2014

Waterway & Catchment report

Great Lakes Council 2014 Waterway and Catchment Report

Prepared by:

Great Lakes Council
Natural Systems and Estuaries Section

Enquires should be directed to:

Great Lakes Council
PO Box 450
Forster NSW 2428
telephone: (02) 6591 7222
fax: (02) 6591 7221
email: council@greatlakes.nsw.gov.au

Contents

Introduction

The Great Lakes region depends heavily on the health of local waterways and their catchments. The waterways form the basis of the region's economy (supporting tourism and primary production), contribute to our way of life and provide habitat for extraordinary biological systems. The region's catchments are under continued pressure from pollution and impacts associated with catchment land use, development and tourism. If unmanaged this has the potential to result in a decline in the health of our waterways.

All our local waterways are critically susceptible to environmental pressures; a Hepatitis A event in oysters in Wallis Lake in 1997, reoccurring blue-green algae in Myall Lakes and episodic fish kills are all examples of what can go wrong.

This report has been presented to accompany the 2014 Waterway and Catchment Report Card. It provides the technical information on how the Report Card scores were calculated as well as providing more detail on the results. A summary of the management responses undertaken in each estuary to address water quality are also presented here.

The Goal for our waterways is to maintain or improve their condition in order to protect biological diversity and maintain ecological processes

Water quality - ecological health

The health of the waterways in the Great Lakes region is fundamental for achieving the Vision set out in the Community Strategic Plan 'Great Lakes 2030': "A unique and sustainably managed environment balanced with quality lifestyle opportunities created through appropriate development, infrastructure and services". Since 2008 the NSW Government Office of Environment and Heritage (OEH) have undertaken an ecological health monitoring program in Wallis Lake as part of the state-wide Monitoring, Evaluation and Reporting Strategy (MER). As part of the Strategy, Wallis Lake was selected as one of seven estuaries across the state to be sampled each year to track inter-annual variability in two ecological health indicators; chlorophyll a (the amount of algae) and turbidity (the amount of sediment).

Since 2011 Great Lakes Council, in cooperation with state and federal agencies, has ensured that the program has been expanded to cover other key sites across the Great Lakes Local Government Area (LGA). The OEH have provided an independent scientific evaluation on the ecological health of Wallis Lake, Karuah River & Estuary, as well as Myall Lake and the Bombah Broadwater in the Myall Lakes.

Ecological health does not refer to environmental health issues such as drinking water quality, safety for swimming, heavy metal contamination, disease, bacteria, viruses or our ability to harvest shellfish or fish.

Figure 1.1.1 Myall Lake looking south

Ecological health results presented in easy to understand Report Card

The results of ecological health monitoring have been presented in a Catchment and Waterways Report Card (See Appendix) which grades the health of the waterways in a similar way to school Report Cards with a grade ranging from A (excellent) to F (very poor).

The information provided below includes the background details for the Report Card including the objectives, methods and a detailed description of the results.

Report Card objectives

The objectives for the Report Card are:

1. To report on ecological health.
2. To track progress on management actions.

These objectives are specifically achieved by providing information to:

- Assist in the current and ongoing protection of "high conservation" areas that currently provide substantial water quality and biodiversity benefits to the rivers and estuaries.
- Guide and report on the remediation of areas that have high pollutant loads and highlight areas that may require further action.
- Help protect all areas of Wallis, Smith and Myall Lakes and the Karuah River against further declines in water quality.

In addition to the ecological results, management actions being undertaken in the catchments are also presented in the Report Card. A more detailed description of the management actions is provided in this report. These management actions have been developed to target specific environmental values which Council and the community have determined as important to the region.

Environmental values

The environmental values that management actions in the catchment are aiming to achieve are:

1. Minimal algal growth.
2. Minimal sediment inputs and maximum clarity.
3. Intact aquatic habitats like seagrass, macrophyte and riparian vegetation.

Figure 1.1.2 Clear waters with minimal algal growth and maximum clarity support key habitats such as seagrass

Methods

Development of Report Card grades

The monitoring program has assessed the ecological health of Wallis and Myall Lakes as well as the Karuah River Estuary. There are a number of steps taken to determinine the score for each zone and subsequent Report Card grade:

1. Selecting the indicators.
2. Identifying the trigger levels.
3. Collecting the data.
4. Calculating the zone score.
5. Allocating the Report Card grade.

1. Selecting the indicators

In order to meet the objectives of the Report Card, indicators must report on ecological health but also be able to report on the outcomes of management actions. The management actions are linked to the environmental values set for the region (listed above), and the indicators selected have been shown to be responsive to catchment management actions.

There are many different estuary reporting programs world-wide, with indicators specifically chosen to suit local conditions or issues. Chlorophyll and turbidity are commonly used as they are proven to be very informative and responsive indicators, see Table 1.1.1.

Algal growth can be measured by assessing chlorophyll a levels in the water and sediment inputs are assessed by measuring the turbidity (see side box). These indicators are easy to measure and directly relate to the environmental values.

While the extent of seagrass beds, macrophytes and riparian vegetation are not currently measured, low chlorophyll and turbidity levels are necessary to ensure healthy habitats. Expansion of the program in the future is likely to include assessment of these habitats.

Table 1.1.1 Indicators used in various estuarine monitoring programs

Monitoring Program	Chlorophyll a	Turbidity	Dissolved Oxygen	Nutrients	Riparian vegetation	Seagrass	Other critical habitats (e.g coral)
South East Queensland Ecosystem Health Monitoring Program	✓	✓	✓	✓	✓	✓	✓
Chesapeake Bay EcoCheck program	✓	✓	✓			✓	✓
Northern Rivers CMA Ecohealth	✓	✓	✓		✓		
NSW Monitoring, Evaluation and Reporting Program *	✓	✓	F		F	✓	
Great Lakes Council Report Card (this program)	✓	✓	F		F	F	

F - future

* NSW Monitoring, Evaluation and Reporting Program also samples fish in a limited number of sites

The NSW Monitoring, Evaluation and Reporting Program, concluded that measurement of chlorophyll a and turbidity provides an effective measure of the short-term response of estuary health to management actions. Seagrass and other macrophytes provide a long-term integration of estuary health.

Dissolved oxygen has been widely used as an indicator of the amount of oxygen in the water column with many critical aquatic processes dependent on a healthy level and minimal variability. Great Lakes and NSW Monitoring, Evaluation and Reporting Program both acknowledge that dissolved oxygen is an important variable to measure but have not done so to date due to logistical reasons. There are plans to include this indicator in future monitoring activities.

2. Identifying the trigger levels

A healthy ecosystem refers to a system which has normal ranges of diversity and function. These 'normal' ranges have been established from extensive monitoring of estuaries across NSW. To establish these ranges, sites that represent a variety of ecological conditions from pristine (reference) sites to highly degraded have been sampled over a number of years. The data for pristine (reference) sites have been used to establish the trigger values which are fundamental for ranking the ecological health of a site.

A trigger value is the value which indicates that a variable is outside the "normal range" and could trigger further investigation. In our context, we have used the trigger value to indicate conditions which are not desirable for continued waterway health.

A trigger value is specific to different types of estuary. In this study, Wallis Lake, Pipers Creek, Charlotte Bay, Bombah Broadwater and Myall Lake were all classified as "Lakes" and Wallamba River, Karuah Estuary and the Lower Myall River as a "River estuary" (Roper et al. 2011).

Table 1.1.2 Trigger Values for NSW Estuaries (from Roper et al. 2011)

	Turbidity (NTU)	Chlorophyll (µg/L)
Lake	6.7	2.5
River estuary (mid)	1.9	2.2

Algae

Algae or microscopic plants are always present in waterways but if conditions change and are suited to algal growth, blooms can occur. Blooms may occurr if there is a lot of nutrients in the water which can come from urban stormwater, fertiliser runoff from farms and gardens and seepage from septic tanks. Algal blooms can reduce the amount of light reaching seagrass beds limiting their growth. When blooms of algae die and start to decay, the resulting bacterial activity can reduce oxygen concentrations in the water column, possibly leading to fish kills.

Chlorophyll a

Chlorophyll a is a pigment found in plants and is an essential molecule for the process of photosynthesis (the conversion of light energy to chemical energy resulting in the consumption of carbon dioxide and the production of oxygen and sugars). In estuarine and marine waterways, chlorophyll a is present in phytoplankton such as cyanobacteria, diatoms and dinoflagellates. Because chlorophyll a occurs in all phytoplankton it is commonly used as a measure of phytoplankton biomass (EHMP 2008).

Sediment

Sediment from the land can be washed into waterways when it rains. If land is poorly managed, large amounts of sediment can wash into our waterways. Sediment also comes from roads and pathways washing directly into the stormwater and then the estuaries.

Too much sediment in the water reduces the amount of light reaching the bottom and is detrimental to seagrass which require light for growth. Seagrass is critical for the health of estuaries as it provides essential habitat for fish and invertebrates which support bird life and the local tourism and aquaculture industries. Excess amounts of suspended particles can also smother benthic organisms like sponges, irritate the gills of fish and transport contaminants.

Turbidity

Turbidity provides a measure of sediment in the water. It is the measure of light scattering by suspended particles in the water column, providing an indication of the amount of light penetration through the water column (EHMP 2008).

3. Collecting the data

The Great Lakes region has been divided up into ten reporting zones. A zone is actually a broad area within the estuary rather than a discrete point (see maps in Results Section) and may be represented by a single sample or by multiple samples. Five zones were sampled in Wallis Lake estuary (Wallamba River, Wallamba Cove, Pipers Creek, Wallis Lake, Charlottes Bay). There are three zones in the Karuah River (Karuah River, Branch River, Karuah Estuary) and three zones in the Myall Lakes.

Samples were collected on six occasions between summer and autumn from December to March. This represents the part of the year when the highest chlorophyll concentrations are expected.

At each of the selected sites, samples were taken in accordance with the NSW Monitoring, Evaluation and Reporting protocols which are described in full in Roper et al. (2011). At each of the "Lake" sites, turbidity was measured using a calibrated probe suspended at a depth of 0.5 metres for five minutes as the boat drifted or was motored (generally covering a distance of at least 300 metres), logging data every 15 seconds. The final value for the "site" sampled was the average of all the logged data. During the drift, at least five samples of the top 1m of the water column

Figure 1.1.3 Office of Environment and Heritage staff carry out the monitoring of the waterways in the Great Lakes Region

were collected and combined in a bucket. At the end of the drift, a single 200 millilitre sample for chlorophyll a analysis was taken from the composite in the bucket.

For the river estuary sites, an "underway sampler" is used to pass water past the probe whilst the boat travels at a regulated speed along a transect upstream from the middle to the upper part of the estuary. The turbidity is calculated as the mean of logged values for the transect. At two sites along the transect, composite water samples are collected for chlorophyll a analysis.

Chlorophyll a samples are immediately filtered (within one hour) under mild vacuum and the filter frozen until analysis. Chlorophyll a is extracted into acetone and chlorophyll a concentration determine by spectrometry.

