tuggeranong Ck D/S of Lake	A	C	B	B	C	C	B	B	B
64	Ginninderra Ck at Latham	C	C	B	B	C	D	B	C	B
195	Ginninderra Ck Baldwin Drive	C	D	C	C	B	D	C	C	C
196	Ginninderra Ck D/S of Lake	C	C	C	C	C	C	B	C	C
769	Queanbeyan R at ACT border	C	C	C	D	C	C	C	C	C
608	Molonglo Rat Sutton Road	C	B	C	C	C	B	B	B	B
246	Jerrabomberra Ck at Hindmarsh Drive	B	C	B	B	C	D	B	B	C
189	Yarralumla Ck at Cotter Road bridge	C	D	C	C	C	C	C	C	C
10	Paddys R at Murray's Corner	B	B	B	A	B	A	B	B	B
15	Tidbinbilla R at Paddys River Road	B	A	A	A	A	B	B	A	A
213	Murrumbidgee R at Angle Crossing	B	C	B	B	B	B	B	C	A

Reference sites (10, 15, 213) degraded immediately after the 2003 bushfires, and 213 has remained stressed, first by post bushfire riparian damage and more recently low flow under drought condition. Reference site 15 has returned to reference standard after increased drought stress in 2005-2006. Reference site 10 has remained significantly impaired from autumn 2006. Reference site 213 shows the continued effects of riparian damage from the 2003 fire coupled with the enduring drought and is assessed as severely impaired in spring 2006. By autumn 2007 it has returned to reference. The onset of the drought (winter 2002) saw the biological condition of many urban sites degrade further from reference condition. The biological communities in urban sites are under considerable stress from habitat degradation, altered flow regimes, pollutant inputs, pest species and thus are not as resilient to natural stresses such as drought compared with non-urban sites.

Those sites that in spring 2006 retained the same assessment as autumn 2006 were: 20 and 204 (A); 10, 58, 246, and 608 (B); 189, 195 and 769 (C). Site 20 remains the most consistently acceptable site for biological activity. Sites 64, 196 and 213 all decreased in biological condition from B in autumn 2006 to C. Site 608 has shown 18 months of significantly, but not severely, impaired condition, while the data on biodiversity indicate similarities in macroinvertebrates with other partly rural sites 58 and 204.

When sampled in Autumn 2007 most sites were significantly impaired, including reference site 10 once again. The improvement at reference site 213 is probably related to the on-going improvement in riparian condition, even with low flows. Sites 20 and 204 showed a decline from similar to reference to significantly impaired most likely as a consequence of little flow. Ginninderra Ck at Latham improved from severely to significantly impaired, while the other sites remain severely impaired. Jerrabomberra Ck, which had shown improvement in 2006, again slipped back to severely impaired.

Lakes

Lake Tuggeranong

Two sites are monitored in Lake Tuggeranong, one at the Kambah Wetland (Site 248), which is near the northern inflow to the lake, and the other at the dam wall (Site 249).

Data collected since 1992 has indicated decreasing trends in nitrogen, phosphorus and conductivity at both sites. High turbidity readings, formally typical for Lake Tuggeranong, have been replaced by levels well within guidelines. The continued reporting of values within limits for turbidity and suspended solids indicates structural stability of the lake bottom has been achieved. There were high levels of chlorophyll 'a' from October to May in the Kambah Wetland embayment consistent with alerts or closures in summer because of medium to high levels of blue-green algae observed in the recreation areas, as well as other planktonic algal activity as local storm water inflows resumed with late autumn rains.

