Further Information:

Raw data for all of the sites reported are available on the Internet under the ACT Government web site at www.act.gov.au/Water_Quality/start.cfm

Should you wish to seek further information in relation to this report, please contact:

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EXECUTIVE SUMMARY

Urban Services undertakes a water monitoring program for the ACT which includes water quality and streamflow monitoring. This information is used to determine whether waters in the ACT are of adequate quality and if the management strategies used to achieve or maintain such water quality are adequate.

This report provides the ACT community with the results of the program and the level of compliance with the ACT Water Quality Standards.

Water quality is monitored in the major urban lakes (with the exception of Lake Burley Griffin, a Commonwealth responsibility) and Burrinjuck Reservoir which is immediately downstream of the ACT. The major rivers and some urban streams are also monitored. River flow is measured at a number of sites throughout the ACT. This information is necessary for interpreting water quality data.

Rainfall for the period was well below the long term average with the ACT experiencing the driest six month period on record. As a result, streamflow was also below the long term average in the major streams and rivers.

The report uses the median value for the year as the measure of the average condition. The condition of water quality at the monitoring sites is assessed by comparison of the median value with concentrations listed in the water quality standards.

Trend assessment of data available for the period 1992 - 1998 has been carried out for sites with sufficient data for trends to be detected.

Water quality in the ACT for lakes and streams is generally good. The main impacts on water quality in the urban area are a direct result of land development with urban run-off carrying suspended sediment and nutrients.

Water quality in Lake Tuggeranong and Lake Ginninderra continues to improve as the catchments stabilise after extensive development. Point Hut Pond has only been monitored since 1994 and after showing no change in water quality has shown an improvement this reporting period in a number of indicators. Gungahlin Pond is also beginning to show an improvement in some indicators as the catchment begins to stabilise.

Water quality in the Murrumbidgee River is quite good showing that the ACT has minimal impact on the water quality in the river and that management practices appear to be effective in controlling pollution from the ACT. Water quality in the Molonglo River was also quite good with median values complying with the water quality standards at all sites monitored.

INTRODUCTION

Purpose

This report is intended to provide the ACT Community with information on the water quality in ACT lakes, rivers and streams for the year 1 April 1997 to 31 March 1998. In order to establish a more statistically significant analysis of water quality trends, the analysis has included data for the period 1992 to 1998.

The report is divided into three main sections. The first introduces the report and provides background information for interpreting the water quality data. The second section discusses water quality condition. The indicators used are introduced and results discussed for the lakes and rivers in light of the Territory Plan and Water Quality Standards. The final section briefly discusses special water quality studies in the ACT region.

Scope

The report focuses on the waterways of the ACT with the exception of the Cotter catchment and Lake Burley Griffin. The water quality of the Cotter catchment is not of significant concern because of the undisturbed nature of the catchment. Lake Burley Griffin is a Commonwealth responsibility and is the subject of an annual report produced by the National Capital Authority.

Landuse

There are four major land uses in the ACT (see Figure 1). Conservation land use tends to have a minimal impact on water quality. Plantation forestry and agricultural use can have significant impacts on water quality where these activities result in soil erosion, or the release of agricultural chemicals and animal waste to water bodies. Urban use has the greatest potential for impact on water quality per unit area. Materials entering urban waterways which are likely to impact on water quality include fertilisers and other chemicals, organic matter, soil, oil, and sewage effluent.

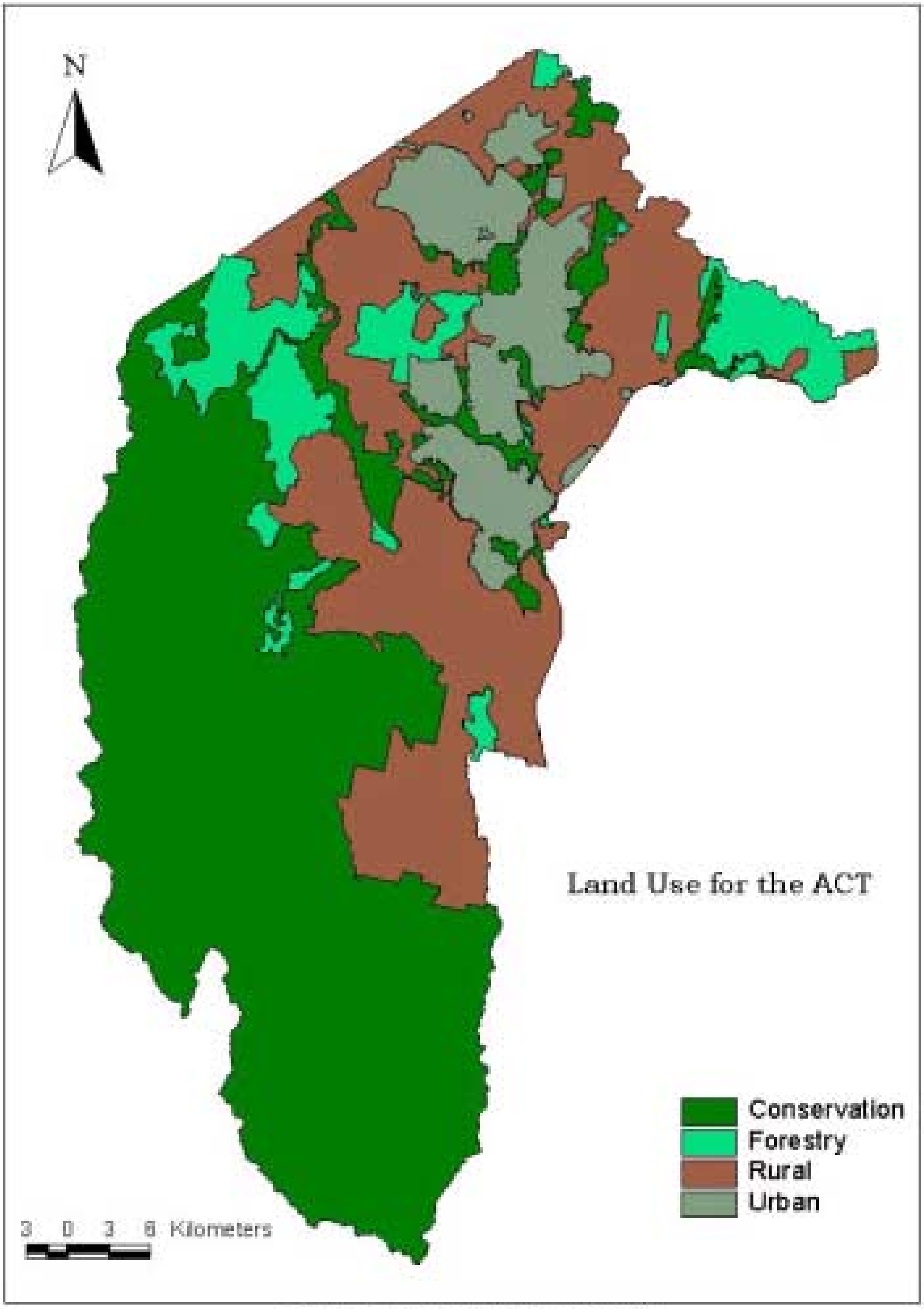


Figure 1: Land Use Catchment Map

Figure 1: Land Use map

Climate

Rainfall in the ACT is strongly affected by the landform. In the mountainous region to the west of the Murrumbidgee, annual average rainfall ranges from 800 - 1000 mm. The flatter tablelands on which Canberra is built are in a rain shadow area, and the annual rainfall reaches only 600 - 700 mm.

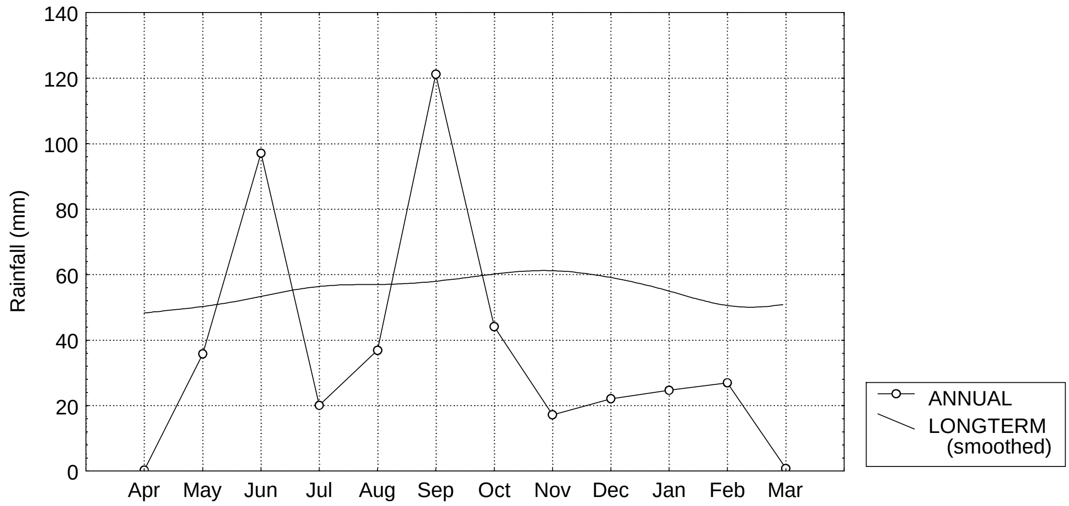


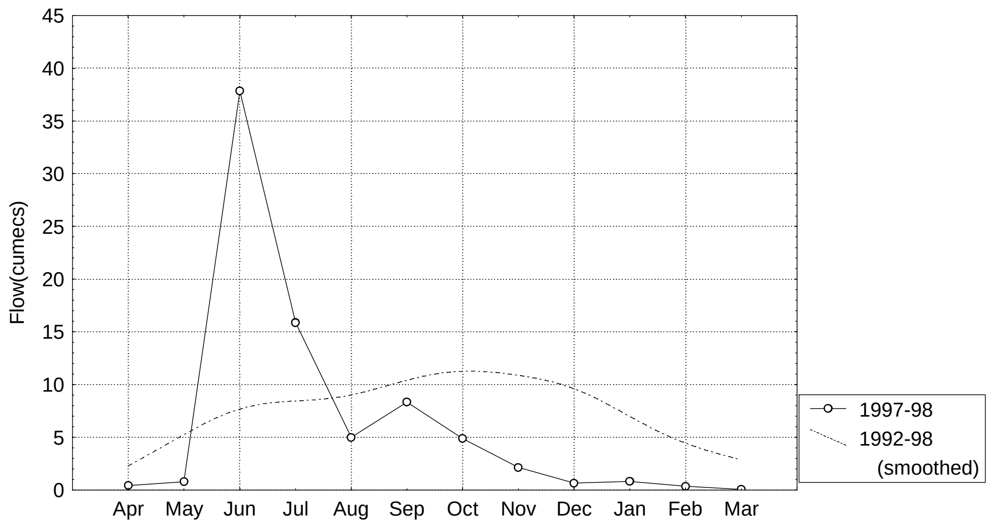
Figure 2: Rainfall in Belconnen near Barton Highway

The ACT Government measures rainfall at a number of sites in the ACT. Rainfall for a site in Belconnen near the Barton Highway is presented in Figure 2, and shows both the monthly rainfall over the period as well as the long term average. The long term average rainfall in Belconnen is 649 mm. The annual rainfall for the reporting period was below this at 447 mm, illustrating the drought conditions that affected the ACT during this period.

