CTENVIRONMENTAL
ECOSYSTEM MANAGEMENT AND MONITORING

May Biannual Aquatic Ecosystem Monitoring Report

Liverpool City Council

June 2023

Project	**Liverpool Aquatic Ecosystem Monitoring 2017 - 2023**
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Report Structure

This report presents the May Aquatic Ecosystem Monitoring Monthly Progress Report (Part 1) which is accompanied by the first biannual report (December 2022 to May 2023).

Part 1

Aquatic Ecosystem Monitoring Monthly Progress Report - May 2023

May 2023 aquatic ecosystem monitoring of the Georges River and South Creek catchments was conducted on May 04, 2023.

This report provides a summary of recreation water quality indicators (Cyanobacteria, *Enterococci* and *Faecal Coliforms*) at Georges River recreation monitoring sites and observations from freshwater monitoring sites.

Badgerys Creek weather monitoring station is expected to be representative of weather conditions in the Kemps Creek catchment and Holsworthy Aerodrome station is expected to be representative of conditions in the locale of the Georges River monitoring sites.

Weather conditions during May sampling were warm to cool with 41.2mm of rain recorded at Badgerys Creek AWS (Table 1) and 23mm recorded at Holsworthy Aerodrome (Table 2) in the week prior to sampling.

Table 1: Weather observations for Badgerys Creek AWS, NSW (BOM 2023).

Date	Temp min (°C)	Temp max (°C)	Rainfall (mm)
28/04/2023	8.8	28.3	0.2
29/04/2023	15.2	17.2	2
30/05/2023	13.6	19.4	38.6
01/05/2023	6.7	20	0.2
02/05/2023	5.8	22.5	0.2
03/05/2023	8.0	23.6	0
04/05/2023	7	21	0

Table 2: Weather observations for Holsworthy Aerodrome (BOM 2023).

Date	Temp min (°C)	Temp max (°C)	Rainfall (mm)
28/04/2023	10.1	27.1	0.2
29/04/2023	14.1	17.3	1.2
30/05/2023	13.5	18.8	21.6
01/05/2023	7.9	20.1	0
02/05/2023	6.5	21.4	0
03/05/2023	8.5	23.9	0
04/05/2023	7.3	-	0

Blue Green Algae (Cyanobacteria) monitoring at recreation sites in the Georges River was undertaken on May 04, 2023, during high tide.

Results show that potentially toxic cyanobacteria were not detected at any sites during sampling at all Georges River sites, and biovolume calculations indicate (Table 3) -

- NHMRC Surveillance Mode (Green Level) was triggered at the recreation monitoring sites GR1, GR1.5, and GR2 (Table 3).
- NHMRC Alert Mode (Amber Level) was triggered at the recreation monitoring sites GR3, GR4, and GR5

Table 3: Results summary for recreation monitoring sites, May 2023.

Site	Sampled	Potentially Toxic Blue Green Algae	NHMRC Alert Level	Safety Issues
GR1	Yes	Not detected	Green	None
GR1.5	Yes	Not detected	Green	None
GR2	Yes	Not detected	Green	None
GR3	Yes	Not detected	Amber	None
GR4	Yes	Not detected	Amber	None
GR5	Yes	Not detected	Amber	None

GR1 recorded one species of cyanobacteria, *Aphanocapsa spp.* Due to the biovolume of this species, the NHMRC (2008) Green Level surveillance mode was triggered.

GR1.5 recorded two species of cyanobacteria, *Aphanocapsa spp.* and *Cyanogranis libera.* Due to the biovolume of these species, the NHMRC (2008) Green Level surveillance mode was triggered.

GR2 recorded no species of cyanobacteria. No NHMRC (2008) mode was triggered.

GR3 recorded five species of cyanobacteria, *Aphanocapsa spp., Chroococcus spp., Cyanogranis libera, Merismopedia spp.,* and *Synechococcus spp.* Due to the large biovolume of these species, the NHMRC (2008) Amber Level alert mode was triggered.

GR4 recorded four species of cyanobacteria, *Aphanocapsa spp., Merismopedia spp., Phormidium spp.* (<5 µm)*,* and*, Phormidium spp.* (>5 µm). Due to the large biovolume of these species, the NHMRC (2008) Amber Level alert mode was triggered.