Table 18: Site 248 Lake Tuggeranong Kambah Wetland

Indicator	units	Reg limits	Long term average	Mean	Aug-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	May-07
Acidity	pH	6-9	7.73	7.70	7.6	8.2	7.9	7.7	7.6	7.1	8.2	7.3
Chlorophyll 'a'	ug/L	10	12.66	24.03	9.2	19.0	17.0	16.0	15.0	50.0	14.0	52.0
Conductivity	uS/cm	N/A	191.29	119.50	130.0	130.0	140.0	150.0	140.0	130.0	16.0	120.0
Dissolved Oxygen	mg/L	>4	7.40	5.0	*	*	*	7.5	7.1	0.6	4.9	4.9
Faecal Coliforms - Confirmed	cfu/ 100mL	1000	14209	141.83	6.0	5.0	690.0	*	*	70.0	20.0	60.0
Suspended Solids	mg/L	25	21.93	12.50	13.0	9.0	13.0	11.0	3.0	20.0	7.0	24.0
Total Nitrogen	mg/L N	N/A	1.08	1.02	0.7	0.7	0.7	0.7	0.8	1.5	1.1	1.9
Total Phosphorus	mg/L P	0.1	0.09	0.10	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2
Turbidity	NTU	30	33.74	11.73	13.0	11.0	14.0	9.6	8.7	9.4	7.1	21.0

Table 19: Site 249 Lake Tuggeranong Dam Wall

Indicator	units	Reg limits	Long term average	Mean	Aug-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	May-07
Acidity	pH	6-9	7.69	7.55	7.7	8.0	8.0	7.6	7.3	7.0	7.2	7.6
Chlorophyll 'a'	ug/L	10	9.63	14.19	6.5	13.0	29.0	11.0	10.0	3.7	8.3	32.0
Conductivity	uS/cm	N/A	183.92	128.75	110.0	120.0	140.0	150.0	140.0	130.0	120.0	120.0
Dissolved Oxygen	mg/L	>4	7.42	7.4	10.1	10.0	9.1	8.2	5.0	4.6	4.9	7.5
Faecal Coliforms - Confirmed	cfu/ 100mL	1000	321.85	25.33	2.0	1.0	50.0	*	*	30.0	5.0	64.0
Suspended Solids	mg/L	25	17.70	9.50	13.0	9.0	12.0	7.0	6.0	9.0	7.0	13.0
Total Nitrogen	mg/L N	N/A	1.04	0.99	0.7	0.7	0.8	0.7	0.9	1.2	1.1	1.8
Total Phosphorus	mg/L P	0.1	0.08	0.09	0.1	0.0	0.1	0.0	0.1	0.2	0.1	0.1
Turbidity	NTU	30	35.54	12.68	14.0	13.0	15.0	8.0	17.0	10.0	8.4	16.0

* Data not available for month

Point Hut Pond

Water quality in Point Hut Pond (Site 270) has been historically poor compared with the standards set for its designated uses in the Territory Plan and comparison with other lake sites in the ACT. Turbidity remains slightly elevated, but suspended solids loads are now generally close to or within guidelines. The elevated chlorophyll 'a' reading in October was consistent with a natural lacustrine springtime phytoplankton flush that EPA reports indicate had subsided by the end of the month. Below limit dissolved Oxygen levels in summer reflect the lack of mixing and nil inflow in a closed system.

Table 20: Site 270 Point Hut Pond

Indicator	units	Reg limits	Long term average	Mean	Aug-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	May-07
Acidity	pH	6-9	7.95	7.76	8.0	8.1	8.0	8.2	7.6	7.5	7.2	7.5
Chlorophyll 'a'	ug/L	10	10.69	6.10	5.3	20.0	5.7	5.7	6.8	2.0	2.0	1.3
Conductivity	uS/cm	N/A	238.73	200.00	190.0	210.0	220.0	230.0	200.0	200.0	180.0	170.0
Dissolved Oxygen	mg/L	>4	8.05	6.6	10.9	9.2	8.3	8.0	3.7	4.1	3.6	5.3
Faecal Coliforms - Confirmed	cfu/ 100mL	1000	149.19	31.00	18.0	10.0	56.0	10.0	14.0	30.0	70.0	40.0
Suspended Solids	mg/L	25	30.99	21.75	39.0	19.0	13.0	24.0	9.0	26.0	17.0	27.0
Total Nitrogen	mg/L N	N/A	1.17	1.04	1.0	0.9	0.9	0.8	1.1	1.4	1.2	1.1
Total Phosphorus	mg/L P	0.1	0.08	0.11	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1
Turbidity	NTU	30	75.57	61.63	69.0	49.0	64.0	62.0	110.0	48.0	39.0	52.0