Stream Flow

Stream flow during the period appeared generally below the long term average. Figure 3 "Flow in the Murrumbidgee River near Angle Crossing", shows that the mean monthly flow exceeded the long term average in June 1997. However, the remaining months were generally well below the long term average. The lower than average flow in the Murrumbidgee River illustrates the severity of the drought in the Monaro Region.

Figure 3: Flow in the Murrumbidgee River near Angle Crossing



Flow in Ginninderra Creek illustrates the effects of the drought on the urban area. With the exception of June and September, flows were generally well below the long term average.

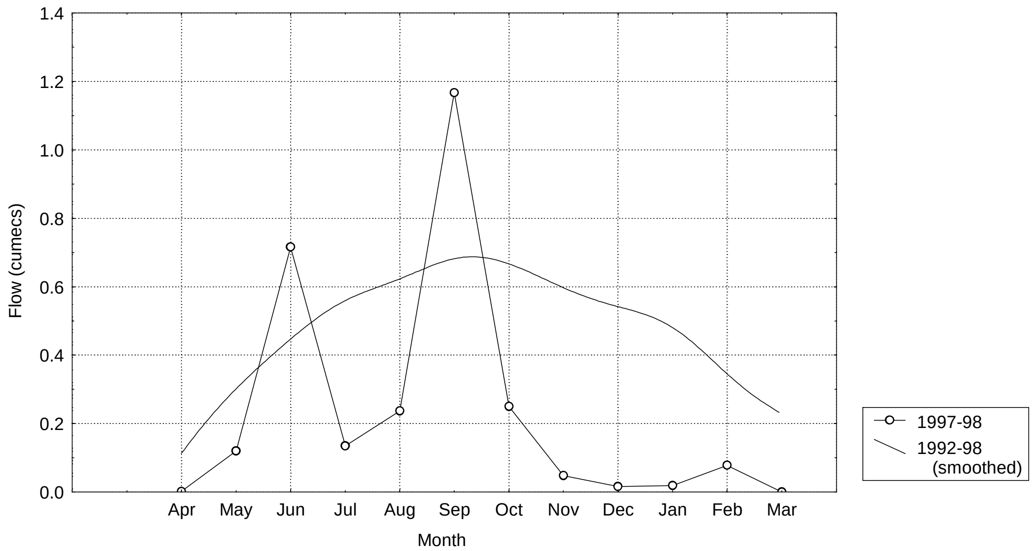


Figure 4: Flow in Ginninderra Creek near Charnwood Road

Rivers of the ACT and Region

A number of the rivers and streams that flow through the ACT and National Capital Area (Lake Burley Griffin) arise in NSW. Other major rivers in the ACT have their catchment boundaries forming the border.

The Murrumbidgee arises well to the south of the ACT, and its headwaters are impounded by Tantangara reservoir and the river is further regulated downstream of the ACT at Burrinjuck Reservoir.

The Molonglo River and Jerrabomberra Creek rise to the east of the ACT with both flowing into Lake Burley Griffin.

The Cotter catchment forms the western boundary of the ACT and the Naas and Gudgenby form the south and south eastern boundaries.

	Water Use				
Indicator	Water based recreation - swimming	Water based recreation - boating	Water supply - stock	Water supply - irrigation	Aquatic habitat - wetland
Total Phosphorus (mg/L)	0.1	0.1			0.1
Turbidity (NTU)	not objectionable	not objectionable			10 - 30
Suspended Solids (mg/L)				So as not to block irrigation systems	12.5 - 25
Chlorophyll ‘a’ (µg/L)	10	10	10		2 - 10
Algal Cells Counts (cells/mL)	5,000	5,000	up to 10,000 depending on species		5,000
Bacteria (faecal coliforms/100mL)	150	1,000	1,000	1,000	
Dissolved Oxygen (mg/L)					>4
Acidity (pH)	6.5 - 8.5	6.5 - 8.5	6.5 - 9.2	4.5 - 9.0	6 - 9
Total Dissolved Solids (mg/L)			3000	500	

Table 1: Water Quality Standards

ACT Government responsibilities in relation to water quality

The Territory Plan and Water Quality Standards

The Territory Plan sets the designated uses for the waterways in the ACT. The Plan identifies three categories of water use and catchment policies. For each category the primary use or environmental value is identified (that is either conservation, water supply, or drainage and open space), as well as a range of secondary values which can be managed so that they are consistent with the primary value.

Water quality standards are identified in the *Environment Protection Regulations 1997*. These regulations contain a set of tables that list the necessary water quality to support each of the water uses referred to in the Territory Plan. Table 1 provides examples of the water quality standards for certain water uses.

Protection of Water Quality

The ACT Government has broad responsibilities in relation to water quality. This includes the responsibility to meet ACT and national standards. The ACT Water Quality Standards are at Schedule 4 of the *Environment Protection Regulations 1997.* Situations or activities which are not included in the Water Quality Standards are managed under the appropriate part of the *National Water Quality Management Strategy.*

The Government seeks, through an integrated approach, to ensure waterways are managed so that standard levels are not exceeded or remain within their prescribed range. This includes planning and policy decisions that aim to prevent environmental problems from occurring, infrastructure such as gross pollutant traps to reduce impacts on water quality and specific management actions to prevent or reduce problems.

Urban Services has a water monitoring program for the ACT which includes the collection of water quality and hydrographic information. Such information is used to determine whether waters in the ACT are of adequate 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.

Monitoring program

The data for this report is sourced from the ACT Government water quality monitoring program and licensed dischargers (including Lower Molonglo Water Quality Control Centre and Queanbeyan Sewage Treatment Plant), who are required to provide data under licence conditions.

The ACT Government program is based on regular sampling of the lakes and rivers.

Lakes

The major urban lakes (with the exception of Lake Burley Griffin) are monitored eight months of the year (see Table 2).

Month	*Sample type*
August	Routine plus sediment particles plus BOD
October	Routine
November	Routine
December	Routine
January	Routine plus sediment particles plus BOD
February	Routine
March	Routine
May	Routine

Table 2: Lake sampling occasions

The ACT Government also monitors Burrinjuck Reservoir. ACT's impact on the Murrumbidgee River is not readily identifiable downstream of Burrinjuck Reservoir mainly as a result of the Reservoir's size and the residence time of water entering it.

Rivers

The major rivers and some urban streams are also monitored. Not all urban streams are included as many have little flow for most of the year and may not be indicative of general stream condition.

Samples are collected within four flow percentile groupings as indicated below (see table 3). The 5 percentile flow is the flow exceeded only 5% of the time, i.e. very high flow, conversely the 90 percentile flow indicates very low flow.

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

Table 3: Flow percentiles for river sampling

Flow percentile based monitoring enables a more cost effective characterisation of water quality than time based monitoring, where streamflow is the major determinant of quality.

River flow is measured at a number of sites throughout the ACT. This information is valuable for interpreting water quality data. Most of the pollutants that wash off streets and fields do so during the few intense rainfall events that occur each year.

In conjunction with water quality monitoring, river flow allows for the calculation of pollutant loads in our lakes and rivers.

Due to low river flows for significant periods of the reporting period, only six of the proposed eight river samples were taken.

Sampling Sites

Sites are located so as to be representative of stream and lake conditions in the ACT. It is not possible to monitor all sites of interest, consequently those considered most representative of environmental conditions are selected with the intention of generalising to other similar areas. The site locations can be seen on the indicator maps such as Figure 5.

WATER QUALITY CONDITION

Analysis

For individual indicators, the report uses the median value for the reporting period. The median is the middle value in a list of the results ordered from lowest to highest. The median is seen as the most useful measure of the "average" condition as it is less affected by extremely high or low values than is the mean. The mean is strongly biased toward the infrequent extreme conditions that may occur in water bodies.

The condition of water quality at the monitoring sites can be assessed by comparison of actual concentrations with concentrations listed in the water quality standards described earlier. Appropriate values from the water quality standards are shown in Table 1.

The data for the various indicators has been presented on a number of maps. Some sites have been coded as good, fair or poor relative to the standards. A good classification is rated where a site is well within the standards for the particular indicator. A fair classification occurs where the value is on the threshold of the standards and a poor classification occurs where a site noticeably exceeds the standards.

Trend analysis of data available between 1992 to 1998 has been carried out for sites with sufficient data for trends to be detected. This period corresponds with flow based monitoring of rivers and creeks. Prior to this period, monitoring was carried out at regular intervals with no reference to flows, and it is not appropriate to compare the data.

Indicators

Nutrients

Nutrients are a natural component of all water bodies, but increases in the nutrient supply often have undesirable effects, including the eutrophication of aquatic ecosystems. Eutrophication is the presence of an abnormally high quantity of aquatic plant life and can include toxic algal blooms. This can also produce other unwanted side-effects, for example, low dissolved oxygen levels in the water.

The two most important plant nutrients for aquatic ecosystems are phosphorus and nitrogen. In ACT waterbodies phosphorus is the nutrient that commonly determines the amount of algae that can occur. Total phosphorus is the measurement of the total quantity of phosphorous in the water column. Values ranged from 0.0085 mg/L at Angle Crossing to 0.08 mg/L at Lake Tuggeranong near Kambah Wetland as shown in Figure 5. The Standard is 0.1 mg/L.