GR5 recorded three species of cyanophytes*, Aphanocapsa spp., Merismopedia spp.,* and *Pseudanabaena spp.* Due to the biovolume of these species, the NHMRC (2008) Amber Level alert mode was triggered.

Due to the persistence of cyanobacteria, there is potential for future blooms to occur. NHMRC (2008) recommends weekly or fortnightly monitoring when 'Green' mode is triggered (Table 4).

Table 4: Recommended monitoring actions and corresponding NHMRC Alert Levels.

Blue Green Algae Alert Level	Recommended Actions
Surveillance Mode **(Green Level)**	• Weekly sampling and cell counts at representative locations in the water body where known toxigenic species are present. • Fortnightly for other types including regular visual inspection of water surface for scums.
Alert Mode **(Amber Level)**	• Increase sampling frequency to twice weekly at representative locations in the water body where toxigenic species are dominant within the alert level definition (i.e. total biovolume) to establish population growth and spatial variability in the water body. • Monitor weekly or fortnightly where other types are dominant. • Make regular visual inspections of water surface for scums. • Decide on requirement for toxicity assessment or toxin monitoring.
Action Mode **(Red Level)**	• Continue monitoring as for alert mode. • Immediately notify health authorities for advice on health risk. • Make toxicity assessment or toxin measurement of water if this has not already been done. • Health authorities warn of risk to public health (ie the authorities make a health risk assessment considering toxin monitoring data, sample type and variability).

Results of bacteria monitoring at recreation sites in May 2023 show that the ANZECC Primary Contact guidelines for *Faecal coliforms* was exceeded at all six Georges River Sites (GR1, GR1.5, GR2, and GR3, GR4 and GR5. The ANZECC Secondary Contact guidelines for *Faecal coliforms* was not exceeded at any of the sites sampled. The ANZECC Primary Contact guidelines for *Enterococci* was exceeded at GR1.5 and GR2. The ANZECC Secondary Contact guidelines for *Enterococci* was exceeded at GR1 and GR3.

Table 5. Summary of conditions observed/recorded at each site during May 2023 monitoring. Orange indicates exceedance of the primary contact guideline; red indicates exceedance of the secondary contact guideline.

	Recreation sites					
SITE	**Sampled**	**Tide**	***Faecal coliforms*** **CFU/100 mL**	***Enterococci*** **CFU/100 mL**	**Safety Issues**	**Observations**
GR1	Yes	N/A	180	500	None	Clear
GR1.5	Yes	N/A	200	100	None	Clear
GR2	Yes	N/A	250	70	None	Clear
GR3	Yes	Mid	330	250	None	Clear
GR4	Yes	Mid	310	8	None	Clear
GR5	Yes	Mid	750	22	None	Clear
Primary Contact	-	-	150	35	-	-
Secondary Contact	-	-	1000	230	-	-

Surface water samples were collected at all freshwater monitoring sites in May 2023, except for KC11 (due to construction of a pipeline).

Table 6. Summary of conditions observed/recorded at each site during May 2023 monitoring.

Site	Water quality	Aquatic Macroinvertebrates	Benthic Diatoms	Flow	Observations	Safety Issues
MC1	Yes	No	No	Elevated	Clear	None
AC1	Yes	No	No	Elevated	Clear	None
KC1	Yes	No	No	Elevated	Clear	None
KC2	Yes	No	No	Elevated	Clear	None
KC3	Yes	No	No	Elevated	Clear	None
KC5	Yes	No	No	Elevated	Clear	None
KC6	Yes	No	No	Elevated	Clear	None
KC8	Yes	No	No	Elevated	Clear	None
KC10	Yes	No	No	Elevated	Turbid	None
KC11	No	No	No	-	-	No access due to construction
KC12	Yes	No	No	Elevated	Turbid	None
SC1	Yes	No	No	Elevated	Clear	None
SC2	Yes	No	No	Elevated	Clear	None
BC1	Yes	No	No	Elevated	Turbid	None
WG	Yes	No	No	Elevated	Clear	None
HC	Yes	No	No	Elevated	Clear	None

All data has been supplied in an Excel spreadsheet separate to this report and no safety issues were recorded/observed during monitoring.

Statistical analysis of data collected by the monitoring program will be undertaken and presented in the annual report and program recommendations will be made.

