Australian Government
Commonwealth Environmental Water

Institute for Land, Water and Society
Charles Sturt University

research for a sustainable future

Monitoring of the algal bloom in the Edward-Wakool system 2016, update #4

May 2016

Robyn J Watts, Julia A Howitt, Nicole McCasker, James Abell and Xiaoying Liu (2016) Monitoring of the algal bloom in the Edward-Wakool system 2016, Update number 4. Institute for Land, Water and Society, Charles Sturt University, Prepared for Commonwealth Environmental Water.

Summary

Fourteen sites in the Edward-Wakool system were monitored weekly between 29th February and 18th May 2016 for water quality parameters including biovolume of cyanobacteria. This report includes field observations from May 2016 and some preliminary data. A full analysis of all data will be included in the 2015-16 Edward-Wakool Long term Intervention Monitoring annual report.

The spot water temperatures on 17-18 May ranged between 15.5 to 17.6 °C which is considerably lower than temperatures recorded in March. A small fresh in Yallakool Creek and the upper Wakool river in early May combined to increase the discharge in the mid-Wakool River. There was also a flush in Colligen Creek in late April/early May 2016.

The presence of cyanobacteria has decreased considerably in Yallakool Creek, the upper Wakool River, Colligen Creek and the Edward River over the past two weeks compared to samples collected in March and April 2016. On 17-18 May algae was still evident in the samples from Wakool River zone 4, Wakool River at Gee Gee Bridge, and the Niemur River at Nancurrie Road.

Background

A blue green algal bloom commenced in the Murray River and the Edward-Wakool River system in February 2016. There was a risk that the bloom may adversely impact on water quality, especially once it begins to break down. Commonwealth environmental water is planned for potential use in the Edward-Wakool River system during March-June 2016 as a contingency measure to:

- prevent a deterioration in water quality, especially dissolved oxygen, in the Yallakool, Upper Wakool & Colligen-Niemur if feasible
- seek to improve the ability for fish and other aquatic fauna to move to areas of better quality habitat if required.

In response to the blue-green algae outbreak, the Commonwealth Environmental Water Office (CEWO) commissioned a team from the Institute for Land, Water and Society at Charles Sturt University to undertake weekly water quality monitoring in addition to monitoring undertaken as part of the CEWO Long Term Intervention Monitoring (LTIM) Project.

The aims of the project were to:

1. Undertake additional water quality sampling at all the sites where the Edward-Wakool River LTIM Project currently has dissolved oxygen loggers plus some additional sites including the Niemur River at Nancurrie Road Bridge, Colligen Creek, Stevens Weir (source of water) and Mulwala canal (potential source of water)
2. Provide regular updates on monitoring results to the CEWO and partner NRM agencies/forums, in particular the Murray Dissolved Oxygen Group.
3. Develop practical recommendations or guidelines for the management of environmental water to maximise the benefits to water quality, particularly dissolved oxygen levels, in the Edward-Wakool system. These recommendations will include a focus on management options when the system is experiencing blue green algae outbreaks.

The expected outcomes are:

