Environment Protection Authority

A freshwater release from the Morella Basin, through Salt Creek & into the Coorong South Lagoon

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EPA South Australia

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Cover Photo: The view looking towards Salt Creek outlet. The photograph is standing in the Coorong's South Lagoon, with water levels dropping significantly into November. The stream pictured is the last freshwater flow to come out of the Morella Basin, through Salt Creek, and into the South Lagoon. Photo Credit to Adam Watt (DEWNR).

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Abbreviations

ANZECC	Australian and New Zealand Environment Conservation Council
DEWNR	Department of Environment, Water and Natural Resources
EPA	South Australian Environment Protection Authority
NATA	National Association of Testing Authorities

*Oxidative reduction potential is determined in the field, and not NATA accredited.

Acknowledgements

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1 Introduction

The Environment Protection Authority (EPA) has worked with the Department of Environment, Water and Natural Resources (DEWNR) to monitor water quality in the Coorong's South Lagoon for the last two years. A key focus has been on the release of built-up water within the Morella Basin (herein called Morella) which is located east of the Salt Creek Township. During winter, rainfall and groundwater naturally drains into the wetlands of Morella, and surrounding agricultural land can become soaked. To mitigate excess water becoming an issue for nearby landholders, and to achieve a small natural flow into the Coorong, a controlled pulse of freshwater is managed through a regulator into Salt Creek. This flow then enters the southern end of the Coorong's South Lagoon at the settlement of Salt Creek. In 2014, over 99 days from 23 July to 29 October 2014, 18.6 GL of freshwater was released from the Morella Basin. The following summarises the 2014 component of monitoring.

Aims

The aims of the monitoring were to improve the understanding of the:

- nutrient (including nitrogen and phosphorus species) load entering the Coorong South Lagoon via Morella releases from Salt Creek
- fate of nutrients inflowing at Salt Creek within the Coorong
- spatial and temporal salinity effect of Salt Creek inflows within the Coorong

2 Methods

During winter and spring, fortnightly water quality monitoring was undertaken throughout the South Lagoon. Surface water profiles and depth profiles were collected at ten sites (Figure 1) in the Coorong itself, and two sites within Salt Creek (Table 1). Field measurements were taken using YSI pro plus and Sonde multi-parameter meters, and samples were taken for analyses at the Australian Water Quality Centre (NATA accredited laboratory) – see Table 2.

Water quality sampling was undertaken in the South Lagoon before the release of freshwater from Morella, so water quality parameters are considered an accurate pre-release value for comparing against post-release data.

Table 1: Monitoring sites in the Coorong and Morella Basin.

Site Name	Easting	Northing	Collection Method
Morella Basin @ Outlet Regulator	380179	6001380	Sampled once (grab sample) on 1st monitoring event (Monday 21 July), prior to release
Morella Creek @ Flow Gauge (Composite Sampler) (Figure 2)	378811	6001360	Sample in the composite sampler collected on 2nd and subsequent monitoring events.
Morella Creek @ Flow Gauge (Figure 1)	378811	6001360	Grab sample in Salt Creek (by the Flow Gauge) collected on 2nd and subsequent monitoring events.
Coorong central lagoon 3.2km South Salt Creek	377570	5997290	Collected by boat
Coorong Sub Lagoon 12 Sth Salt Creek	377597	6000430	Collected by boat
Coorong central lagoon 1.8km west Salt Creek	375882	6000470	Collected by boat
Coorong central lagoon @ Snipe Point	374406	6002900	Collected by boat
Coorong central lagoon @ Seagull Island	372453	6005680	Collected by boat
Coorong Sub Lagoon 10 Nth Jack Point	369342	6010970	Collected by boat
Coorong central lagoon @ Stoney Well	365104	6017790	Collected by boat
Coorong central lagoon @ Villa de Yumpa	359175	6022890	Collected by boat
Coorong @ Parnka Point boat ramp	355237	6025730	Collected by boat on 1st monitoring, but collected on foot due to shallow subsequent conditions
Coorong @ McGrath Flat north	354600	6029390	Collected by boat on 1st monitoring, but collected on foot due to shallow subsequent conditions
Coorong Sub Lagoon 3 Long Point	333756	6048260	Collected on foot
Coorong Sub Lagoon 1 Tauwitchere	320219	6059690	Collected on foot

Table 2: Field and laboratory parameters. Field parameters are collected in two primary methods, transects and depth profiles. A surface water "transect" is a recording of the entire suite of field parameters every ten seconds at the surface. Depth profiles are the suite of field parameters taken at the surface and 0.5m depth increments to the bottom.

Field Parameters	
	Alkalinity (mg/L as CaCO3) • at surface only • Acidity is recorded when alkalinity is <50mg/L
	Dissolved Oxygen (% and mg/L) • at surface and at 0.5m increments to the bottom where depth permits
	Conductivity (SPC and EC in uS/cm) • at surface and at 0.5m increments to the bottom where depth permits
	pH (pH units)
	ORP (mV)
	Temperature (°C)
	Total Dissolved Solids (ppk)
	Turbidity (NTU)
	Chlorophyll a (µg/L)
	Field observations (e.g. fish, macro-algae and riparian vegetation)
Laboratory Parameters	
General	Conductivity (SPC and EC in uS/cm
	Total Dissolved Solids (ppk)
	Turbidity (NTU)
Major Ions	Chloride (mg/L)
Nutrients	Total Kjehldahl Nitrogen (as N) (mg/L)
	Ammonia (as N) (mg/L)
	Oxidised Nitrogen (mg/L)
	Total Nitrogen (mg/L)
	Phosphorus (filterable reactive) (mg/L)
	Phosphorus (Total) (mg/L)
	Silica (reactive)
Micro-algae	Chlorophyll *a* and *b*

Figure 1: Salt Creek in the States South East. All freshwater released from Morella Wetland through Salt Creek and into the Coorong's South Lagoon flows over the pictured concrete flow gauge (or wedge). On the downstream side of the flow gauge, a small pipe fills a composite sampler nearby (not pictured).