Gungahlin Pond

Water quality in Gungahlin Pond (Site 346) is now good, and while the water is occasionally slightly more alkaline than guidelines recommend, biological activity, as indicated by faecal Coliform counts and chlorophyll 'a' records, is within expectations. The implementation of development controls together with sediment retention ponds upstream of Gungahlin Pond have contributed to the improving water quality. The reduction in suspended solids concentrations is expected to continue as the immediate catchment area stabilises now that the extensive development during previous years has declined.

Table 21: Site 346 Gungahlin Pond

Indicator	units	Reg limits	Long term average	Mean	Aug-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	May-07
Acidity	pH	6-9	8.16	8.76	8.7	9.4	9.0	9.2	8.3	8.4	8.8	8.3
Chlorophyll 'a'	ug/L	10	5.95	7.93	6.4	2.4	*	2.2	10.0	7.5	15.0	12.0
Conductivity	uS/cm	N/A	321.75	341.25	290.0	310.0	330.0	330.0	370.0	410.0	350.0	340.0
Dissolved Oxygen	mg/L	>4	8.13	9.8	13.5	10.5	10.0	9.0	6.7	7.5	11.3	9.6
Faecal Coliforms - Confirmed	cfu/ 100mL	1000	23.01	7.75	6.0	2.0	6.0	10.0	8.0	12.0	2.0	16.0
Suspended Solids	mg/L	25	18.52	13.25	5.0	4.0	3.0	19.0	35.0	17.0	9.0	14.0
Total Nitrogen	mg/L N	N/A	1.03	0.58	0.5	0.4	0.5	0.5	0.7	0.7	0.7	0.6
Total Phosphorus	mg/L P	0.1	0.04	0.04	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Turbidity	NTU	30	30.97	12.18	4.8	5.7	5.3	17.0	29.0	17.0	6.6	12.0

* Data not available for month

Lake Ginninderra

Two sites are monitored in Lake Ginninderra, one near the inflow in the East Arm (Site 321) and the other at the outflow dam wall, or West Arm (Site 318). Water quality in the lake was good and generally better than the other lakes monitored. Localised weather events, like the rain of 3rd and 4th November 2006, which subsequently raised suspended solids and turbidity levels at the dam wall, stand out in otherwise consistent figures.

Table 22: Site 318 Lake Ginninderra East Arm

Indicator	units	Reg limits	Long term average	Mean	Aug-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	May-07
Acidity	pH	6-9	7.92	8.19	8.1	8.2	8.1	8.4	8.5	8.4	7.9	7.9
Chlorophyll 'a'	ug/L	10	5.48	8.50	10.0	14.0	8.9	8.6	5.8	10.0	6.1	4.6
Conductivity	uS/cm	N/A	281.31	238.75	210.0	220.0	230.0	240.0	250.0	260.0	250.0	250.0
Dissolved Oxygen	mg/L	>4	7.26	9.1	11.7	10.2	8.2	8.5	8.0	10.2	8.3	7.6
Faecal Coliforms - Confirmed	cfu/ 100mL	1000	96.13	6.43	*	4.0	2.0	2.0	4.0	2.0	9.0	22.0
Suspended Solids	mg/L	25	12.18	7.00	8.0	8.0	8.0	5.0	5.0	6.0	8.0	8.0
Total Nitrogen	mg/L N	N/A	0.74	0.57	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.7
Total Phosphorus	mg/L P	0.1	0.04	0.03	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Turbidity	NTU	30	14.35	6.43	7.4	9.2	8.7	4.8	4.0	3.6	6.1	7.6

