Salty Lagoon Post Closure Monitoring

Project Management and Ecosystem Health Report April 2018



AQUATIC SCIENCE AND MANAGEMEN

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1. Introduction

1.1 Introduction

This document comprises the fourth bi-monthly monitoring report for the Salty Lagoon Post-Closure monitoring years 6-10 (GeoLINK 2017). The monitoring program is as described in *Final Evaluation Report - Salty Lagoon Monitoring: Pre-Post Closure of Artificial Channel – Project Finalisation Report,* which forms an extension of the monitoring undertaken as part of the *Salty Lagoon Ecosystem Recovery Monitoring Program; Pre-Post Closure of Artificial Channel* (MPPC) (Hydrosphere Consulting 2010).

This report is for the monitoring period 28 February 2018 until 30 April 2018.

1.2 Guiding Values

Guiding values were developed for Salty Lagoon and Salty Creek as part of the MPPC program (GeoLINK 2012) to assist with the contextualisation of monthly water monitoring results, rather than as a measure of the health of the waterway. These values are used as part of the current post-closure monitoring and provide a yardstick, around which the adaptive management of Salty Lagoon can be discussed.



2. Methodology

2.1 Discrete Sampling

This was the fourth of the bi-monthly site visits for post-closure monitoring at Salty Lagoon. It included routine maintenance of permanent water quality monitoring stations and discrete water quality sampling. The site visit was undertaken on 1 May 2018. Water quality samples were collected between the hours of 8:00 am and 11:30 am on that day. A high tide of 1.52 metres was forecast for 9.09 am.

Discrete water quality samples were taken from surface water (approximately 0.2 metre depth) at four sites in Salty Lagoon and a single site (S5) in Salty Creek. An additional quality assurance (QA) replicate sample was collected at S1. The specific locations of all sites sampled are presented in **Table 2.1** and **Illustration 2.1**. They are the same sites previously used for the MPPC (GeoLINK 2017).

Site	S 1	S 2	S 3	S 4	S 5
Eastings	0542064	0541799	0542037	0541738	0542187
Northings	6782801	6782669	6783013	6783033	6783665
Site Description	Lagoon monitoring station	SE of Drainage Channel	NE area of lagoon	NW area of lagoon	Creek monitoring station

Physico-chemical water quality parameters were measured with a calibrated HORIBA U-52 hand held water quality meter. Samples were collected from the surface, and at depth intervals of one metre where water levels allowed.

Samples were collected in jars for analysis of chemical and biological parameters at the Coffs Harbour Laboratory (CHL). Sterile jars were used for collection of samples for bacteriological analysis and brown glass jars were used for collection of samples for analysis of chlorophyll-a and blue green algal (BGA) content. Samples were placed upon ice in an esky and delivered to CHL on the same day.

2.2 Fixed-Point Photo Monitoring

In addition to water quality samples, photos were taken showing the environment to the north, east, south and west of each water quality sample site. An additional photo monitoring site is located on the in-filled artificial channel.

2.3 Erosion Monitoring

A series of stations have been set up around the active head cut to the east of the infilled channel and some nearby control sites to assess the progression of erosion between Salty Lagoon and Salty Creek. The specific locations of all sites sampled are presented in **Table 2.2** and **Illustration 2.1**.



The stations were set up in July 2017 at the head cut (Stations 4, 5 and 6), with control sites at points where lateral tributaries from Salty Creek lead towards Salty Lagoon (Stations 1, 2 and 3). At each site the monitoring involves a fixed-point photo and a measurement from a fixed peg to the nearest point of the head cut.

Site	Control/Impact	Peg Location			
		Easting	Northing		
ER1	Control	541961	6783356		
ER2	Control	541934	6783355		
ER3	Control	541978	6783342		
ER4	Impact	542112	6783277		
ER5	Impact	542129	6783262		
ER6	Impact	542121	6783272		

	Table 2.2	Type and Locations	(WGS84) of Erosic	on Monitoring Sites
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2.4 Permanent Water Quality Monitoring Stations

There are two permanent water quality monitoring stations (PWQMS) in place with YSI EXO3 series water quality sondes measuring temperature, pH, conductivity, turbidity and dissolved oxygen (DO) concentrations at 30-minute intervals. One PWQMS is located in Salty Lagoon at S1 and one in Salty Creek at S5. The data from these sites will be downloaded at bi-monthly intervals for reporting purposes.