4. Calculating the zone score

The measured values of all indicators are summarised into one value which can then be compared between different reporting zones.

Two basic calculations have been performed for each zone:

- Non-compliance score – are the indicator values non-compliant with the trigger value?
- Distance from the benchmark score – how far from the trigger value are the indicator values?

The distance measure is a recognition that the trigger values only allow for two possible states, compliant and non-compliant. The distance measure provides for more sensitivity for ecological condition along the gradient from good to poor.

Calculating the non-compliance score

The non-compliance score iss simply calculated by taking the number of samples that are above the trigger value as a proportion of the total number of samples taken in the sampling period. The non-compliance score is then expressed as a value between 0 and 1 with 0 equal to none of the values being non-compliant (i.e. all compliant) and 1 equal to all values being non-compliant.

Non-compliance score equals the number of samples non-compliant with trigger value divided by the total number samples.

Calculating the distance from benchmark score

The distance score has been expressed as a proportion between 0 and 1 to be standardised with the non-compliance score. To do that the distance score is expressed as a proportion of the worst expected value (WEV) with a score of 0 equal to the benchmark value and 1 equal to the worst expected value for each of the indicators.

The worst expected value has been determined by examination of a data set for all of NSW. The 98th percentile value was selected as the worst expected value Table 1.1.3. In the small number (2 %) of circumstances where measured values were greater than worst expected value, the distance measure became 1 (which is the highest possible value).

Table 1.1.3 Worst expected value for Condition Calculations

	Turbidity WEV (NTU)	Chlorophyll WEV (µg/L)
Lake	20	30
River (mid)	60	30
Lagoon	20	30

WEV = worst expected value

Distance of each non-compliant value equals: (measured value – trigger value) / (worst expected value – trigger value)

The distance score is calculated as the mean distance from the trigger of those values that are non-compliant for the reporting period.

Once the non-compliance and distance score have been calculated, the geometric mean of both scores is calculated to arrive at a single score that can be used to assess the condition of each indicator in that zone.

$$\text{Final Score for indicator} = \sqrt{(\text{non-compliance} \times \text{distance score})}$$

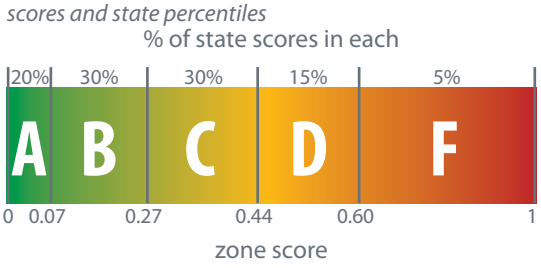
The final "zone score" for each reporting zone is then the simple average of the indicator scores.

5. Allocating the Report Card Grade

Defining the Report Card grade is an important step in the development of the Report Card. The grade definitions below are linked to the environmental values outlined above and are structured to allow easy comparison between each system and over time.

It is important that the cut-off values for each grade reflect the condition of each zone in comparison to a broader scale of condition across all NSW estuaries. (i.e. an "Excellent" grade represents an excellent condition for a NSW estuary). To assist with the derivation of cut-offs, scores were calculated for 130 zones across a wide range of NSW estuaries using the same triggers and worst expected values as the Great Lakes analyses. Cut-offs were then defined as representing a percentage of the scores for the state (Table 1.1.4). For example, a zone score less than 0.07 defined the 20% of best zone scores in the state and this became our "Excellent" grade (see Table 4 for other cut-offs). We did not use a score of 0 as excellent because, as a consequence of how the trigger values are calculated, we expect that even pristine reference sites will exceed trigger values 20% of the time. The definition of the grades and description are shown in Figure 1.1.4.

Figure 1.1.4 Relationships between grades, zone scores and state percentiles



Summary of the process for calculating the zone score

In summary, the process for calculating the zone involved:

- Calculating the proportion of time that the measured values of the indicator are above the adopted guideline limits or Trigger Values.
- Calculating the distance/departure from the guidelines for that indicator - the extent the data extends past the trigger value and approaches the worst expected value (WEV) for that indicator.
- Calculating the geometric mean of the non-compliance and distance scores to get a final score for that indicator for each zone.
- Averaging the scores for the two indicators at each site – this gives the "zone score".
- Grade the zone based on the zone score as A, B, C, D, F.

Table 1.1.4 Report Card results, definitions, descriptions and cut-off

Grade	Result	Definition	Description
A	Excellent	All environmental values met (The indicators measured meet all of trigger values for almost all of the year)	The best 20% of scores in the state
B	Good	Most environmental values met (The indicators measured meet all of the trigger values for most of the year)	Next 30% of good scores
C	Fair	Some of the environmental values met (The indicators measured meet some of the trigger values for some of the year)	Middle 30% of scores
D	Poor	Few of the environmental values met (The indicators measured meet few of the trigger values for some of the year)	Next 15% of poorer scores
F	Very Poor	None of the environmental values met (The indicators measured meet none of the trigger values for almost all of the year)	The worst 5% of scores in the state

Rainfall results

The amount of rainfall that occurs around the period of sampling for the Report Card (September – March each year) influences the Report Card results. If there is more rain, there is more runoff in the catchment resulting in greater quantities of sediment and nutrients entering our waterways (2011/12 for instance was a particularly wet summer and this was reflected in the sampling data).

This year (2013/14), rainfall was relatively similar to total recorded rainfall in 2012/13. Though relatively dry over the whole sampling period, above average falls during November kept total rainfall over the sampling period in line with annual averages.

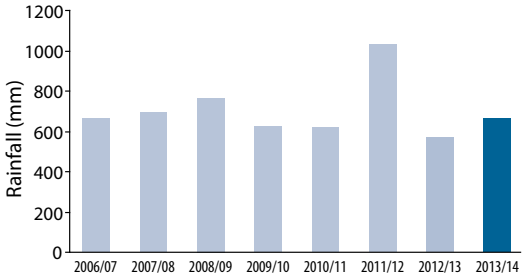


Figure 1.1.5 Data presented includes total rainfall September to March each year. The rainfall data is taken from the Forster Bureau of Meteorology rainfall station (Tuncurry Marine Rescue) (www.bom.gov.au/climate/data). The same trends were seen in data from Wootton and Bungwahl stations.

References

ANZECC (2003) Australian and New Zealand Guidelines for fresh and marine water quality. Volume 1, The guidelines / Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.

Roper T, Creese B, Scanes P, Stephens K, Williams R, Dela-Cruz J, Coade G, Coates B (2011) Assessing the condition of estuaries and coastal lake ecosystems in NSW. Technical Report (19 September 2011). NSW State of the Catchments.

Scanes P, Coade G, Doherty M, Hill R (2007) Evaluation of the utility of water quality based indicators of estuarine lagoon condition in NSW, Australia. Estuarine, Coastal and Shelf Science.

EHMP (2008). Ecosystem Health Monitoring Program 2006-07 Annual Technical Report. South East Queensland Healthy Waterways Partnership, Brisbane.

Acknowledgements

The methodology presented here was developed by the Office of Environment and Heritage, Scientific Services Section with input from Hodge Environmental and the International Water Centre.

Figure 1.1.6 Coomba Aquatic Wetland

Wallis Lake

Catchment description

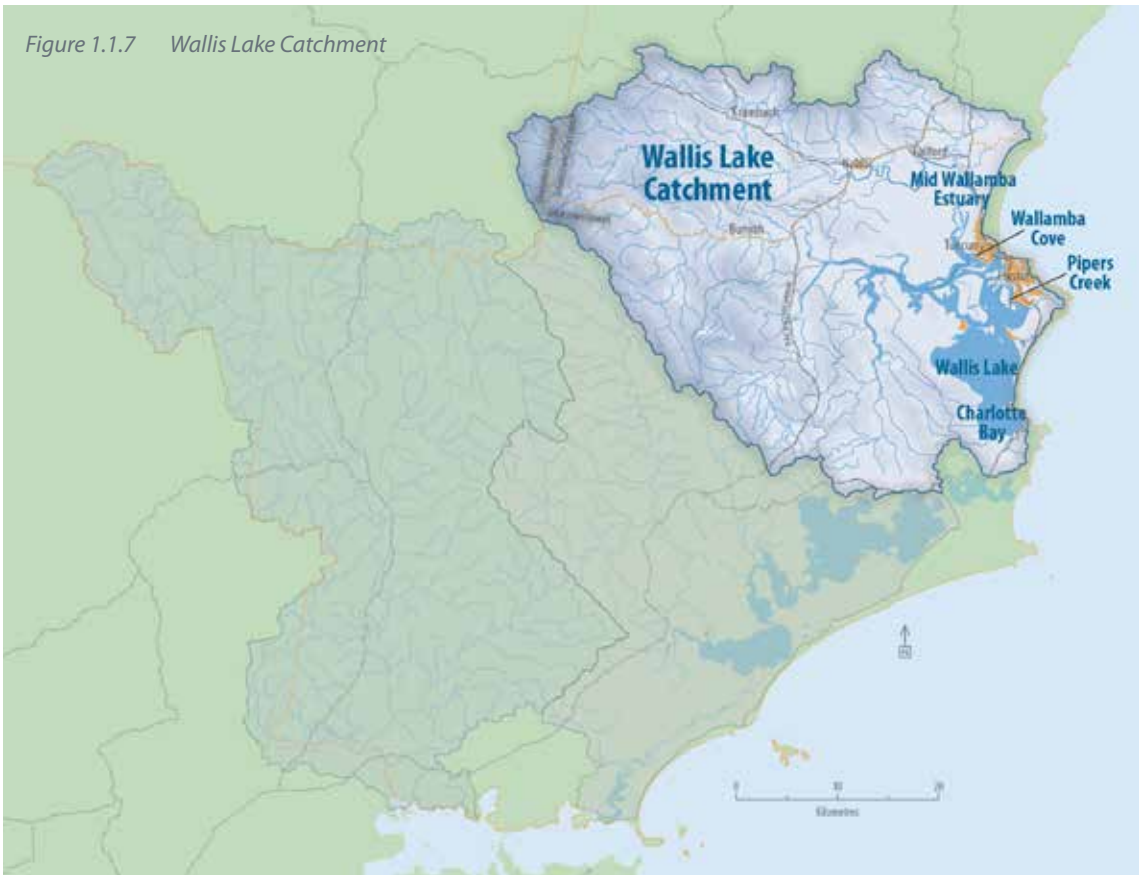
The Wallis Lake catchment extends over 1400 square kilometres and is shared between the Great Lakes Council LGA (65%) and the Greater Taree City Council LGA (35%). This catchment includes the region's major urban centre of Forster-Tuncurry.

Wallis Lake is one of the most significant producers of Sydney Rock Oysters in Australia and is also central to the local tourism industry, valued at over $315m per year. The lake is one of NSW's top three producing estuarine fisheries and is utilised extensively for recreation including boating, fishing and swimming.