Figure 2: The composite sampler installed at the Salt Creek Flow Gauge. The peristaltic pump at the top of the bucket draws a small volume of water into the clear acrylic bowl. Once a rinse has taken place, a tap at the bottom of the acrylic bowl lets a set volume fall into the green bucket every 24 hours.

3 Results

Water levels in the Coorong can vary, with water level variation over the course of the experiment demonstrated in Figure 3. The water level variation did have an influence on the connection between the two lagoons, and our ability to access both. In Figure 4, the transect reaches beyond the “Needles”, or the small opening which restricts connection between the North and South Lagoons of the Coorong. This was passable in July, and sites such as McGrath Flat North and Parnka Point Boat Ramp were sampled via boat. Over several weeks, the Needles were impassable using the same small rigid-hull inflatable. Over the four month period, it was possible to reach Villa de Yumpa by boat, although water was in some parts less than 30cm in depth.

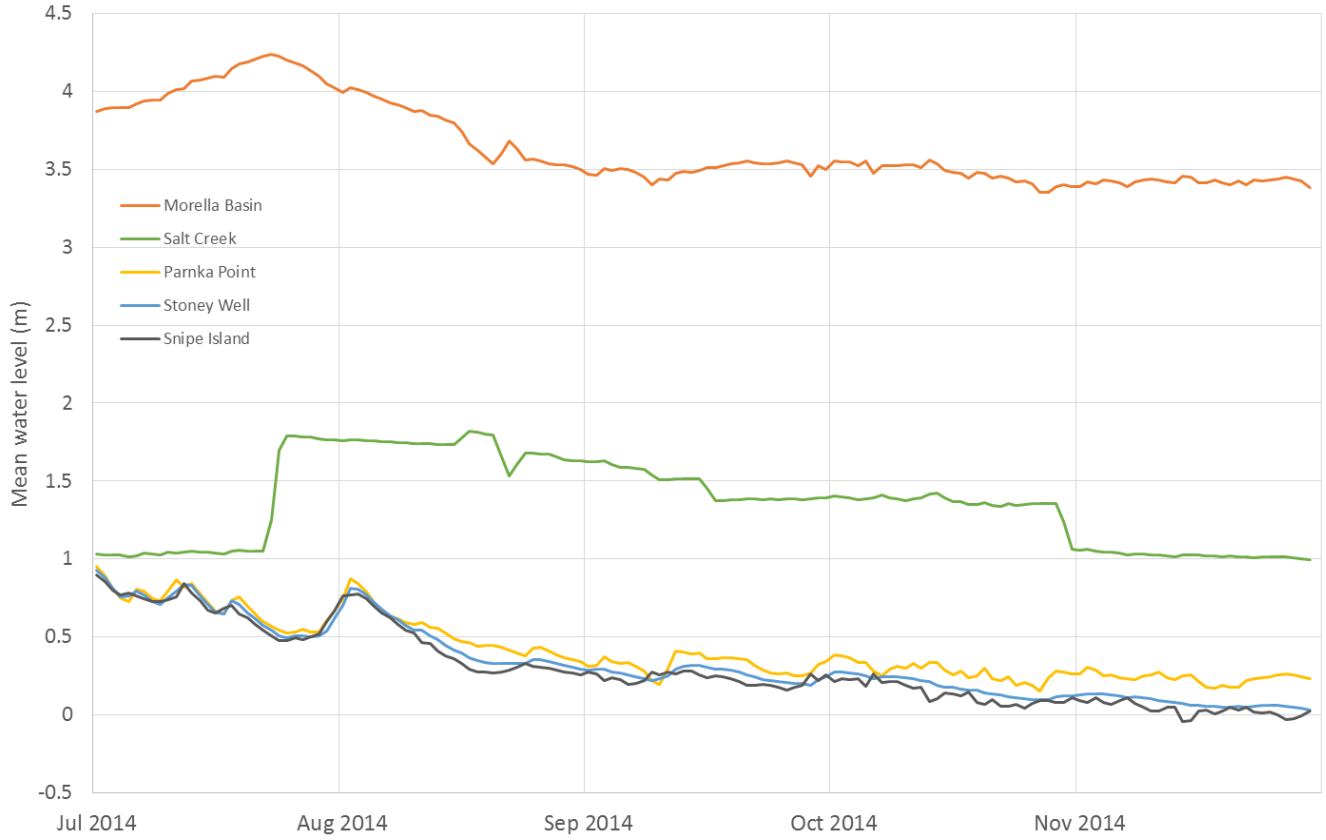

Figure 3: South Coorong water level (Source DEWNR).