Total nitrogen ranged from 0.21 mg/L at the Gudgenby River to 17 mg/L at Sturt Island on the Molonglo River as shown in Figure 6. Nitrogen is not generally a limiting factor in algal growth in regional waters and it is non-toxic to other organisms. The levels of nitrogen measured at Sturt Island are typical of waters downstream of a sewage treatment plant where plant discharge forms a high proportion of stream flow. In situations where nitrogen is limiting, research indicates a potential for encouragement of the growth of nitrogen fixing blue-green (scum and toxicant forming) algae. In these situations, the discharge of nitrogen in sewage effluent with limitations on phosphorus, will discourage the growth of nitrogen fixing blue-green algae. In addition, the discharge of nitrogen can have a beneficial effect by restricting the release of phosphorus from lake or reservoir sediments.

In this context, management and licensing arrangements in the ACT concentrate on minimising the input of phosphorus to waterways as a priority with nitrogen reduction encouraged as a second priority. There is no standard for total nitrogen for the ACT.

Suspended solids

All streams and rivers naturally carry some suspended material as organic and inorganic particles of a range of sizes. Most land uses and activities have the potential to increase suspended solids concentrations 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, reducing plant growth and changing the type of algae present. Secondly, increases in suspended solids concentrations ultimately result in increased sedimentation in streams and lakes, smothering the plants and animals living on the bottom of such water bodies.

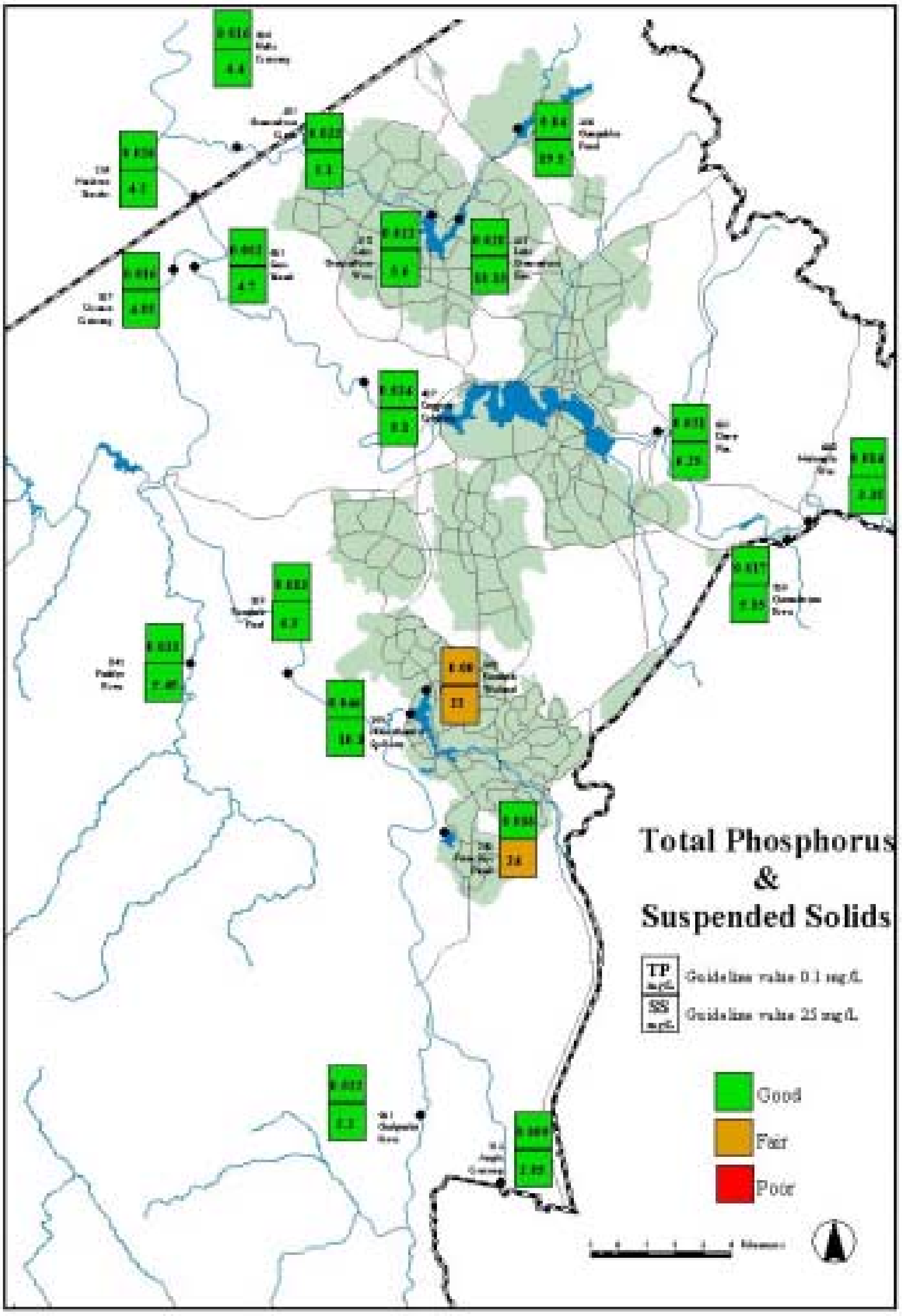


Figure 5: Total Phosphorus and Suspended Solids

Figure 5: Total phosphorus and suspended solids map

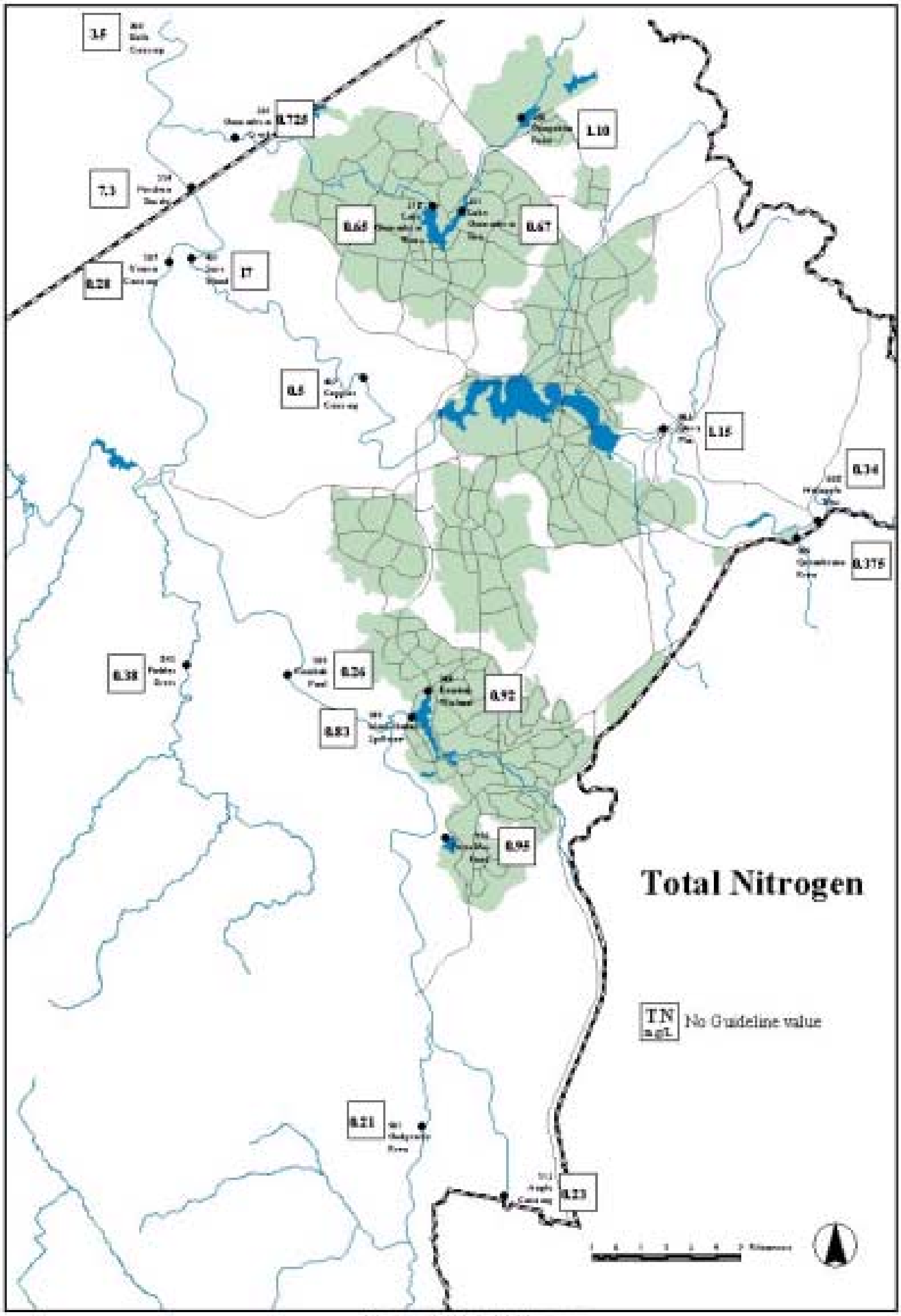


Figure 6: Total Nitrogen

Figure 6: Total nitrogen map

Suspended Solids median values ranged from 2.2 mg/L at Tennent on the Gudgenby River to 24 mg/L at Point Hut pond as shown in figure 5. The standard is 25 mg/L.

Faecal Coliforms

Bacteria occur naturally in all waterbodies. Only bacteria of faecal origin are monitored in the sampling program. The presence of faecal coliforms in a water sample is an indication that the water has been contaminated by human or animal faeces, and consequently that more harmful, less easily detectable pathogens 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 in fact serve as a food source.

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 contact recreational use, but does not deal with the quality of tap water.

Cryptosporidium and Giardia are protozoan species which can significantly affect human health if present in drinking water. They are not however, important environmental indicators and are not monitored in environmental water quality programs.

Results are expressed as colony forming units (cfu) per 100 mL. Median values ranged from 5 cfu/100 mL at Lake Ginninderra at the dam wall to 225 cfu/100 mL at Ginninderra Creek at Parkwood as shown in Figure 7. The standard for recreational use is 150 cfu/100 mL.