The Wallis Lake catchment contains habitat for threatened and international migratory species and contains 35% of the seagrass beds of NSW, as well as the second largest representation of saltmarsh in the state.

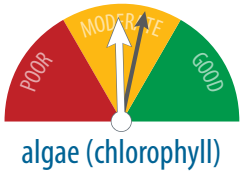
Figure 1.1.8 Learning sustainable farming techniques in the Wallis Catchment

Figure 1.1.7 Wallis Lake Catchment

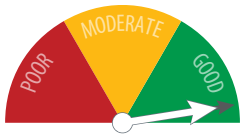


Mid Wallamba Estuary

2014	2013	2012	2011	2007
B	B	C	D	D



algae (chlorophyll)



clarity (turbidity)

Ecological health continues to be good

Waters of the mid Wallamba continue to be very clear, however the amount of algae in the water remains higher than desired. Nutrients from the catchment combined with clear waters and the still hot conditions led to overall high concentrations of algae and a small algal bloom in January.

Rainfall in the summer of 2013-14 was about average, but was not evenly spread out over the period: 44% of the rain fell in November 2013, and just 4% and 6% in December and January.

Catchment works to reduce erosion of soils from bare paddocks, stream banks and unsealed roads are beginning to take effect and the turbidity target was only exceeded in 16% of samples and those exceedances were very small – only 1% of the worst value. This has resulted in an excellent score for water clarity (turbidity).

The weather conditions were ideal for algae, with the heavy rain bringing nutrients into the river and clear warm waters combining to stimulate growth. Algal abundance (chlorophyll) exceeded the trigger values every time it was measured, and those exceedances were relatively large (26% of worst value). Unhealthy growth of small algae in the waters is stimulated by nutrients washed from urban areas and pastures, or from stock directly accessing waterways. If this continues, then algae may reach levels in the water which are detrimental to fish, humans and livestock. Even though the rainfall was less this year, the clear waters provide plenty of light and this combines with the nutrient loads to grow undesirable amounts of algae.

Great Lakes Council has initiated actions to control sediments and nutrients from the catchment as part of the Water Quality Improvement Plan. The results for 2014 continue the trend for improvement seen in the 2012 and 2013 data. It is too early to tell whether this represents a permanent shift in the condition. The chlorophyll data show that targeted work in the catchment is still required.

Estuary description

The Mid Wallamba Estuary sub catchment covers almost one third of the Wallis Lake catchment (550 km^2). The catchment is one of the most modified sub catchments in Wallis Lake. Agriculture is the dominant land use with a small urban centre at Nabiac. The Mid Wallamba Estuary faces additional localised pressures from the erosion and collapse of stream banks due to its popularity for water sports over the summer period.

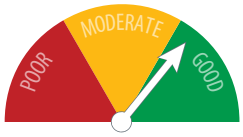
The water quality sampling occurs in the estuarine reaches of the river from Wallamba Island to Failford.

Wallamba Cove

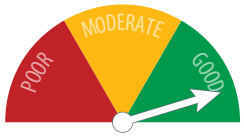
C

2014

River end of Cove

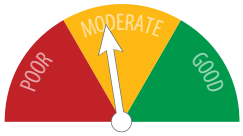


algae (chlorophyll)

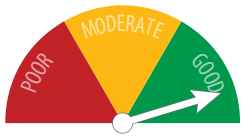


clarity (turbidity)

Upstream end of Cove



algae (chlorophyll)



clarity (turbidity)

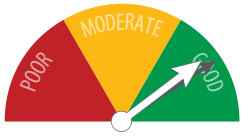
In Wallamba Cove, there is a large difference in health between the site near the river, which is good and the upstream site which is only fair. At the upstream site there are high levels of algae, all samples exceeded the trigger, many by 30 to 50% of the worst value. Turbidity criteria were also exceeded in 60 – 80% of samples, but generally by only a small amount. This information shows clearly that urban runoff is having a large effect in Wallamba Cove, but that effect is somewhat diluted at the downstream end by mixing with the Wallamba River.

This is the first time that the Cove has been sampled so it is not possible to know if these results are typical. The chlorophyll data show that targeted work in the catchment is still required.

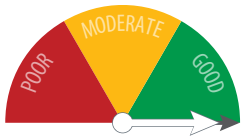
Figure 1.1.9 Urban stormwater runoff flows from Tuncurry to Wallamba Cove

Pipers Creek

2014 B 2013 B 2012 B 2011 B 2007



algae (chlorophyll)



clarity (turbidity)

Algae still higher than desired

The ecological health in Pipers Creek continues to be good, with results similar to 2011, 2012 and 2013. Waters in Pipers Creek remained clear. The nutrient loads from the urban catchment of Forster resulted in algal levels that were still higher than desired, but slightly less than last year.

Ecological health in Pipers Creek is strongly influenced by inputs from the large urban catchment. Nutrients from houses, lawns and pets, wash into the creek through stormwater and continue to stimulate algal growth to levels which are higher than desired for this type of waterway.

The trigger value for chlorophyll was exceeded in 67% of the samples collected, though the exceedences were not large. Similar to 2011, 2012 and 2013, this shows a constant pattern of mild excess algal growth rather than the occasional very large bloom. The chlorophyll score in 2014 was slightly higher than in 2013, resulted from slightly more exceedances rather than higher algal levels.

Water clarity was excellent with turbidity levels less than trigger values all of the time. This maintains the improvement seen from previous years back to 2007. Low turbidity levels are critical for the protection of important habitats such as seagrass beds which enhance the biodiversity of the system. This was a good result for Pipers Creek and shows that with the additional efforts being made to control nutrient runoff from the catchment; it may be possible for Pipers Creek to achieve excellent water quality in the future.

Recent improvements made to water quality should not be lost as a consequence of future development or re-development in this catchment. There should therefore be a continued emphasis on achieving water quality targets for all development and protection of existing native vegetation.

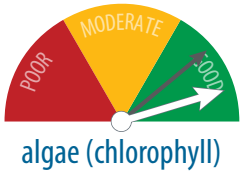
Estuary description

The majority of the Forster township is located in Pipers Creek Catchment. The rainfall that once infiltrated into the ground through native vegetation now meets impervious surfaces (roofs, roads and footpaths) and runs directly into stormwater drains and Pipers Creek. This stormwater runoff carries with it pollutants such as sediments and nutrients from houses, lawns and pets. In the past, Pipers Creek and Pipers Bay have experienced large algal blooms and shown signs of poor ecological health. Following large rainfall events, the water from Pipers Creek and Pipers Bay can reach Wallis Lake and Charlotte Bay areas. Reducing the impacts of stormwater from the Pipers Bay Catchment therefore has benefits across the whole of Wallis Lake.

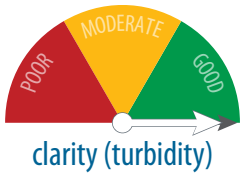
The samples for this Report Card are taken next to Big Island adjacent to Forster Keys.

Wallis Lake

2014	2013	2012	2011	2007
A	B	B	A	A



algae (chlorophyll)



clarity (turbidity)

Wallis Lake scores as good as last year but moderate algal growth remains

Wallis Lake is of a high conservation value, with abundant seagrass and high biodiversity. Ecological health was excellent this year, with the amount of algal growth less than the last 2 years. Chlorophyll samples exceeded the trigger value in about one third of samples (down from two thirds last year) and the size of the exceedances was less than last year. This probably reflects the dry summer as well as the on-going work to reduce runoff of nutrients from the catchment.

Wallis Lake has long been recognised as having high environmental values due to its extensive seagrass beds. Seagrass beds are important estuarine habitats that not only support biodiversity but provide essential ecosystem services such as nursery areas for aquatic bugs, fish and many other species. Seagrass beds in turn support a healthy community of larger animals such as turtles, large bodied fish, crabs, birds and dolphins. Healthy seagrass beds depend on good ecological health to survive.

All turbidity samples remained below trigger values meaning the waters are very clear, allowing plenty of light to penetrate the water, this means that seagrasses can survive to greater depths and maintain a large area of coverage.

The algal scores over the last two years show that Wallis Lake is maintaining its health, but only just. These results remind us that if there is not a continued effort to prevent of excessive nutrient inputs to the lake excessive algal growth could re-occur quickly.

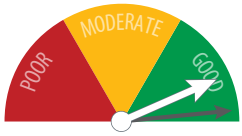
Estuary description

Wallis Lake is in the centre of the estuary and receives runoff from a narrow catchment immediately surrounding the lake. Adjoining areas directly influencing Wallis Lake include Coomba Park, Green Point and the rural residential land on the western side of Wallis Lake. During large rainfall events, water from the major rivers and the Pipers Creek catchment flow into this area carrying pollutants with it.

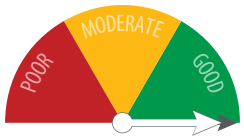
Sampling in Wallis Lake takes place in the centre of the estuary between Yahoo Island in the north and Earps Island in the south.

Charlotte Bay

2014 A 2013 A 2012 A 2011 A 2007



algae (chlorophyll)



clarity (turbidity)

Charlotte Bay remains in excellent condition

Charlotte Bay is of high conservation value, with abundant seagrass and high biodiversity. Ecological health remained excellent, algal growth is at very low levels, continuing the reversal of the small increase in algal levels seen in 2012. Water clarity was excellent.

Charlotte Bay was identified in the Water Quality Improvement Plan as having high environmental values primarily due to its extensive seagrass and macrophyte beds, which support possibly the highest diversity of sponges and associated animals in NSW estuaries. Good water quality, particularly clear water, were identified as being important in protecting this unique ecosystem.

The water quality results for Charlotte Bay have remained excellent, with no exceedences of turbidity trigger values for any samples in 2014. The waters are very clear, allowing plenty of light to reach the seagrasses and associated sponges.

Greater than desired growth of algae occurred in 33% of the samples, which is slightly greater than in 2013. The levels were still only just above the trigger levels. These levels were ranked as excellent. The average rainfall means that the inputs of nutrients are reduced to a level where Charlotte Bay can remain in excellent condition.

These results justify Council's position in relation to water quality targets for new development which prevent further nutrient inputs to the lake. The results from 2012 show that if there is not a continued effort to prevent of excessive nutrient inputs to the lake, excessive algal growth could occur quickly, but when pressure is reduced conditions will improve.

Estuary description

Charlotte Bay covers the southern most part of the Wallis Lake estuary. There is limited mixing between the northern and southern parts of Wallis Lake, therefore the condition of this area is influenced mainly by the surrounding catchment. The catchment is largely vegetated with a small amount of residential, commercial and rural residential land.

Sample collection in Charlotte Bay occurs in the middle of the water body south of Earps Island.