HOBO U20 water level loggers are installed at each PWQMS and a third HOBO was installed at S1 to collect barometric pressure data for offsetting atmospheric pressure variability.

The temperature, pH, conductivity, turbidity and DO sensors on the EXO3 sondes installed at the Salty Lagoon PWQMS were removed and replaced by a calibrated set.

The status of the two YSI EXO3 sondes on 1 May 2018 is displayed in Table 2.3.



Table 2.3	YSI sonde Status on 1 May 2018
	1 SI SUNUE Status UN I May 2010

Sonde	SN17F104100	SN 17H104488	Spare Probes
pH (cap life expectancy 18 months)	EXO pH 17H105049 Manufactured 08/2017	EXO pH 17H105048 Manufactured 08/2017	EXO pH 17H105047 Manufactured 08/2017
Temp/ cond (life expectancy 7-10 years)	EXO Wiped CT 17F102685 Manufactured 06/2017	EXO Wiped CT 17F103252 Manufactured 06/2017	EXO Wiped CT 17F102047 Manufactured 06/2017
DO (cap life expectancy 18 months)	EXO Optical DO 17H103494 Manufactured 08/2017	EXO Optical DO 17H103495 Manufactured 08/2017	EXO Optical DO 17H103493 Manufactured 08/2017
Turbidity (life expectancy 7-10 years)	YSI EXO Turbidity 17H103513 Manufactured 08/2017	YSI EXO Turbidity 17H101468 Manufactured 08/2017	YSI EXO Turbidity 17H101465 Manufactured 08/2017
Wiper	YSI Exo Wiper 17G101952	YSI Exo Wiper 17G101954	No Spare wiper
Status	Serviced probes installed in Salty Lagoon 01/05/2018	Serviced probes installed in Salty Creek 28/02/2018	Probes being calibrated for redeployment
Notes	 Batteries changed Estimated sonde battery life 217.9 days Memory 50045.3 days logging 	 Batteries changed Estimated sonde battery life 217.9 days Memory 50045.3 days logging 	- Probes Removed 01/05/2018

Climate information was sourced from the Evans Head bombing range weather station on the Bureau of Meteorology website (BoM 2018). Evans Head Sewage Treatment Plant (STP) facility routine sampling information was provided by Richmond Valley Council (RVC).







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Water Quality and Erosion Monitoring Site Locations

3. Results

3.1 Water Quality Samples

Results of the water quality monitoring undertaken on 1 May 2018 are reported in Table 3.1.

3.2 Permanent Water Quality Monitoring Stations

The water quality and level data collected at the PWQMS, and rainfall data correlating to the reporting period are presented in **Illustration 3.1** and **Illustration 3.2**.