The data from this report is reflected in the web reported supplied to Liverpool council.

Part 2

Introduction

This report outlines results for the biannual report (December 2021 to May 2023) for the 2022-2023 monitoring period.

This report presents results of nutrient, turbidity, bacteria, and Blue Green Algae parameters which are typical indicators used to assess degradation of urban streams. Analysis of all parameters monitored by this program will be presented in the annual report.

Georges River catchment sites are reported as Recreation sites (GR1, GR1.5, GR2, GR3, GR4 and GR5) and Georges River Tributaries (AC1, MC1, HC and WG). South Creek catchment sites are reported as South Creek (SC1 and SC2), Badgerys Creek (BC1), Kemps Creek (KC1, KC5, KC8, KC10, KC11 and KC12) and Kemps Creek Tributaries (KC2, KC3 and KC6).

Freshwater monitoring sites

Water quality was variable across all freshwater monitoring sites and all sites recorded degraded water quality and impairment typical of urban streams. The phrase 'urban stream syndrome' (Walsh et al. 2005) was coined to describe the multiple common symptoms occurring in urban streams, including degraded water quality, geomorphology, hydrology and biodiversity. All freshwater sites frequently recorded nutrient levels (phosphorous and nitrogen) that exceeded the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines for fresh and marine water quality (2000). Other parameters, including turbidity, dissolved oxygen, pH and electrical conductivity, were also recorded to be outside the ANZECC 2000 water quality guidelines at the majority of sites at throughout the six-month monitoring period.

Total Nitrogen

Total nitrogen (TN) variations were constant across the Kemps Creek sites for the December 2022 to May 2023 period. Results show that all sites recorded non-compliance to the ANZECC lowland river guideline for southeast Australia (0.35 mg/L). The highest concentration, 71.6 mg/L, was recorded at KC5 in March, which is approximately 200 times greater than the ANZECC guideline. TN remained at similar concentrations throughout the monitoring period. There was a spatial trend where sites in the upper catchment (KC1, KC5 and KC8) had increased TN concentrations than the sites further downstream (KC10, KC11 and KC12)

Total nitrogen was variable across Kemps Creek tributary sites. All sites recorded non-compliance to the ANZECC lowland river guideline for southeast Australia (0.35 mg/L). KC6 recorded the highest TN concentration of 78 mg/L in March 2023. These results are approximately 220 times higher than the recommended ANZECC guideline.

Total nitrogen within all sites of Georges River tributaries was fairly stable and did not comply with the ANZECC lowland river guideline for southeast Australia, with the exception of AC1 in May. The highest concentrations were recorded at MC1 in March at 2.1 mg/L. TN recorded at AC1 was generally lower than HC and WG, however was still generally non-compliant with the ANZECC guideline.

Total nitrogen levels in sites within the South Creek catchment were variable and did not comply with the ANZECC guideline value of 0.35 mg/L during the monitoring period. TN concentration was highest at SC1 in April reaching 3.9 mg/L. TN concentrations at BC1 and SC2 were generally lower than SC1.

Total phosphorous

Total phosphorous (TP) was consistently high across Kemps Creek sites, with no clear temporal trend evident. All sites recorded non-compliance to the ANZECC lowland river guideline for southeast Australia of 0.025 mg/L. KC1 recorded the highest TP concentration of 9.33 mg/L in March 2023, approximately 370 times the guideline limit.

Kemps Creek tributary sites had elevated TP and did not comply to the ANZECC guideline. KC6 recorded the highest concentration of TP (6.91 mg/L) in March 2023. KC2 and KC3 readings were relatively constant.

Georges River tributary sites had variable TP. All sites were non-compliant to the ANZECC guideline of 0.025 mg/L. Maximum TP was recorded at HC was 0.28 mg/L in March 2023.

Total phosphorus concentrations at all South Creek catchment sites (SC1, SC2, and BC1) were variable and exceeded the ANZECC guideline for all monitoring events. TP was highest at SC2 in March 2023, with a value of 0.94 mg/L.

Turbidity

During the monitoring quarterly monitoring period, turbidity across the waterways of Liverpool was variable, and complied to the ANZECC guideline of between 6 and 50 NTU, with the exception of BC1 in January. The highest turbidity recorded was 60.2 NTU at SC2 in January 2023, followed by 29.9 NTU at KC2 in January 2023.