Pre-release, an obvious salinity gradient was present (Figure 4) with salinity increasing with distance away from the freshwater influence of the North Lagoon. Salinity ranged from 62.5 g/L in Villa de Yumpa and increased to 69.0 g/L in 3.2km South Salt Creek (3.2km south of the Salt Creek township, and the site furthest south). This is a pre-release gradient of 6.5 g/L over a distance of 31km (a change of +0.2 g/L per km). Over the course of the 99 days, flow peaked in mid-August before falling away (Figure 5). This contributed to a decrease in salinity gradient, with Villa de Yumpa and 3.2km South Salt Creek recording 64.65 and 63.66 g/L on the 18th of August. This equated to a negative gradient of -0.99 g/L over the 31km (or -0.033 g/L per km).

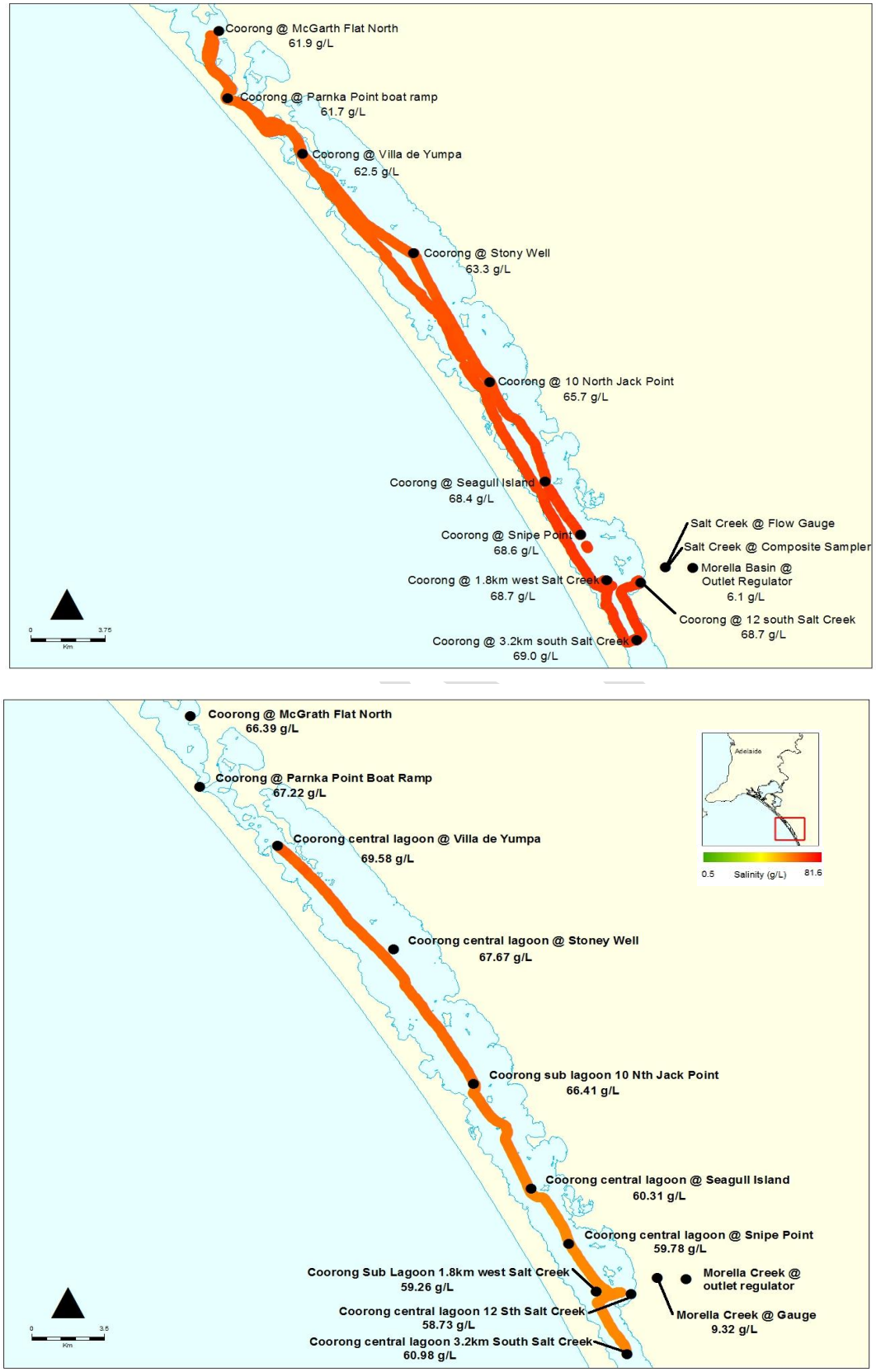

Figure 4: Water quality transects taken on the surface of the Coorong South Lagoon, a) in July and b) October.

Villa de Yumpa and 3.2km South Salt Creek reached 72.80 and 64.70 g/L respectively at the end of sampling in October. This gradient was -0.26 g/L per km between the two furthest north and south monitoring sites. Peak flow in August had some influence on the slight alteration to the salinity gradients observed in 2014 during the Morella release, but the subtle shift in total salinity over three months prior was insignificant compared to differences naturally observed in annual seasonal fluctuations.