Myall Lakes

Catchment description

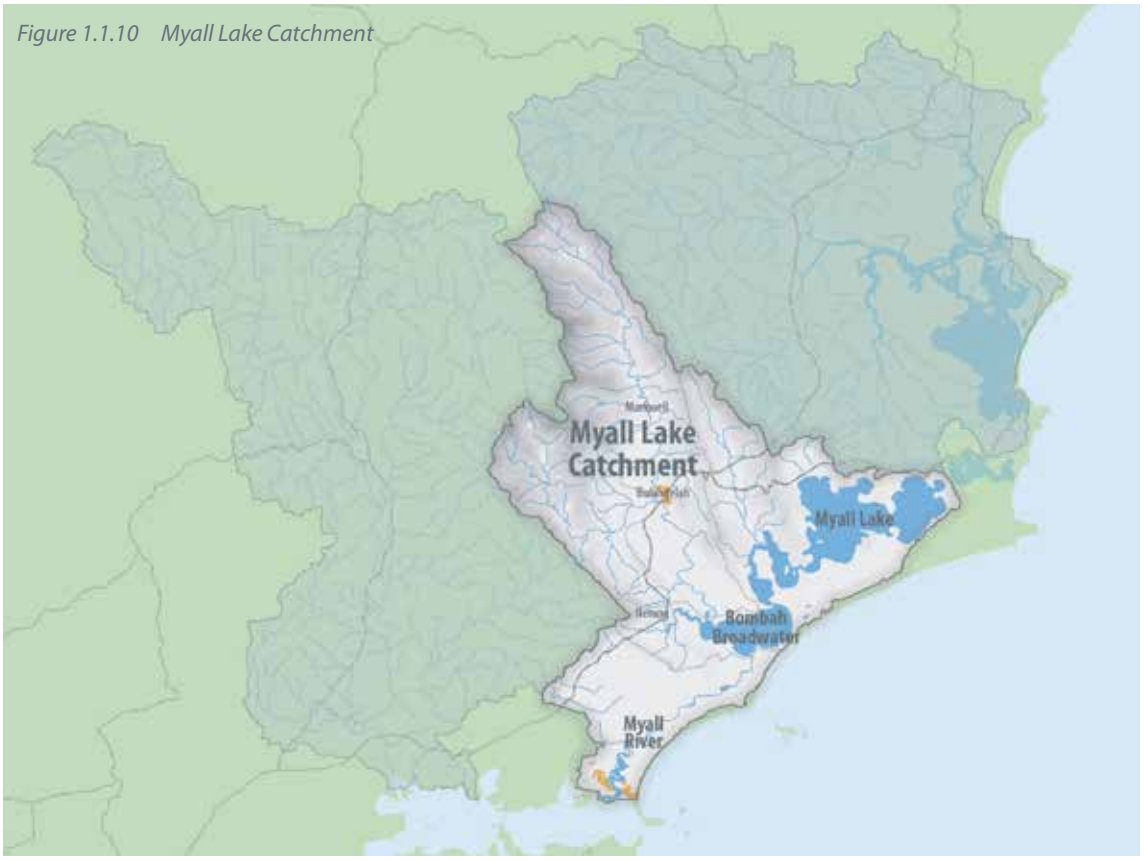
The Myall Lakes catchment covers 440 square kilometres. Its major tributary is the Myall River, whose headwaters extend to Craven Nature Reserve and the Kyle Range. The catchment is largely occupied by agricultural land, with forestry and protected vegetation in the steeper areas and a small amount of urban land in the townships of Bulahdelah and the well-known tourist destinations of Tea Gardens-Hawks Nest.

The Myall Lakes and Myall River in particular are part of a large tourism and recreation industry which includes Myall Lakes National Park, one of NSW's most visited National Parks with estimated annual visitor numbers of 250,000.

Major issues for the Myall Lakes system include the impacts of rural runoff on water quality including nutrients, noxious weeds and other pathogens. Urban runoff and the impacts from tourism and recreation uses of the lakes and estuaries are more prevalent in the lower reaches of the catchment.

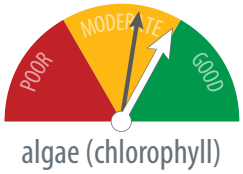
Figure 1.1.11 Landcare members visiting the Durness Property in the Myall River Catchment

Figure 1.1.10 Myall Lake Catchment

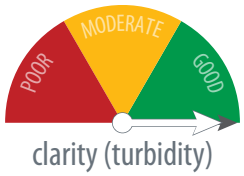


Bombah Broadwater

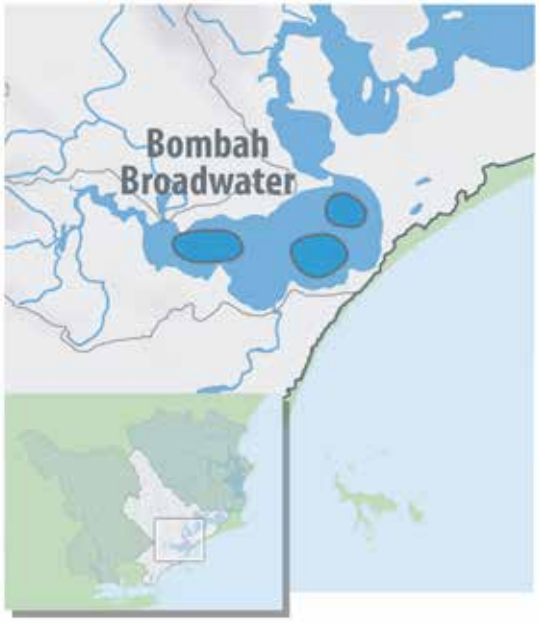
2014	2013	2012	2011	2007
B	B	D	B	B



algae (chlorophyll)



clarity (turbidity)



Good grade but algal growth remains a problem in Bombah Broadwater

The Bombah Broadwater is part of the Myall Lakes National Park. Overall ecological health has remained the same as last year. However, there were still large amounts of algae over summer.

Excessive algal growth in Bombah Broadwater, as a consequence of nutrient inputs from the upper Myall River catchment, has been a concern in Bombah Broadwater for at least a decade. High levels of algae threaten the conservation values of the Broadwater and adjoining Myall Lake.

The marked improvement in ecological health of the Broadwater in 2013 (compared to 2012) has continued into this year, but the elevated algal growth from 2012 has persisted, though it has mostly remained below bloom levels. As a consequence, between 80 and 100% of the chlorophyll samples were greater than the desired level though exceedances were only moderate (14 – 30% of worst value). This still resulted in a fair to poor grade for chlorophyll.

The good news is that water clarity has remained excellent, with all samples less than trigger values. This is a consequence of less runoff and a reduction in the large blue-green algal cells which can also lead to turbidity. The continuing high level of algal growth indicates that more needs to be done to control nutrient levels entering the Broadwater and the short-term target is to reduce the frequency and severity of these extended blooms.

Estuary description

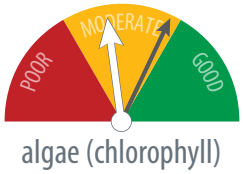
The Bombah Broadwater and Myall Lake are part of the Myall Lakes system which is comprised of four linearly connected brackish to freshwater basins: Myall Lake, Two Mile Lake, Boolambayte Lake and the Bombah Broadwater. The Myall Lakes National Park surrounds the lakes and is listed as a Ramsar wetland of international importance.

While the Bombah Broadwater itself is surrounded by National Park, it receives the majority of its inflow from the Upper Myall River and Crawford River catchments which together drain an area of approximately 440km^2. These catchments are largely occupied by agricultural land with forestry and protected vegetation in the steeper areas and a small amount of urban land in the township of Bulahdelah.

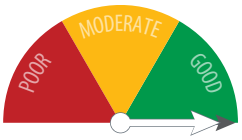
Samples were taken from three sites in the Bombah Broadwater and were combined to give an overall score for the health of the system.

Myall Lake

B 2014 B 2013 B 2012



algae (chlorophyll)



clarity (turbidity)

Good grade but algal growth still an issue in Myall Lake this year

Myall Lake has high conservation values; it is an internationally listed protected wetland and is part of Myall Lakes National Park. Overall, the health has remained good. Water clarity in the Myall Lake was excellent but there continues to be some undesirable growth of algae.

Myall Lake was identified in the Water Quality Improvement Plan as having very high environmental values primarily due to its extensive macrophyte beds and listing as an internationally significant wetland under the Ramsar convention. Good water quality, particularly clear water, were identified as being important in protecting this unique ecosystem.

The water quality results for Myall Lake were good overall. The clarity was excellent with no exceedences of turbidity trigger values for any samples in 2014. The waters are very clear, allowing plenty of light to reach the macrophytes on the lake floor.

Greater than desired growth of algae occurred in all samples, with some exceedances up to 46% of the worst values. These results were reflected in the need to issue algal bloom warnings for Myall Lake this year. Water moving from the Broadwater to Myall Lakes, carrying with it nutrients and algae, is believed to have contributed to the greater than desired levels of algae. The higher than desired level of algal growth in Myall Lake emphasises the ongoing need to control nutrient levels entering the Myall Lakes system via the upper Myall River.

Estuary description

Myall Lake along with the Bombah Broadwater is part of the Myall Lakes system which is comprised of four linearly connected brackish to freshwater basins: Myall Lake, Two Mile Lake, Boolambayte Lake and the Bombah Broadwater.

The Myall Lakes National Park surrounds the lakes and is listed as a Ramsar wetland of international importance.

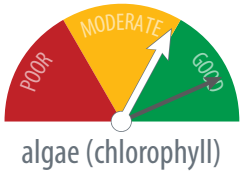
Myall Lake is directly influenced by a small fringing catchment which is contained within the Myall Lakes National Park. During times of high rainfall however, water from the Broadwater (and therefore the Upper Myall River and Crawford River catchments) influences Myall Lake by carrying with it nutrients and algae.

Samples were taken from two sites in Myall Lake and were combined to give an overall score for the health of the system.

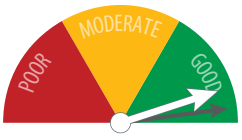
Myall River

B

2014 B 2011



algae (chlorophyll)



clarity (turbidity)

Good grade but algal growth an issue in Myall River

The Myall River connects the Bombah Broadwater with Port Stephens and thence the sea. It is part of the Myall Lakes National Park and has high ecological value.

Sampling for this report was concentrated in the region between Monkey Jacket and Brasswater. Overall ecological health was good, but the river is affected by algae moving downstream from Bombah Broadwater. As a consequence, between 80 and 100% of the chlorophyll samples were greater than the desired level, though exceedances were relatively small (12 – 14 % of worst value). This still resulted in a fair grade for chlorophyll. The water clarity is good, with 33 – 50% of samples less than trigger values and the exceedances were very small (1 – 3 % of worst value). This turbidity is usually a result of fine particles and organic fresh water molecules from the lakes clumping together as they mix with salt water from Port Stephens on the rising tides. The continuing high level of algal growth in waters from the Broadwater indicates that more needs to be done to control nutrient levels entering the Broadwater from the catchment of the upper Myall River.

Estuary description

The Lower Myall Estuary near Tea Gardens is the mouth of the Lower Myall River and is situated in an area of highly mobile sand features. The river discharges into the moderately sheltered waters of Port Stephens but the river entrance is exposed to swell from the south-east coming through the entrance of the Port.