Table 23: Site 321 Lake Ginninderra Dam Wall

Indicator	units	Reg limits	Long term average	Mean	Aug-06	Oct-06	Nov-06	Dec-06	Jan-07	Feb-07	Mar-07	May-07
Acidity	pH	6-9	8.00	8.19	8.1	8.0	7.9	8.5	8.6	8.5	8.1	7.8
Chlorophyll 'a'	ug/L	10	9.86	9.03	7.6	12.0	13.0	12.0	8.4	13.0	3.3	2.9
Conductivity	uS/cm	N/A	295.34	242.50	230.0	230.0	230.0	240.0	250.0	260.0	250.0	250.0
Dissolved Oxygen	mg/L	>4	8.03	8.6	11.6	8.6	7.4	9.0	8.5	8.9	8.3	6.5
Faecal Coliforms - Confirmed	cfu/ 100mL	1000	284.85	15.00	*	2.0	20.0	4.0	4.0	4.0	*	56.0
Suspended Solids	mg/L	25	23.39	27.13	15.0	17.0	110.0	17.0	11.0	27.0	6.0	14.0
Total Nitrogen	mg/L N	N/A	0.80	0.67	0.8	0.7	0.9	0.6	0.6	0.6	0.5	0.7
Total Phosphorus	mg/L P	0.1	0.05	0.05	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Turbidity	NTU	30	26.92	22.16	11.0	22.0	80.0	13.0	11.0	18.0	6.3	16.0

* Data not available for month

Rivers

Ginninderra Creek

Ginninderra Creek runs through a highly urbanised catchment with intensive development occurring in the upper parts of Gungahlin. The monitoring site for water quality in Ginninderra Creek is at Parkwood (Site 301) below the confluence with Gooromon Ponds Creek downstream of the lake. The biological monitoring sites in Ginninderra Creek are Baldwin Drive bridge (Site 195), downstream of Lake Ginninderra (Site 196) and Latham (Site 64).

While it is expected that willow removal work in the area will eventually make inroads towards improving Ginninderra Creek habitat, the compounding affect of the continued low flows and degraded habitat has resulted in a reduction in AUSRIVAS spring scores at two sites (196 and 64) for this reporting period. Spring 06 sampling continues to reveal impoverished AUSRIVAS scores for Ginninderra Creek. Very low levels of dissolved oxygen in summer and autumn 2007, associated with water flow of <10 ML/day (Figure4) may coincide with poor AUSRIVAS scores indicating continued degraded riparian habitat. The raised level of chlorophyll 'a' for October is related to a normal spring phytoplankton flush. High faecal coliform counts after rain events (June 2007) are not uncommon in urban catchments, especially following long dry periods.

Table 24: Values of Indicators Sampled at Sites 301, 195, 196 and 64 along Ginninderra Creek

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	7.76	7.33	7.5	6.9	7.1	7.80
Chlorophyll 'a'	ug/L	10	14.59	10.68	33.0	2.8	3.8	3.10
Conductivity	uS/cm	N/A	413.59	312.50	540.0	260.0	240.0	210.00
Dissolved Oxygen	mg/L	>4	8.22	5.88	8.3	2.1	2.1	11.00
Faecal Coliforms - Confirmed	cfu/100mL	150/1000	1259.62	236.50	56.0	260.0	20.0	610.00
Suspended Solids	mg/L	25	15.83	17.50	15.0	11.0	23.0	21.00
Total Nitrogen	mg/L N	N/A	1.17	0.88	0.7	1.3	0.6	0.90
Total Phosphorus	mg/L P	0.1	0.94	0.07	0.1	0.1	0.1	0.05
Turbidity	NTU	30	12.05	13.50	9.5	14.0	*	17.00
AUSRIVAS score (195)	A, B, C, D	N/A			C		C	
AUSRIVAS score (196)	A, B, C, D	N/A			C		C	
AUSRIVAS score (64)	A, B, C, D	N/A			C		B	

Ginninderra Creek is constrained as it flows through urban areas. Poor riparian vegetation encourages excessive growth of filamentous algae.