Despite an initial pulse of freshwater flow from Morella, which peaked in August, salinity throughout the South Lagoon remained stable (Figure 5). All sites throughout the lagoon began to increase as time went on and releases decreased. Salinity differences between sampling sites remained low. The only site to show rapid salinity variation was the site closest to the outlet regulator, as expected.

Salinity gradients are likely to return to conditions similar to those observed in July, where salinity was lowest near the entrance to the North Lagoon, and increased further south into the South Lagoon. Monitoring post-release will occur quarterly as part of a separate program, and will not include Morella Basin or Salt Creek.

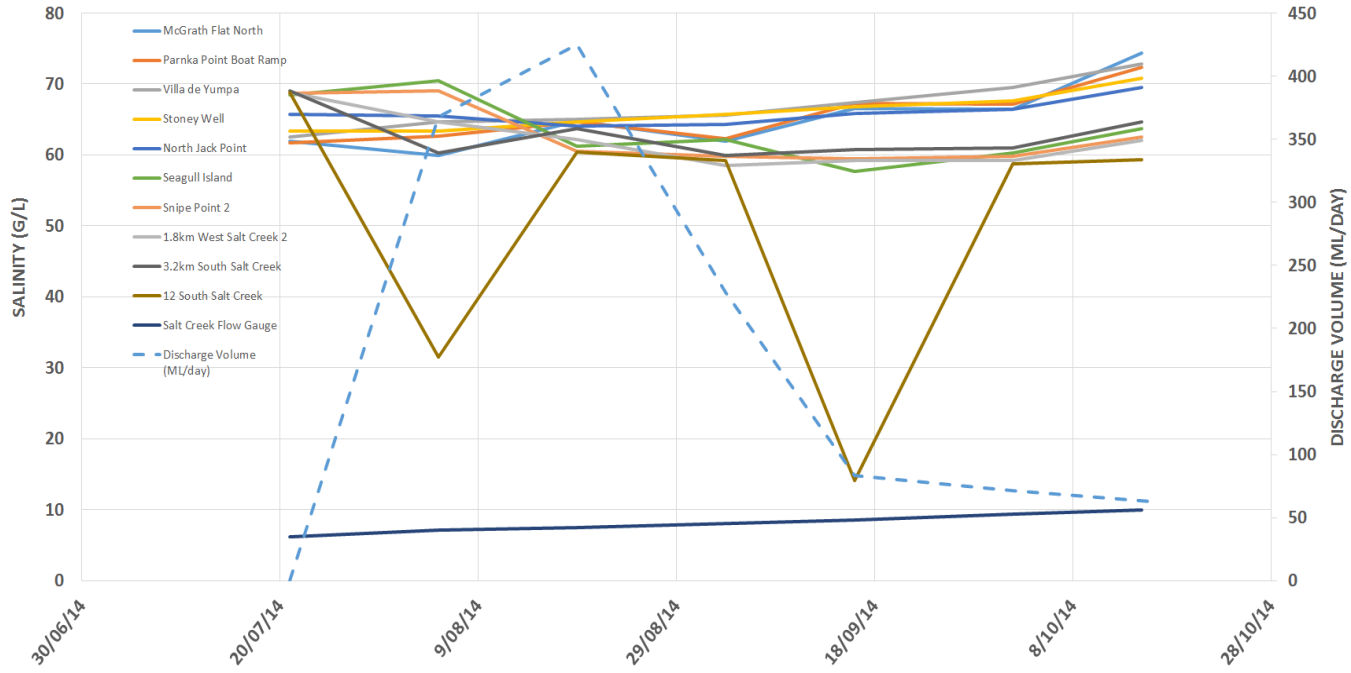

Figure 5: Salinity (as g/L) at sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

Due to the influence of the lime-stone dominated Morella Basin, the initial basin water had an elevated pH and alkalinity (Figure 6). pH dropped shortly after the release began, and there was no direct flow-on observations made to pH inside the South Lagoon during the peak release time. Later in September, pH increased in several sites, including Parnka Point and McGrath Flat North (both in the North Lagoon). The 12 South Salt Creek site in the South Lagoon showed a similar rise in pH during September. Changes in pH in the North Lagoon could have been contributed to tidal influence on the day of sampling, but considering 12 South Salt Creek is one of the furthest from the tidal influence and other sites are closer to the potential source of tidal fluctuation, it is suggested this is an outlier, as pH quickly falls back to standard ranges (Figure 6).