Turbidity

Turbidity, or opacity, of a water body is related to the suspended solids concentration because it is affected by any sediment in the water, but also includes colouration. A stream may have very low quantities 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 type of algae present.

Turbidity data are reported in Nephelometric Turbidity Units (NTU). To provide a sense of scale, water with a turbidity of 1 NTU is crystal clear, water at 5 NTU has a tiny trace of discolouration, and water at 100 NTU is brown and opaque.

Median turbidity values ranged from 2.3 NTU at Angle Crossing on the Murrumbidgee River to 37.6 NTU at Gungahlin Pond as shown in Figure 7. The standard is less than 10 NTU for rural streams and rivers and less than 30 NTU for urban lakes and ponds.

pH (Acidity and Alkalinity)

The pH refers to the degree of acidity or alkalinity of a substance. A pH of 7 is neutral. A value above 7 indicates that the water is more alkaline and a pH below 7 indicates acidic conditions. It is generally accepted that the range pH 6-9 is acceptable for aquatic ecosystems.

Median values ranged from 7.3 at the railway bridge on the Queanbeyan River to 8.35 at Sturt Island on the Molonglo River. The standard is 6.5 - 9 for rural streams and rivers and 6 - 9 for urban lakes and ponds.

Ammonia

Ammonia concentrations are generally related to the level of suspended and sedimented organic material in water and whether conditions exist which are conducive to ammonia formation. Ammonia concentrations are increased by the direct discharge of the chemical. The toxicity of ammonia (un-ionised component) is a function of the pH and the temperature of the water.

The median ammonia concentrations ranged from 0.004 mg/L at Uriarra Crossing on the Murrumbidgee River to 0.038 mg/L in Lake Tuggeranong at the Dam Wall and Point Hut Pond as shown in Figure 8. The standard is calculated from a table and is dependent on the pH and temperature of the water at the time of the sample. There is no indication that these results are beyond the standard.

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 result in fish kills. Levels of DO are affected by turbulence, temperature (colder water can hold more dissolved oxygen), photosynthesis (during periods of sunlight algae produce oxygen while in darkness they consume oxygen) and the level of biochemical oxygen demand.

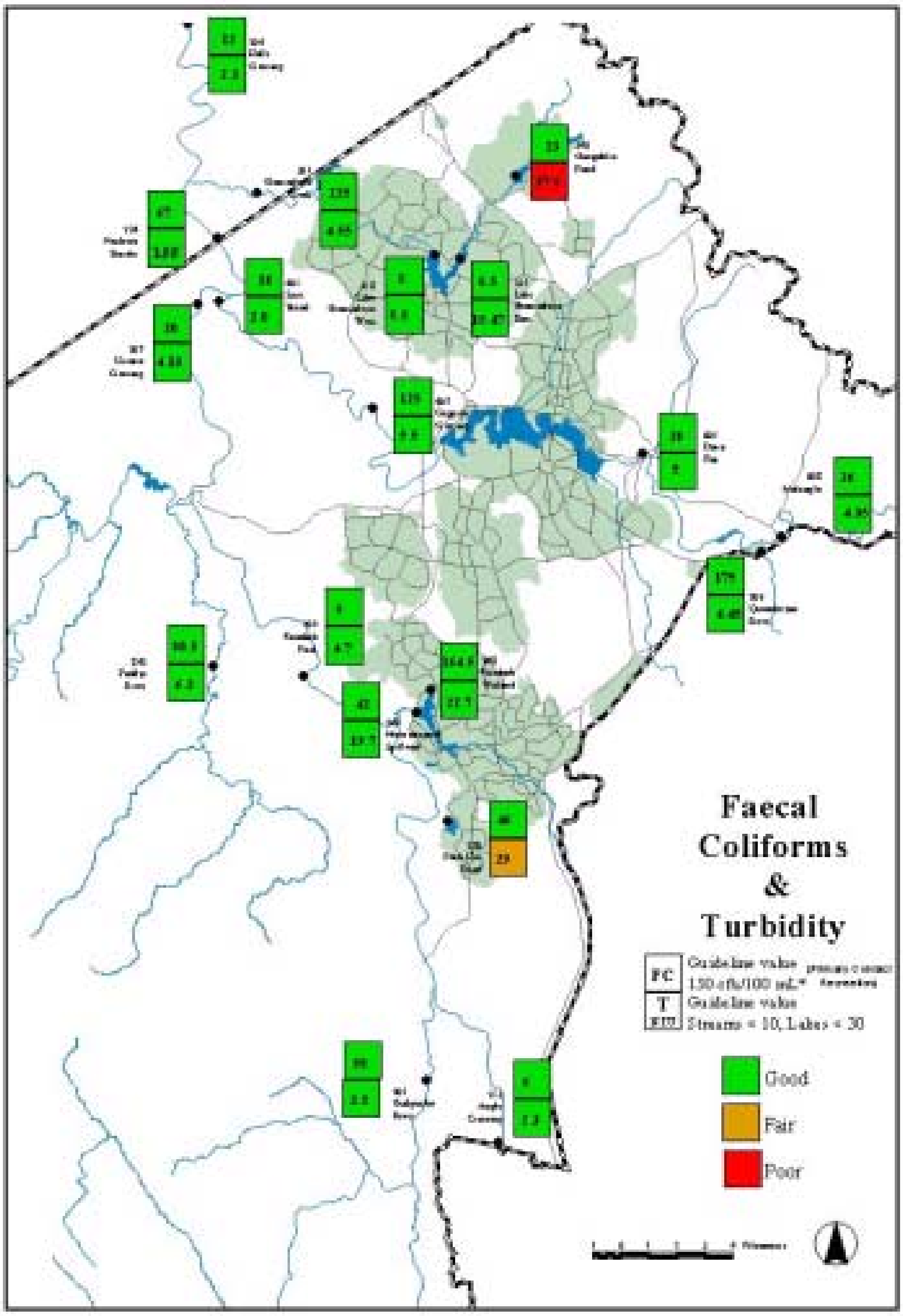
The Median DO concentrations ranged from 7.95 mg/L at Gungahlin Pond to 11.2 mg/L at Sturt Island on the Molonglo River as shown in Figure 9. The standards require DO to be greater than 4 mg/L.

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.

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.

Median Chlorophyll 'a' concentrations ranged from 1.65 μg/L at Gudgenby River and Paddys River to 10.8 μg/L at Dairy Flat on the Molonglo River as shown in Figure 9. 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.



* The guideline value refers to primary contact recreation areas. The guideline for secondary contact recreation is 1000 cfu/100mL. Sites such as 249 - Lake Tuggeranong and 301 - Ginninderra Creek have not been designated as fair or poor as primary contact recreation is not a designated use at these sites.