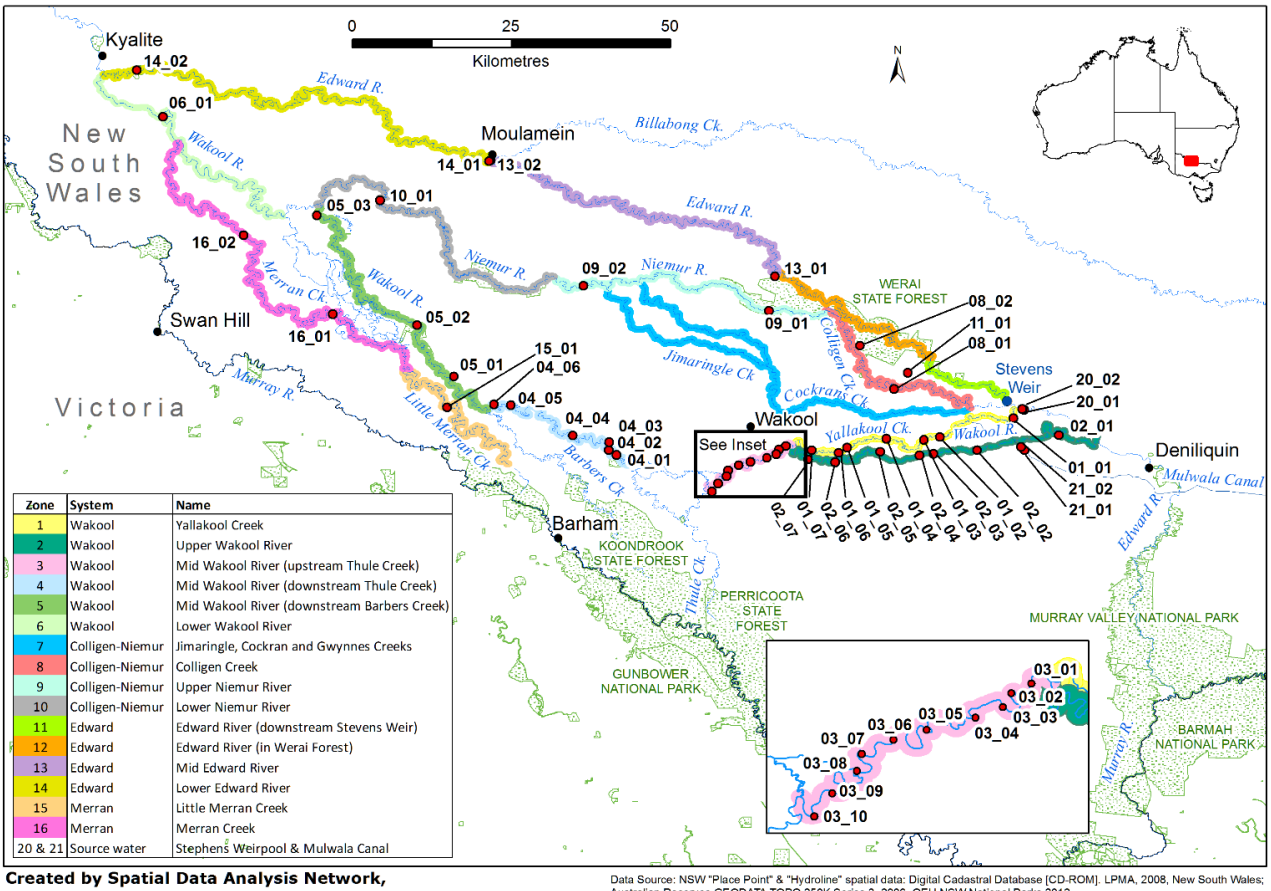
1. An increased understanding of how water quality may respond to environmental watering in the Edward-Wakool system under a range of scenarios, including those influenced by the presence of blue green algae in the system.
2. More informed decision making and effective use of environmental water to maximise improvements in water quality outcomes within an adaptive management framework.

Sites monitored

Fourteen sites in the Edward-Wakool system have been monitored weekly between 29th February and 18th May 2016 (Table 1). These sites are included in the map of LTIM monitoring sites in this system (Figure 1).

Table 1: Blue-green sampling sites

River	Site no	Site Name
Yallakool Creek	01_02	Hopwood
Yallakool Creek	01_07	Windra Vale
Upper Wakool River	02_02	Yaloke
Upper Wakool River	02_06	Widgee 1
Mid Wakool River	03_02	Tralee
Mid Wakool River	03_10	Llanos Park
Mid Wakool River	04_01	Barham Bridge
Mid Wakool River	04_06	Noorong 2
Mid Wakool River	05_02	Gee Gee Bridge
Niemur River	Between 10_01 and 09_02	Nancurrie Rd Bridge
Colligen Creek	upstream of site 08_01	Bowen Park
Colligen Creek	Near Werai station site 08_02	Near Werai station
Edward River	20_02	Stevens Weir
Mulwala canal	21_01	Canal 1



Zone	System	Name
1	Wakool	Yallakool Creek
2	Wakool	Upper Wakool River
3	Wakool	Mid Wakool River (upstream Thule Creek)
4	Wakool	Mid Wakool River (downstream Thule Creek)
5	Wakool	Mid Wakool River (downstream Barbers Creek)
6	Wakool	Lower Wakool River
7	Colligen-Niemur	Jimaringle, Cockran and Gwynnes Creeks
8	Colligen-Niemur	Colligen Creek
9	Colligen-Niemur	Upper Niemur River
10	Colligen-Niemur	Lower Niemur River
11	Edward	Edward River (downstream Stevens Weir)
12	Edward	Edward River (in Werai Forest)
13	Edward	Mid Edward River
14	Edward	Lower Edward River
15	Merran	Little Merran Creek
16	Merran	Merran Creek
20 & 21	Source water	Stephens Weirpool & Mulwala Canal

Created by Spatial Data Analysis Network, Charles Sturt University, May, 2015

Data Source: NSW "Place Point" & "Hydroline" spatial data: Digital Cadastral Database [CD-ROM]. LPMA, 2008, New South Wales; Australian Reserves GEODATA TOPO 250K Series 3, 2006, OEH NSW National Parks 2012

Figure 1. Edward-Wakool Long term Intervention Monitoring sites

Spot water quality data from 17 -18 May 2016

Spot water results from 17-18 May 2016 are presented in Table 2. Note that the time of day will influence the temperature, dissolved oxygen and pH results, so spot measures cannot be directly compared with data from previous weeks because they were measured at different times of the day. All water quality data including dissolved oxygen concentrations and temperature data from loggers will be presented in the 2015-16 Edward-Wakool LTIM annual report.
Key points:

- On 17-18 May the spot water temperature ranged between 15.5 to 17.6 °C which is considerably lower than temperatures recorded in March. On 14-15 March the spot water temperature was in the range 24.5 to 28.8 °C and on 7-8 March the range of water temperature was 26.3 to 31 °C.
- The percent saturation of dissolved oxygen on 17-18 May was generally lower than values recorded previously, but was in a good range.
- On 17-18 May the turbidity was considerably lower at most sites compared with data collected in March and April. The sites where turbidity remains high were the Wakool River Zone 4 site 5 at 'Noorong', the Wakool River at Gee Gee Bridge, and the Niemur River at Nancurrie Road. Spot DO levels were also highest at these three sites.
- On 17-18 May the Mulwala canal at the Deniliquin-Wakool Road crossing was empty, so no water samples were collected from the canal this week.

Table 2. Spot water quality results on 17/5/16 to 18/5/16 at sites in the Edward-Wakool system

Zone	Zone name	Site	Name	Date	Time	Temp (°C)	pH	EC (mS/cm)	Turb (NTU)	DO (mg/L)	DO (%)
1	Yallakool Ck	2	Hopwood	17/05/16	12:13	16.46	6.53	0.027	61.6	9.37	98.9
1	Yallakool Ck	7	Windra Vale	17/05/16	12:45	16.33	6.30	0.028	64.4	9.41	99.1
2	Upper Wakool	2	Yaloke	17/05/16	11:47	15.92	6.82	0.214	85.5	9.90	103.4
2	Wakool R	6	Widgee1	17/05/16	13:12	16.38	5.97	0.054	88.1	9.49	100.0
3	Mid Wakool R	2	Tralee	18/05/16	10:35	16.04	6.17	0.034	63.3	8.75	91.6
3	Mid Wakool R	5	Llanos Park	18/05/16	08:36	15.51	6.49	0.054	91.5	8.12	84.1
4	Mid Wakool R	1	Barham Bridge	17/05/16	16:50	16.57	6.06	0.069	76.3	9.40	99.5
4	Mid Wakool R	5	Noorong 2	17/05/16	16:00	16.23	6.34	0.053	162.0	10.29	108.1
5	Mid Wakool R	2	Gee Gee	17/05/16	15:05	16.35	6.71	0.065	203.1	10.75	113.2
10	Niemur River		Nancurrie Rd	17/05/16	14:34	16.52	6.29	0.025	159.0	10.55	111.5
8	Colligen Creek		Bowen Park	18/05/16	12:07	16.27	5.92	0.029	47.6	9.24	97.2
8	Colligen Creek		Near Werai Station	18/05/16	11;13	16.08	5.94	0.029	47.0	8.88	93.0
20	Edward River	2	Stevens Weir	18/05/16	12:34	17.65	6.12	0.028	40.5	9.92	107.3
21	Mulwala Canal	1	Canal - Wakool	Canal empty - Not sampled							

Hydrology and water level changes over the past month

The Mulwala canal has been drained over the past two weeks and is now empty (Figure 2), and there was evidence that the flush of water that would have occurred during emptying had inundated an instream bench at 'Widgee' in zone 2. The flow in zone 2 combined with the increased discharge in Yallakool Creek (Figure 3) contributed to an increase in discharge in the Wakool River at Barham Road in zone 3 (Figure 4). There has also been a flush in Colligen Creek (Figure 5).

Figure 2. a) Mulwala Canal at Deniliquin-Wakool Road crossing 22/3/16 (Photo J Abell). b) The Mulwala canal was empty on 17/5/16. (Photo R Watts)

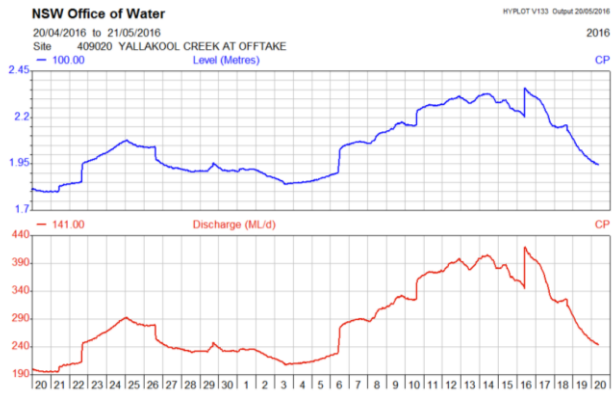


Figure 3. Water level and discharge at Yallakool Creek offtake from 20/4/2016 to 20/5/2016.