Paddys River (842)

Paddys River catchment has a combination of rural, forestry and conservation land uses. It was affected directly by the January 2003 bushfires. This was reflected in the AUSRIVAS data at Murray's Corner (Site 10), which was below reference for some time after the bushfires.
Sampling results for Paddys River for this year are similar to the last two years, with good water quality and biological condition at reference or just below reference condition.

Table 25: Values of Indicators Sampled on Sites 842 and 10 along Paddys River

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Mar 07	Jun 07
Acidity	pH	6-9	7.62	7.73	7.80	7.70	7.70
Chlorophyll 'a'	ug/L	10	2.12	2.27	2.50	1.40	2.90
Conductivity	uS/cm	N/A	88.71	113.67	110.00	150.00	81.00
Dissolved Oxygen	mg/L	>4	10.58	10.90	11.60	8.60	12.50
Faecal Coliforms - Confirmed	cfu/100mL	150/1000	378.59	436.67	110.00	690.00	510.00
Suspended Solids	mg/L	25	9.65	9.70	4.00	8.10	17.00
Total Nitrogen	mg/L N	N/A	0.44	0.54	0.24	0.67	0.72
Total Phosphorus	mg/L P	0.1	0.04	0.07	0.03	0.11	0.08
Turbidity	NTU	30	12.16	15.15	4.30		26.00
AUSRIVAS band (10)	A,B,C,D	N/A			B	B	

Gudgenby River (901)

The Gudgenby River drains a rural catchment dominated by native forest, and is a fire affected site. Nevertheless, water quality at this site was in good condition. Late autumn and winter rain this year has elevated turbidity and suspended solids and may have washed in soil phosphates as well. Similarly the biological condition of the site at Smiths Road Crossing (20) remained at reference condition in spring 2006, indicating good river health.

Table 26: Values of Indicators Sampled on Sites 901 and 20 along the Gudgenby River

Indicator	Units	Regulation limits	Long term average	Average 2005-2006	Oct 06	Mar 07	Jun07
Acidity	pH	6-9	7.71	7.53	7.50	7.40	7.70
Chlorophyll 'a'	ug/L	10	1.98	4.83	1.30	3.20	10.00
Conductivity	uS/cm	N/A	100.39	114.33	87.00	160.00	96.00
Dissolved Oxygen	mg/L	>4	9.96	11.23	14.10	7.10	12.50
Faecal Coliforms - Confirmed	cfu/100mL	1000	268.67	223.33	230.00	80.00	360.00
Suspended Solids	mg/L	25	9.96	29.67	2.00	10.00	77.00
Total Nitrogen	mg/L N	N/A	0.43	0.86	0.28	1.00	1.30
Total Phosphorus	mg/L P	0.1	0.04	0.15	0.03	0.21	0.21
Turbidity	NTU	30	10.78	31.20	2.40	*	60.00
AUSRIVAS score (20)	A, B, C, D	N/A			A	B	

* Data not available for this month

Murrumbidgee River

The Murrumbidgee River flows through the ACT entering at Angle Crossing (213) in the south and is sampled at three locations; Angle Crossing, Kambah Pool (209), and Halls Crossing (204) in NSW just downstream of the ACT. As the main river in the ACT the Murrumbidgee is on the receiving end of most material transported throughout ACT waterways.

In 2007 the above average (and outside limit) readings in turbidity and suspended solids reflect the rain storms on New Year's Eve and February, and the late autumn and winter rains. The exceptional Turbidity figure (1100 NTU) for Kambah Pool (also reported in the Waterwatch data for Coffee's Cottage (450 NTU, 1 Jan 07) upstream of Kambah Pool and opposite Banks at the end of the urban area) indicates that a very dense sediment slug travelled down the Murrumbidgee following the New Year's Eve storm. As these weather events followed a long dry period, some rise in phosphate, in run-off from soils, and biological activity is to be expected. Faecal coliform counts were heightened after both rain events, and at least at the two up-river sites this is not likely to be associated with human waste. The high chlorophyll 'a' reports for June 2007 reflect the same influx of nutrients, and were not reported as associated with blue-green algal activity.