Recreation Monitoring Sites

Turbidity

Turbidity at freshwater sites was compliant with or below the ANZECC freshwater guidelines (6-50 NTU) during this sampling period. At the estuary sites, there was no compliance with the primary contact guideline of 0.5 NTU.

Faecal coliforms and Enterococci

Results of bacteria monitoring at the Georges River Recreation sites shows that breaches of the ANZECC primary and secondary contact guidelines occurred within in all months of this sampling period (Table 7).

Results of bacteria monitoring at recreation sites in January 2023 show that the ANZECC Primary Contact guidelines for Faecal coliforms was exceeded at GR1, GR2, GR3, and GR5, and The ANZECC Secondary Contact guidelines for Faecal coliforms was exceeded at GR1.5. The ANZECC Primary Contact guidelines for Enterococci was exceeded at GR1, GR1.5 and GR2. The ANZECC Secondary Contact guidelines for Enterococci was not exceeded at any of the Georges River Monitoring sites.

At GR1, GR1.5, and GR2, Faecal coliforms were recorded to be elevated since the last monitoring event, where the Faecal coliform had reduced at GR3, GR4, and GR5. Enterococci results show a reduction at GR1, GR3, GR4, and GR5 from the previous month, however, at GR1.5 and GR2, Enterococci results have increased.

Results of bacteria monitoring at recreation sites in February 2023 show that the ANZECC Primary Contact guidelines for Faecal coliforms was exceeded at GR1, GR1.5, and GR3, and the ANZECC Secondary Contact guidelines for Faecal coliforms was exceeded at GR4. The ANZECC Primary Contact guidelines for Enterococci was exceeded at GR1, GR1.5 and GR5. The ANZECC Secondary Contact guidelines for Enterococci was exceeded at GR4.

Results of bacteria monitoring at recreation sites in March 2023 show that the ANZECC Primary Contact guidelines for Faecal coliforms was exceeded at GR1, GR1.5, GR2 and GR5. The ANZECC Secondary Contact guidelines for Faecal coliforms was exceeded at GR4. The ANZECC Primary Contact guidelines for Enterococci was exceeded at GR2, GR3 and GR5. The ANZECC Secondary Contact guidelines for Enterococci was exceeded at GR1 and GR1.5.

Results of bacteria monitoring at recreation sites in April 2023 show that the ANZECC Primary Contact guidelines for Faecal coliforms was exceeded at GR1, GR1.5, GR2, and GR3, and the ANZECC Secondary Contact guidelines for Faecal coliforms was exceeded at GR4 and GR5. The ANZECC Primary Contact

guidelines for Enterococci was exceeded at GR1, GR1.5, GR2, and GR3. The ANZECC Secondary Contact guidelines for Enterococci was exceeded at GR4 and GR5.

Results of bacteria monitoring at recreation sites in May 2023 show that the ANZECC Primary Contact guidelines for Faecal coliforms was exceeded at all six Georges River Sites (GR1, GR1.5, GR2, and GR3, GR4 and GR5. The ANZECC Secondary Contact guidelines for Faecal coliforms was not exceeded at any of the sites sampled. The ANZECC Primary Contact guidelines for Enterococci was exceeded at GR1.5 and GR2. The ANZECC Secondary Contact guidelines for Enterococci was exceeded at GR1 and GR3.

Cyanobacteria (Blue Green Algae)

Monitoring of Cyanobacteria (Blue Green Algae) show that all recreation sites are susceptible to Blue Green Algae blooms, and potentially toxic species of Blue Green Algae are commonly detected (Table 7). The highest NHMRC monitoring level is 'Red Level Action Mode' followed by the 'Amber Level Alert Mode' with 'Green Level Surveillance Mode' being the lowest level in the NHMRC (2008). Each monitoring level has a recommended response.