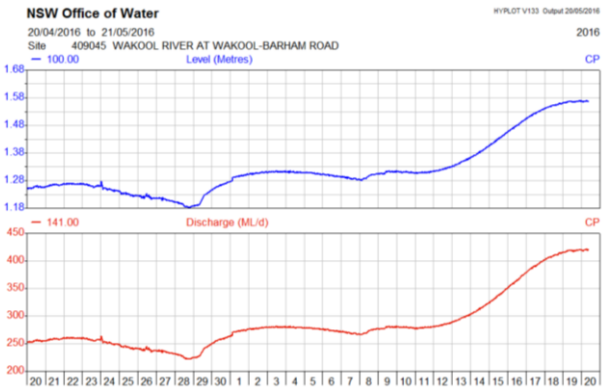


Figure 4. Water level and discharge in the Wakool River at Wakool-Barham Road from 20/4/2016 to 20/5/2016.

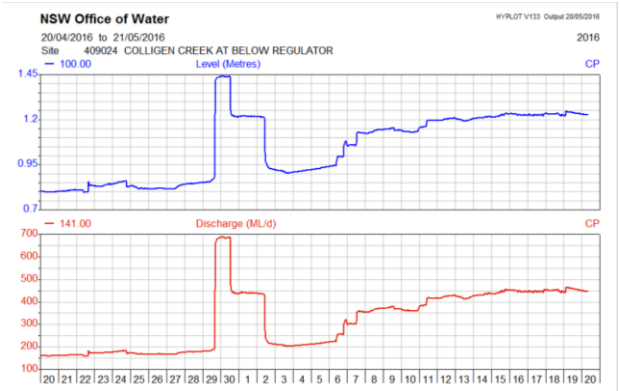


Figure 5. Water level and discharge at the Colligen Creek regulator from 20/4/2016 to 20/5/2016.

Algal bloom observations from 17-18 May 2016

There was visual evidence that the blue-green algal bloom had decreased at many of the sites over the past two weeks. There was less algae present in Yallakool Creek zone 1 (Figure 6) and the upper Wakool River zone 2 (Figure 7). The turbidity of Yallakool Creek and the upper Wakool was between 60 and 80 NTU (Table 1), which is much lower than the values in the mid 100's or 200's recorded previously (see previous reports). The algal bloom had also reduced in Colligen Creek (Figure 8).

Figure 6. a) Yallakool Creek (Zone 1 site 5) on 22/3/16 (Photo J Abell). b) Lower level of algae evident at this site on 17/5/16. (Photo R Watts)

Figure 7. a) Wakool River (Zone 2 site 4) 'Widgee' on 22/3/16 (Photo J Abell). b) Lower level of algae evident at this site on 17/5/16. (Photo R Watts)

Figure 8. a) Colligen Creek (Bowen Park) on 22/3/16 (Photo J Abell). b) Lower level of algae evident at this site on 17/5/16. (Photo R Watts)

Visual assessment of the colour of the water shows there was some algae still present in zones 3 and zone 4, but the concentration appeared to be lower than in previous weeks, and there was no film or scum on the surface of the water amongst the aquatic vegetation. The Wakool River at Gee Gee Bridge had vastly improved compared to the condition during the peak of the algal bloom in March (Figure 9). The Niemur River at Nancurrie road showed little improvement and was still very green on 17/5/2016 (Figure 10).

Figure 9. a) Wakool River (Gee Gee bridge) 22/3/16 (Photo J. Abell) b) Considerably lower level of algae evident at this site on 17/5/16. (Photo R Watts)

Figure 10. a) Niemur River at Nancurrie Road bridge 22/3/16. (Photo J. Abell) b) Blue green algae still very high concentration at this site on 17/5/16 (Photo R. Watts).

Visual assessment of algal concentration

Visual assessment of water samples shows that the concentration of algae in water has reduced in Yallakool Creek, the upper Wakool River, Colligen Creek and the Edward River at Stevens weir compared to samples collected in March and April 2016. On 17-18 May algae was most evident in the samples from Wakool River zone 4, Wakool River at Gee Gee Bridge, and the Niemur River at Nancurrie Road (Figure 11).