Figure 7: Faecal Coliforms and Turbidity

Figure 7: Faecal coliforms and turbidity map

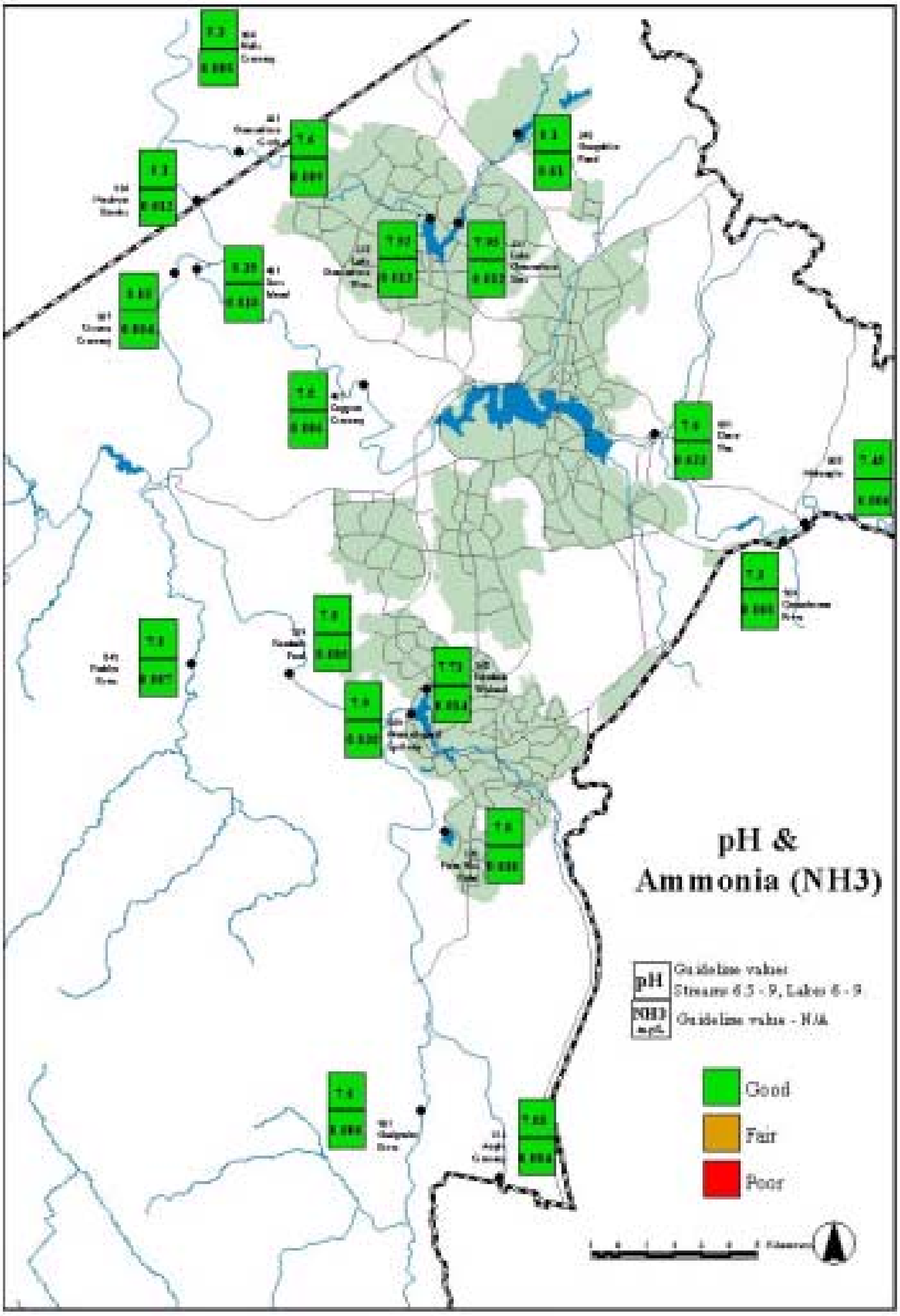


Figure 8: pH and Ammonia

Figure 8: pH and ammonia map

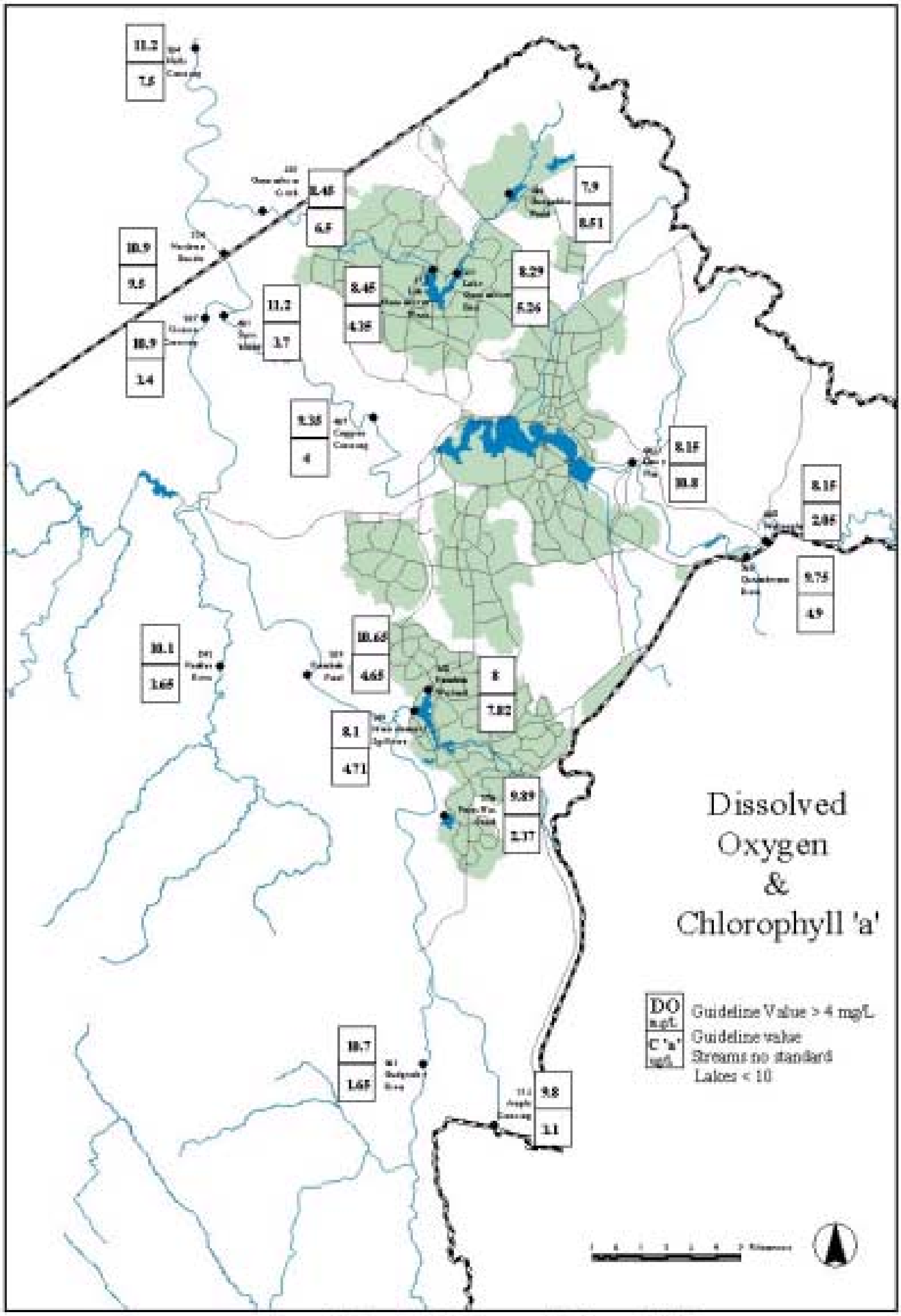


Figure 9: Dissolved Oxygen and Chlorophyll 'a'

Figure 9: DO and chlorophyll 'a' map

Lakes

Lake Tuggeranong

Two sites are monitored in Lake Tuggeranong, one at the Kambah Wetland (northern end of the lake) and the other at the dam wall. Water quality is generally good with median values for all indicators within the standard, except for faecal coliforms at the Kambah Wetland. The faecal coliform standard of 150cfu/100ml, which is the primary contact recreation standard, was exceeded at 164cfu/100ml. This may be the result of water birds which frequent this area. As primary contact recreation such as swimming is not a designated use in the wetland area, the slightly higher value is not of immediate concern but the situation should be reviewed after more monitoring in the next reporting period.

The median values for suspended solids have increased at both sites compared with last reporting periods results. This may be as a result of the higher numbers of algae recorded this year. The concentration of suspended solids was highest at the Wetland site, with a value of 22 mg/L decreasing to 10 mg/L at the dam wall. This indicates that the lake is effectively removing suspended solids from the water column.

Lake Tuggeranong experienced two blue-green algae blooms significant enough to close the lake for short periods in January and February 1998. Low rainfall, which reduced the amount of flushing of the lake combined with high temperatures, would have contributed to these occurrences.

Trend analysis since 1992 indicates that water quality in Lake Tuggeranong continues to improve as the catchment stabilises after extensive development since the mid-eighties. Turbidity, suspended solids, total phosphorus, total nitrogen and ammonia are all gradually reducing in concentration.

Point Hut Pond

Point Hut Pond is monitored at a site adjacent to the dam wall before the water discharges to the Murrumbidgee River. Water quality in the pond is fair, with an improvement in turbidity compared to last reporting period but with an increase in suspended solids. As with Lake Tuggeranong, this may be as a result of higher numbers of algae which may have built up during the dry hot summer which lacked the normal flushing flows. While blue-green algae were present on a number of occasions, levels were not high enough to close the pond to the public.

Point Hut has only been monitored since 1994 and after showing no change in water quality over a number of years has shown an improvement this reporting period in a number of indicators including turbidity, total phosphorus, total nitrogen and ammonia (Figure 10).

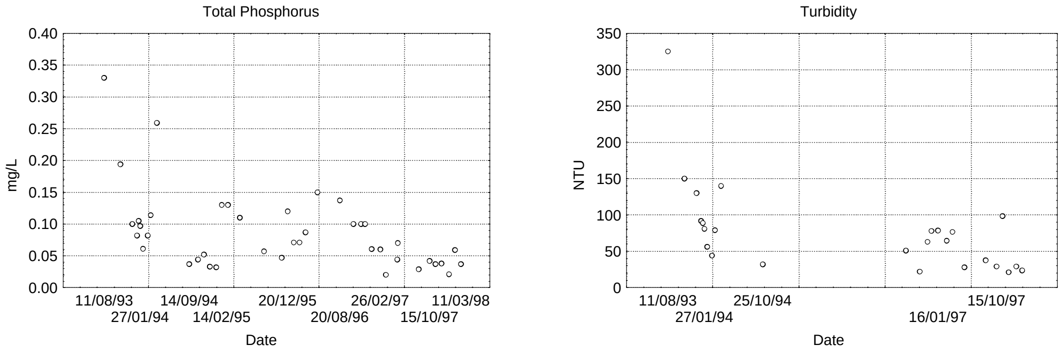


Figure 10: Total Phosphorus and Turbidity in Point Hut Pond

Gungahlin Pond

Water quality in Gungahlin pond was only fair with the highest median turbidity value compared to the other ponds and lakes. The standard was exceeded for this indicator.

Residential development is continuing within the Gungahlin catchment and the erosion from development sites is contributing to the high turbidity. Total nitrogen was also highest in this pond possibly as a result of a high use of fertilisers in the newly developing catchment. All other indicators were within the standard.

Trends since 1992 are beginning to show an improvement in turbidity, suspended solids, total phosphorus and ammonia (figure 11). There is no significant change in the other indicators.

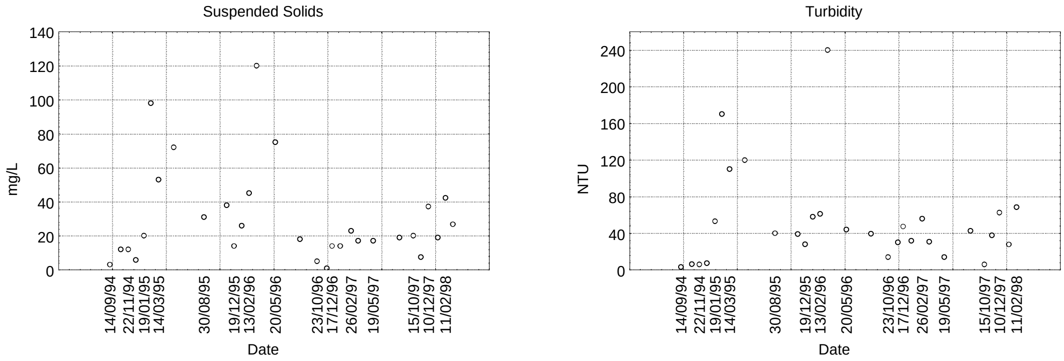


Figure 11: Suspended Solids and Turbidity in Gungahlin Pond

Lake Ginninderra

Two sites are monitored in Lake Ginninderra, one below the Naval Station in the East Arm and the other at the dam wall. Water quality in the lake was good and generally better than the other lakes monitored. Turbidity has improved since the last reporting period although the median value for suspended solids is higher at East Arm site.

Trends since 1992 indicate that turbidity and suspended solids in Lake Ginninderra are generally dropping along with total nitrogen and ammonia (Figure 12). This long term decline may be partly explained by a decline in the rate of development in Gungahlin, together with stabilisation of new development. The increase in suspended solids this reporting period is an exception to this general trend.