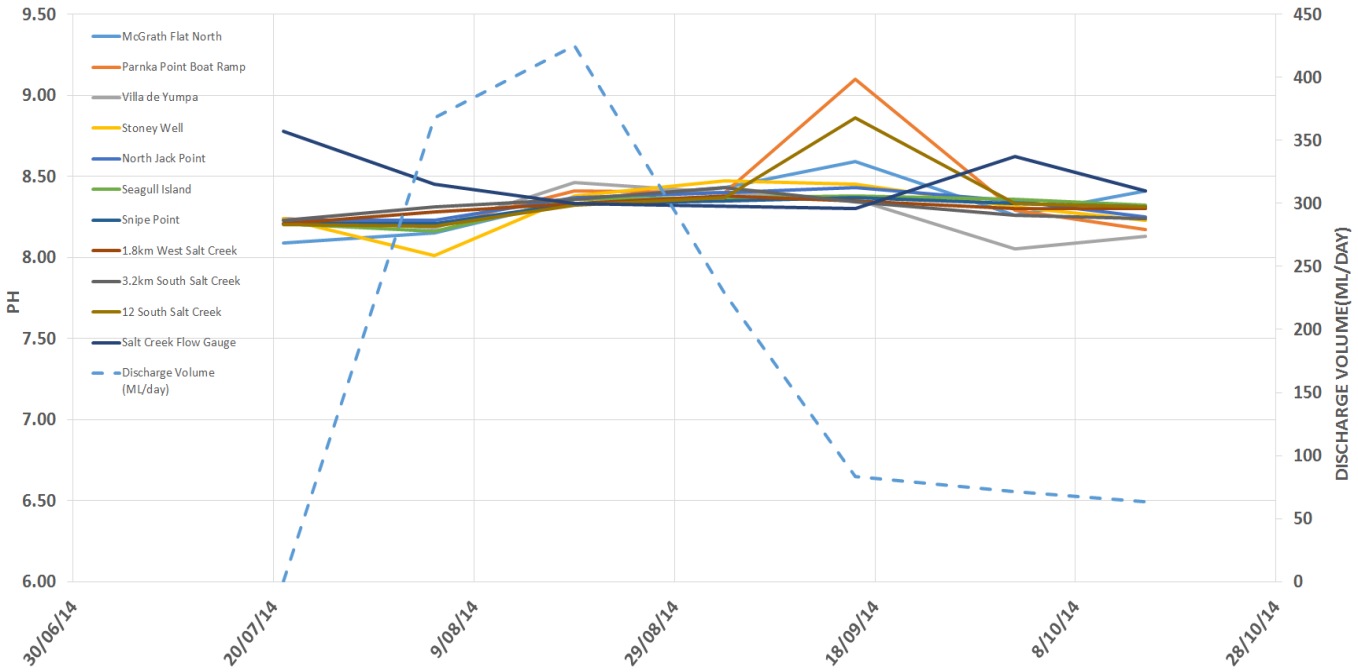

Figure 6: pH (as pH units) in sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

The release of freshwater from within Morella was unlikely to negatively influence turbidity, considering the clear nature of the source water. Turbidity is none-the-less important (Figure 7), especially for ecological components of the South Lagoon (e.g. Ruppia sp). During the initial release, no difference in turbidity was recorded. Background levels were maintained through the release period of mid-August, and this was the case for sites closest to the outlet regulator. Through early and late September, initial spikes were seen in turbidity, but the site distribution (North Jack Point, Seagull Island and McGrath Flat North) suggest the increase in turbidity was not localised to any particular location. Turbidity began to vary between sites over time throughout late September and into October, and is likely the a result of weather conditions during each sampling period, rather than impacts from clear Morella water released through Salt Creek.

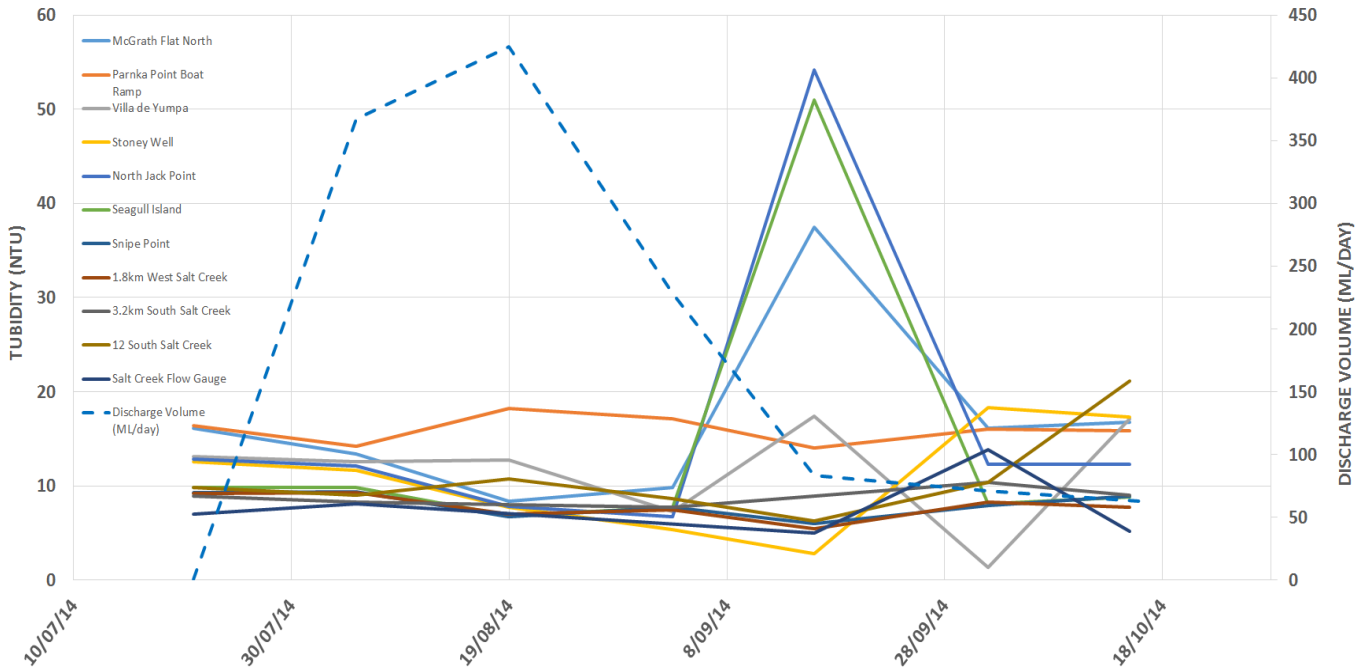

Figure 7: Turbidity (NTU) in sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