The Lower Myall Estuary receives water from the urban area of Tea Gardens and Hawkes Nest and is strongly influenced by the waters of the Bombah Broadwater following rainfall.

Karuah River

Catchment description

The Karuah River is a wide riverine estuary on the Mid-North Coast of New South Wales and provides the only significant input of sediment to Port Stephens. The catchment is approximated 1460km^2, largely comprised of grazing land, forest and woodland and is sparsely populated, the largest settlements being Karuah (pop.~1000), located at the mouth of the river, and Stroud (pop. ~700), located in the centre of the catchment.

Land use in the Karuah River catchment has undergone continuous change since European settlement beginning with land clearing for forestry and agriculture from the late 19th century. The landscape today is a mosaic of rural landuse, including forestry, grazing industries, poultry production, mining, aquaculture and rural residential areas.

Trends from past water quality monitoring shows periods of high sediment and nutrient loads within the Karuah River; whilst at the same time displaying a range of in-stream biological diversity. In 2011 the Karuah River estuary and catchment was assessed as being in a moderate ecological condition, but with some significant threats to the system.

The amount of rainfall (and the intensity) that occurs around the period of sampling for the Report Card (September – March each year) influences the Report Card results. If there is more rain, there is more runoff in the catchment resulting in greater quantities of sediment and nutrients entering our waterways. Rainfall was somewhat below average during the sampling period.

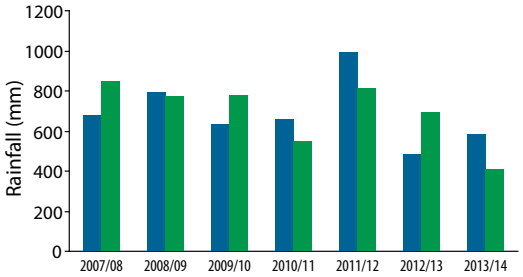
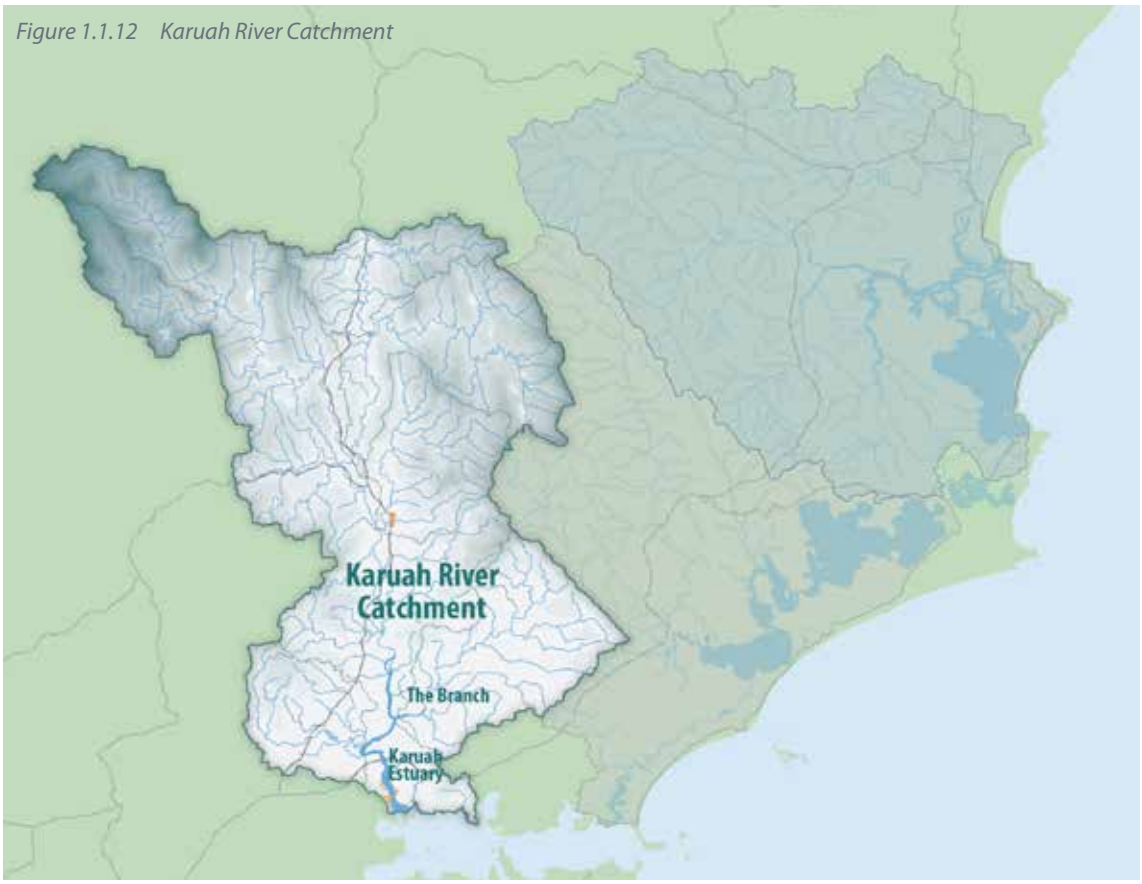


Figure 1.1.13 Total summer (Sept to Mar) rainfall at Stroud (blue) and Gloucester (green).

Figure 1.1.12 Karuah River Catchment



Estuary description

The Karuah River estuary is a priority oyster production area which has suffered periodic water quality issues associated with catchment runoff. The Karuah River estuary discharges into the north western part of Port Stephens, and is the only significant source of sediment to this system.

There are substantial areas of mangrove and saltmarsh habitats in the Karuah River estuary, which provide food sources and nursery areas to fish, but only very small areas of seagrass (seagrass extent has decreased by almost 80% between 1985 and 2009). Low light availability, due to high turbidity is the most likely reason for the lack of seagrass in the Karuah River estuary. The extent of saltmarsh over this time has also reduced, while mangrove has increased. Similar to many estuaries in NSW it is suggested that mangrove assemblages have increased at the expense of saltmarsh.

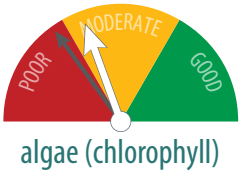
The samples for this report card have been obtained from three sites within the estuary. These sites were also used for data collection in 2007-8, 2010-11, 2011-12. They are:

- Above Allworth (1 site)
- The Karuah River Estuary upstream of the Karuah Bridge between Branch River junction and Allworth (1 site)
- The Branch River (1 site)

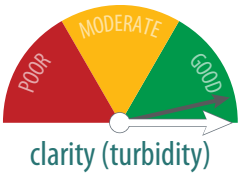
Figure 1.1.14 Karuah River Catchment

Karuah River

B 2014 C 2012



algae (chlorophyll)



clarity (turbidity)

Estuary health good but algal growth remains an issue

Samples were taken from the Karuah River both above Allworth and below (between Allworth and Branch River Junction). Both sites were scored as 'Good'.

Waters of the upper Karuah estuary are much clearer than in past reports, but excessive algal growth remains a problem. In common with all river estuaries, the Karuah is strongly affected by the quality of runoff from its catchment.

Water clarity in 2012 was very poor, but has improved significantly in 2014. The turbidity target was only exceeded in 16% of samples and those exceedances were small (16 % of the worst value). This has resulted in a good score for water clarity (turbidity).

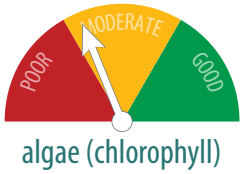
The weather conditions were, however, ideal for algae with the heavy rain in November bringing nutrients into the river and clear warm waters helping to stimulate growth. Algal abundance (chlorophyll) exceeded the trigger values in 67% of samples, but those exceedances were moderate (16% of worst value). Unhealthy growth of small algae in the waters is stimulated by nutrients washed from urban areas and pastures, or from stock directly accessing waterways. If this continues, then algae may reach levels in the water which are detrimental to fish, humans and aquaculture. This chlorophyll data and the past turbidity results show that targeted work in the catchment is required.

Great Lakes Council is finalising a Catchment Management Plan for the Karuah River Catchment. The plan will include actions to control sediments and nutrients.

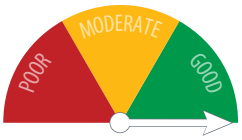
The Branch River

C

2014



algae (chlorophyll)



clarity (turbidity)

Estuary health good but algal growth an issue

Clarity of the waters of the Branch River estuary is good, but there are signs of excessive algal growth. In common with all river estuaries, the Branch is strongly affected by the quality of runoff from its catchment.

Water clarity in 2012 was very poor, but has improved significantly in 2014. The turbidity target was exceeded in all samples, but those exceedances were very small (1 % of the worst value). This has resulted in a good score for water clarity (turbidity).

The weather conditions were, however, ideal for algae, with the heavy rain in November bringing nutrients into the river and clear warm waters helping to stimulate growth. Algal abundance (chlorophyll) exceeded the trigger values in 80% of samples, but again, the exceedances were small (5% of worst value).

The data from this report and from the Karuah River Health assessment in 2012 indicates that there are on-going problems in the Branch River that need to be addressed through catchment management.

Management Actions - LGA wide

Landcare and Sustainability Groups

The Great Lakes Sustainable Farming Program was a collaborative project between Great Lakes Council (GLC), Karuah Great Lakes Landcare (KGLL), Greater Taree City Council and the Hunter Central Rivers Catchment Management Authority (now Hunter LLS). The aims of the program were to facilitate sustainable and productive land use across the Great Lakes catchments.

The program involved rural land managers in "action learning" using local networks, participatory learning, on-farm trials and "Best Practice Farms" to help encourage land managers to develop local solutions for sustainable agriculture.

During the program several Sustainable Farming Groups were established. These groups weren't necessarily only focused on farming issues as a Coomba Sustainable Living Group and a group primarily focused on farm biodiversity (primarily Land for Wildlife) were also established.

In addition to these localised Sustainable Farming Groups, the Sustainable Farming Program incorporated a number of professional workshops, practical hands-on field days, on- farm trials and demonstration sites.

The Great Lakes Sustainable Farming Program was funded through 'Caring for our Country' grants secured in 2008 and 2010, with the most recent grant concluding in June 2013. Currently, a number of Sustainable Farming groups have become independent entities with many of them signing up to become subgroups of Karuah Great Lakes Landcare.

KGLL's subgroups have organised some interesting sessions this year such as fish for farm dams, domestic chicken management, Crown-Rot fungus for Giant Parramatta Grass control, growing garlic, as well as raising honey and native bees.

Sustainable farming practices and capacity building in the catchment continue to be supported by Karuah Great Lakes Landcare and Great Lakes Council including:

- Five Sustainable Farming Program case studies and posters have been produced to showcase the best management practices adopted by landholders through the program.
- The development of a Memorandum of Understanding between GLC and KGLL to facilitate future partnership projects and funding applications.
- Two groundcover workshops were held by KGLL (with funding from Federal Government) in March this year. These were held at Crawford River and The Branch in conjunction with Great Lakes Council, targeting new and absentee landholders.