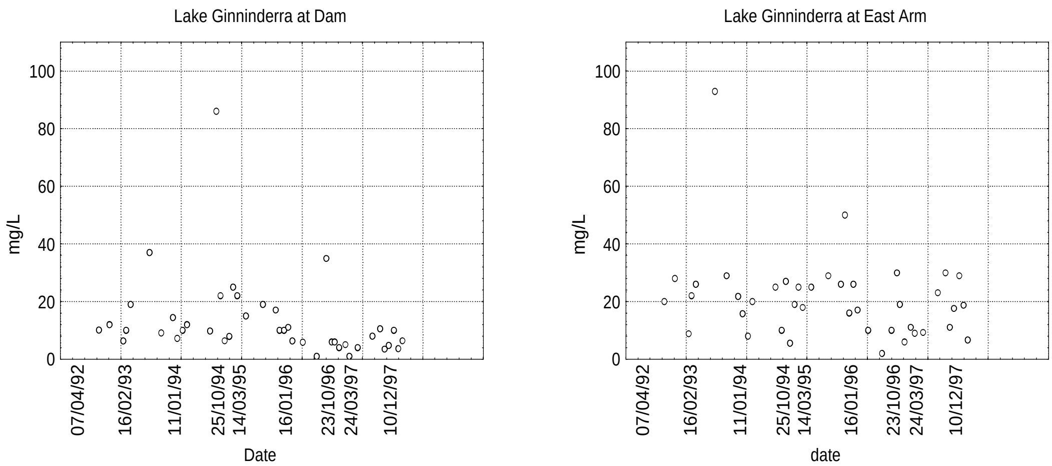


Figure 12: Suspended Solids concentrations in Lake Ginninderra

Rivers

Ginninderra Creek

The monitoring site for Ginninderra Creek is at Parkwood downstream of the confluence with Gooromon Ponds Creek near the ACT border. During this reporting period the median values for all indicators were below the standards. The median values for turbidity and suspended solids have both decreased since the previous reporting period. This may be as a result of a decrease in rainfall combined with landcare works upstream in the creek. Faecal coliforms have also decreased significantly during this period although still high compared with other rivers monitored.

Trends over a six year period indicate that turbidity and suspended solids are increasing slightly. This is probably the result of greenfields development in West Belconnen over this period. The trend may be reversed if the improvements in this reporting period's result continues.

Paddys River

The catchment of Paddys River comprises rural and forestry activities and also encompasses Tidbinbilla Nature Reserve including the water bird ponds on the Tidbinbilla River. This reporting period the sampling site was moved a couple of kilometres downstream to coincide with a stream gauging station. This will facilitate the determination of pollutant loads from this part of the catchment.

The water quality was generally good, with median values for all indicators within the standards. Turbidity and faecal coliforms were lower than the previous reporting period, probably as a result of the lower rainfall on the catchment.

Trend analysis is not possible for Paddys River as monitoring has only been carried out in this area for two reporting periods.

Gudgenby River

The Gudgenby is a rural catchment that comprises predominantly native forest, and registered the lowest median concentration for a number of indicators. The water quality generally is good, with the suspended solids median value the lowest of all the river monitoring sites at 2.2 mg/L and turbidity one of the lowest at 3.5 NTU. The total nitrogen median concentration was also the lowest at 0.21 mg/L.

Since event based sampling began in 1992 there has not been a noticeable change in water quality for total phosphorus, total nitrogen and turbidity. However, there is a slight increase in faecal coliforms over this period presumably as a result of runoff carrying increased amounts of faeces from grazing and native animals.

Murrumbidgee River

The Murrumbidgee River is sampled at a number of sites between Angle Crossing at the southern ACT border and Halls Crossing north of the ACT border. The water quality at all sites is quite good with median values for the indicators complying with standards at all sites.

The median values for most indicators do not significantly change from where the Murrumbidgee enters the ACT to where it leaves. The exception to this is total nitrogen, total dissolved solids and to a lesser extent faecal coliforms. While there is no standard for total nitrogen, the levels are significantly higher at 7.3 mg/L compared with 0.23 mg/L at the southern border. This is the result of the discharge from Lower Molonglo Water Quality Control Centre (LMWQCC) into the Molonglo River which flows into the Murrumbidgee River upstream from the border

It should be noted that total nitrogen levels reduce significantly in the natural environment so that nitrogen levels caused by LMWQCC would decrease significantly before Burrinjuck Reservoir.

The increase is elevated this reporting period as low flows in the rivers provided a much reduced diluting effect on the effluent from the LMWQCC compared with the previous reporting period. Conductivity (salinity) increased from a median of 134 µs/cm to 231 µs/cm and faecal coliforms are also slightly elevated as a result of input from the Molonglo River but not as a result of discharge from LMWQCC.

The generally good water quality is encouraging as it shows that the ACT has a minimal impact on the Murrumbidgee River and that management practices (including sediment retention ponds and building development licensing) appear to be effective in controlling pollution from the ACT.

Trend analysis indicates that suspended solids have increased slightly in the Murrumbidgee River at the ACT/NSW border upstream of the ACT and at Kambah Pool since 1992, while at the same time suspended solids and turbidity decreased at the ACT border as the Murrumbidgee leaves the ACT. Total nitrogen appears to have increased in concentration since 1992 at the ACT border for reasons explained above but remains unchanged at Halls Crossing (Figure 13).

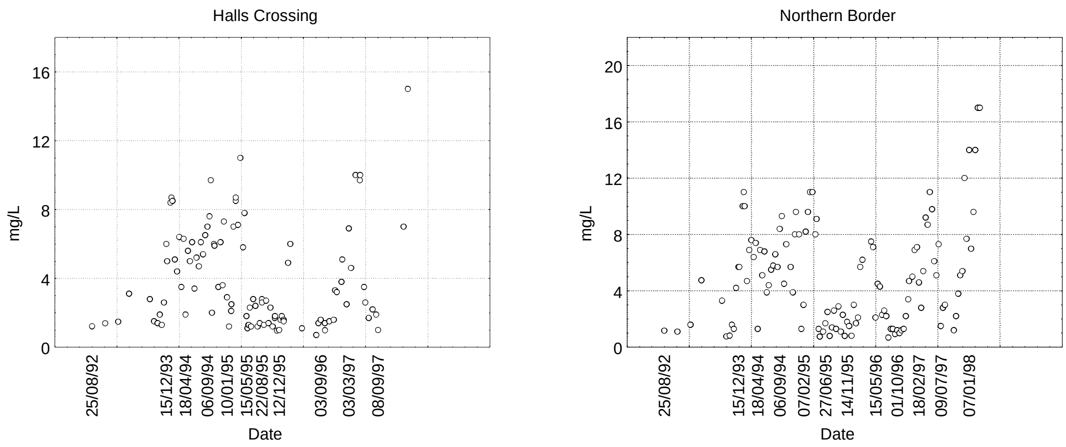


Figure 13: Total Nitrogen in the Murrumbidgee River

Molonglo River

The Molonglo River is sampled at two sites above Lake Burley Griffin and two sites below Lake Burley Griffin before it enters the Murrumbidgee River. At all sites the median values comply with the standards. While there is no standard for total nitrogen the level is significantly higher below the Lower Molonglo Water Quality Control Centre discharge at 17mg/L compared with upstream at Coppins Crossing at 0.5mg/L. The Lower Molonglo Water Quality Control Centre discharges to the Molonglo River 1 kilometre upstream of the confluence with the Murrumbidgee River. Low flows in the Molonglo River during this reporting period have resulted in a much reduced dilution of the total nitrogen in the effluent compared with the previous reporting period.

Monitoring of the Molonglo River upstream of Lake Burley Griffin since 1992 (when event sampling began), indicates a gradual decrease in total phosphorus, turbidity and ammonia at both the Molonglo at Yass Road and at the Dairy Flat site. Suspended solids have decreased at Dairy Flat but remained constant at Yass Road. Faecal coliforms and salinity have increased over this period at the Yass Road. The catchment above this site is largely rural and forestry but also includes stormwater discharge from an industrial area in Queanbeyan.

Monitoring of the Molonglo River downstream of Lake Burley Griffin at Coppins Crossing over the past six years shows a gradual decrease in total phosphorus, total nitrogen and ammonia. All other indicators have remained unchanged.

Water quality in the Molonglo River downstream of the LMWQCC appears to have remained relatively unchanged over the past six years except for total nitrogen and total dissolved solids. While the concentration of total nitrogen in the effluent from LMWQCC has been reducing since 1992, the median concentration in the river this reporting period has reversed this trend. This is a direct result of an extremely dry summer with low flows offering little dilution of the effluent. Total dissolved solids in the river has also increased for similar reasons.

SPECIAL STUDIES

Event Sampling

The purpose of event based monitoring is to measure the export of pollutants from catchments rather than to identify ambient water quality of streams. As it is the cumulative exports of surface runoff and its constituents which determine lake and stream water quality, monitoring of trends in exports is pertinent to the assessment of water quality. The ACT Water Quality Standards include ‘sustainable loading standards’ for critical pollutants and water bodies across the ACT.

Event based monitoring is conducted in different land use areas to enable an understanding of the respective pollutant export loadings. The urban area is represented by the Stranger catchment while rural residential is represented by Burra.

As noted in last years report, an event-based sampling program was established on Jerrabomberra Creek in March 1996, with the intention of sampling 10 events.

Jerrabomberra Creek was chosen as a priority site for event-based sampling as it is largely a rural catchment with potential for future urban development. Results of the program will assist in the planning for future development and in the development and assessment of pollution control measures.

A significant rainfall event is considered to have occurred for Jerrabomberra Creek when flow exceeds 0.66 cubic metres per second (660 litres per second). To put this in perspective, the average monthly flow in Jerrabomberra Creek is 0.125 cubic metres per second.

The event sampling has recently been completed due to the significant rain events that occurred in July and August 1998. The results of the event samples will be reviewed in the near future and discussed in the next Water Report.

Waterwatch

Waterwatch activities were boosted during the period through the employment by the community of two part-time Waterwatch catchment coordinators to assist with promoting the program. Funding was provided through a Waterwatch Australia grant.

Currently there are over 60 groups taking part in the program. A study was undertaken to determine the reliability of the data and showed that the groups are capable of producing data suitable to indicate changes in water quality.

A Planning for Water Monitoring document has been developed incorporating quality assurance requirements.

This will allow a level of confidence to be assigned to the data. The information collected will also contribute to a database of water information for the ACT that includes the ACT Water Quality data. Such information will then be available for a number of purposes including State of the Environment reporting and community use.