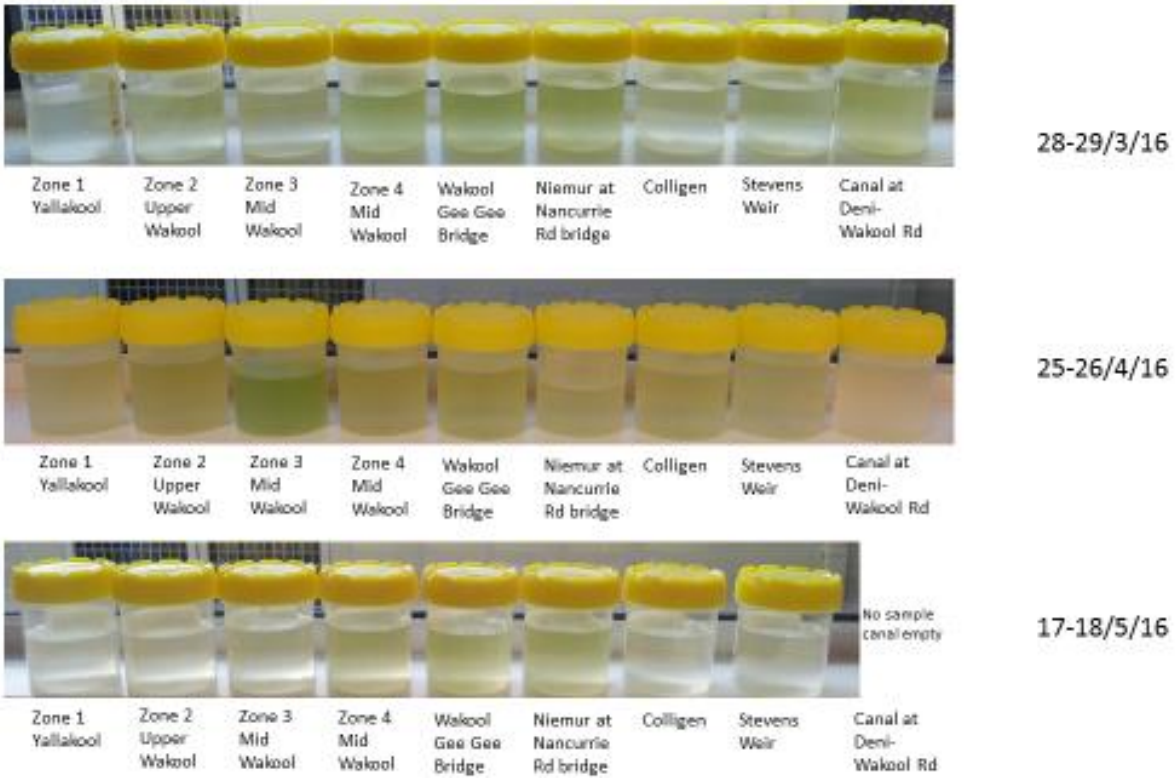


Figure 11. Water samples collected on 28-29 March, 25-26 April and 17-18 May 2016.

Algal biovolume

The biovolume of cyanobacteria in samples from five of the fourteen sites between 14 March and 2 May is shown in Figure 12. The biovolume of cyanobacteria in water from Yallakool Creek, the upper Wakool River (zone 2), Mid Wakool River at Gee Gee Bridge, Niemur River and Edward River at Stevens weir were all well above the red alert level (4 mm^3/L) throughout March and April. The biovolume of cyanobacteria at most sites decreased in early April, but increased again during late April and early May. Samples collected on 10-11 May and 17-18 May have not yet been processed, but it is expected that the biovolume at most sites on 17-18 May will be lower than previous results.

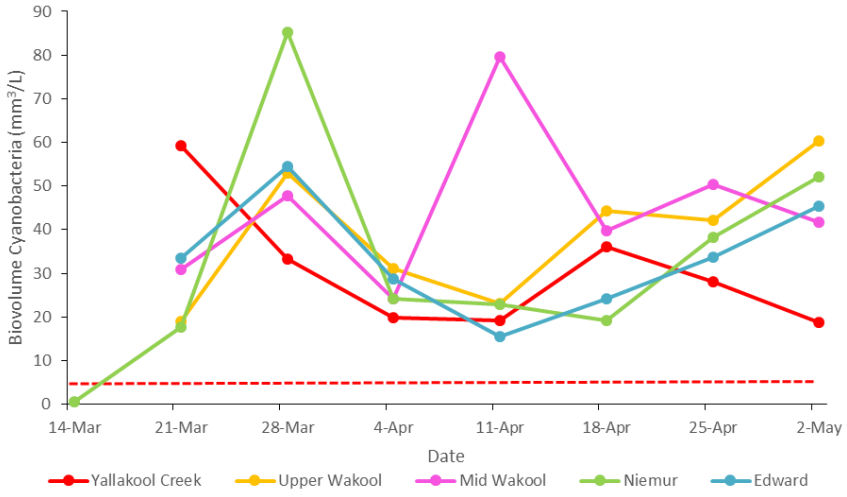


Figure 12. Biovolume of cyanobacteria (mm^3/L) in water samples from sites in the Edward-Wakool system collected between 14 March 2016 and 2 May 2016. The red dotted line shows the concentration at which a red alert is usually declared (> 4 mm^3/L).

Nutrients

Nutrient concentrations between August 2015 and early March 2016 were similar to those observed in previous years (e.g. Watts et al. 2014). However, after the algal bloom had commenced the concentrations of both total nitrogen and NO_x dramatically increased (Figure 13). Further analysis is required but it is likely that this increase reflects the nitrogen fixing properties of the cyanobacteria adding nitrogen to the aquatic system. Total Nitrogen includes nitrogen in the water and nitrogen included within cells and greatly exceeds the ANZECC (2000) trigger levels, while NO_x is measured for the water column only and only occasionally exceeds the guidelines.