Urban engagement - sustainable gardening

During the Sustainable Farming program, a program aimed at urban residents to achieve similar land management and water quality goals, but at an urban audience was also trialled. The concept of 'sustainable gardening' was seen as an excellent framework for council to engage with residents regarding urban impacts on water quality.

Over twelve (12) months in 2012, participants were led through a series of workshops and outdoor training sessions with local gardening experts. The objectives of the program were to work with urban residents to help them to reduce their individual impact on water quality by taking actions in their garden to reduce nutrient application, utilise water and hold water in their soil so that it would not runoff into our waterways. Many actions to achieve this objective have been undertaken by participants including composting, worm farming, mulching and establishing gardens. Many participants indicated that being involved in the Program gave them the confidence to 'have a go' and become more relaxed about learning by doing.

This group continues to meet regularly and in 2014 is in the process of transitioning to become a sub-group of KGLL.

Land for wildlife

Land for Wildlife (*LFW*) is a national voluntary registration scheme for landowners who manage areas of their property for biodiversity and wildlife habitat. The program encourages and assists landholders to include nature conservation in their land management objectives. The *LFW* program is free to join, it is not legally binding and registration does not change the legal status of a property.

Great Lakes Council and Karuah Great Lakes Landcare are partners in delivering the LFW program in our area. KGLL volunteers and GLC staff help identify and assess wildlife habitats on private lands and their connectivity across the landscape, enabling registration with the program. To date 29 properties across the LGA have registered with LFW. Two LFW workshops have been held this year (Nabiac and Bulahdelah) focusing on weed and feral management, respectively.

Many of the objectives of the sustainable farming program have been incorporated into Great Lakes Council and Karuah Great Lakes Landcare's support of the Land for Wildlife program.

Figure 1.1.15 Land for Wildlife Members in the Wallis Lake Catchment

Figure 1.1.16 Parrots Feather can quickly overwhelm waterways

Protection from development and re-development

Council have focussed on protecting all waterways in the Local Government Area through its application of water quality targets for development and re-development. These water quality targets are incorporated into the Great Lakes Development Control Plan. For new developments (greenfield sites) water quality targets ensure that there is a neutral or beneficial effect on water quality which means nutrients are not allowed to increase above current levels. To achieve this, developers are required to present a stormwater strategy including measures such as rain gardens and rain water tanks. Small scale infill development including individual houses and dual occupancies are included in the development control plan providing further protection from nutrient and sediment inputs to our waterways.

Management of aquatic weeds

Sixteen (16) hectares of Cabomba infested waterways were monitored in the Wallis Lake Catchment to evaluate the effectiveness of a two year federally funded Cabomba eradication project. The project complements another federally funded project to conduct trials, leading to the registration of a suitable herbicide for the effective control of Cabomba. Monitoring program identified that five and a half (5.5) hectares were in need of retreatment. The retreatments formed part of ongoing maintenance jointly funded through Great Lakes Councils Noxious Weeds Program and the federal government's Caring for our Country Program. The maintenance program commenced in July 2013 with ongoing monitoring and any subsequent re-treatments being conducted as deemed necessary leading to the long term goal of eradication.

Aquatic weeds were monitored and treated along 46 km's of stream bank in the Myall Catchment. The ongoing monitoring program has revealed significant reductions in densities and occurrences of the target weed Parrots Feather.

One and a half (1.5) hectares of Alligator weed received multiple treatments at the obsolete landfill area contained within Tea Gardens Waste Management Centre. This newly discovered infestation is currently being managed under an intensive, ongoing, integrated weed management program.

One and a half (1.5) hectares of Salvinia infested water bodies were treated at Tea Gardens. These works are a continuation of an integrated program for the wetland's management focusing on water retention ponds in the area. The main pond infestation has been reduced to >0.1% with monitoring and hand removal efforts ongoing. Monitoring has revealed no sign of Salvinia in the main water body since January 2014. The use of biological controls and a containment barrier in the creek adjacent to the pond is maintaining weed densities and the eradication program will extend to this area in subsequent years as funds permit.

One (1) hectare of land has been treated for Longleaf willow primrose and the integrated management program for Longleaf Willow Primrose in drainage areas of Tea Gardens is ongoing.

Management Actions - Wallis Lake

Protection and rehabilitation of key habitats

Council have acquired and are conserving 887ha of wetlands at Darawakh, Minimbah and Lower Wallamba / North Tuncurry to protect water quality and biodiversity. The process of acquisition for public conservation is one of the most effective forms of protecting and restoring critical environmental services functions of the natural landscape, protecting against changed or intensified private land uses. The acquired landscapes are (or will be) all protected as Community Land under the Local Government Act, zoned for Environmental Protection in the applicable Local Environmental Plan and subject to permanent protection by way of a Conservation Property Vegetation Plan. Further, Council actively protects and restores the landscapes by direct and targeted actions, as funding permits.

Figure 1.1.17 Wallamba Island

Council has also restored pre-disturbance hydrology to over 90% of the Darawakh Creek / Frogalla Swamp through the infilling or decommissioning of 22.2km of artificial drains and removal of 1.5km of artificial levees to remediate a significant acid sulfate floodplain wetland system. Monitoring has indicated that the works are having measurable success regarding the protection of the Lower Wallamba River from toxic acid and metal discharges. Further, there has been substantial biodiversity outcomes associated with the program.

Bank stabilisation

5.1 km of the Wallamba River have been stabilised with rock protection, 9,170 native plants have been planted (including 1,170 in 2013/14), and bush regeneration and maintenance are ongoing to conserve 9.5km of streambank.

Rock walls that allow establishment of mangroves have been constructed to reduce bank erosion. The Wallamba River is exposed to severe bank erosion due to past vegetation clearance, ongoing cattle grazing and wash from boats. Monitoring from Great Lakes Council has indicated an erosion rate of up to 1m per year along 12km of river.

Sedimentation downstream is impacting on the health of the Wallis Lake oyster and fishing industry contributing to turbidity levels and in turn affecting the Report Card scores. Sedimentation directly affects oyster leases and turbidity reduces the depth at which seagrass will grow, thus reducing fish habitat.

The Wallamba River Memorandum of Understanding brokered an innovative agreement to the management and remediation of these significant riverbank erosion issues affecting the banks of the lower Wallamba River. The MOU was amended in 2010 to address the increasing impact of wash from wake enhancing activities.

The MOU amendments were negotiated with key stakeholders including caravan park businesses, landholders, waterway users and government agencies. Importantly, the amendments provide a designated area for wakeboarding and other wake enhancing activities within Wallis Lake in an area on the western side of Wallis Island and maintains the existing ski zone within the Wallamba River. It enacted responsibilities on land management agencies and river users to adopt actions and protocols to care for and restore the riverbank landscape to maintain the health of the river and its responsibilities including management of the riparian zone, protection and restoration of the downstream estuary and consider and manage aquatic habitat. Great Lakes Council, with the support of other land management agencies, has been implementing activities that relate to riverbank protection and stabilisation and associated riparian enhancement. Outputs have included installation of 5.1 kilometres of riverbank armouring (rock fillets/revetment), enhancement and re-establishment of riparian vegetation and mangroves, and stock exclusion fencing.

Figure 1.1.18 Rock fillets encourage the establishment of mangroves

Bush rehabilitation

Wallamba catchment

There is a group of active volunteers undertaking bush regeneration around Nabiac. Some 12 members of Nabiac Landcare meet weekly to tackle a range of weeds in a six hectare area of River Flat Sclerophyll Forest at Bullocky Wharf on the Wallamba River. In 2013/14, the group completed 2399 hours of regeneration works, and planted 72 endemic tubestock at the site. The group have cleared vast areas of woody weeds such as lantana, small leaved privet and camphor laurel. Also present at the site are the more problematic madeira vine, asparagus fern and trad.

Pipers Creek

Three volunteer bush regeneration groups currently exist in the Pipers Creek Catchment, working on a variety of vegetation types and weeds. At the southern end of Little Street, a single volunteer maintains a small (0.4ha) public reserve containing remnant floodplain rainforest and important SEPP14 wetland (Saltmarsh) on Wallis Lake foreshore. The area was overrun with woody weeds, such as lantana and senna, but also contains vine weeds such as climbing asparagus and morning glory. Native vines are also present, and in this highly disturbed landscape, are overgrowing old growth rainforest trees. Ongoing support is needed to complete meaningful restoration of the site. The Community Garden volunteers at Pennington Creek continue to maintain the banks of the creek, when they can spare time away from their vegetable plots. The volunteers clean up rubbish, as well as removing weeds. Woody weeds such as lantana, senna, vamphor laurel and date palms once dominated the site, but volunteers are now into the maintenance phase for these species. The ongoing challenge for the group is to manage the more persistent weeds such as asparagus weeds, madeira vine, fishbone fern and invasive grasses from dominating the creek banks.

Council's weeds crew have completed several treatments of weeds on the southern bank of the creek; removing mature date palms, camphor laurels, as well as treating fishbone fern and asparagus on the creek bank.

The site includes mangroves, old-growth remnant rainforest trees, sclerophyll species, as well as natives planted to help outcompete the weeds. The Sanctuary is a 6ha remnant of swamp sclerophyll forest adjacent to the golf course in Forster. Two volunteers have maintained this area since 2005, in which time the area has been transformed from a degraded camphor laurel forest with weed understorey, to an active regeneration site full of native regrowth. Garden escapes (from green waste dumping) are now the main focus of works here.

Wallis Lake

Four volunteer groups are actively regenerating their local bushland reserves in the Wallis catchment. Green Point Coastcare has been meeting weekly since 1996 to reduce weeds along the foreshore of Wallis Lake. Their initial work involved clearing vast tracts of lantana and bitou bush, now the remaining four members are tackling vine weeds, asparagus fern and invasive grasses. In 2013/14 the group have contributed 463 hours and planted 1330 tubestock. The group mainly focus on a 2ha area that has casuarinas fringing the lake's edge, with rainforest and eucalypt canopy in some areas.

Two volunteer groups are active at Coomba Park. One group, with six volunteers, works on a 3ha site at Coomba Aquatic Gardens. This area contains a Sclerophyll Forest on the headland point, and a large area of Saltmarsh with mangroves fringing the lake. The site was heavily infested with lantana when the group commenced in 1994.

The woody weeds (lantana and senna) are mostly under control. However, vine weeds (passionfruit, morning glory) and garden escapes are proving more problematic in the long-term management of the area. Over the past 12 months, this group have completed 711 hours and planted 348 native plants.

The Coomba Foreshore group has 12 members who meet weekly to work in a 1.5km long foreshore reserve that contains both Sclerophyll Forest and Saltmarsh. In 2013/14, the group completed 1044 hours of on-ground works in their area. Woody weeds, such as lantana and senna have been systematically removed, and

Figure 1.1.19 Great Lakes Bushcare volunteers

the group is now working on asparagus weeds (ground and climbing), vine weeds, including morning glory, madeira vine, moth vine and passionfruit vines (two species). Garden escapes and grass weeds are also a problem at this site. The group works in a 7ha area on Wallis Lake.