Another important indicator for system production may have been Chlorophyll a (Figure 8). Pre-release, chlorophyll a maintained a relatively high average between 60 and 80 µg/L, with little between-site variation. This consistency remained a feature of chlorophyll a throughout the monitoring period. Chlorophyll concentrations fell after the Morella release event, and subsequent quarterly sampling will determine if levels have reached the pre-release concentrations or whether the drop in chlorophyll observed is a function of season or another environmental variable.

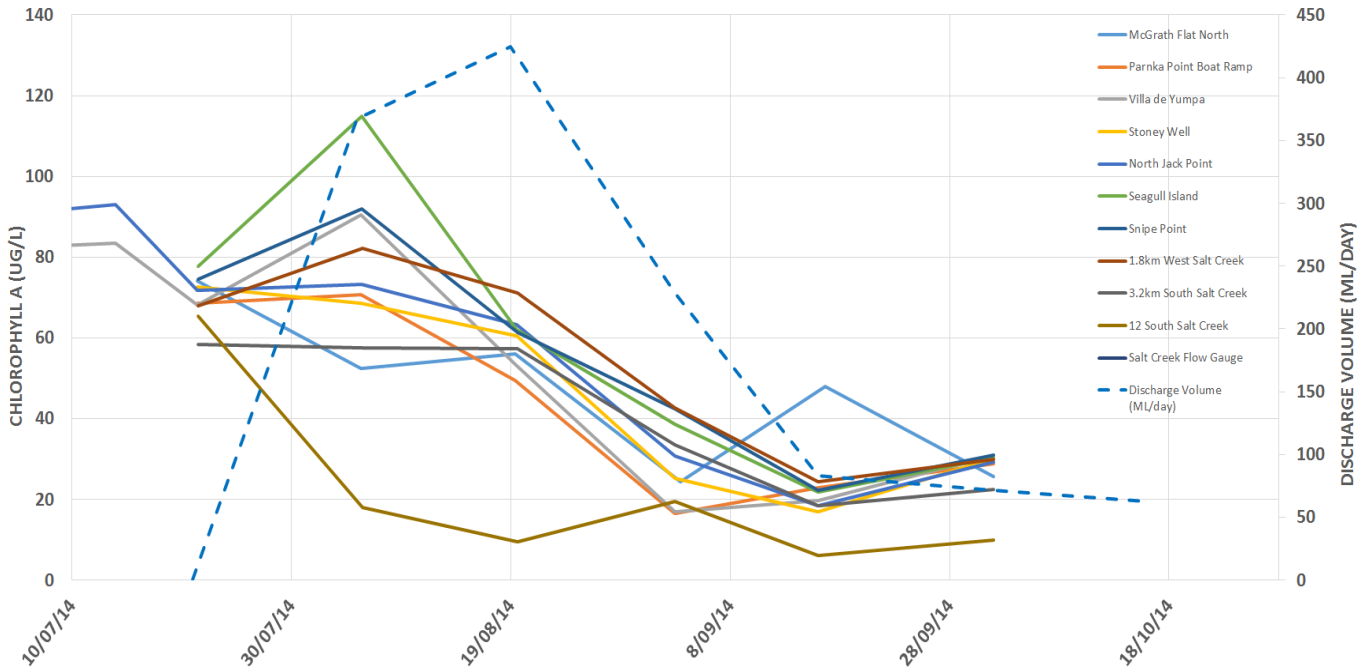

Figure 8: Chlorophyll a (µg/L) in sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

Water quality analyses also included parameters such as alkalinity, phosphorous, ammonia, nitrite and nitrate. Although phosphates and nitrogenous wastes such as nitrite and nitrate can have a large impact on ecological processes, no significant variation in these parameters occurred within the Coorong over the length of the monitoring.

Phosphorus is a key nutrient limiting growth in ecological components such as phytoplankton. Although this was sampled throughout, no significant variation in phosphorus was recorded within the Coorong, even close to the Salt Creek mouth in the South Lagoon. Phosphorus increased slightly when flow began, rising from an average of 0.003mg/L to 0.01mg/L between July and August. Phosphorus subsequently decreased back to pre-release levels of 0.003 mg/L (Figure 9) in October. There was an unrelated outlier in Long Point during September, but this could not be attributed to any freshwater release.