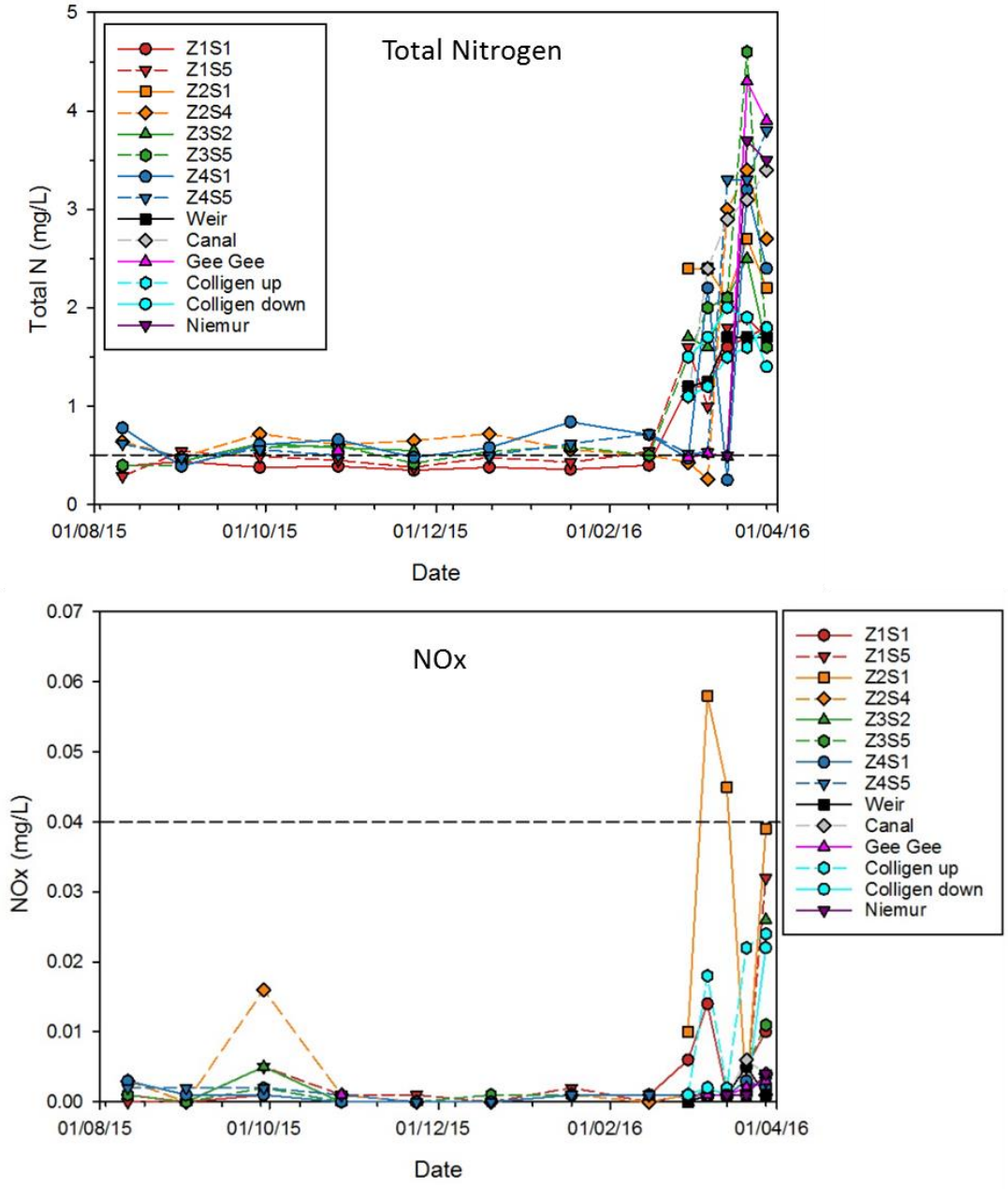


Figure 13. Total Nitrogen and NOx at sites in the Edward-Wakool system from 1/8/15 to 1/4/16. ANZECC (2000) trigger values are marked with dotted lines.

In comparison with the Total Nitrogen data, only a small increase in Total P was observed and concentrations of filterable reactive P remained steady (Figure 14). This suggests that nutrient concentrations did not trigger the algal bloom, but instead the algal bloom has contributed to nutrient levels in the system as cells break down or there may be leakage through cell walls. The small increase in Total P is likely to be the result of the higher biomass suspended in the water column as P incorporated into the cells will be released during sample analysis. Total phosphorus was well above ANZECC levels but filterable reactive phosphorus remained well below ANZECC guideline levels.