These two Coomba groups have been supported recently by bush regeneration contractors, funded by a NSW State Government Environmental Trust Grant.

A small group of locals at Wootton started working along creek banks of Carrington Creek in 2009. Large tracts of privet (both large and small leaved varieties), as well as moth vine and annual pasture weeds over-ran the area. Two volunteers now maintain the regenerated area with occasional working bees. Ongoing support for this group is needed to see sustainable regeneration outcomes at this site .

Charlotte Bay

Two volunteers meet every second week at the wetland behind the Community Hall at Pacific Palms. The group commenced in 2009 on the four hectare site. In 2013/14, they completed 28.5 hours at this site, which contains a mixture of saltmarsh species, old-growth mangroves and orchid-bearing casuarinas; as well as dense stands of cabbage-tree palms, grey gums and swamp mahoganies. Over a five year period of consistent regeneration works, the wetland has been converted from a weed dominated understorey, to a healthy mix of wetland reeds and rushes, and various rainforest understorey species.

Environmental Trust funding has supported the restoration of this important wetland area. The site is a natural wetland, doing vital work in filtering water coming off the adjacent village and infrastructure. The removal of weeds at this site has seen a proliferation of native rushes and sedges, and subsequently improved functioning of this important natural system.

Water Sensitive Urban Design

Over the past five years Great Lakes Council have been building water quality gardens in the Pipers Creek Catchment to filter the sediments and nutrients out of the stormwater prior to flowing out into Wallis Lake. Six gardens have been built in the Palms Estate drainage reserve between Kularoo Drive and the Southern Parkway. An additional garden was built out the front of Council on Breese Parade as a demonstration, filtering water from the road, further protecting Pipers Creek. In 2013, another water quality garden was constructed at the Forster campus of Great Lakes College, the number of gardens constructed now totals eight (8). A ninth water quality garden is currently under construction on the corner of Pipers Bay Drive and Tahiti Avenue. The water quality gardens work by slowing down the stormwater so that large particles like soil drop out of suspension. The water then flows over a planted area and the microscopic alga (biofilms) which grow on the plant roots remove the nutrient nitrogen. The sandy loam soil that the plants grow in also acts as an additional filter removing other pollutants like heavy metals, petrochemicals and phosphorus. The water that then flows into the stormwater drain is cleaner prior to flowing into Wallis Lake.

Figure 1.1.20 Pipers Bay Drive water quality garden (under construction)

Great Lakes College: incorporating local water quality issues into the curriculum

In 2012 and '13 Council worked with Great Lakes College Forster Campus to design a program to embed local water quality and catchment issues into the geography curriculum for Years 7-10. Council, in cooperation with Mid-Coast Water, has continued to work with Great Lakes College to run a twice-annual field day with year ten geography students.

To date, over 220 students have learnt about catchment management, threats to water quality in natural areas and water quality improvement gardens through these field days. Class room theory lessons are combined with a specially-designed catchment trailer, dip-netting for macro-invertebrates in the lake and undertaking water quality monitoring in Pipers Creek.

Great Lakes College have begun water quality monitoring at their school site with the Waterwatch program, and have also constructed a water quality improvement garden on-campus for water quality outcomes, and as a practical demonstration of the types of actions that can be taken to improve water quality in urban catchments.

Figure 1.1.21 Great Lakes College

Management Actions - Myall Lakes

Erosion control

Since 2008 the NSW National Parks and Wildlife Service have undertaken a program of track rationalisation and rehabilitation to reduce erosion and sediment reaching the Myall Lakes. In total, 120km of trails and roads have been treated with 89km closed and rehabilitated and the remaining 31km the trails have been improved including with erosion and sediment controls (for instance, installation of rollover drainage structures).

Sites for rehabilitation were identified based on the steepness, level of erosion and their location in the catchment. To rehabilitate the roads trails were re-shaped to match the contour of the land, where possible the natural drainage was reinstated and erosion and sediment controls were put in place to reduce sediment transport. Staff were trained in best practice erosion and sediment control to assist with future management of gravel roads.

In the areas where the roads were closed, signs, gates and bollards were constructed, trees were left across the track and the surface of the land was roughened to promote vegetation growth. These areas have begun to revegetate naturally. Outside of the National Park, erosion hot spots on gravel roads in the catchment have begun to be addressed. On Old Inn Road a concrete causeway was constructed across the Wild Cattle Creek along with sealing of the road on the approaches to the creek combined with geofabric and rock lining of the table drain significantly reducing sediment loads and turbidity to the creek.

Bush Rehabilitation

The Myall Koala and Environmental Support Group (Bitou Busters) originally started as a group who focused predominantly on bitou bush. They have now expanded their focus to include other garden escapees such as asparagus fern, coastal morning glory and Polygala. They have a membership upwards of 25 and in 2013/14 undertook 226 hours of volunteer work in the region.

Protection and rehabilitation of key habitats

The Water Quality Improvement Plan recognised the critical role that wetland protection and restoration plays in the maintenance and improvement of water quality and aquatic health. Functional floodplain wetlands are particularly important in the protection of receiving waterways from catchment runoff. Given that algae concentrations remain an issue in the Myall Lakes system, it is important that Myall River Floodplain wetland systems are appropriately protected and managed.

One example of a floodplain wetland restoration project is the acquisition and restoration of the Bulahdelah Plain Wetland. This 371 hectare area is located on the Myall River Floodplain above the Myall Lakes Ramsar Site. It was acquired by Great Lakes Council and with support from the NSW Estuary Grants and the Hunter Central Rivers Catchment Management Authority. The public acquisition of this wetland system has ensured that the important ecosystem services functions are protected against changed or intensified private land use. Further, the wetland is being actively restored so that ecosystem services functions are improved. Council has benefitted from the funding support of the Commonwealth Biodiversity Fund, NSW Environmental Trust and NSW Estuary Grants programs and is revegetating previously cleared areas of the land, controlling weeds and feral animals and excluding stock. The works will safeguard downstream waterways and will conserve an important area of habitat for significant biodiversity, including threatened species and endangered ecological communities.

Lower Myall

Whilst no data has been collected for the Lower Myall Estuary in Tea Gardens, actions in the catchment have continued and are presented below.

Council is a strategic partner in a project to establish connected habitat corridors and preserve and restore native vegetation over degraded farmland at Durness Station, Tea Gardens. The Durness – Borland Landcare Corridor project involves the establishment of corridors of native vegetation linking the northern foreshores of Port Stephens with habitats in Nerong State Forest and Myall Lakes National Park.

The corridors protect 92ha of land, which contains 20ha of remnant native vegetation. The remaining 72ha of land in the protected corridors is being revegetated by the establishment of environmental plantings. Over 65,000 native plants have been established in these corridor areas, to restore functional native vegetation to previously cleared areas. The project is associated with the establishment of stock exclusion fencing and riparian restoration on the trunk and tributaries of Kore Kore Creek as well as the remediation of active gully and sheet erosion sites and un-vegetated steep lands. This will deliver significant water quality benefits to Kore Kore Creek and the lower Port Stephens estuary.

The project is being delivered as part of a major re-development of the agricultural production system on Durness to ensure greater sustainability including the establishment of a rotational grazing system and farm-scale offstream watering network. The project site will be utilised for education and awareness activities.

Figure 1.1.22 Bulahdelah Plains Wetland

The Durness – Borland Landcare Corridor is being delivered by Landcare Australia Ltd and the landowner (Nepean Group) with funding provided by a bequest from the estate of the Late Raymond Borland. Council and Hunter LLS are significant contributing partners. As a further contribution to this project, Council has acquired and conserved 122ha of land to protect water quality and biodiversity in the Kore Kore Creek catchment. This land is a core conservation node and protects a landscape important for water quality protection. Beneficial, low-intensity uses shall be developed in the Kore Kore Conservation Reserve, including walking trails and signage to encourage stewardship and awareness. The Kore Kore Conservation Area has been subject to primary weed controls to enhance the condition and function of the native vegetation of the land.

Bush Rehabilitation

The Myall Koala and Environmental Support Group (Bitou Busters) originally started as a group who focused predominantly on bitou bush. They have now expanded their focus to include other garden escapees such as asparagus fern, coastal morning glory and Polygala. They have a membership upwards of 25 and in 2013/14 undertook 226 hours of volunteer work in the region.

Management Actions - Karuah River

Draft Karuah River Catchment Management Plan

Great Lakes Council with support from NSW Office of Environment and Heritage has drafted a Catchment Management Plan for the Karuah River to guide future management actions within the catchment. In order to ensure local knowledge and values are incorporated into the Plan, considerable time has been spent working with the community of the Karuah River Catchment.

This community engagement has included informal one-on-one farm and industry visits, field days, workshops, general communication, and presentations to gain an insight into the catchment from the community viewpoint. To formally capture community and stakeholder input, Council hosted the Karuah Catchment Forum in Stroud in June, attracting 135 people over two days.

Figure 1.1.23 Karuah River Catchment Forum

Appendix 1

2014 Waterway & Catchment Report Card for Wallis and Myall Lakes and Karuah Estuary

2014

Waterway & Catchment reportcard

for Wallis and Myall Lakes and the Karuah Estuary

Great Lakes COUNCIL

NSW Office of Environment & Heritage

NSW Local Land Services Hunter

Greater Taree City Council

Karuah Great Lakes Landcare

Water quality improvement projects are made possible by the Great Lakes Environmental Special Rate

Wallis Lake

Water quality report card

Pipers Creek

B 2014

B 2013 B 2012 B 2011 B 2007

The ecological health in Pipers Creek continues to be good, with results similar to 2011, 2012 and 2013. Waters in Pipers Creek remained clear. The nutrient loads from the urban catchment of Forster resulted in algal levels that were still higher than desired, but slightly less than last year.

Wallis Lake

A 2014

B 2013 B 2012 A 2011 A 2007

Wallis Lake is of a high conservation value, with abundant seagrass and high biodiversity. Ecological health was excellent this year with the amount of algal growth less than the last two years.

Charlotte Bay

A 2014

A 2013 A 2012 A 2011 A 2007

Charlotte Bay is of high conservation value, with abundant seagrass and high biodiversity. Ecological health remained excellent, algal growth is at very low levels, reversing the small increase in algal levels seen in 2012. Water clarity was excellent.

Mid Wallamba estuary

B 2014

B 2013 C 2012 D 2011 D 2007

Waters of the Wallamba River estuary have improved since 2012 and are very clear but algal growth is still higher than desired. The clear waters provide lots of light, which combined with nutrients from the catchment resulted in overall high concentrations of algae.

Wallamba cove

C 2014

This is the first time Wallamba Cove has been sampled. Waters were between fair and good, with algal growth increasing at sites furthest from the main estuary.