Table 3.1 Results of Discrete Samples Collected 1 May 2018

	Salty Lagoon Salty Creek								ek	
Parameter	Guiding Value	S1	S1* (QA)	S1 (1m)	S2	S3	S3 (1m)	S4	Guiding Value	S5
Blue Green Algae ID (cells/mL)	0	Nil	Nil	ns	Nil	Nil	ns	Nil	0	Nil
Nitrite Nitrogen (mg/L)	0.01	<0.010	<0.010	ns	<0.010	<0.010	ns	<0.010	0.01	<0.010
Nitrate Nitrogen (mg/L)	0.01	0.022	0.023	ns	<0.010	0.026	ns	<0.010	0.01	<0.010
Oxidized Nitrogen (mg/L)	-	0.022	0.023	ns	<0.010	0.026	ns	<0.010	-	<0.010
Ammonia Nitrogen (mg/L)	0.05	0.03	0.026	ns	<0.010	0.016	ns	<0.010	0.11	<0.010
Total Kjeldahl Nitrogen (mg/L)	1.6	1.16	1.15	ns	1.17	1.11	ns	1.04	1.63	1.08
Total Nitrogen (mg/L)	1.6	1.18	1.17	ns	1.17	1.14	ns	1.04	1.63	1.08
Total Phosphorus(mg/L)	0.14	0.12	0.08	ns	0.1	0.08	ns	<0.03	0.04	<0.03
Orthophosphate (mg/L)	0.11	0.056	0.056	ns	0.073	0.06	ns	<0.010	0.01	<0.010
Chlorophyll-a (µg/L)	5	<1	<1	ns	<1	<1	ns	<1	3	<1
Enterococcus (CFU/100mL)	170	5	25	ns	60	40	ns	25	40	110
Faecal Coliforms (CFU/100mL)	135	25	40	ns	190	25	ns	15	150	355
Temp (°C)	25.9	18.18	ns	18.43	17.8	19.08	18.93	17.7	13.1 - 28.8	19.24
рН	6.9	7.07	ns	6.82	6.21	7.28	7.01	5.16	4.3 - 6.8	4.47
ORP (mV)	-	136	ns	157	155	167	181	210	-	248
Cond (mS/cm)	8.0	2.41	ns	2.52	0.487	2.58	2.58	1.25	0.3 - 21.5	4.05
Turbidity (NTU)	13	2.6	ns	2	5.4	1.7	2	4.1	11	2.1
DO (mg/L)	4.09	4.65	ns	5.74	1.28	7.02	6.65	4.16	5.52	5.23
DO (% sat)	-	51.2	ns	63.4	13.8	78.5	74.2	45.2	-	58.9
TDS (mg/L)	-	1.54	ns	1.61	0.317	1.65	1.65	0.8	-	2.59
Sal (ppt)	-	1.2	ns	1.3	0.2	1.3	1.3	0.6	-	2.1
Depth (m)	-	Surface	Surface	1m	Surface	Surface	1m	Surface	-	Surface

Note: * = randomly selected quality assurance sample.

red text = not compliant with MPPC guiding values (see GeoLINK 2012).

levels below detection limits will be incorporated into databases as 0 for the purpose of statistical analyses



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Illustration 3.1 Salty Lagoon Rainfall and Water Quality Monitoring Station Data 28 February 2018 to 30 April 2018



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Illustration 3.2 Salty Creek Rainfall and Water Quality Monitoring Station Data 28 February 2018 to 30 April 2018



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3.3 Erosion Monitoring Stations

The data collected at the erosion monitoring stations is presented in **Table 3.2**. There was a variable advance of the head cut at the three impact stations in relation to the previous measurements in February 2018. There was no advance at any of the control stations.

Station	Control/Impact	Distance 25July 2017 (m)	Distance 01 May 2018 (m)	Cut Movement (m)
ER1	Control	7.55	7.55	0.00
ER2	Control	10.20	10.25	-0.05
ER3	Control	9.95	9.90	0.05
ER4	Impact	8.35	7.20	1.15
ER5	Impact	12.35	9.75	2.60
ER6	Impact	10.40	9.80	0.60

Table 3.2Erosion monitoring results from 1 May 2018



4. Discussion

4.1 Water Quality

There were two periods of moderate to heavy rainfall during this reporting period and a large number of dispersed small to moderate rainfall events. The rainfall had an impact upon water levels and quality in Salty Lagoon and Salty Creek. The data from the Salty Creek PWQMS indicates that the entrance to Salty Creek was open for much of the reporting period and that tidal movements and seawater ingress were also strong determinants of water quality in Salty Creek. Water levels in Salty Lagoon remained high for the entire reporting period while water levels in Salty Creek were highly variable. With the exception of one short period after heavy rainfall in the first week of March 2018 water appears to have flowed out of Salty Lagoon into Salty Creek for the entire monitoring period. At the time of the site inspection on 1 May 2018 the entrance to Salty Creek was open and water levels was draining rapidly.

Erosion monitoring indicated that the head cut has advanced between 0.6 and 2.6 m since July 2017 in three distinct locations. These measurements indicate that the head cut advanced significantly during this reporting period, up to two metres at one site. There has been little or no advancement of the head cuts at the control sites. This indicates that, either the control sites are inherently more stable or that water is leaving Salty Lagoon preferentially through the pathway to the east of the old artificial channel.