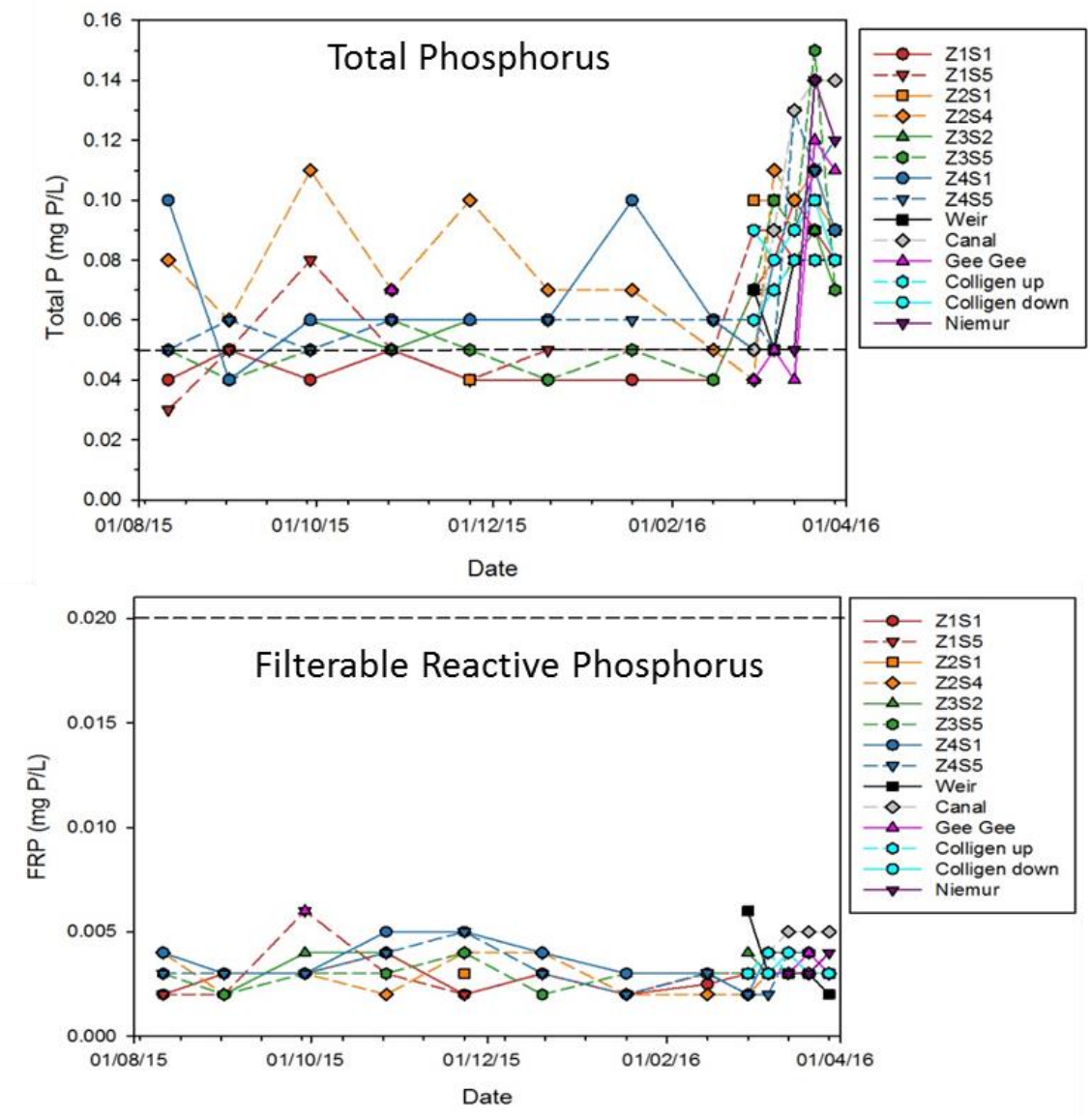


Figure 14. Total Phosphorus and Filterable Reactive Phosphorus at sites in the Edward-Wakool system from 1/8/15 to 1/4/16. ANZECC (2000) trigger values are marked with dotted lines.

Dissolved carbon - Absorbance and fluorescence data

Dissolved organic carbon concentrations were similar to previous years between August 2015 and March 2016. Towards the end of March and in early April levels of DOC increased, particularly in the upper Wakool River at Widgee (Figure 15). No water samples had spectroscopic characteristics that would suggest problematic concentrations of dissolved organic matter. Fluorescence analysis is more sensitive to changes in carbon composition and analysis of these data is ongoing. The increase in organic matter at the Niemur River site was evident in the fluorescence results (Figure 16).