ACT AusRivAS Report

The AusRivAS program is part of a nationwide program of biological assessment of river health funded jointly by the States and Territories and the Federal Government.

As part of the National AusRivAS study, surveys of macro-invertebrates 'bugs' in ACT streams have been undertaken over the period 1993-98. Sixty-five test sites and ten reference sites were sampled for a range of streams in the Upper Murrumbidgee catchment in Autumn and Spring 1997.

Test sites are identified as a result of a community consultation process. The identified test sites are then selected according to their potential or known impacts and their proximity to previously sampled test sites. Reference sites were established to represent a range of environmental factors, and used as a basis for comparison with the test (impacted) sites.

The reference site data is used to develop a predictive model of expected 'bugs' (E) at sites, based on environmental factors. Observed 'bugs' (O) for the test sites are then compared with expected (E) 'bugs' for those sites, and observed/expected (O/E) ratios used as a measure of the level of impactedness.

Impacts are ranked according to O/E bands, as follows:

X Above reference
A Equivalent to reference sites
B Slightly impaired
C Moderately impaired
D Severely impaired

At the time of the autumn sampling, the study area was in drought with flows in the majority of rivers at less than 50% of the long term median.

Seven of the ten reference sites sampled exhibited conditions below reference indicating a regional reduction in biological condition due to the drought. Based on this impaired condition of the reference sites it is likely that a similar proportion of the test sites would have been affected by the low flows.

In addition to drought induced impacts, other impacts on the rivers and streams of the Upper Murrumbidgee River Catchment include nutrient enrichment, chemical pollutants, habitat degradation, sedimentation and river regulation. With the exception of river regulation, all the described impacts are directly related to land use practices.

Although stream flow in spring was still low, the effect of streamflow on biological condition appears to be less than that in Autumn with the condition of all of the same 10 test sites, at or above reference conditions.

The urban areas appear to be the most impacted with the majority of urban sites exhibiting conditions well below reference or impoverished.

Appendix 2 contains the tabulated results of O/E bands.

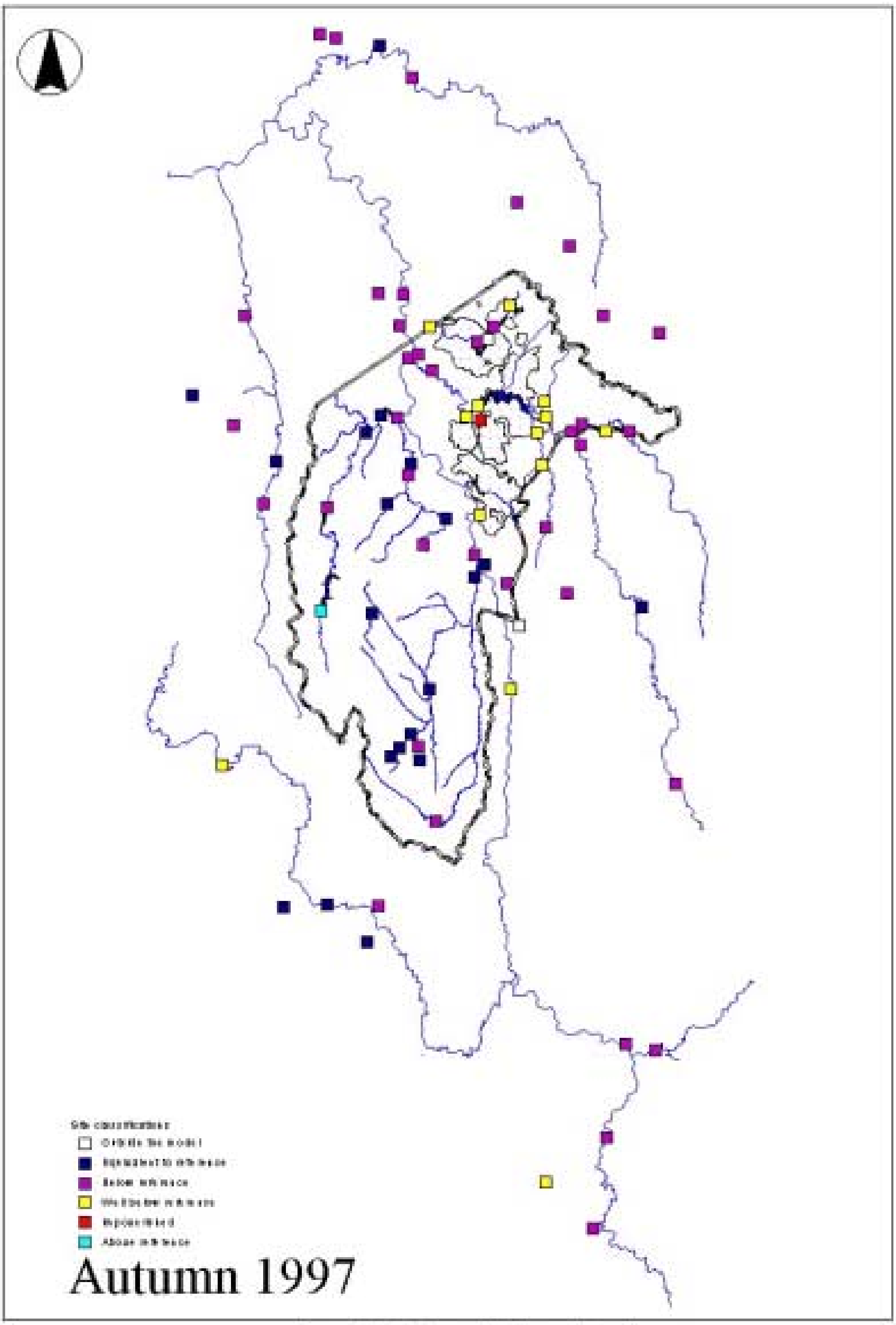


Figure 14 : Autumn 1997 sampling sites

Figure 14: Autumn 1997 sampling sites

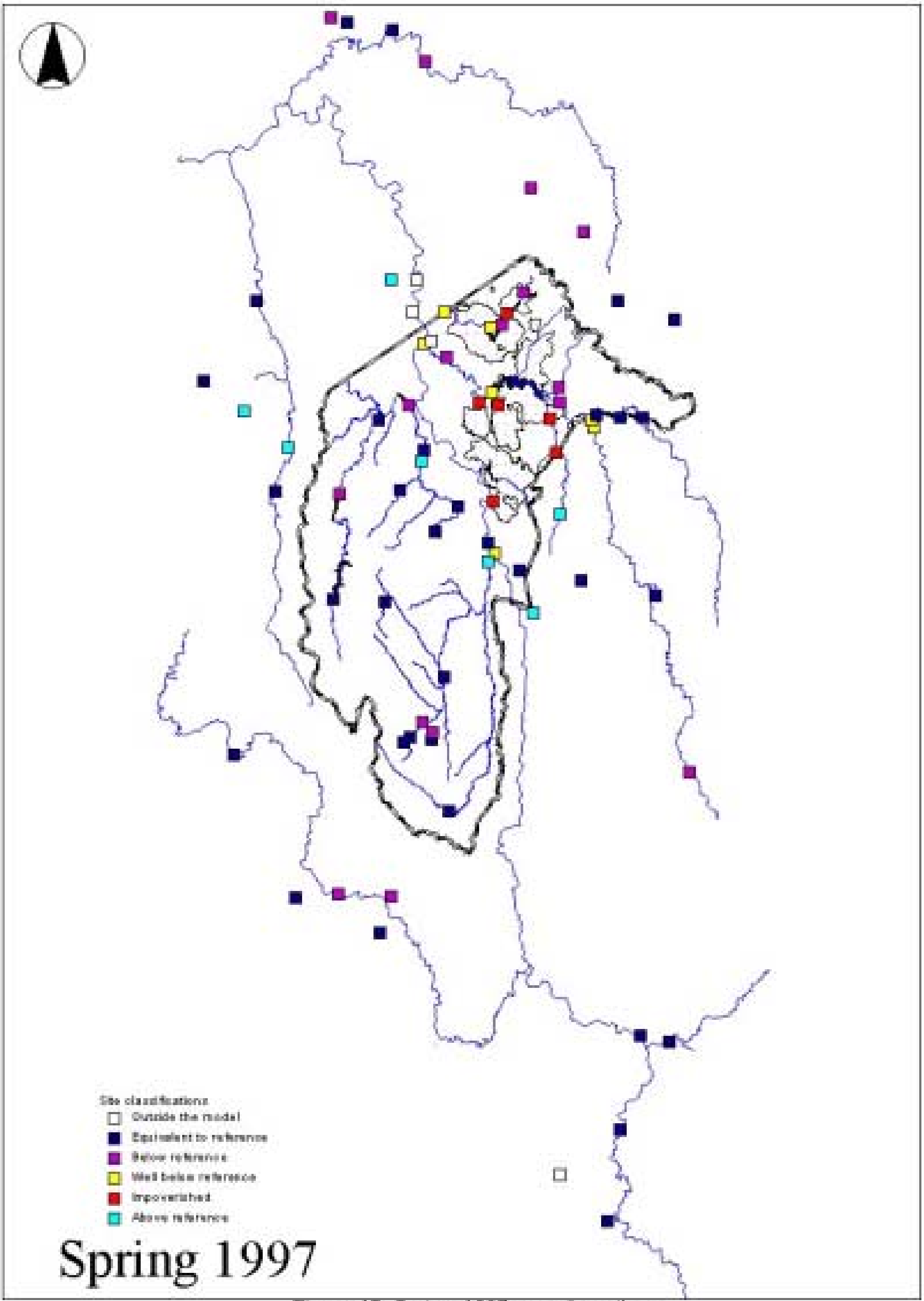


Figure 15: Spring 1997 sampling sites

Figure 15: Spring 1997 sampling sites

Stranger Creek catchment pollutant exports & interception

The ACT Government is a major partner in the Cooperative Research Centre for Freshwater Ecology. As part of its research program, the CRC undertook over the period 1993 to 1996, analysis of runoff and pollutant exports from the Stranger Creek catchment (Tuggeranong), and of the performance of the Stranger Gross Pollutant Trap in intercepting pollutants.

The results of the research provide a useful indication of the effectiveness of urban stormwater management programs. Earlier assessment of stormwater pollutant discharges was based on several years of event monitoring for Yarralumla Creek at Curtin. The following table provides comparisons between previous and current urban stormwater management in respect to the export and interception of pollutants.