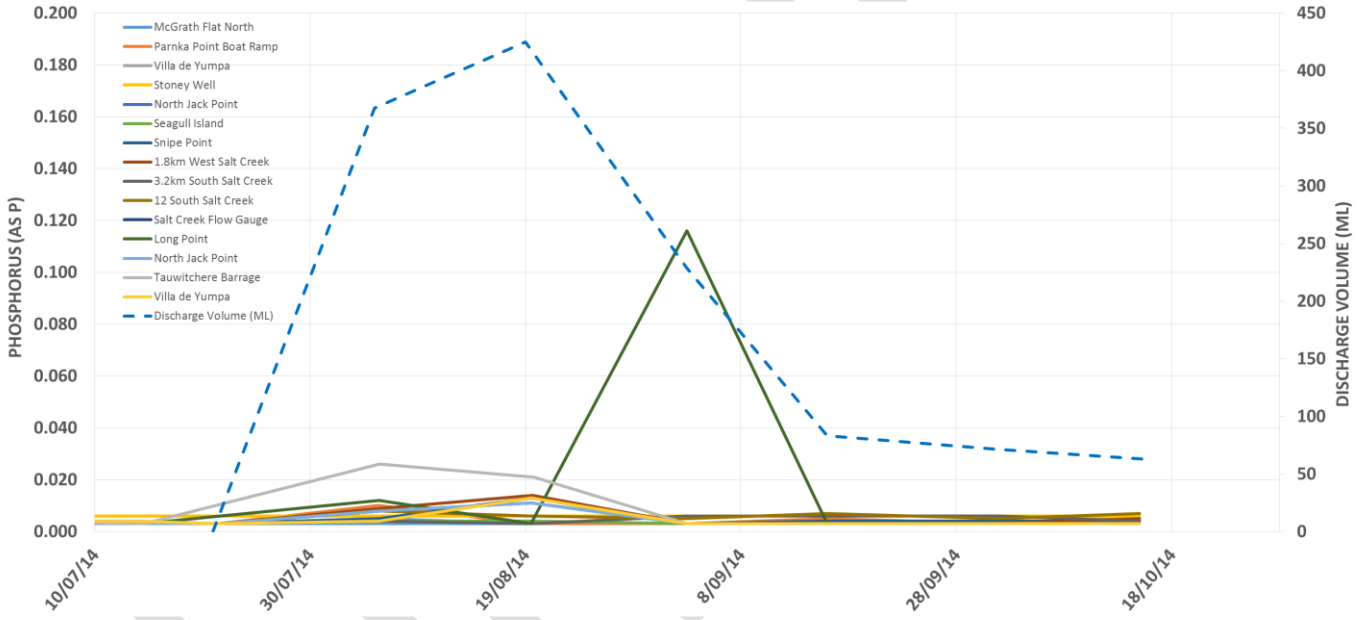

Figure 9: Phosphorus (mg/L) in sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

Nitrate and nitrite (as N) showed more variation, but not within the South Lagoon (Figure 10). Two sites which did see an increase in nitrate and nitrite throughout the sampling period were sites furthest away from the Salt Creek outlet, including Villa de Yumpa and Long Point in the North Lagoon. This increase would be attributable to other processes, and not freshwater releases into the South Lagoon from Morella.

Water within Salt Creek did show a positive correlation with an increase in flow from Morella. Samples taken at the Salt Creek Flow Gauge (in the Creek) showed Nitrate and Nitrite reach 1.73 mg/L. No nitrate and nitrite was recorded even close to the outlet in the South Lagoon, indicating it was likely used quickly by biological processes. Average nitrate and nitrite within all the South Lagoon ranged from 0.036, 0.032 and 0.012mg/L between July, August and October respectively.

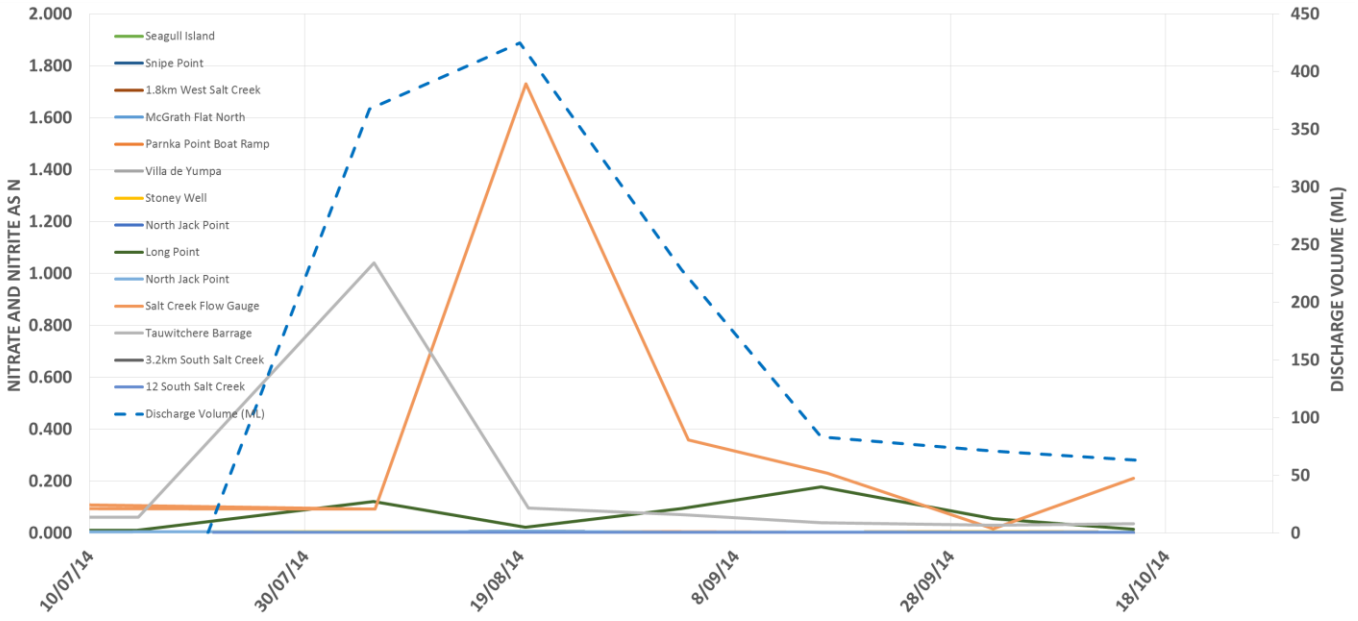

Figure 10: Phosphorus (mg/L) in sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