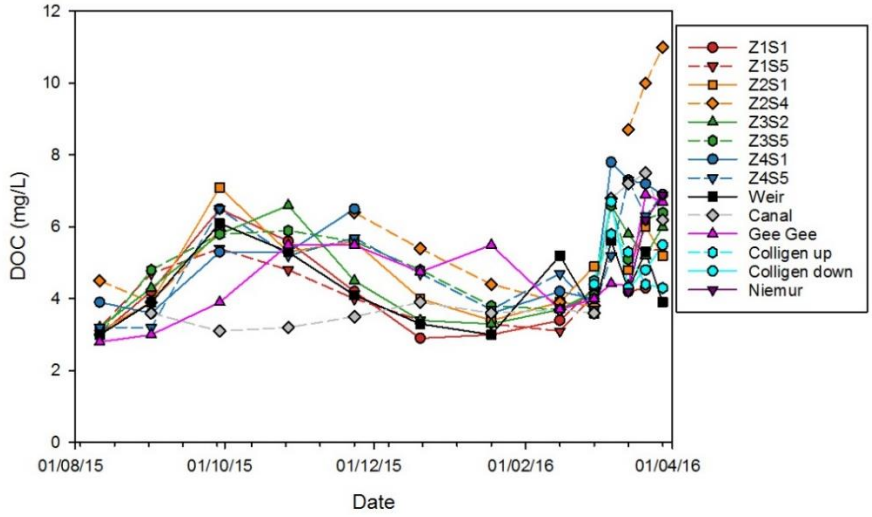


Figure 15. Dissolved organic carbon concentrations at study sites and water sources.

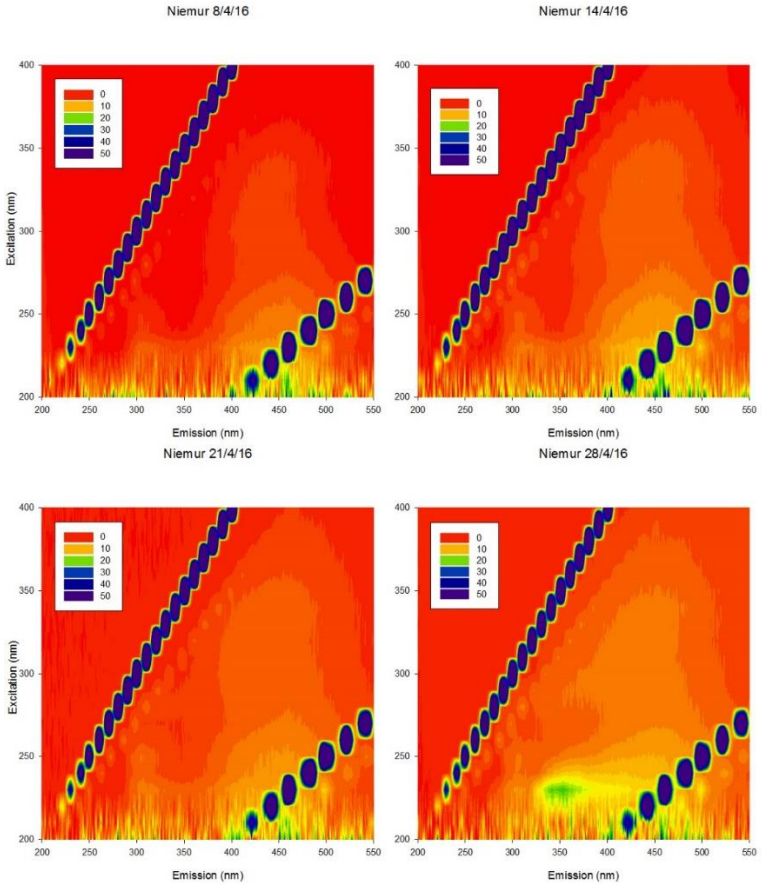


Figure 16. Progressive increase in organic matter fluorescence in the Niemur River over four weeks from 8/4/16 to 28/4/16. For interpretation of this figure see explanation in Watts et al (2014).

Acknowledgements

We respectfully acknowledge the Traditional Owners, their Elders past and present, their Nations of the Murray–Darling Basin, and their cultural, social, environmental, spiritual and economic connection to their lands and waters. We extend our thanks to the Wakool River Association, the Edward-Wakool Anglers Association and landholders in the Edward-Wakool river system for allowing access to their properties and for their keen interest in this project. We thank Amelia Walcott for assistance with field sampling. Maps were prepared by Deanna Duffy (Charles Sturt University Spatial Analysis Unit). This project was funded by the Commonwealth Environmental Water Office with in-kind contribution from Charles Sturt University.

References

Watts, R.J., McCasker, N., Thiem, J., Howitt, J.A., Grace, M. Healy, S., Kopf, R.K., Dyer, J.G., Conallin, A., Wooden I., Baumgartner L., Bowen P. 2014. Monitoring the ecosystem responses to Commonwealth environmental water delivered to the Edward-Wakool river system, 2013-14. Institute for Land, Water and Society, Charles Sturt University, Final Report. Prepared for Commonwealth Environmental Water Office. http://www.environment.gov.au/water/cewo/publications/monitoring-ecosystem-responses-cew-edward-wakool-river-system-2013-14-final-report