Pollutant	Yarralumla Creek (1976 - 83)	Stranger Creek (1993 - 96)
Suspended Solids	200R	$219R^{1.24}$
Total Phosphorus	$0.4R^{0.8}$	0.32R
Total Nitrogen	$3R^{0.84}$	$2.04R^{1.08}$

Table 4: Pollutant export from urban catchments (kg/km^2)
R is runoff in mm/storm event

Pollutant	Interception (%)
Suspended Solids	90%
Total Phosphorus	70%
Total Nitrogen	50%

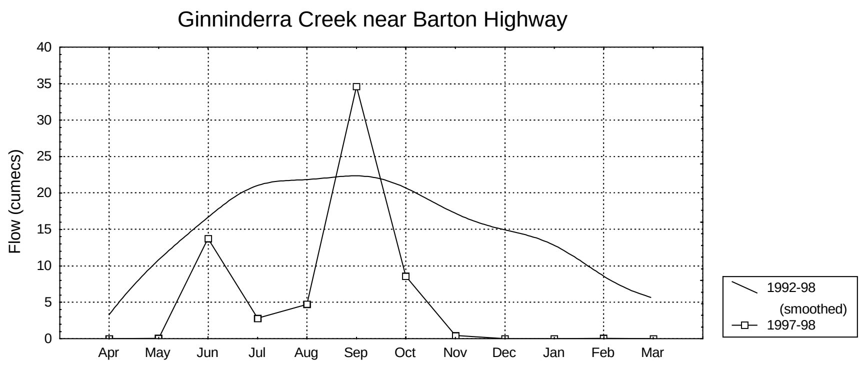
Table 5: Pollutant interception - Stranger Pond (1993 - 96)

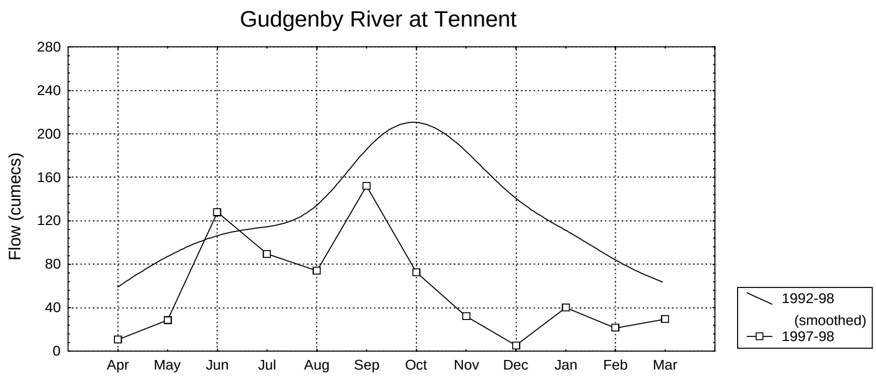
The analysis indicates comparable export of suspended solids (a function of the steeper catchment of Stranger as compared to Yarralumla Ck), and a 25% reduction in nutrient exports for average storm runoff conditions.

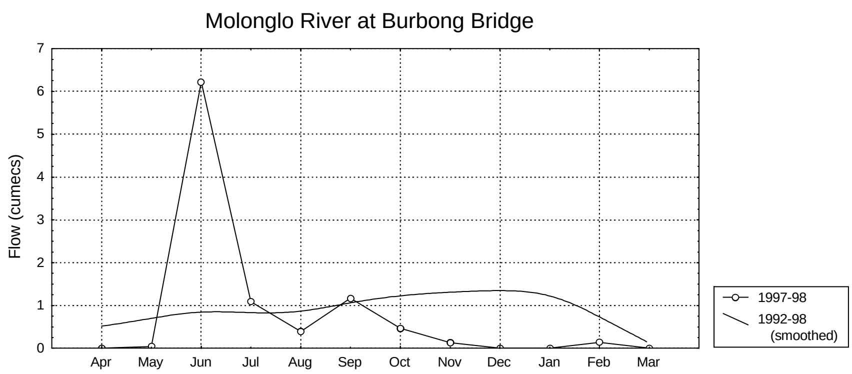
The level of interception of pollutants in the pollution control pond limits suspended solids and phosphorus exports to pre-urban land use (low intensity grazing) levels, and limits nitrogen exports to 3 times the pre-urban land use levels.

APPENDIX 1 - CHARTS ILLUSTRATING RIVER FLOW IN THREE CLIMATIC REGIONS

The charts below illustrate the flow from three different climatic regions. Within each chart are the mean monthly flow and the mean monthly flow for the six year period 1992-98 for the sampling station.







This section contains the tabulated results of the AusRivAS monitoring program.

Key:

- A Equivalent to reference
- B Below reference
- C Well below reference
- D Impoverished
- X Above reference
- * Outside the experience of the model

Site	River	Location	Autumn 1997 Edge	Spring 1997 Edge
3	Cotter River	Cotter River at Vanitys Crossing	A	A
19	Gudgenby River	Gudgenby River at Smiths Road Bridge	A	X
28	Gudgenby River	Gudgenby River at Glendale Crossing	A	A
41	Murrumbidgee River	Murrumbidgee River at Tharwa Bridge	B	A
89	Jerrabomberra	Cooma Road bridge	B	X
115	Yass River	Mac's Reef Road bridge	B	A
129	Goodradigbee River	Goodradigbee River, Swinging Bridge Reserve	B	X
130	Micalong Creek	Micalong Creek, Micalong Creek Reserve	B	A
133	Goodradigbee River	Goodradigbee River, Brindabella Station	B	A
136	Goodradigbee River	Goodradigbee River at Bridge on Brindabella Road	A	X
138	McDonald Creek	McDonald Creek, off Brindabella Road	B	X
139	Oaks Creek	Oaks Creek , Brindabella Road	A	A
172	Murrumbidgee River	Murrumbidgee River downstream of Bridge near	A	B
187	Molonglo River	Pialligo	C	B
188	Molonglo River	Downstream of Scrivener Dam	C	C
189	Yarralumla Creek	Cotter Road bridge	D	D
190	Molonglo River	Upstream of LMWQCC	B	B
191	Molonglo River	Downstream of LMWQCC	B	C
192	Woolshed Creek	Fairbairn Avenue bridge	C	B
193	Ginninderra Creek	Mirrabei Drive bridge	C	B
194	Ginninderra Creek	Downstream Gungahlin dam wall	B	D
195	Ginninderra Creek	Baldwin Drive bridge	*	B
196	Ginninderra Creek	Downstream of Lake Ginninderra	B	C
197	Queanbeyan River	Queanbeyan bridge	B	C
198	Weston Creek	Off Cotter Road	C	D
201	Murrumbidgee River	The Willows	C	
202	Cotter River	Downstream Bendora Dam	B	B
203	Spring Station	Naas Road bridge	A	A
204	Paddys River	Tidbinbilla Road bridge	A	A
205	Tanners Flat	Paddys River Road bridge	B	X
206	Cotter River	Downstream of Cotter dam	B	B
208	Goorudee Rivulet	Yaouk Road bridge	A	A
209	Murrumbidgee River	Downstream of Tantangara Dam	C	A
210	Jones Creek	near "Yarrawa"	B	B
211	Caddigat Creek	Caddigat Mail Road bridge	A	A
214	Tom Groggins	Rock Flat/Nimmitabel	B	A
215	Rock Flat Creek	Snowy Mountains Highway	C	*
216	Numeralla River	Glenfern Station	B	A
218	Big Badja River	4 km Upstream of Numeralla Confluence	B	A
219	Numeralla River	Downstream of Numeralla	B	A
221	Waterhole Creek	off Monaro Highway	*	X
222	Murrumbidgee River	Cusacks Crossing	B	*
223	Murrumbidgee River	Valleybrook	B	*
225	Reedy Creek	Junction of Gundaroo and Max Reef Road	B	A
227	Back Creek	Murrumbateman Road bridge	B	B
228	Murrumbateman	Murrumbateman/Gundaroo Road	B	B
Site	River	Location	Autumn 1997 Edge	Spring 1997 Edge

229	Yass River	Upstream of Pearses Bridge	B	B
230	Yass River	Hattons Corner	A	A
231	Derringullen	Black Range Road bridge	B	A
232	Bowning Creek	Black Range Road bri	B	B
233	Murrumbidgee River	Woodstock Reserve	B	*
234	Cotter River	Upstream of Cotter Dam	A	
235	Queanbeyan River	Below Queanbeyan cemetery	B	C
236	Molonglo River	Upstream of Blue Tiles	C	A
237	Ginninderra Creek	Kilby Park	C	C
238	Tidbinbilla River	Tidbinbilla Nature Reserve	A	A
240	Cotter River	Upstream of Corin Dam	X	A
241	Molonglo River	Burbong Bridge on Kings Highway	B	A
242	Molonglo River	Sutton Road bridge	B	A
243	Queanbeyan River	The Springs	A	A
244	Queanbeyan River	Camelot	B	B
246	Jerrabomberra	Hindmarsh Drive bridge	C	D
247	Jerrabomberra	Lanyon Drive bridge	C	D
248	Burra Creek	Williamsdale Road bridge	B	A
250	Grassy Creek	Mount Clear camp ground	B	A
251	Paddys River	Flints Crossing	A	A
252	Blue Gum Creek	Boorooma Station	B	A
253	Guises Creek	Guises Flat	B	A
254	Bogong Creek	Boboyan Pine Forest	A	A
255	Bogong Creek	Boboyan Pine Forest	A	A
256	Bogong Creek	Boboyan Pine Forest	A	B
257	Hospital Creek	Boboyan Pine Forest	A	A
258	Hospital Creek	Boboyan Pine Forest	B	B
259	Point Hut Creek	Downstream of Point Hut Dam	C	D
260	Sawpit Creek	Smokers Trail	A	A

Edge refers to the habitat sampled. In the Upper Murrumbidgee catchment there are two habitats generally sampled, these include edge and riffle. The recent drought has had significant effects on river flow, which has meant that riffle habitats have not existed at the majority of sampling sites.

APPENDIX 3 - RESULTS FROM ALL SAMPLING SITES

This section contains the scatterplots of data for all sites sampled and the indicators discussed in this report.