Blue Green Algae Biovolume calculations indicate levels recorded across Georges River Estuary monitoring sites triggered NHMRC (2008) monitoring level 'Green Level Surveillance Mode' (NHMRC 2008) was triggered at all sites on at least one occasion. In January the 'Green Level Surveillance Mode' was triggered at GR1.5, GR2 and GR4. The 'Amber Alert' was triggered at GR3 in January. In February, the 'Green Level Surveillance Mode' was triggered at GR1.5, GR2, GR3 and GR4. In March the 'Green Level Surveillance Mode' was triggered at GR5 while the 'Amber Alert' was triggered at GR3 and GR4. In April the 'Green Level Surveillance Mode' was triggered at GR1, GR1.5, GR2 and GR5 while the 'Amber Alert' was triggered at GR3 and GR4. In May the 'Green Level Surveillance Mode' was triggered at GR1, GR1.5 and GR2 while the 'Amber Alert' was triggered at GR3, GR4 and GR5.

Table 7: Data summary for recreation monitoring sites. Non-compliance to ANZECC (2000) primary guidelines is indicated in orange and secondary guidelines in red and NHMRC (2008) Blue Green Algae alert levels.

SITE	DATE	*FAECAL COLIFORMS*	*ENTEROCOCCI*	CYANOBACTERIA
		(cfu/100ml)	(cfu/100ml)	NHMRC Alert Level
GR1	December	Not Sampled	Not Sampled	Not Sampled
	January	320	40	-
	February	190	43	Green
	March	510	23000	-
	April	400	70	Green
	May	180	500	Green
GR1.5	December	Not Sampled	Not Sampled	Not Sampled
	January	1100	65	Green
	February	200	83	Green
	March	160	300	-
	April	530	170	Green
	May	200	100	Green
GR2	December	Not Sampled	Not Sampled	Not Sampled
	January	390	37	Green
	February	140	3	Green
	March	200	~110	-
	April	220	60	Green
	May	250	70	Green
GR3	December	Not Sampled	Not Sampled	Not Sampled
	January	170	33	Amber
	February	200	19	Green
	March	71	~110	Amber
	April	710	30	Amber
	May	330	250	Amber
GR4	December	Not Sampled	Not Sampled	Not Sampled
	January	42	6	Green
	February	13000	350	Green
	March	1800	13	Amber
	April	1200	1000	Amber
	May	310	8	Amber
GR5	December	Not Sampled	Not Sampled	Not Sampled

	January	320	6	-
	February	110	38	-
	March	750	160	Green
	April	14000	660	Green
	May	310	8	Amber

Table 8: NHMRC Blue Green Algae Levels and recommended response (NHMRC 2008).

NHMRC MONITORING LEVEL	RECOMMENDED RESPONSE
SURVEILLANCE MODE (GREEN LEVEL)	This level involves routine sampling to measure contaminants (e.g. physical, microbial, cyanobacterial and algal).
ALERT MODE (AMBER LEVEL)	This level requires investigation into the causes of elevated contaminant levels, and increased sampling to enable a more accurate assessment of the risks to recreational users.
ACTION MODE (RED LEVEL)	This level requires the local government authority and health authorities to warn the public that the water body is considered unsuitable for recreational use.

Conclusion

It is evident that most freshwater sites across the Liverpool LGA have elevated nutrient levels, often at orders of magnitude higher than the recommended ANZECC guidelines. Elevated nutrients in the urban and peri-urban setting are commonly sourced from stormwater run-off, sewer leakage or other wastewater sources, fertiliser contamination and decay of organic material. This program cannot quantify the source of the elevated results continually recorded across the Kemps Creek sites; however, likely drivers include the combination of flow conditions and the decay of organic matter, and increased stormwater runoff due to high rainfall and the flooding events.

Results of monitoring at Georges River freshwater sites shows elevated nutrient concentrations were apparent for most of the monitoring period, the source of which is likely elevated stormwater runoff.

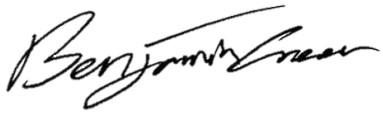
Monitoring of the Georges River estuary sites show bacteria levels were frequently elevated above the ANZECC (2000) Primary Contact levels, and at times above Secondary Contact levels, particularly after the flooding events that occurred prior.

Statistical analysis of data collected by the monitoring program will be undertaken and presented in the annual report and program recommendations will be made.

All data has been supplied in an Excel spreadsheet separate this report and no safety issues were recorded/observed during monitoring.

If you have any questions, please get in touch.

Kind regards,



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