The poor spring AUSRIVAS score for Angle Crossing confirms the stress the long drought has put on non-riparian catchment vegetation. The continued satisfactory AUSRIVAS score at Hall's Crossing may indicate that the ACT's contribution of water is beneficial at that point in the system.

Murrumbidgee River upstream, Angle Crossing, February 2007

Table 27: Values of Indicators Sampled on Site 213 on the Murrumbidgee River at Angle Crossing

Indicator	Units	Regulation limits	Long term average	Average 2005-2006	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	7.79	7.28	7.6	6.6	7.4	7.50
Chlorophyll 'a'	ug/L	10	3.95	11.35	6.6	7.9	2.9	28.00
Conductivity	uS/cm	N/A	127.90	96.75	78.0	98.0	140.0	71.00
Dissolved Oxygen	mg/L	>4	9.27	8.23	10.9	2.4	6.8	12.80
Faecal Coliforms - Confirmed	cfu/100mL	150	222.87	3115.00	10.0	12000.0	110.0	340.00
Suspended Solids	mg/L	25	14.72	207.50	10.0	250.0	190.0	380.00
Total Nitrogen	mg/L N	N/A	0.52	4.88	0.3	16.0	1.3	1.90
Total Phosphorus	mg/L P	0.1	0.05	0.66	0.0	1.8	0.3	0.51
Turbidity	NTU	30	10.41	168.80	6.4	190.0	*	310.00
AUSRIVAS score	A, B, C, D	N/A			C		A	

Table 28: Values of Indicators Sampled on Site 209 on the Murrumbidgee River at Kambah Pool

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	7.95	7.35	7.8	6.5	7.5	7.60
Chlorophyll 'a'	ug/L	10	5.89	13.80	9.7	2.2	8.3	35.00
Conductivity	uS/cm	N/A	138.92	102.25	92.0	84.0	140.0	93.00
Dissolved Oxygen	mg/L	>4	9.47	10.25	9.7	11.1	7.3	12.90
Faecal Coliforms - Confirmed	cfu/100mL	150	297.37	3067.50	2.0	12000.0	18.0	250.00
Suspended Solids	mg/L	25	23.50	353.25	13.0	780.0	110.0	510.00
Total Nitrogen	mg/L N	N/A	0.58	2.30	0.4	5.2	1.3	2.30
Total Phosphorus	mg/L P	0.1	0.05	0.61	0.0	1.6	0.2	0.60
Turbidity	NTU	30	18.59	477.00	11.0	1100.0	*	320.00

* Data not available for this month

Table 29: Values of Indicators Sampled on Site 204 on the Murrumbidgee River at Halls Crossing

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	8.31	8.10	9.1	7.5	7.8	8.00
Chlorophyll 'a'	ug/L	10	14.66	18.75	7.9	6.1	18.0	43.00
Conductivity	uS/cm	N/A	196.77	252.50	290.0	200.0	220.0	300.00
Dissolved Oxygen	mg/L	>4	10.09	9.30	10.8	6.8	7.8	11.80
Faecal Coliforms - Confirmed	cfu/100mL	150	414.25	537.00	8.0	1800.0	100.0	240.00
Suspended Solids	mg/L	25	17.34	75.50	7.0	37.0	78.0	180.00
Total Nitrogen	mg/L N	N/A	3.59	3.40	6.7	1.5	3.2	2.20
Total Phosphorus	mg/L P	0.1	0.11	0.14	0.0	0.1	0.2	0.20
Turbidity	NTU	30	13.04	45.47	4.4	33.0	*	99.00
AUSRIVAS score		N/A			A		B	