Management actions 2007-2014

LAND FOR WILDLIFE

29 properties across the LGA, and 23 in the Wallis Lake catchment have registered with LFW

EROSION AND SEDIMENT CONTROL

Protecting creek crossings in the upper reaches of the Wallamba River catchment

PROTECTION AND REHABILITATION OF KEY HABITATS

Acquiring and conserving 887 ha of wetlands at Darawakh, Minimbah and Lower Wallamba/North Tuncurry to protect water quality and biodiversity

WATER SENSITIVE URBAN DESIGN

9 water quality gardens and two wetlands built to treat 39.6 ha of land in the Pipers and Muddy Creek catchments

BUSH REHABILITATION

43 volunteers active in bush regeneration at 10 sites

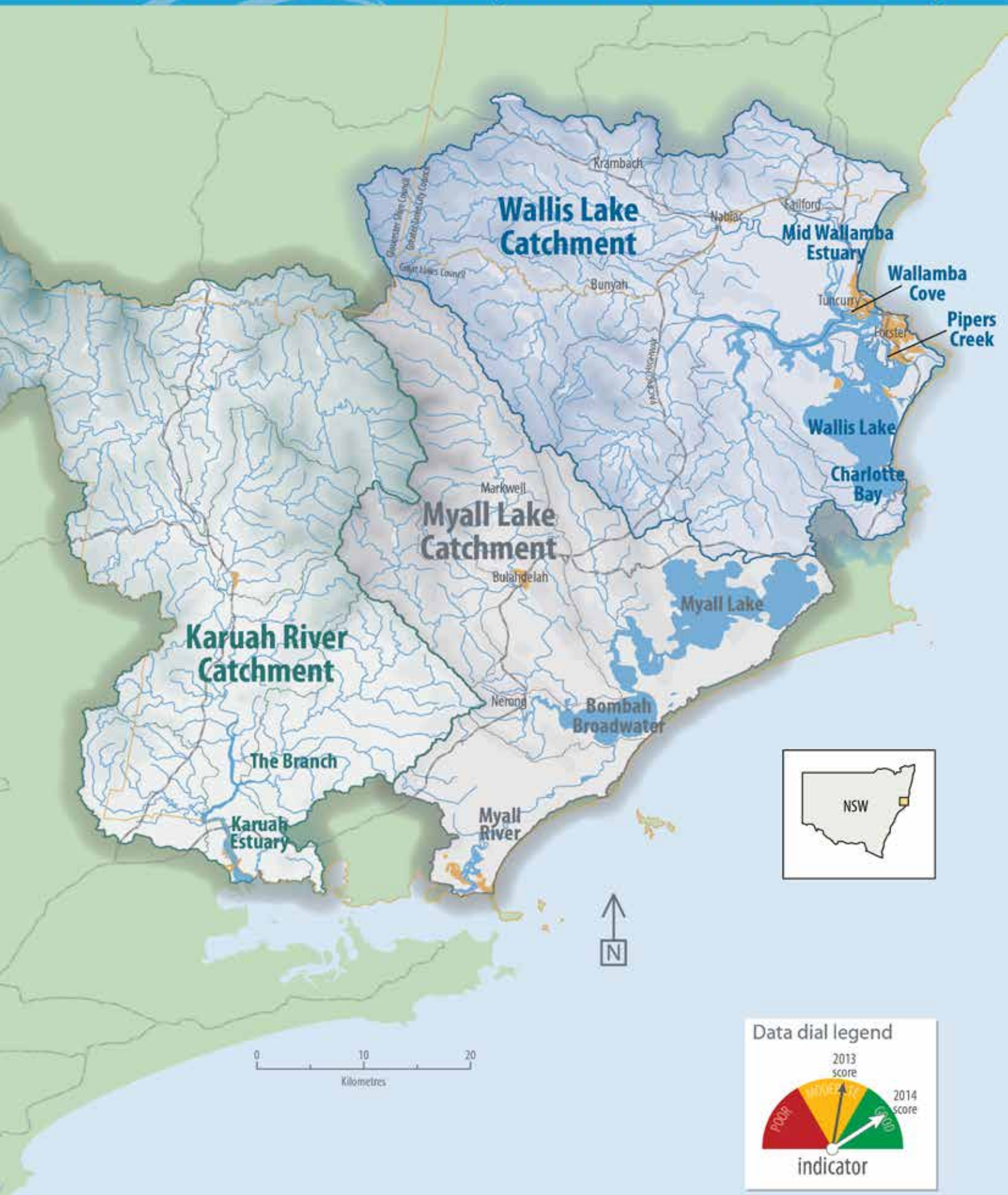
WORKING WITH STUDENTS

Incorporated water quality and catchment management issues into the Great Lakes College Geography curriculum for years 7-10

BANK STABILISATION

Stabilising 5.1 km of the Wallamba River with rock protection, planting 9170 native plants and conserving 9.5km of stream bank

Catchments of the Wallis and Myall Lakes and the Karuah Estuary



Myall Lakes

Water quality report card

Myall Lake

B 2014 (B 2013, B 2012)

Myall Lake has high conservation values, it is an internationally listed protected wetland and is part of Myall Lakes National Park. Overall, the health has remained good. Water clarity in the Myall Lake was excellent but there continues to be some undesirable growth of algae.

Myall River

B 2014 (B 2011)

The Myall River connects the Bombah Broadwater with Port Stephens and thence the sea. Overall ecological health was good but the river is affected by algae moving downstream from Bombah Broadwater.

Bombah Broadwater

B 2014 (B 2013, D 2012, B 2011, B 2007)

The Bombah Broadwater is part of Myall Lakes National Park. Overall ecological health has remained the same as last year. However, there were still large amounts of algae over summer.

Management actions 2007-2014

REMOVAL OF AQUATIC WEEDS
Aquatic weeds monitored along 46km of streambank and 3 ha of waterways treated

EROSION CONTROL
120km roads and trails closed, rehabilitated and maintained to reduce erosion and sedimentation in Myall Lakes National Park

SUSTAINABILITY AND LANDCARE GROUPS
2 sustainability groups are active in the catchment

PROTECTION AND REHABILITATION OF KEY HABITATS
Acquiring 371 ha of wetlands in the Bulahdelah area, creating a major wildlife corridor at Durness protecting 90 ha of land and revegetating 70 ha to protect water quality and biodiversity

Karuah Estuary

Water quality report card

Karuah Estuary

B 2014 (C 2012)

Waters of the upper Karuah estuary are much clearer than in past reports but excessive algal growth remains a problem.

The Branch

C 2014

Clarity of the waters of the Branch River estuary is good but there are signs of excessive algal growth. In common with all river estuaries, the Karuah and The Branch are strongly affected by the quality of runoff from their catchment.

Management actions 2007-2014

COMMUNITY EDUCATION
Informal one-on-one farm and industry visits, field days, workshops, and presentations to development the Karuah River Catchment Plan

CATCHMENT FORUM
135 community stakeholders over two days participated in the first Karuah Catchment Forum in June

Report Card Overview

Further details on the information contained in this report card are available in the 2014 Water Quality Report www.greatlakes.nsw.gov.au/Environment/Plans_and_Strategies

Introduction

This is the fourth Report Card for the waterways and catchments within the Great Lakes Local Government Area. The water quality data presented here was collected during the summer of 2013-2014.

Each waterway has received a grade based on the data which tells us the condition of the waterways this year. As more and more data is collected, we should be able to establish whether the waterways are changing. We will also be able to evaluate the impacts of extreme events (such as floods) and identify areas in need of protection and rehabilitation.

Methods

This Report Card is intended to read like a report card a student might receive at school. It assesses the condition or health of the waterways compared with what we would like it to be. A healthy waterway can be characterised by clear water and low levels of algae. It would provide habitat for a wide range of plants and animals.

This report card is rated for ecological health rather than other human health issues such as drinking water quality, safety for swimming, bacteria, viruses or our ability to harvest shellfish or fish.

To calculate the Report Card grade, scientists have assessed the condition of particular parts of the waterways using indicators. Just as your body temperature is used as an indicator that something may be wrong with your own health, indicators are used to show if something is out of balance or unhealthy in the system.

Two indicators have been used to assess the condition of the waterways. Chlorophyll a is the amount of microscopic algae in the water and high levels indicate high inputs of nutrients. Turbidity, or water clarity, is a measure of the amount of sediment or dirt suspended in the water. Sensors are used by scientists to collect the information.

Measurements were taken six times over the 2013-2014 summer at seven sites across the region. The condition of each site is established by comparing the indicator levels to a benchmark level measured from an undisturbed, healthy site of a similar type.

The information collected is converted into a grade. Grades have been set after looking at scores from over 130 sites across the state. The grade indicates where a site ranks in comparison to the other sites.

Grade	Result	Description
A	Excellent	The highest 20% of scores in the state
B	Good	Next 20% of high scores in the state
C	Fair	Middle 40% of scores in the state
D	Poor	Lower 15% of scores in the state
F	Fail	Lowest 5% of scores in the state

This Report Card presents the ecological health for 2014 and (where available) also shows data from 2011 to 2013 for comparison. The dial from poor to good shows how chlorophyll and turbidity levels have changed since the last Report Card.

Spotlight on the Wallamba River estuary

DARAWAKH CREEK AND FROGALLA SWAMP

This 1000ha wetland was identified as a key source of acid flowing into the Wallamba River from historical agricultural drainage works. Restoration works commenced in 2003 including removal of drains and a tidal headwall, weed control and revegetation as well as incorporation of key wetlands into the existing Darawank Nature Reserve. Significant improvements in downstream water quality have since been achieved as well as the restoration and conservation of biodiversity.

RIVERBANK PROTECTION AND RESTORATION WORKS

To protect and reinforce riverbanks from erosion rock revetment walls have been installed along high-risk sites. Rock fillets have also been installed to assist mangroves regenerate along eroding riverbanks and riparian areas have been replanted with native vegetation.

GEREEBA AND WALLAMBA ISLAND RESTORATION PROJECT

Works are currently occurring on Gereeba and Wallamba Island wetlands to restore the islands' biodiversity as well as the important services their wetlands provide. Activities on the island include fox and wild dog control, weed removal and native replanting. This project has involved multiple partners including the Environmental Trust, Biodiversity Fund, OEH and an innovative project with Greenfleet to sequester carbon through replanting of native vegetation.

Tuncurry

Wallamba River

Forster

Wallis Island

WALLAMBA RIVER MOU

High speed use of waterways can wash away riverbanks, increasing water turbidity and damaging important fish habitats. To manage this, a Memorandum of Understanding has been established between government agencies, oyster farmers, caravan park owners, water skiers and fishermen to ensure that boating activities are safe and sustainably managed. Activities causing excessive wakes now have a designated area on the western side of Wallis Lake and water skiers can use a 9km area north of the Wallamba broadwater.

Enquires should be directed to:

Great Lakes Council
PO Box 450
Forster NSW 2428
telephone: (02) 6591 7222
fax: (02) 6591 7221
email: council@greatlakes.nsw.gov.au