Ammonia was highest at Long Point, in the Coorong's North Lagoon. Clearly unrelated to releases at the Salt Creek outfalll, no increase in ammonia was observed throughout the length of monitoring in any site throughout the South Lagoon (Figure 11).

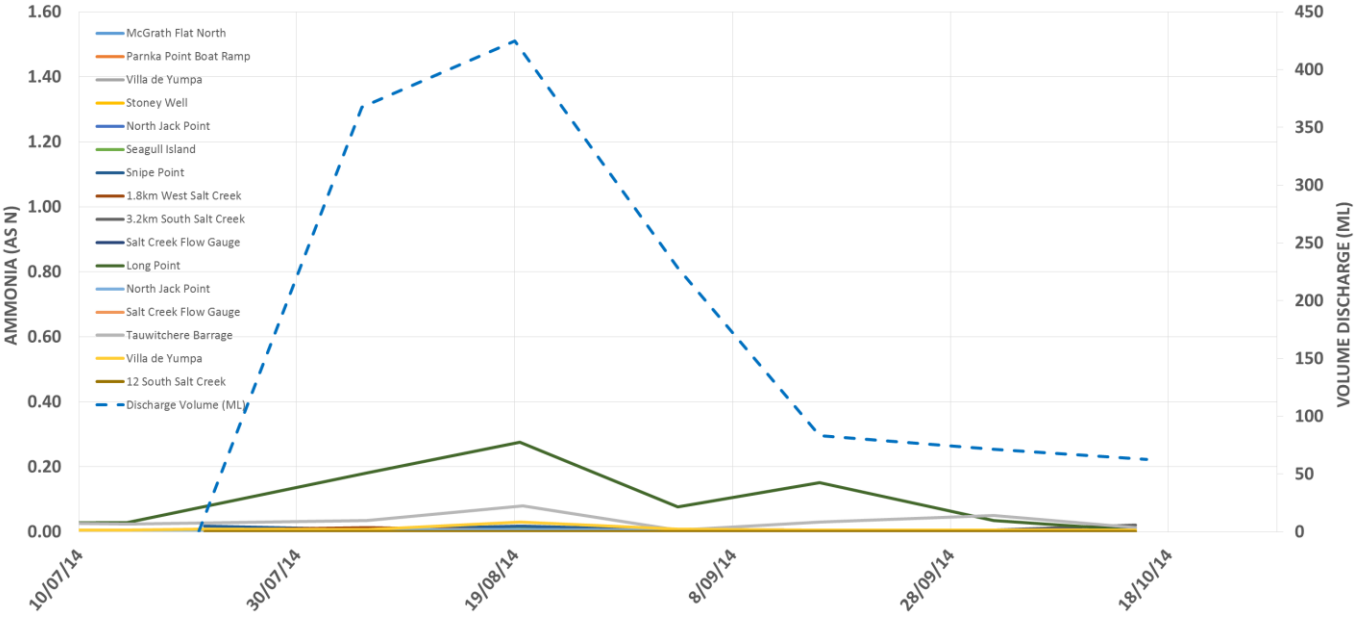

Figure 11: Ammonia (as N) (mg/L) in sites monitored throughout the Coorong's South Lagoon Morella Basin Release event between July & October 2014. Blue dashed line is discharge per day (in ML) on the day of sampling.

4 Discussion & Conclusion

The discharge of freshwater through Salt Creek from Morella Basin had minor influences on water quality in the South Lagoon. In total, 19.8 GL of freshwater entered the South Lagoon over 99 days, but this was did not create a visible gradient in any parameter away from the outlet, and salinity in all sites throughout the Coorong (both North and South Lagoons) remained stable. Only one site, the site closest to the outlet, showed some strong variation, but this was to be expected. Other sites nearby the outlet showed salinity levels similar to sites furthest away. This pattern was repeated with parameters such as turbidity, pH and chlorophyll.

The highest readings of nitrites, nitrates, phosphorus and ammonia were recorded at sites furthest away from the flow discharge point of Salt Creek, including Long Point, and no gradient was observed leading away from the outlet. Highest nitrate and nitrite was recorded in Salt Creek, but this was likely consumed through biological processes close to the outlet. A higher nitrate and nitrite was expected around the outlet, considering the source of the water had been run off from the highly agricultural-dominated landscape surrounding the Morella Basin. It is hypothesised the relatively small amounts of nitrogenous and phosphorous compounds that were released as part of this event into the Southern Lagoon would have likely been used via numerous ecological and chemical processes closely surrounding the Salt Creek outlet in the Coorong.

Throughout the experiments length, field staff continued to make general observations on the presence of Ruppia. The ecologically important macrophyte was present in the northern sand flats, especially abundant near Villa de Yumpa.