Molonglo River

The Molonglo River is sampled at two sites above Lake Burley Griffin, near where the river enters the ACT at Dairy Flat (Site 601), and Sutton Road bridge (Site 608) downstream of the Molonglo Gorge. Additional sampling of the Molonglo River, near its confluence with the Murrumbidgee River, is carried out by ActewAGL as part of monitoring the impact of the Lower Molonglo Water Quality Control Centre (Canberra's main sewerage treatment plant) may have on downstream waters. During times of low flow (January 07, Table 30) the amount of Dissolved Oxygen in the river is distressing for aquatic organisms. When the Molonglo River enters the ACT it has flowed along the periphery of urban/industrial areas of Queanbeyan and continues through intensive land use in the ACT. The June data at the urban site (601) reflect the run-off effects resulting from the autumn and winter rain. That for the rural site (608) may be a little further heightened by back-burning in the Molonglo Gorge in April 2007. Both degraded habitat and the at times poor water quality can contribute to the impaired biological scores in the Molonglo River. AUSRIVAS scores for this reporting period have remained the same for the last two years.

Table 30: Values of Indicators Sampled on Site 601 on the Molonglo River at Dairy Flat Bridge

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	7.57	7.43	7.30	7.30	7.40	7.70
Chlorophyll 'a'	ug/L	10	13.89	14.43	7.50	13.00	29.00	8.20
Conductivity	uS/cm	N/A	243.97	342.50	450.00	450.00	360.00	110.00
Dissolved Oxygen	mg/L	>4	7.52	7.65	9.20	4.30	5.70	11.40
Faecal Coliforms - Confirmed	cfu/100mL	150	112.10	425.50	2.00	20.00	80.00	1600.00
Suspended Solids	mg/L	25	12.79	35.85	4.00	12.00	7.40	120.00
Total Nitrogen	mg/L N	N/A	1.41	1.89	3.60	0.85	1.30	1.80
Total Phosphorus	mg/L P	0.1	0.10	0.07	0.02	0.05	0.05	0.15
Turbidity	NTU	30	12.74	50.47	2.90	8.50	*	140.00

Table 31: Values Indicators Sampled on Site 608 on the Molonglo River at Sutton Road

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	7.32	7.25	7.20	6.90	7.30	7.60
Chlorophyll 'a'	ug/L	10	4.23	5.23	4.90	8.60	3.80	3.60
Conductivity	uS/cm	N/A	350.83	385.00	640.00	550.00	260.00	90.00
Dissolved Oxygen	mg/L	>4	6.91	6.33	7.10	1.00	5.20	12.00
Faecal Coliforms - Confirmed	cfu/100mL	1000	382.77	253.00	2.00	180.00	170.00	660.00
Suspended Solids	mg/L	25	12.89	18.75	8.00	7.00	10.00	50.00
Total Nitrogen	mg/L N	N/A	0.47	0.76	0.38	0.47	0.79	1.40
Total Phosphorus	mg/L P	0.1	0.04	0.06	0.02	0.05	0.05	0.13
Turbidity	NTU	30	20.37	29.30	5.90	13.00	*	69.00
AUSRIVAS score		N/A			B		B	

* Data not available for this month

Queanbeyan River (769)

The Queanbeyan River is sampled at the ACT border. Most indicators for water quality are quite acceptable. Low flow downstream of the town weir associated with hot weather and little rain leads to concerningly low levels of dissolved oxygen at this sampling point. Poor but improving in-stream conditions for aquatic life are supported by the low, but improved, AUSRIVAS score for autumn 2006. Further improvements in riparian condition in the urban reaches of the river (in New South Wales) should be reflected in continuing acceptable indicator values at the sampling site.

Table 32: Values Indicators Sampled on Site 769 on the Queanbeyan River at the ACT Border

Indicator	Units	Regulation limits	Long term average	Average 2006-2007	Oct 06	Jan 07	Mar 07	Jun 07
Acidity	pH	6-9	7.4	7.28	7.30	7.00	7.20	7.60
Chlorophyll 'a'	ug/L	10	6.7	6.95	4.50	14.00	2.80	6.50
Conductivity	uS/cm	N/A	206.3	235.00	240.00	300.00	230.00	170.00
Dissolved Oxygen	mg/L	>4	7.8	5.25	7.80	1.10	1.30	10.80
Faecal Coliforms - Confirmed	cfu/100mL	1000	508.1	333.00	22.00	400.00	70.00	840.00
Suspended Solids	mg/L	25	8.0	11.73	7.00	11.00	4.90	24.00
Total Nitrogen	mg/L N	N/A	0.5	0.93	0.51	0.74	0.78	1.70
Total Phosphorus	mg/L P	0.1	0.0	0.09	0.03	0.12	0.12	0.10
Turbidity	NTU	30	6.7	16.00	6.80	7.20	*	34.00
AUSRIVAS score	A, B, C D	N/A			C		C	

Tidbinbilla River (15)

The Tidbinbilla River is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. The October AUSRIVAS score, one of the reference site scores, has returned the score that indicates the river is healthy.