Conductivity measurements from the PWQMS in Salty Lagoon and Salty Creek clearly show the impact of rainfall, seawater ingress and saline water movements on Salty Creek and Salty Lagoon. Conductivity in Salty Lagoon reduced gradually from high levels at the beginning of the reporting period to values approximately five per cent of seawater in response to continued rainfall. At the time of the site inspection the water column was well mixed at the Salty Lagoon sites. Results from the Salty Creek PWQMS show that the conductivity in Salty Creek fluctuated dynamically throughout the reporting period in response to rainfall, entrance conditions and tidal movements. On 1 May 2018, at the Salty Creek site, the water column was distinctly stratified into a fresh upper layer and saline lower layer. This is typical in Salty Creek when seawater ingress is followed by rainfall runoff.

The DO concentrations in discrete samples collected on 1 May 2018 were typical at all sites, except S4 which, unusually, complied with the guiding values. The DO concentrations also complied with guiding values in the open water sites of Salty Lagoon but not at S2, which is usually oxygen poor. The DO concentration at the Salty Creek site did not comply with guiding values. Low DO concentrations in Salty Creek are often associated with seawater ingress.

Most of the nutrient concentrations complied with guiding values for this reporting period except for the nitrate concentrations from S1 and S3. The chlorophyll-a concentrations complied with the guiding values at all sites. The reduction of nutrient concentrations following significant rainfall events indicates that historical nutrient pollution is the cause of elevated nutrient concentrations in Salty Lagoon and that continued nutrient loss to the system will eventually result in lower average nutrient concentrations. There were no blue-green algae detected in any samples.

Other results that did not comply with guiding values included the pH measurements from S1 and S3, the enterococccus concentrations from S5 and the faecal coliform concentrations from S2 and S5. All other measurements complied with guiding values. The high pH measurements from S1 and S3 are likely to be associated with the continued presence of saline water, although at times the pH at these



Salty Lagoon Project Management & Ecosystem Health Report, April 2018 1731-1302 sites appears to be buffered towards higher values. The high faecal indicator organism concentrations at S2 and S5 are likely to be associated with waterbird use of those areas and rainfall runoff in the days prior to the site inspection. There is no current trend towards high faecal indicator organism concentrations in Salty Lagoon.

4.2 Erosion Monitoring

The impact headcuts advanced significantly during this monitoring period while there was no movement at the control headcuts. There has been a total advance of between 0.6 m and 2.6 m in the impact headcuts since the monitoring points were established in July 2017.

4.3 Other Observations

The entrance to Salty Creek was open on 1 May 2018 (**Plate 4.1**). A variety of birds were observed incidentally during the site inspection including Pacific Black Duck, Australasian Grebe, Eurasian Coot, Purple Swamphen, Black Swan, Great Egret and Little Black Cormorant.



Plate 4.1 Water draining rapidly from the open entrance to Salty Creek on 1 May 2018



Plate 4.2 The erosive headcut advanced in response to water flowing from Salty Lagoon into Salty Creek



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5. Key Points

- 1. Significant rainfall fell during this monitoring period but tidal movements and seawater ingress and into Salty Creek also influenced water quality.
- 2. A small number of results did not comply with the guiding values.
- 3. Total nutrient concentrations were relatively low at all sites. Bioavailable nutrients were moderately high at the open water sites in Salty Lagoon.
- 4. Chlorophyll-a concentrations complied with guiding values at all sites. No BGA were detected.
- 5. The erosive headcut to the east of the old channel between Salty Lagoon and Salty Creek advanced significantly during this reporting period.



References

Bureau of Meteorology (2018). http://www.bom.gov.au/. Accessed 24/05/2018

GeoLINK (2012). Salty Lagoon Monitoring: Pre-Post Closure of Artificial Channel – Project Management and Ecosystem Health Monthly Report – September 2012. Report to Richmond Valley Council.

GeoLINK (2017). *Final Evaluation Report - Salty Lagoon Monitoring: Pre-Post Closure of Artificial Channel – Project Finalisation Report.* Report to Richmond Valley Council.

Hydrosphere (2010). *Salty Lagoon Monitoring Program Pre/Post Closure of the Artificial Channel*. Unpublished report to Richmond Valley Council. Hydrosphere Consulting, Ballina.



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