Table 33: Values Indicators Sampled on Site 15 on the Tidbinbilla River

Indicator	Units	Regulation limits	October 06	March 07
Conductivity	(µS/cm)	N/A	79.8	*
Acidity	pH	6.5-9	7.85	*
Alkalinity	(mg/L $CaCO_3$)	N/A	40	*
Dissolved Oxygen	(mg/L)	>4	9.41	*
Turbidity	(NTU)	<10	42.6	*
AUSRIVAS score	A, B, C D	N/A	A	A

Jerrabomberra Creek (246)

Site 246 (Figure 7) on Jerrabomberra Creek is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. Jerrabomberra Creek drains through industrial, rural and urban settings and water quality is in a satisfactory condition although the turbidity was elevated, perhaps because of stock movements or local construction, biological condition remains poor and may continue so until riparian vegetation improves.

Table 34: Values of Indicators Sampled on Site 246 on Jerrabomberra Creek near Hindmarsh Drive

Indicator	Units	Regulation limits	October 06	March 07
Conductivity	(µS/cm)	N/A	447	*
Acidity	pH	6.5-9	7.62	*
Alkalinity	(mg/L $CaCO_3$)	N/A	155	*
Dissolved Oxygen	(mg/L)	>4	8.26	*
Turbidity	(NTU)	<10	305.3	*
AUSRIVAS band	A, B, C D	N/A	B	C

Yarralumla Creek (189)

Site 189 (Figure 7) on Yarralumla Creek is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. This creek is mostly a concrete lined drain meandering through the urban areas of Phillip and Woden. The poor AUSRIVAS score for this site reflects the highly modified nature of the creek.

Table 35: Values of Indicators Sampled on Site 189 on Yarralumla Creek Downstream Curtain

Indicator	Units	Regulation limits	October 06	March 07
Conductivity	(µS/cm)	N/A	345	*
Acidity	pH	6.5-9	7.45	*
Alkalinity	(mg/L $CaCO_3$)	N/A	120	*
Dissolved Oxygen	(mg/L)	>4	3.09	*
Turbidity	(NTU)	<10	9.9	*
AUSRIVAS	A, B, C D	N/A	C	C

Concrete lined sections of Yarralumla Creek provide poor habitat for anything but filamentous algae

Tuggeranong Creek (58)

Site 58 (Figure 7) on Tuggeranong Creek is only sampled using the AUSRIVAS macroinvertebrate rapid bioassessment protocol in spring and autumn. Water quality results presented for this site are those sampled in conjunction with the macroinvertebrate sampling. This site is in the creek downstream of Lake Tuggeranong. Although Lake Tuggeranong helps prevent sediments and pollutants from reaching this section of the creek habitat, the surrounding land use of grazing and the disturbance by bushfires means this site is susceptible to degradation.

Tuggeranong Creek, looking back towards the Lake Tuggeranong wall, May 2007.

Table 36. Values of Indicators Sampled on Site 58 on Tuggeranong Creek downstream of Lake Tuggeranong

Indicator	Units	Regulation limits	October 06	March 07
Conductivity	(µS/cm)	N/A	488.4	*
Acidity	pH	6.5-9	7.92	*
Alkalinity	(mg/L $CaCO_3$)	N/A	220	*
Dissolved Oxygen	(mg/L)	>4	6.32	*
Turbidity	(NTU)	<10	7.65	*
AUSRIVAS score	A, B, C D	N/A	B	B